

Motion Control

*DirectLOGIC Micro PLC/CTRIO Module
to SureStep Stepping System
with C-more Micro-Graphic Panel (HMI)*

Motion Control

*DirectLOGIC Micro PLC/CTRIO Module
to SureStep Stepping System
with C-more Micro-Graphic Panel (HMI)*

Part 1 of 8 - Video Series Rundown &
SureStep Product Lineup

Motion Control Video Series Rundown

There are eight (8) videos in this series on Motion Control using the *AutomationDirect's* SureStep Stepping System components controlled by pulses and a directional signal obtained from a High-Speed Counter Interface Module, p/n H0-CTRIO, installed in a *DirectLOGIC* DL05 Micro PLC. A *C-more* Micro-Graphic panel is used as a simple HMI operator interface to allow the operator the ability to control the position of a linear leadscrew slide, and execute various programmed move profiles. The list to the right is a breakdown of the topics that the videos in this series will cover.

This handout can be used to follow along with the videos, and can also be useful as a refresher to the steps required to create a working Motion Control System.

“Links” pointing to available technical information from *AutomationDirect* have been included, such as below.

- a. What is Motion Control?
- b. Stepping System Product Lineup
- c. Control Methods
- d. Example Hardware
- e. Wiring
- f. Hardware Setup
- g. CTRIO Workbench Utility
- h. *DirectSOFT5* Ladder Logic & *IBoxes*
- i. *C-more* Micro-Graphic Panel (HMI)
- j. Operation Demonstration

Link to *SureStep* Stepping Systems User Manual: <http://bit.ly/r5dgUO>

Reference: Automation Notebook “Starting with Steppers” Article

You may find the two part Tech Thread article titled “Starting with Steppers” that was published in the Automation Notebook useful as a reference to Motion Control using steppers.

Part 1 of 2 (Issue 21, Fall 2011) covers the *SureStep* product and explains the various methods to control a stepping system by way of pulse and directional signals.

Part 2 of 2 (Issue 22, Spring 2012) focuses on using ASCII commands as available from the Advanced Microstepping Drivers, and includes links to other useful design materials.



Link to “Starting with Steppers” Part 1: <http://bit.ly/J5U0tN>

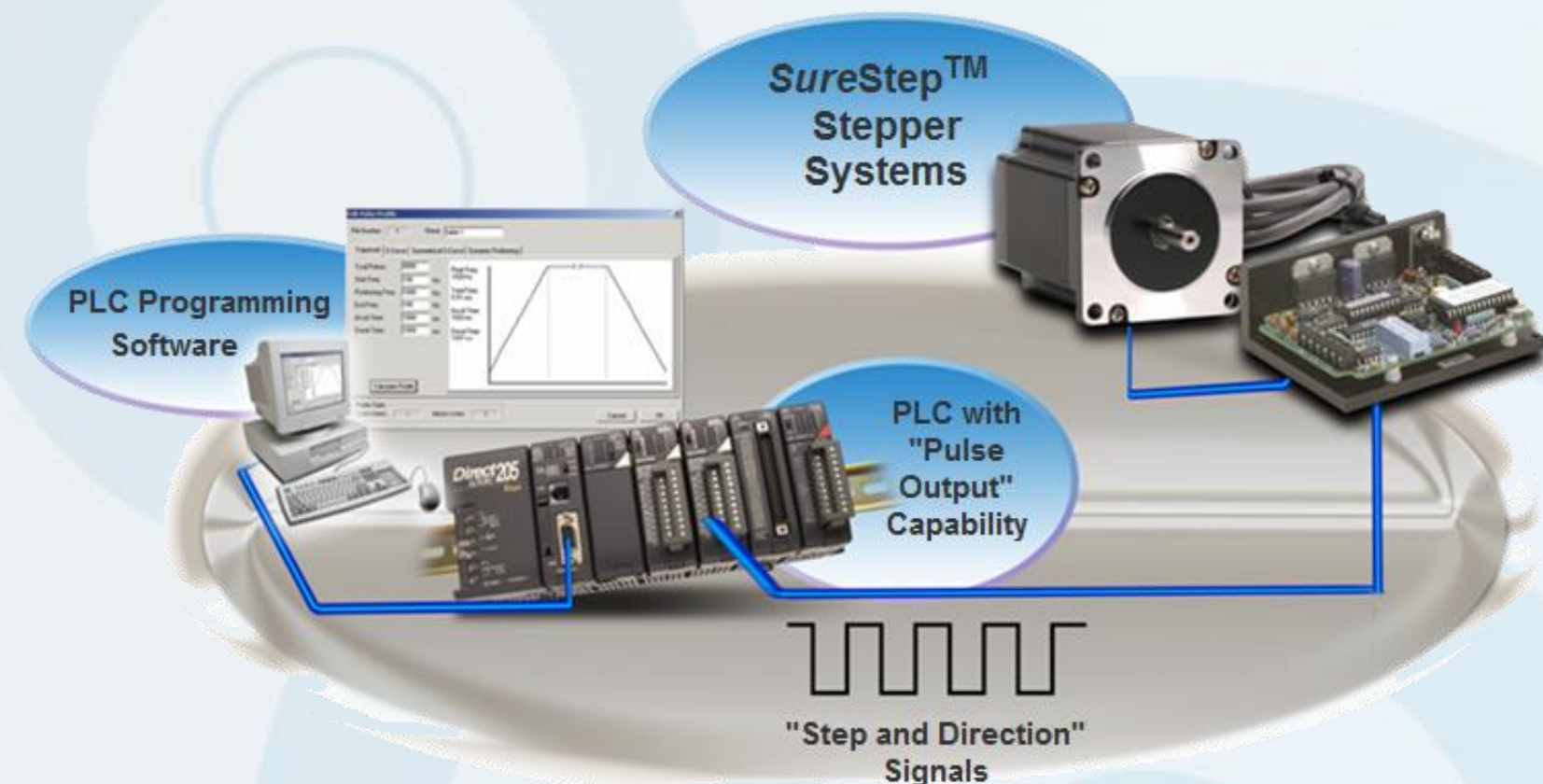
Link to “Starting with Steppers” Part 2: <http://bit.ly/IQSjUb>

What is a Motion Control System?

Motion Control, as used in industrial automation, is the task of controlling the position and/or velocity of an actuator, typically an electric motor. Motion Control is a very important component of robotics applications, but it is also used extensively in industrial applications where the motions are less complex. For example, Motion Control Systems are used widely in industry for packaging, printing, manufacturing and assembly, as well as many others. Common Motion Control product manufacturing applications include conveyor system controls, food processing, or other material handling applications.

Motion Control System architectures include:

- A motion controller to generate the trajectory and close the position loop, the velocity loop is sometimes referred to as a servo control.
- Servo can also refer to servomechanism – which is a device used to cause mechanical motion for a specific distance.
- A drive or amplifier to transform the velocity or torque signal into a high power electrical current.
- A motor used for actuation of mechanical motions, such as cams.
- Some mechanical device such as a gearbox , pulleys & belt, or rack & pinion.
- A feedback sensor to return the final position back to the motion controller.



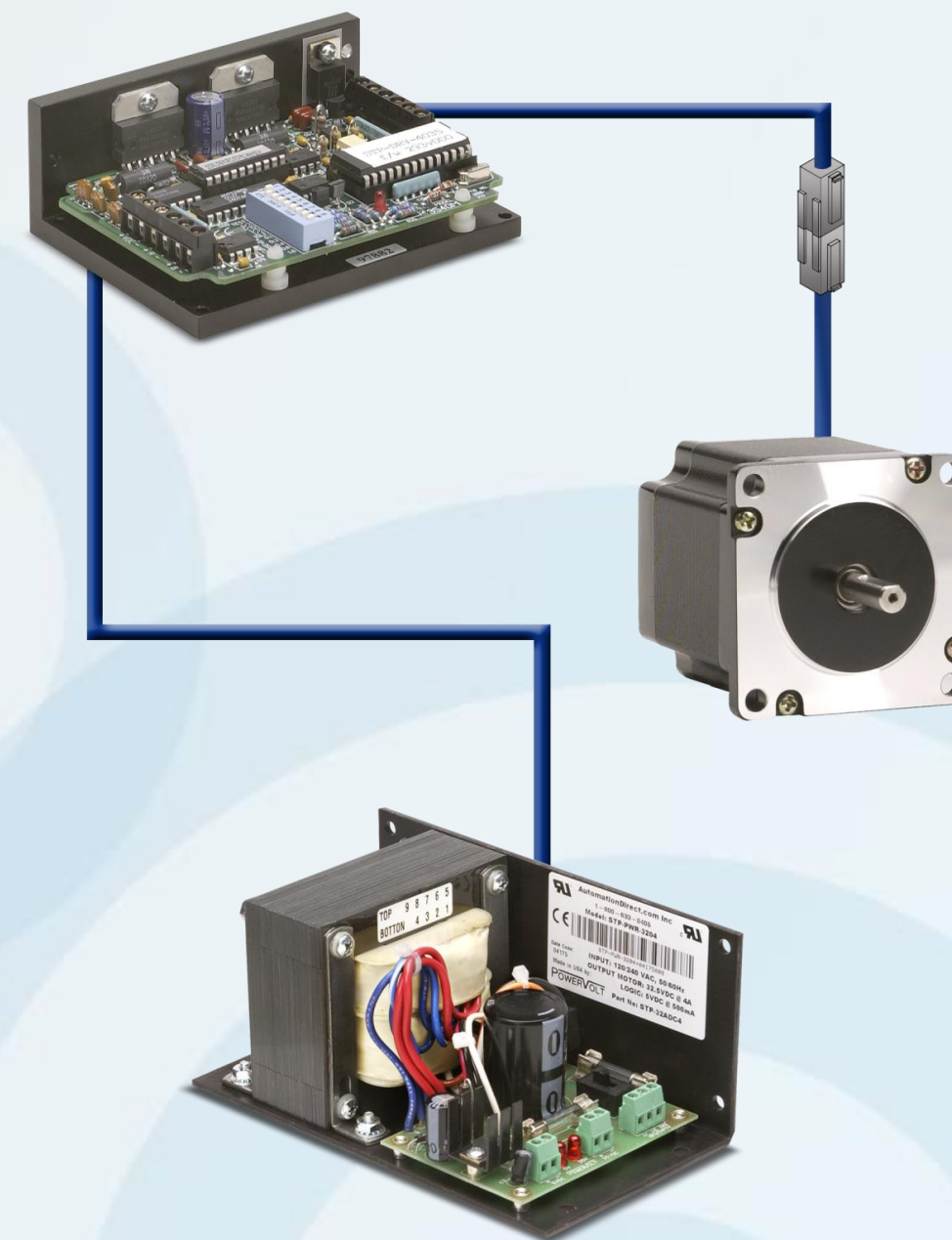
SureStep Stepping System Product Lineup – 1 of 5

The *SureStep* open-loop stepping systems provide simple and accurate control of position and speed where lower power and cost are considerations.

AutomationDirect's family of PLCs, or other indexers and motion controllers, can be used to provide the signals that are "translated" by the microstepping drives into precise movement of the stepping motor shaft.

The *SureStep* product line consists of the following:

- **One** DIP-switch configurable microstepper drive.
- **Two** software configurable advanced microstepper drives.
- **Four** step motor power supplies.
- **Nine** stepper motors (NEMA 17, 23, 34 frame sizes).
- **Two** stepper motor extension cables.
- **FREE** stepper configuration software for advanced drives.



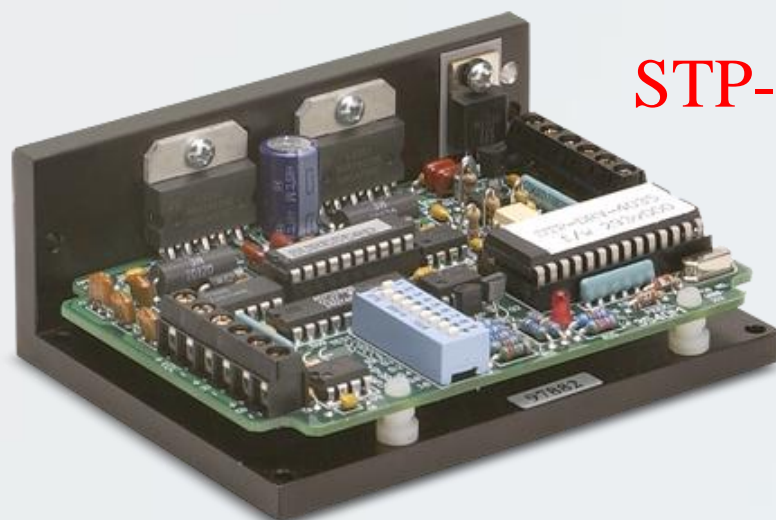
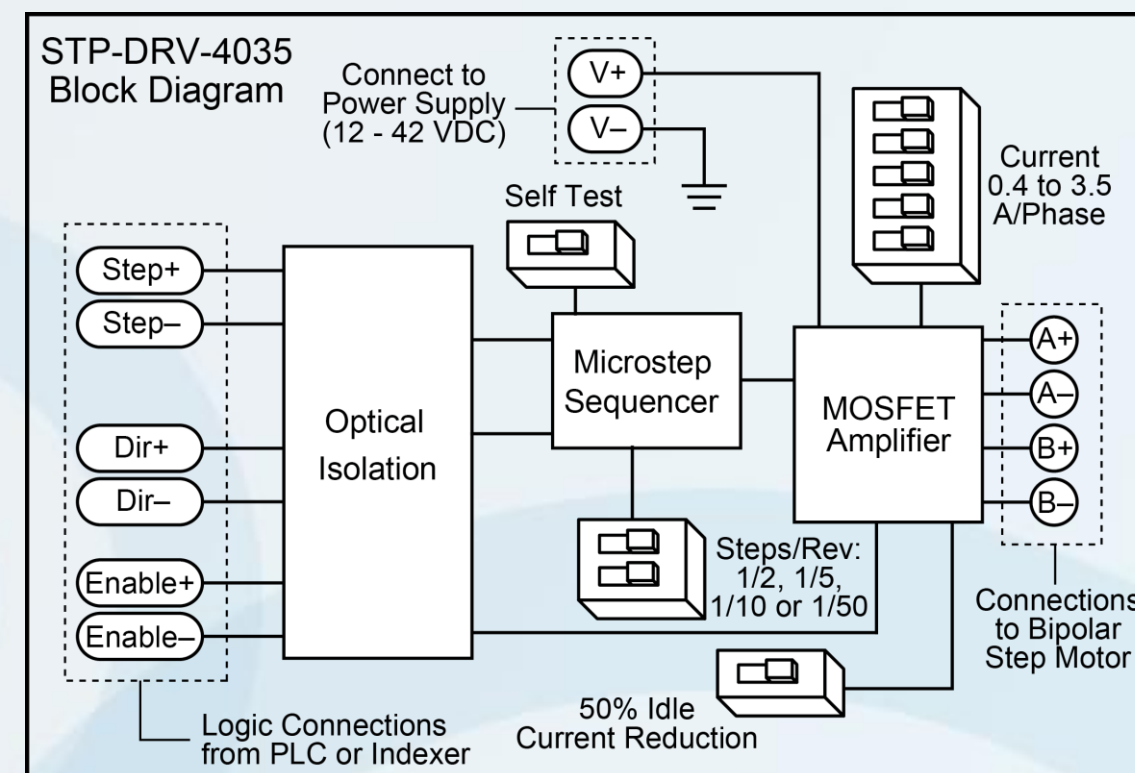
Link to *SureStep* Stepping Systems Overview: <http://bit.ly/rscNQR>

SureStep Stepping System Product Lineup – 2 of 5

DIP-Switch Configurable Microstepper Drive:

The standard *SureStep* drive requires setting a few DIP switches, hooking up a step motor, connecting to a PLC or other controller, and applying power to the components in order to have an operating motion control system.

The STP-DRV-4035 Microstepping Drive can accept an input voltage of 12-42 VDC and produces an output current selectable from 0.4 to 3.5 Amps/phase of stepping motor current.



STP-DRV-4035



NOTE: The STP-DRV-4035 Drive is used with the linear leadscrew slide demo that is shown in this LEARN site Motion Control video series.

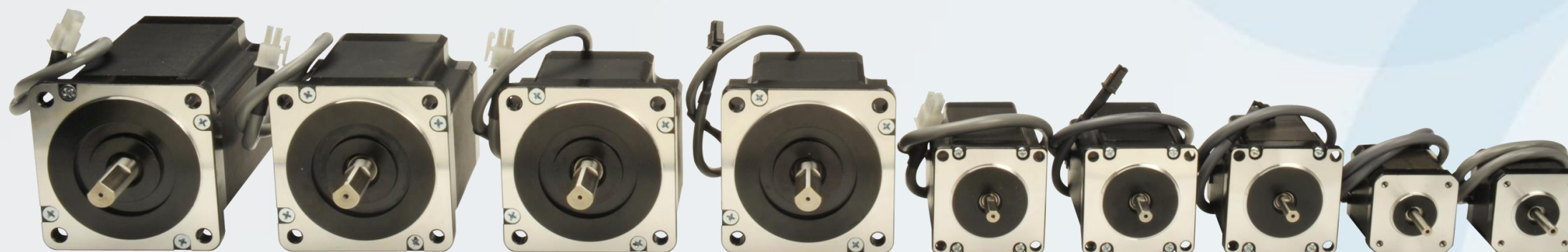
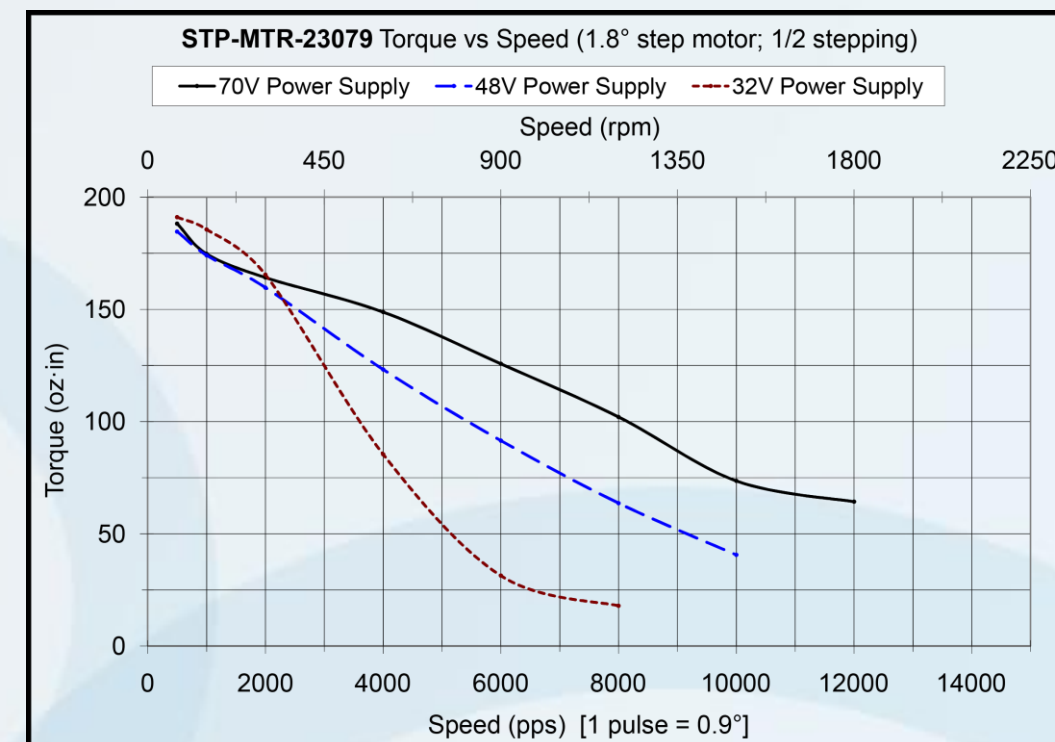
Link to Microstepping Drive Data Sheet: <http://bit.ly/oh9MiI>

SureStep Stepping System Product Lineup – 4 of 5

Stepper Motors and Cables:

The *SureStep*™ stepper motors are 2-phase technology with 200 full steps per revolution or 1.8° per full step, and there are nine standard motors offered to handle a wide range of automation applications. The stepper motors include different torque ratings in NEMA sizes 17, 23 and 34.

The 20 foot STP-EXT-020 and STP-EXTH-020 extension cables with locking connectors are standard options to interface the various stepping motors to the stepping drives.



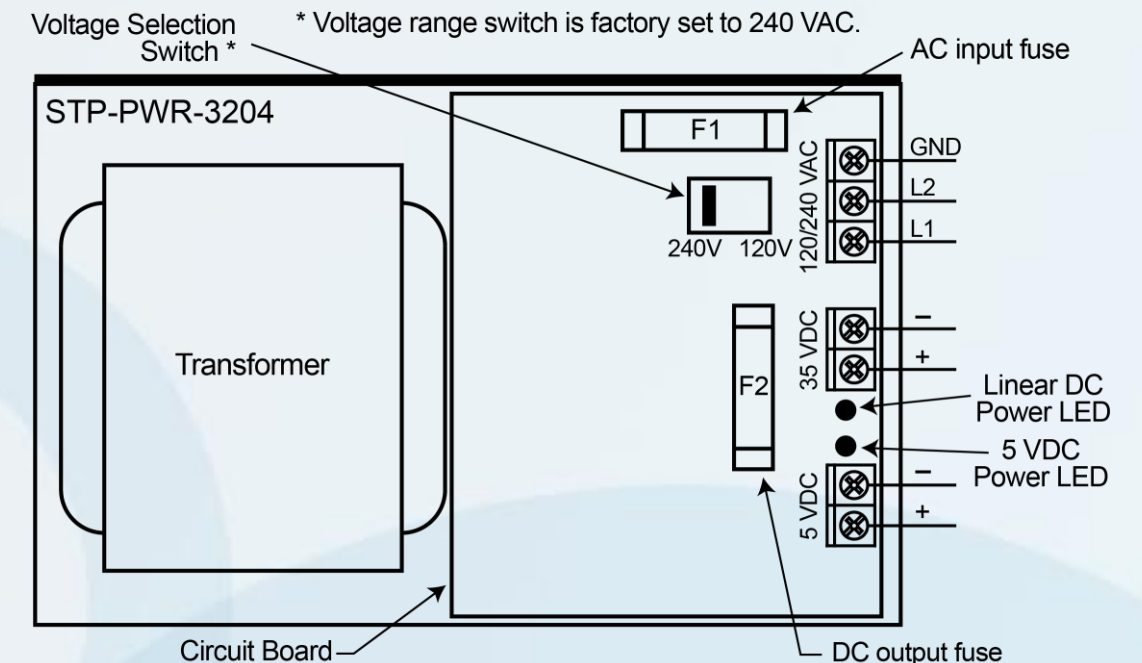
Link to Bipolar Step Motors Data Sheet: <http://bit.ly/rhEcyt>

SureStep Stepping System Product Lineup – 5 of 5

Stepping System Power Supplies:

Less expensive than regulated supplies, these power supplies are perfectly suited to power *SureStep* stepper drives and stepper motors.

- Four models available with 32V@4A, 48V@5A, 48V@10A, & 70V@5A DC unregulated step motor power.
- 5VDC $\pm 5\%$ at 500 mA regulated logic power (electronic overload).
- Screw terminal AC input and DC output connectors.
- 120 or 240 VAC, 50/60 Hz power input, switch selectable.
- Power ON LEDs.
- Integrated input and output fusing.
- Matched to *SureStep* drives for maximum voltage.



Link to Stepping System Power Supplies Data Sheet: <http://bit.ly/oRYdXe>

Motion Control

*Direct*LOGIC Micro PLC/CTRIO Module
to *SureStep* Stepping System
with *C-more* Micro-Graphic Panel (HMI)

Part 2 of 8 - *SureStep* Stepping System
Control Methods

SureStep Stepping System Control Methods – 1 of 4

Once the components in the *SureStep* Stepping System have been determined, a means to control the microstepping drive is required. Currently there are **two control methods** available from *AutomationDirect* to accomplish controlling the stepping system. The first method uses **pulse and direction** signals that can be obtained from PLCs with built-in high-speed pulse outputs, or the use of a high-speed counter interface module specific to certain PLCs. The second method uses **ASCII commands** via a serial communications connection that is a feature of the Advanced Microstepping drives. See Diagram 1 on Page 21 of the Automation Notebook Issue 21, Fall 2011, Tech Thread article titled “Starting with Steppers” listing the many choices that can be taken between *AutomationDirect* PLCs and specialty modules to any one of the currently available microstepping drives.



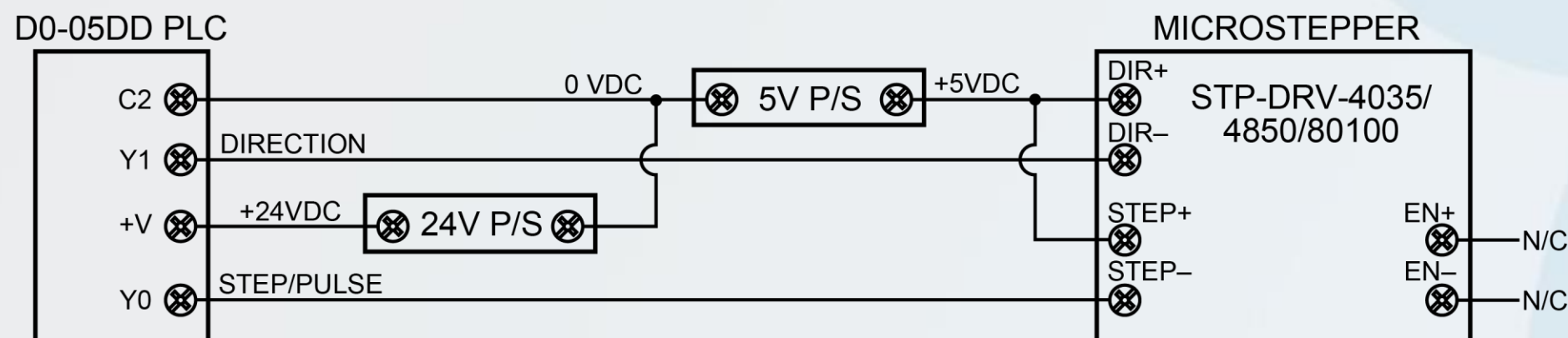
NOTE: Although there are different ways to control the *SureStep* Stepping System as explained in this and the next couple of slides, our demo will make use of the H0-CTRIO High-Speed Counter Interface Module.

Link to *SureStep* and *DirectLOGIC* Controller Compatibility: <http://bit.ly/pjc1Y3>

SureStep Stepping System Control Methods – 2 of 4

Mode 30 Built-in Pulse/Direction Control:

The *Direct*LOGIC DL05, DL06 and DL105 micro PLCs have a built-in feature referred to as High-Speed Input and Pulse Output. The high-speed input feature is available on the PLC models with DC inputs, while the high-speed pulse output is available on models with DC outputs. The number of high-speed inputs varies with the particular PLC, while all three PLC series mentioned have two high-speed outputs. There are several modes of operation available for the inputs and outputs, designated as Modes 10, 20, 30, 40, 50 and 60. The majority are for the inputs that allow high-speed counting, encoder input, interrupts, pulse catching and filtering. Mode 30 is reserved for high-speed pulse output that will control the *SureStep* Stepping System. Mode 30 is the normal function used to control direction, speed and profiles for pulses going to the stepping motor drives. Only one High-Speed I/O mode can be in use at one time.



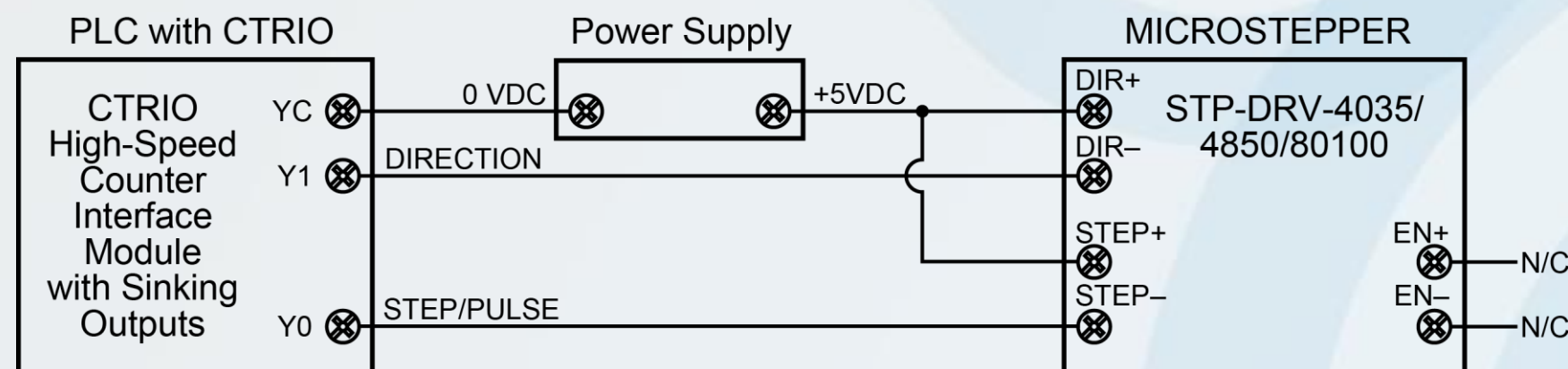
NOTE: A D2-CTRINT Counter Interface Module can be used with the D2-240, D2-250-1 & D2-260 CPUs for high-speed I/O features.

SureStep Stepping System Control Methods – 3 of 4

CTRIO Pulse/Direction Control:

Another option to produce pulse/direction signals that allows greater flexibility in controlling a *SureStep* Stepping System is to use one of *AutomationDirect's* High-Speed Counter Interface Modules. These are available for use with DL05 and DL06, DL205, and DL405 PLCs, as well as Terminator Field I/O. The part numbers for these modules include H0-CTRIO, H2-CTRIO, H4-CTRIO and T1H-CTRIO.

The H0-CTRIO High-Speed Counter Interface Module is used in the demo that is part of this video series on Motion Control.

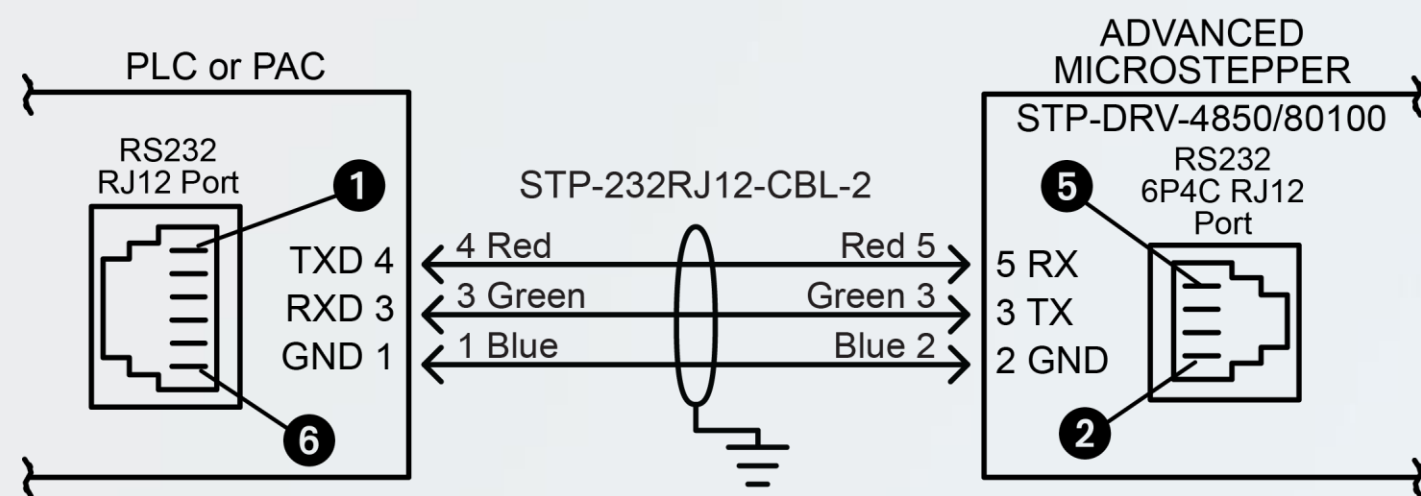


SureStep Stepping System Control Methods – 4 of 4

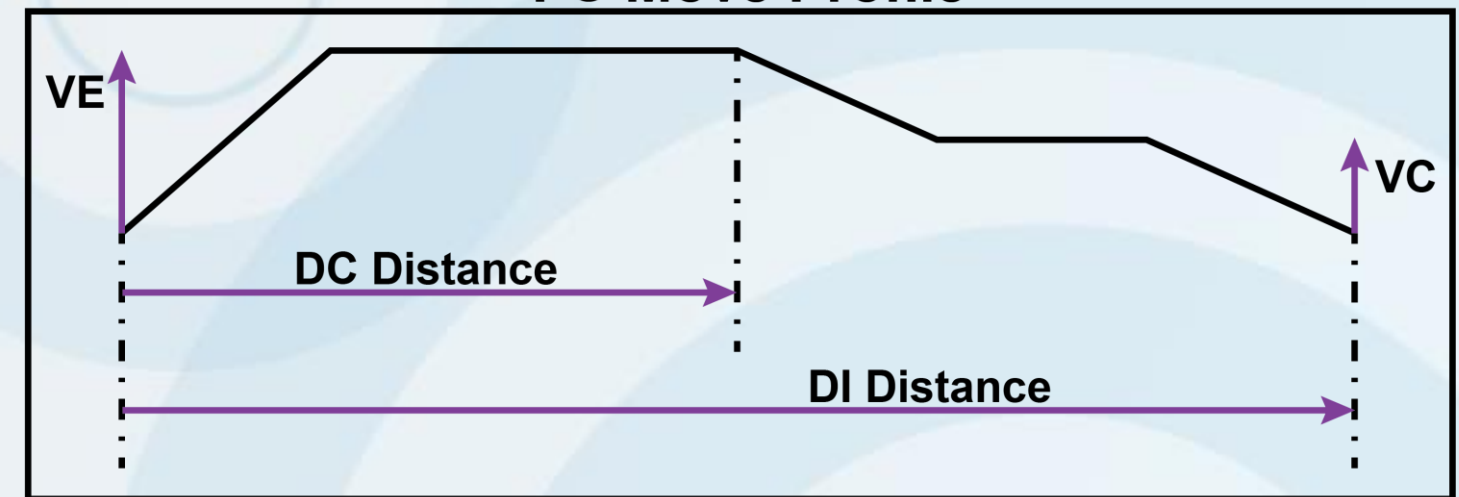
ASCII Serial Communications Control:

The second method for control is done by taking advantage of the Advanced Stepping drives' ability to accept ASCII data commands via RS-232 serial communications. This method is supported from certain serial ports of all *Direct*LOGIC PLCs, CLICK PLCs, and the Productivity3000 Programmable Automation Controller. Review the instruction set for the specific PLC and investigate the instructions that can produce the ASCII data commands, then confirm which RS-232 serial communications port is supported by those instructions, usually configurable as an ASCII port.

The Advanced Stepping drives make use of a Serial Command Language (SCL) that can be used to control motion by accepting serial ASCII commands from a PLC or PC serial port.



FC Move Profile



Serial Command Language

- | | |
|----------|----------|
| "MD" | "ME" |
| "CM21" | "DI9000" |
| "AC2" | "DC6000" |
| "DC2" | "VC1.5" |
| "VE3" | "SA" |
| "EG1000" | "FC" |

Motion Control

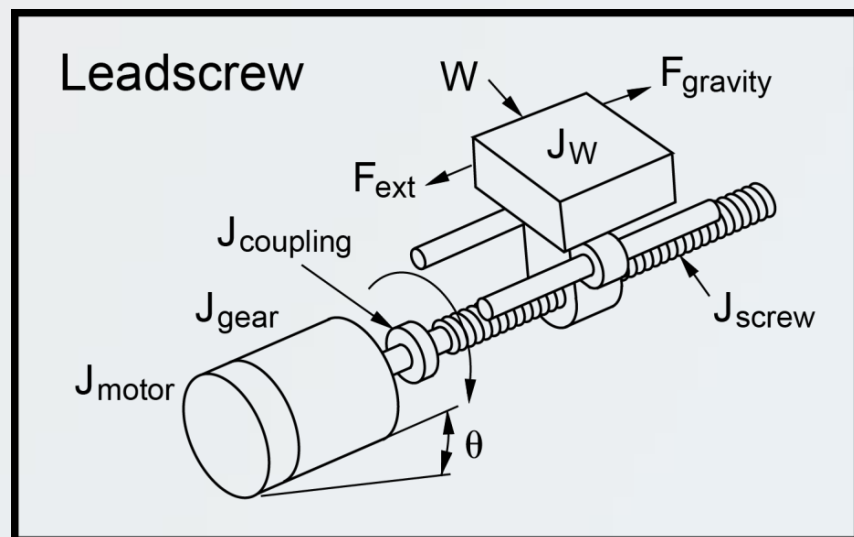
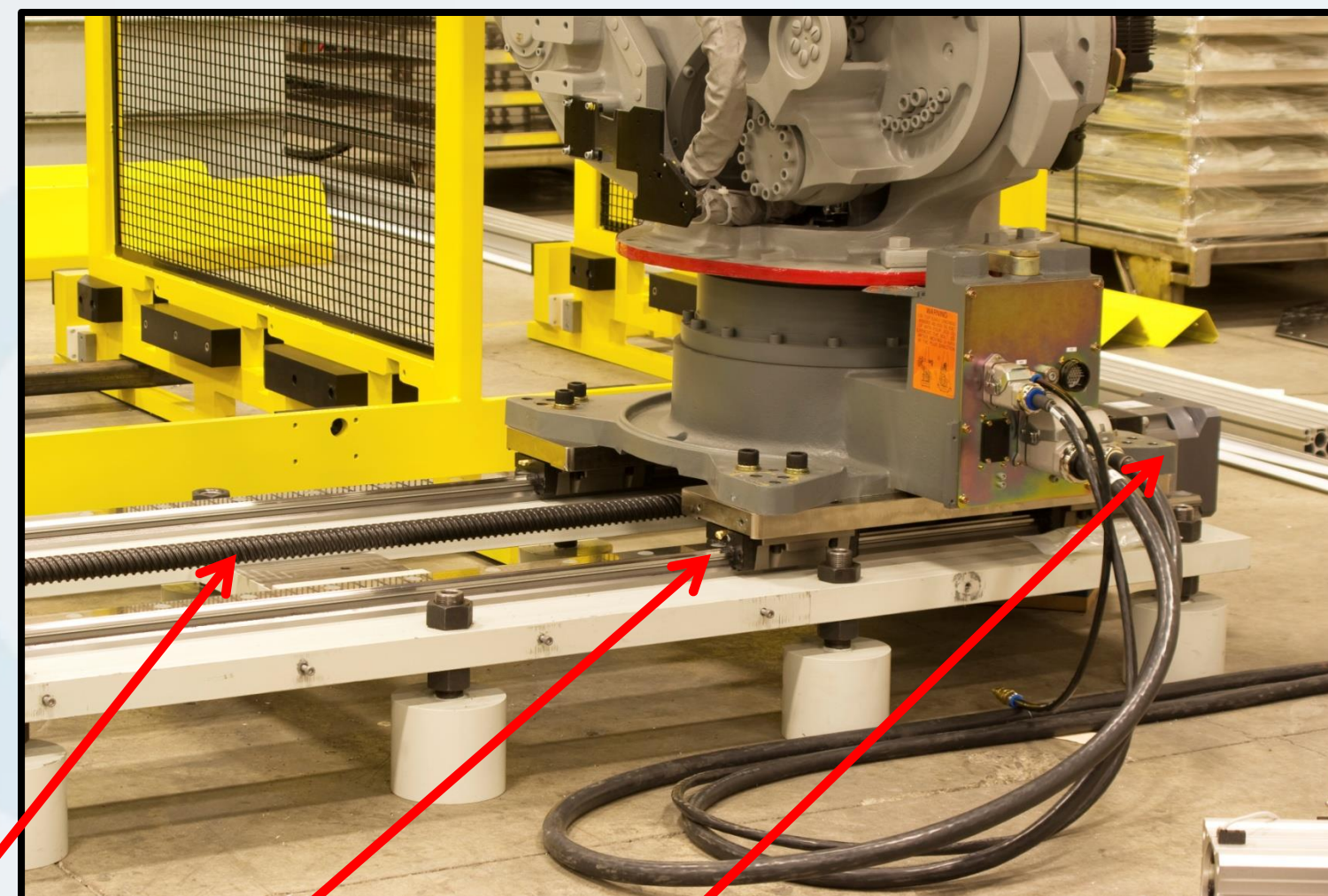
*Direct*LOGIC Micro PLC/CTRIO Module
to *Sure*Step Stepping System
with *C-more* Micro-Graphic Panel (HMI)

Part 3 of 8 - Typical Stepping System
Applications & Demo Linear Slide Hardware

Typical Applications – Leadscrew – 1 of 3

One of the more popular methods for converting the stepping motor's rotary motion into linear motion is through the use of a leadscrew. Using a leadscrew running through a matching threaded nut adapted to a slide mechanism provides the mechanical translation. The slide mechanism is used to carry the working part of the process and move it from position to position as needed.

The number of threads per inch determines the distance the slide mechanism will travel. For example, if we use a leadscrew with 10 threads per inch, then one revolution of the attached stepping motor will cause the leadscrew to produce 0.100 inches of travel. More on this later.



Leadscrew

Slide Mechanism

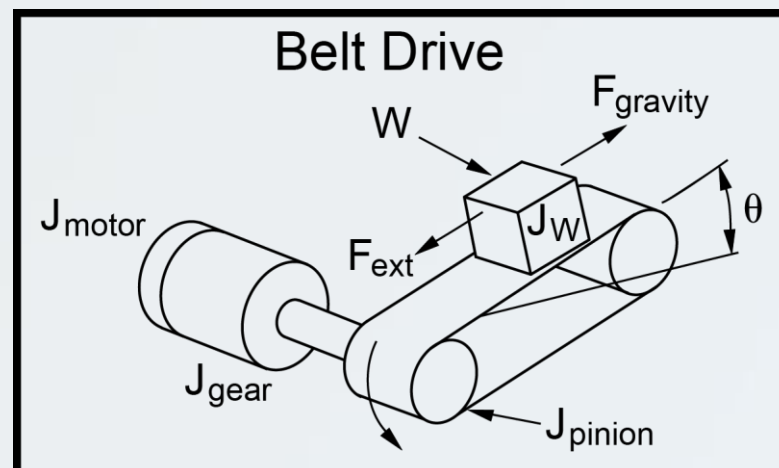
Stepping Motor

Typical Applications – Belt Drive – 2 of 3

Another application suited for a stepping motor is to drive a belt, such as a conveyor belt. In this type of application we are able to control the position of product on the conveyor, stop it at various positions, and even back up if the process requires a second look be taken, such as in a visual inspection application.

Using a stepping motor to control a conveyor has the advantage of providing precise positioning. The positioning can be altered on the fly to suit changing conditions.

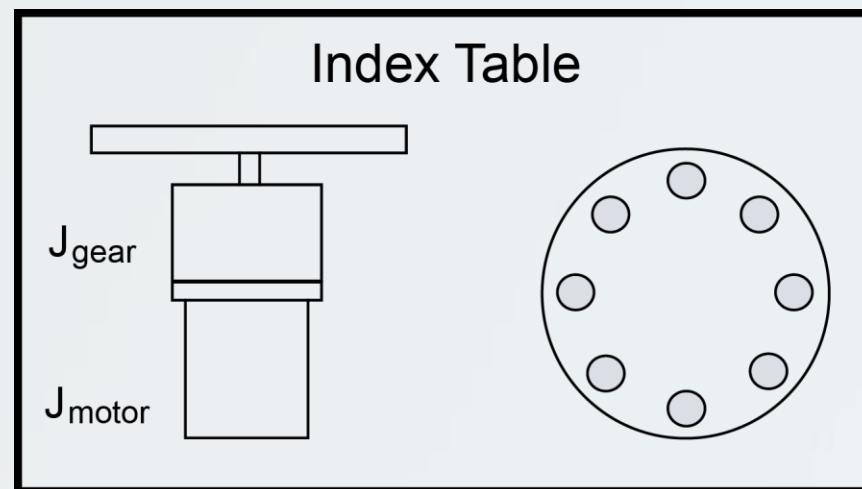
Complex movement can also be handled with the use of a stepping motor driving a conveyor or multiple drive mechanisms that are linked together. Different speed rates can be programmed, along with various acceleration and deceleration times, to coordinate synchronization with other devices in the process.



Typical Applications – Rotary Index Table – 3 of 3

Using a stepping motor coupled to a rotary table, or through a gear reduction to increase available torque, provides a simple method for indexing the table into precision locations. This application of a stepping motor is ideal for assembly machines that may have multiple locations where various steps or operations are preformed.

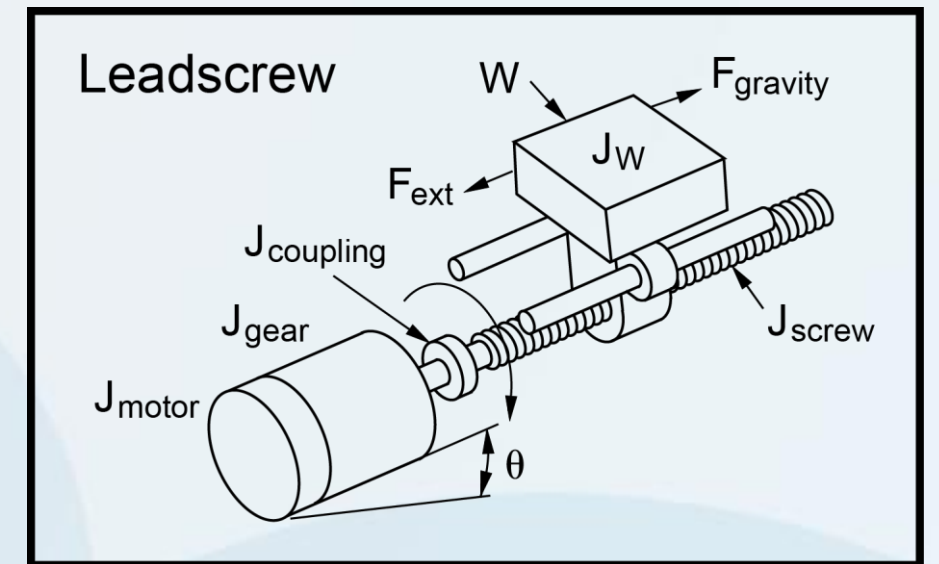
The use of a stepping motor can provide excellent repeatability between the various stations on an assembly machine. The positions will return to the same location accurately. Another great benefit of using a stepping motor for the type of applications outlined here, and the proceeding application slides, is the stepping motor cannot be damaged by mechanical overload.



Linear Leadscrew Driven Slide Hardware

A linear leadscrew slide was chosen to use as the demo in this video series on Motion Control. A manufactured linear slide with a total travel stroke of 300 mm and a NEMA 23 motor frame mounting with shaft coupling was selected. The assembly was mounted on standoffs to a wood base for display purposes.

The leadscrew I have chosen for the application demonstration has 8 threads per inch. It is general practice to define inch-based leadscrews in terms of threads per inch (TPI), while metric threads are defined by 'Pitch'. I can say my leadscrew has a pitch of 1/8 inch or 0.125 inches. The slide will move a distance of 0.125 inches for every revolution of the stepping motor. Based on the 2,000 microstepping steps per revolution we will use to set our driver, our slide will move 0.0000625 inches per step!



NOTE: You may also run across the term 'Lead' when defining a leadscrew. 'Pitch' and 'Lead' are closely related terms, and if the screw threadform is defined as single-start, 'Pitch' and 'Lead' are the same.



Motion Control

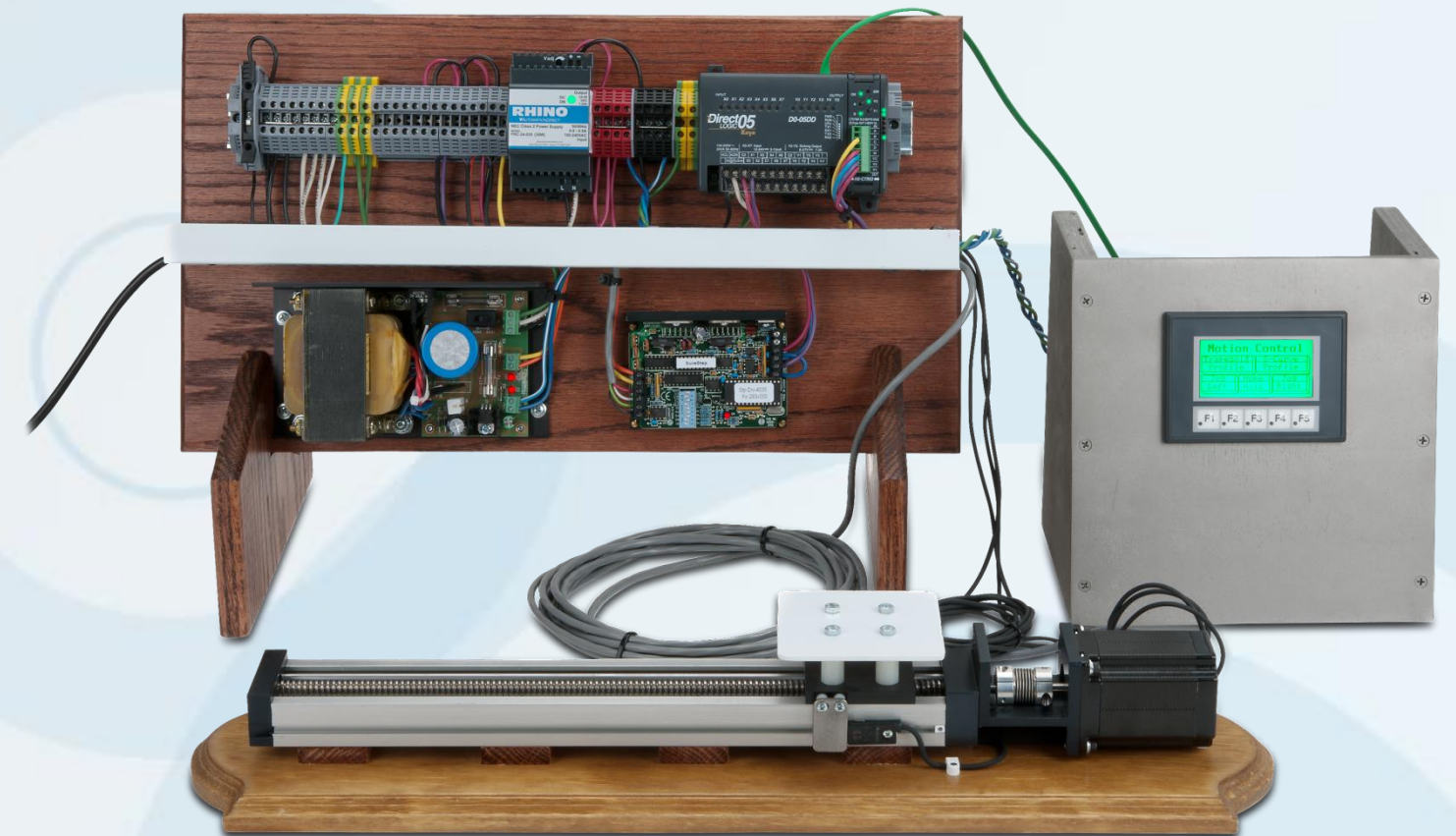
*DirectLOGIC Micro PLC/CTRIO Module
to SureStep Stepping System
with C-more Micro-Graphic Panel (HMI)*

Part 4 of 8 - Wiring, CTRIO Jumper
Settings & Drive DIP Switch Settings

Motion Control Wiring Diagram – Components

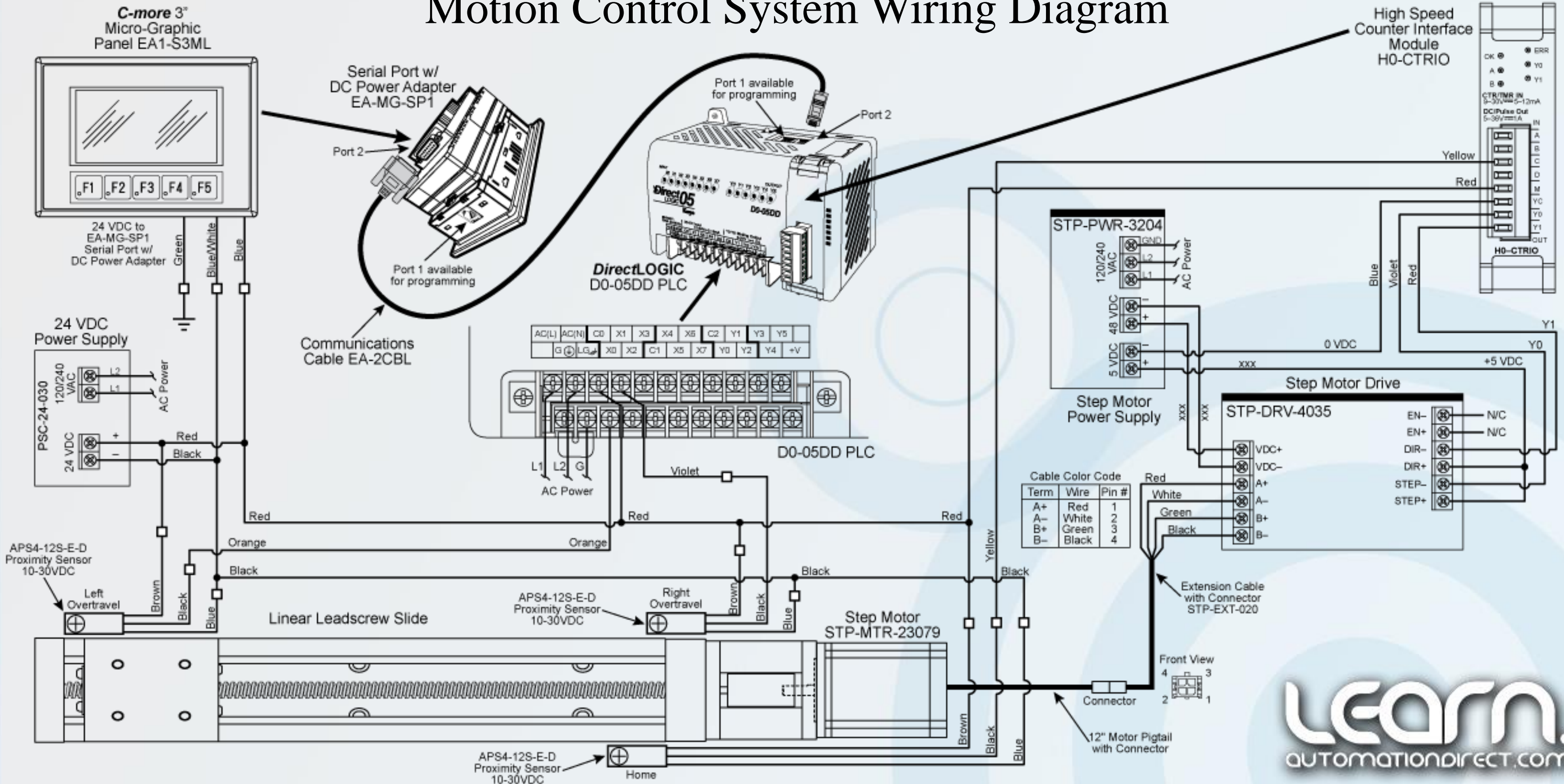
The wiring diagram for the Motion Control System is shown on the next slide. Included in the wiring diagram are the following products and devices:

- *Direct*LOGIC DL05 Micro PLC, D0-05DD
- High Speed Counter Interface Module, H0-CTRIO
- *Sure*Step Microstepping Drive, STP-DRV-4035
- *Sure*Step Stepper Motor, STP-MTR-23079
- *Sure*Step Stepper Power Supply, STP-PWR-3204
- *Sure*Step Stepper Motor Extension Cable, STP-EXT-020
- *C-more* Micro-Graphic Touch Panel, EA1-S3ML
- *C-more* Serial Port w/ DC Power Adapter, EA-MG-SP1
- *C-more* Communications Cable, EA-2CBL
- Rhino 24 VDC Power Supply, PSC-24-030
- ProSense Proximity Sensors, APS4-12S-E-D
- Linear Leadscrew Slide, ‘Pitch’ equals 0.125 inches per revolution



Linear Leadscrew Slide Demo

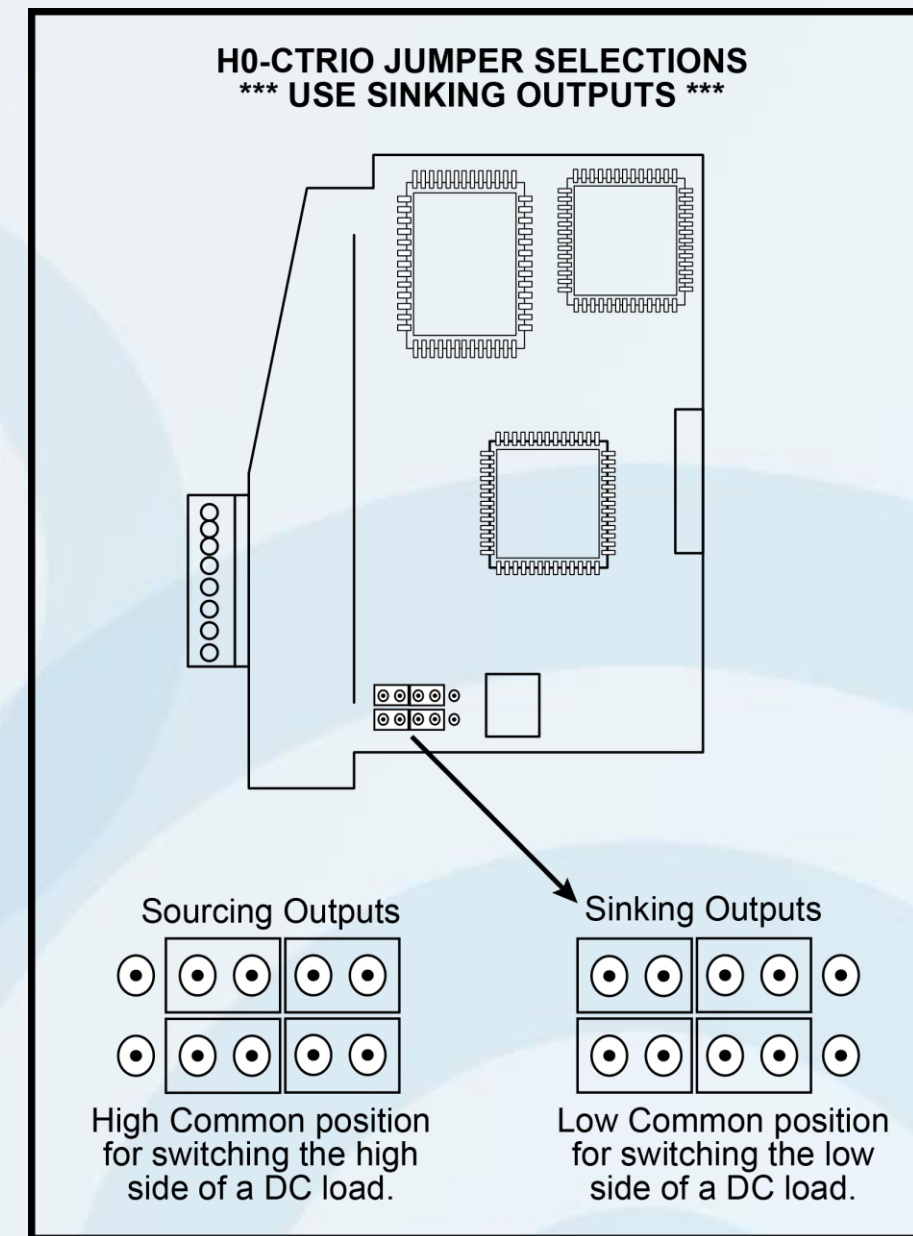
Motion Control System Wiring Diagram



H0-CTRIO High Speed Counter Interface Module Jumper Settings

The output signals from the High Speed Counter Interface Module, H0-CTRIO, can be jumper configured for either sinking or sourcing operation. In our example we will be sinking the pulse and direction signals that feed the *SureStep* STP-DRV-4035 microstepping motor driver, so the four jumpers need to be placed over the set of pins to the left as shown in the diagram to the right.

Note: The H0-CTRIO module has one input channel, consisting of 4 optically isolated input points (terminals A-D common to terminal M). The inputs can be wired to either sink or source current. The module has 2 optically isolated output points (terminals Y0-Y1 common to terminal YC). The outputs can be wired to either sink or source current, but the sink/source jumper selection sets both outputs to the same option. Sourcing outputs must be wired so positive current flows into the YC terminal and then out of the Yn terminal. Sinking outputs must be wired so positive current flows into Yn terminal and then out of the YC terminal. Source operation is the factory default setting for the outputs.



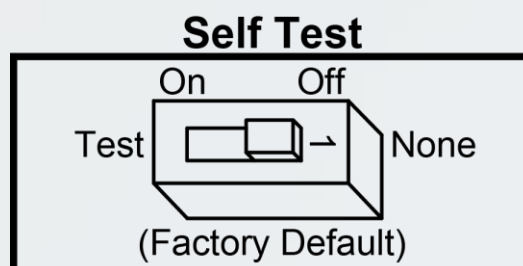
H0-CTRIO

SureStep STP-DRV-4035 Drive Dip Switch Settings – 1 of 3

The STP-DRV-4035 drive includes a 9-position DIP switch. The DIP switch is used to set the drive's various parameters which include a self test function, 400/1,000/2,000 or 10,000 steps/revolution microstepping resolution, current reduction at idle, and the step motor's phase current.

The Self Test feature can be used for troubleshooting your system. Slide DIP switch position 1 toward the label marked "TEST" and the step motor will slowly rotate 1/2 revolution forward and then 1/2 revolution backward. This motion will repeat until the DIP switch is returned to the off position.

The self test will use half step mode and ignore any input signals on the STEP and DIR terminals. The ENABLE input will continue to function normally.



Microstepping is accomplished by precisely controlling the amount of current in each phase at each step position and allows the steps to be electronically subdivided even further. The drive can be set up for either half step or three microstep resolutions, 1/5, 1/10 or 1/50 microsteps. In a typical 1.8 degree step motor, this will equate to 400, 1,000, 2,000 or 10,000 steps per revolution. DIP switch positions 2 and 3 are used to set the resolution as shown below:

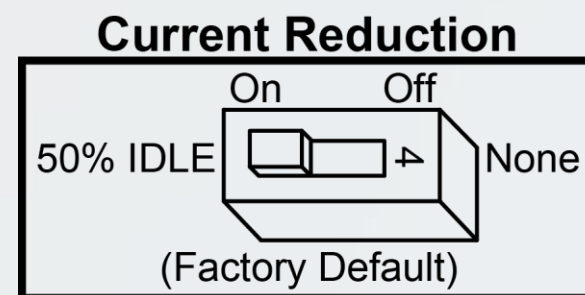
Microstepping Resolution Table

<p>400 STEPS/REV (HALF)</p> <p>1/2 1/10 1/5 1/2</p> <p>1/5 1/50 1/10 1/50</p>	<p>2,000 STEPS/REV (1/10)</p> <p>1/2 1/10 1/5 1/2</p> <p>1/5 1/50 1/10 1/50</p>
<p>1,000 STEPS/REV (1/5)</p> <p>1/2 1/10 1/5 1/2</p> <p>1/5 1/50 1/10 1/50</p> <p>(Factory Default)</p>	<p>10,000 STEPS/REV (1/50)</p> <p>1/2 1/10 1/5 1/2</p> <p>1/5 1/50 1/10 1/50</p>

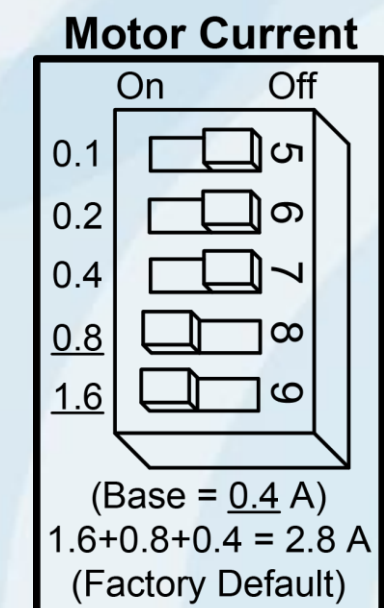
SureStep STP-DRV-4035 Drive Dip Switch Settings – 2 of 3

The drive's Current Reduction built-in feature will reduce the motor current by 50% anytime the motor is not moving. Drive heating is reduced by about 50% and the feature lowers motor heating by 75%. Slide DIP switch position 4 toward the label marked "50% Idle" to enable this feature.

Note: Please be aware that when this feature is used, holding torque is reduced.

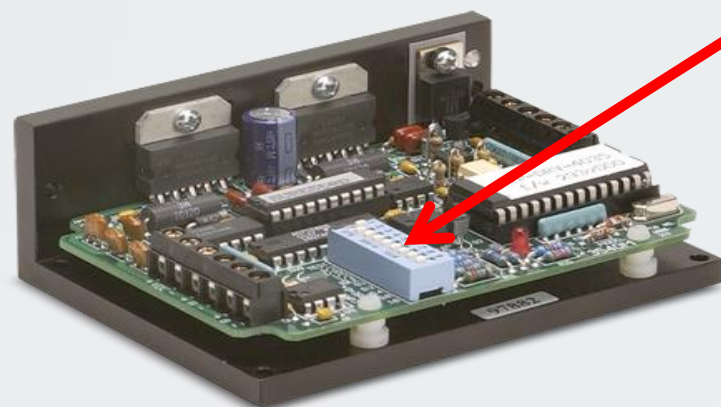


The Motor Current of the step motor is set using the last five positions, 5-9, of the DIP switch. The value of current for each position is printed adjacent to the DIP switch. There is always a base current of 0.4 A. To add to the base current, slide the appropriate switches toward their labels marked on the drive's PC board. The factory default is set for 2.8 Amps, which is also the current rating for the STP-MTR-23079 step motor that is used in our demo.

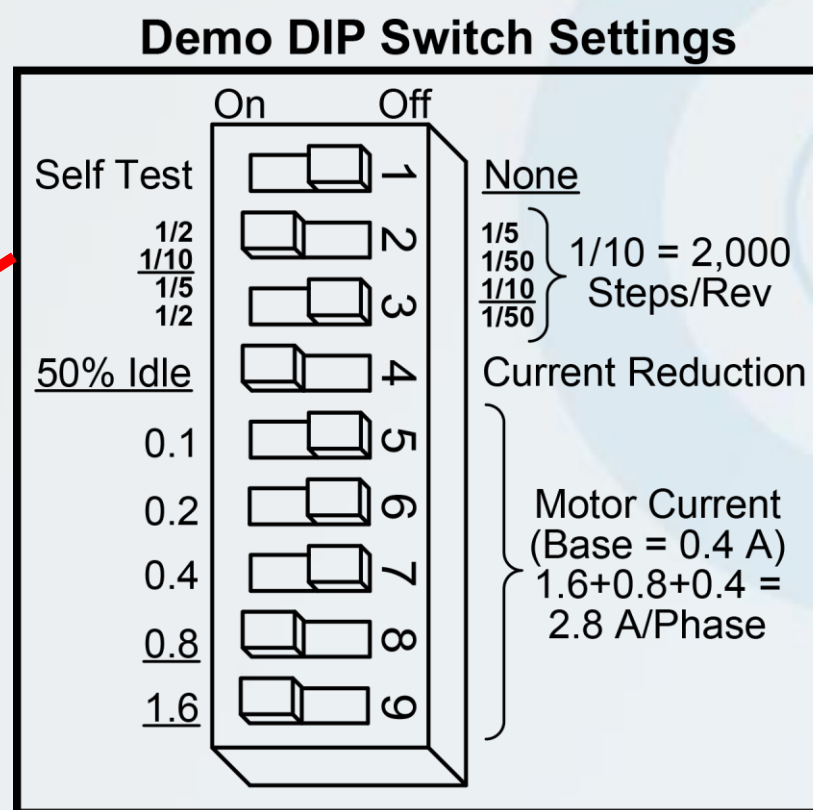


SureStep STP-DRV-4035 Drive Dip Switch Settings – 3 of 3

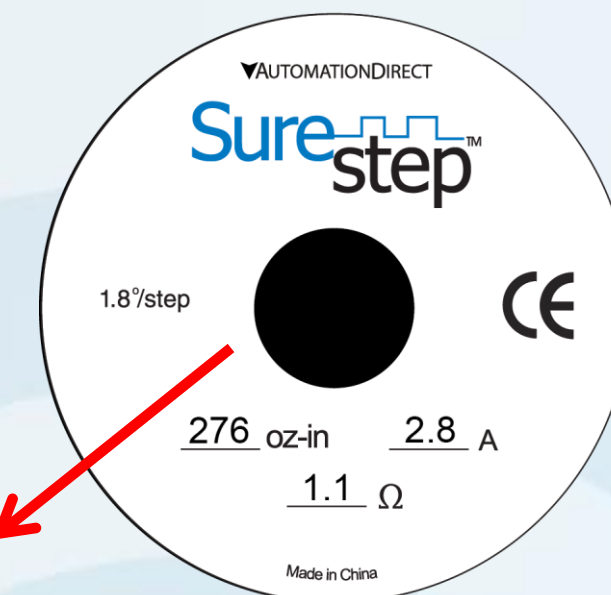
Below is shown the drive's DIP Switch settings that are used for the demonstration linear leadscrew slide. The Self Test position is Off. The Microstepping Resolution is set for 1/10 which will allow us to use 2,000 steps per revolution. The Current Reduction position is On to allow 50% current at idle. The Motor Current per the step motor nameplate has been set for 2.8 Amps.



Microstepping Drive
STP-DRV-4035



Step Motor
STP-MTR-23079



Motion Control

*Direct*LOGIC Micro PLC/CTRIO Module
to *SureStep* Stepping System
with *C-more* Micro-Graphic Panel (HMI)

Part 5 of 8 - Workbench Utility -
Configure CTRIO Module &
Create Motion Profiles

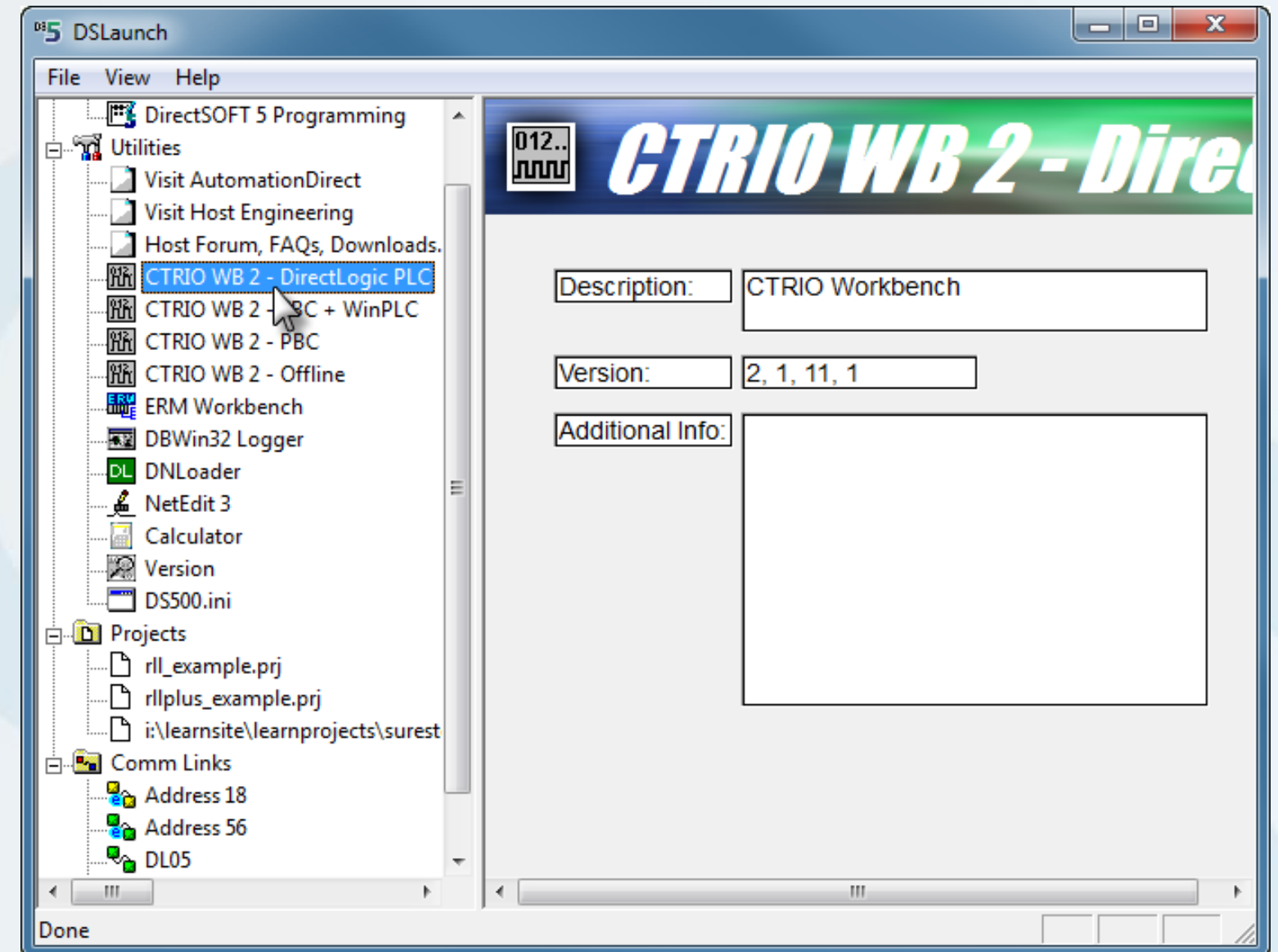
CTRIO Workbench – Open WB 2 for DirectLOGIC PLC – 1 of 28

Start the *DirectSOFT5* DSLaunch application and open the Workbench support version titled ‘CTRIO WB 2 – DirectLOGIC PLC’ under the ‘Utilities’ menu.

There are additional support versions of the CTRIO Workbench that can be used with a WinPLC that uses Windows CE and Think & Do runtime software, or an EBC interface device.

There is also an Offline support version that allows the user to create a complete CTRIO configuration file (.cwb) that can be read into the CTRIO module at a later time.

The following steps here will cover in detail configuring the CTRIO module online. Also included will be updating the Firmware to the latest version and the use of the I/O Monitoring feature.

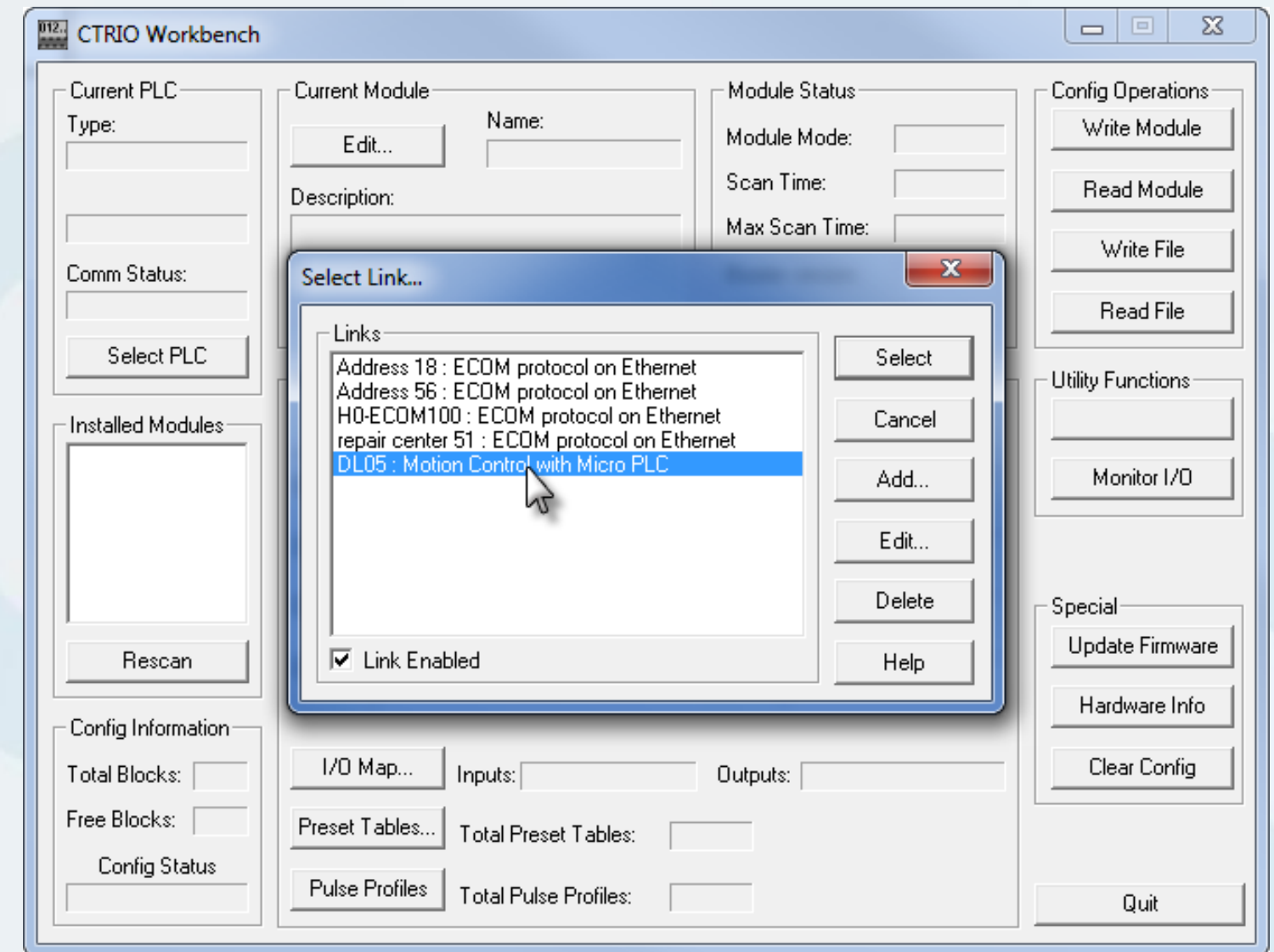


CTRIO Workbench – Select & Establish Link – 2 of 28

Once the CTRIO Workbench dialog window opens, the Select Link box will prompt you to establish a link to any found CTRIO modules, or other devices that are supported by the application. In my case I will select the ‘DL05: Motion Control with Micro PLC’ for our link.

After the Link is selected, the CTRIO Workbench window will display without any info shown while waiting for the link to become established. This may take a few seconds or longer. After the link is established, all of the known parameters and information will be displayed.

As shown on the next slide, the ‘Comm Status’ should indicate ‘OK’, and the ‘Config Status’ most likely will show as ‘Same as Module’, if this is the first time use of the CTRIO module.



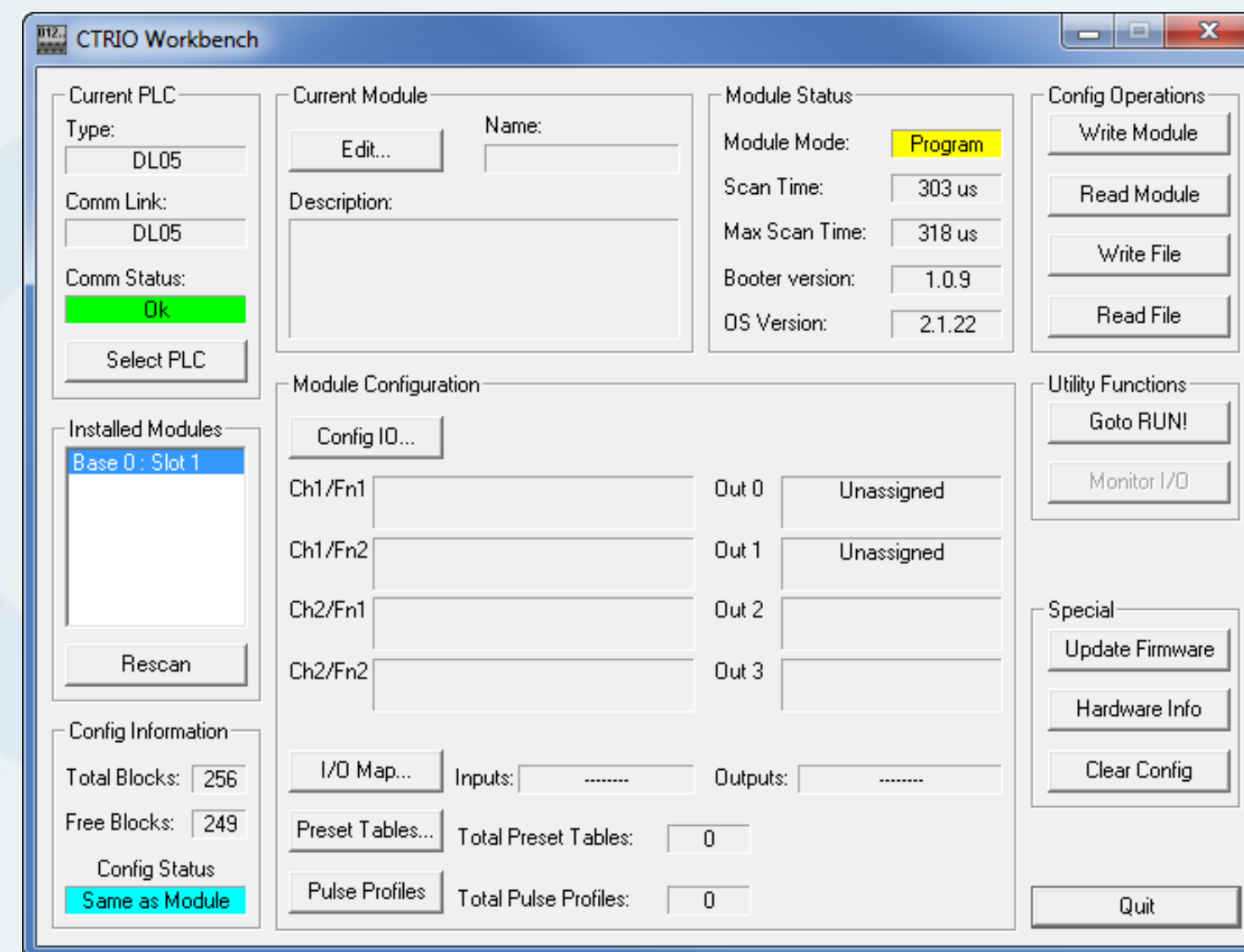
CTRIO Workbench – Linked and in Program Mode – 3 of 28

All of the CTRIO modules installed in the PLC that are linked will be displayed in the ‘Installed Modules’ window. Make sure the CTRIO module that you are configuring is the one highlighted.

Most likely the CTRIO Workbench dialog window will indicate the ‘Module Mode’ is in ‘Program’ mode.

After I have entered all of my configuration, I/O mapping, profiles, and other parameters, I will show how to place the CTRIO module in ‘Run’ mode and test the settings.

It is good practice to take a look at the ‘Module Status’ to become familiar with the Scan Time and check which OS Version is running on the module. In our example, we have OS Version 2.1.22 being used. We will cover updating the firmware version a little later in this series.

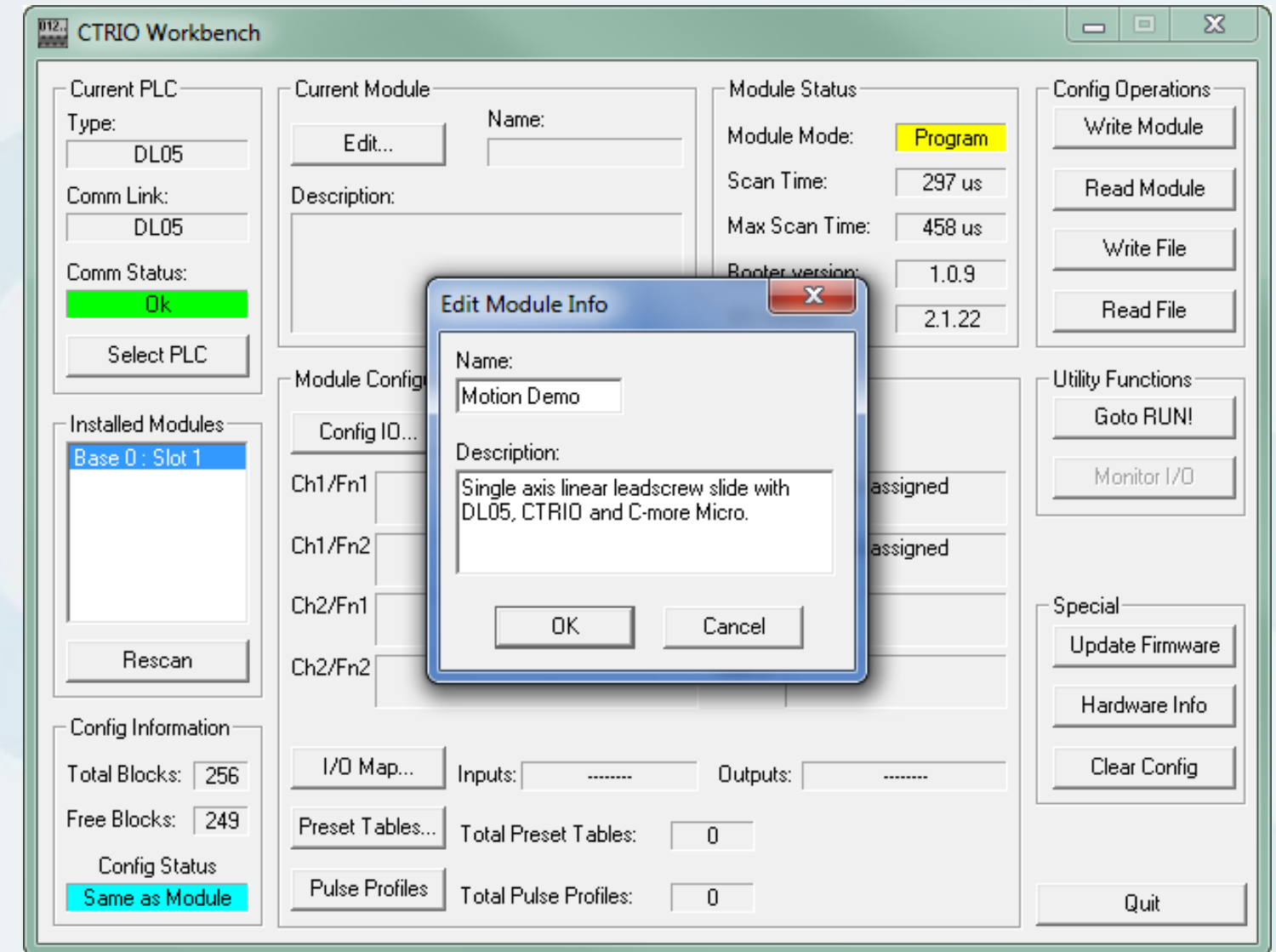


CTRIO Workbench – Module Name & Description – 4 of 28

Its always good practice to provide a name and description of the CTRIO module for identifying later, and especially if there are multiple modules in your application.

Under the heading ‘Current Module’, select the ‘Edit’ button to type in a ‘Name’ and ‘Description’ of the module. In my case, I named the module ‘Motion Demo’ and gave a description of ‘Single axis linear leadscrew slide with DL05, CTRIO and *C-more* Micro.

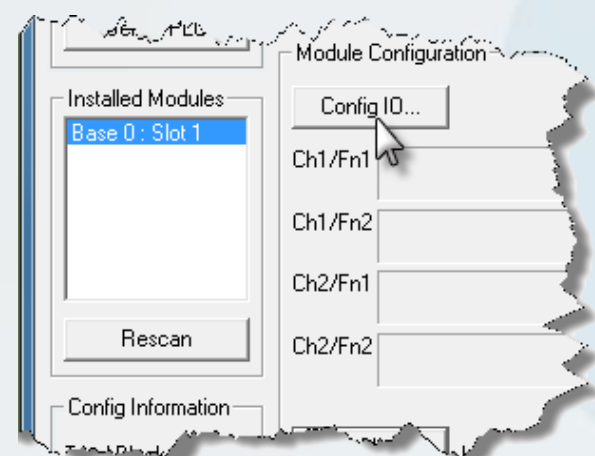
Click OK to accept the edits.



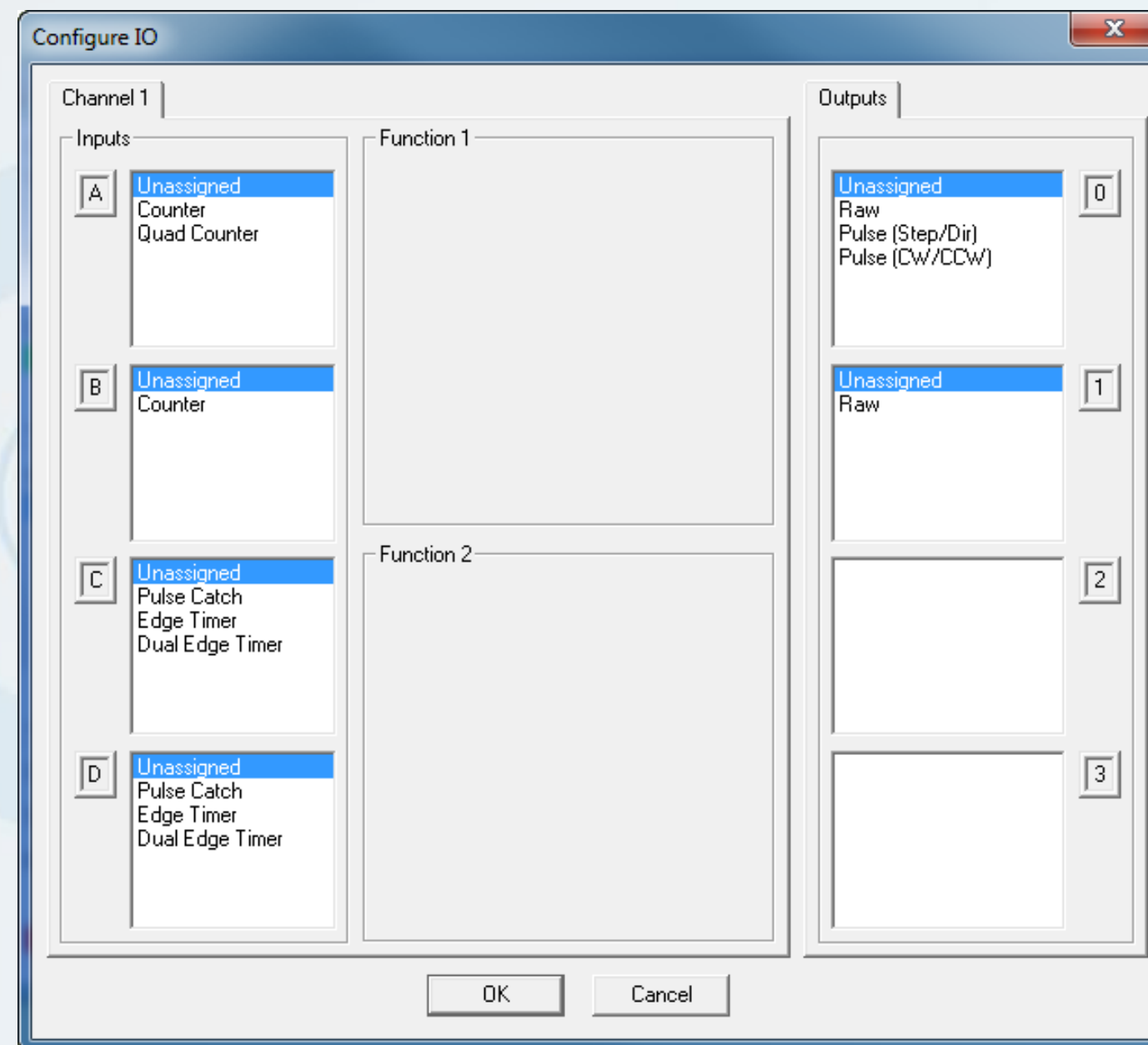
CTRIO Workbench – Configure IO – 5 of 28

The first step is to determine how the CTRIO module will be used in your application. I will be using the module to output step pulses and a directional signal to the stepping motor driver, and I also will make use of the CTRIO module’s built-in inputs as explained on the next slide.

I next click the ‘Configure IO’ button at the middle left of the CTRIO Workbench dialog window.



The opened ‘Configure IO’ window shows the various functions that can be selected for the H0-CTRIO module’s four inputs and two outputs. Please note that the available functions within each input and output function box change based on the selections made in other function boxes.

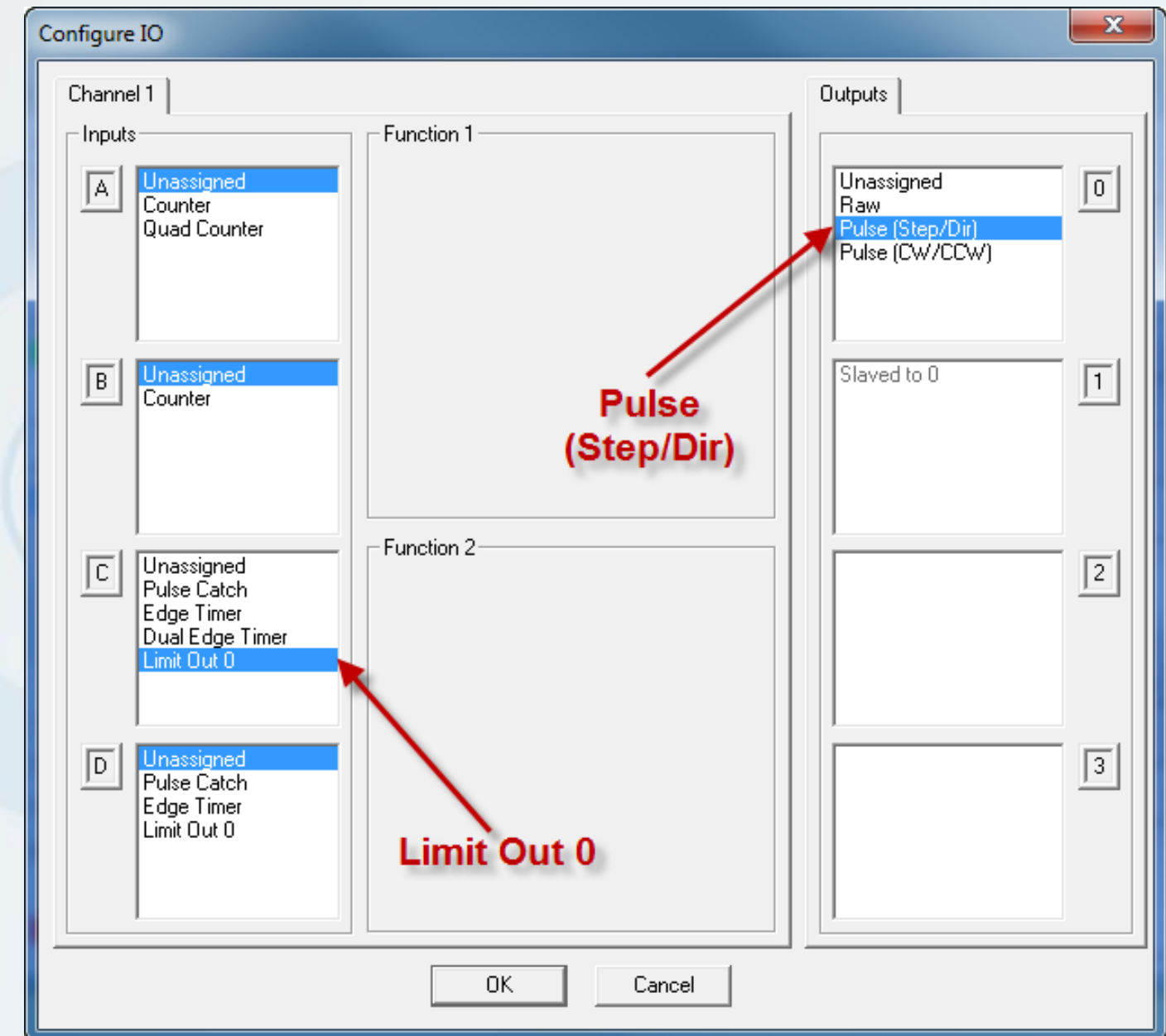


CTRIO Workbench – Configure IO – 6 of 28

I select the ‘Pulse (Step/Dir)’ function listed in the Output 0 function box. Output function box 1 will now show ‘Slaved to 0’. Output 0, designated as ‘Y0’ on the CTRIO module, and not the same as Y0 on the DL05 PLC, will provide the step pulses, while Output 1, designated as ‘Y1’, also not the same as Y1 on the DL05 PLC, will provide the stepping driver’s direction signal.

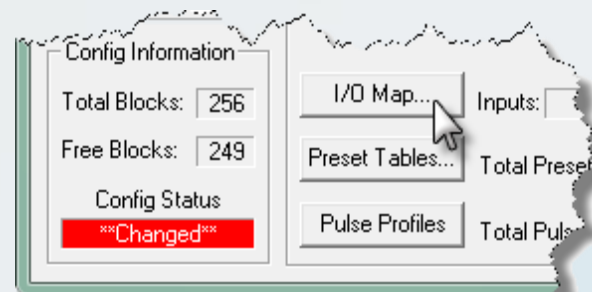
I will be using the Homing profile in my demo, so I will set Input C to the ‘Limit Out 0’ function, which will allow us to use it to indicate when the linear slide is at the home proximity sensor.

Configuring the IO at this point will allow us to see how the Input and Output addresses are assigned when we Map the I/O in the next step.



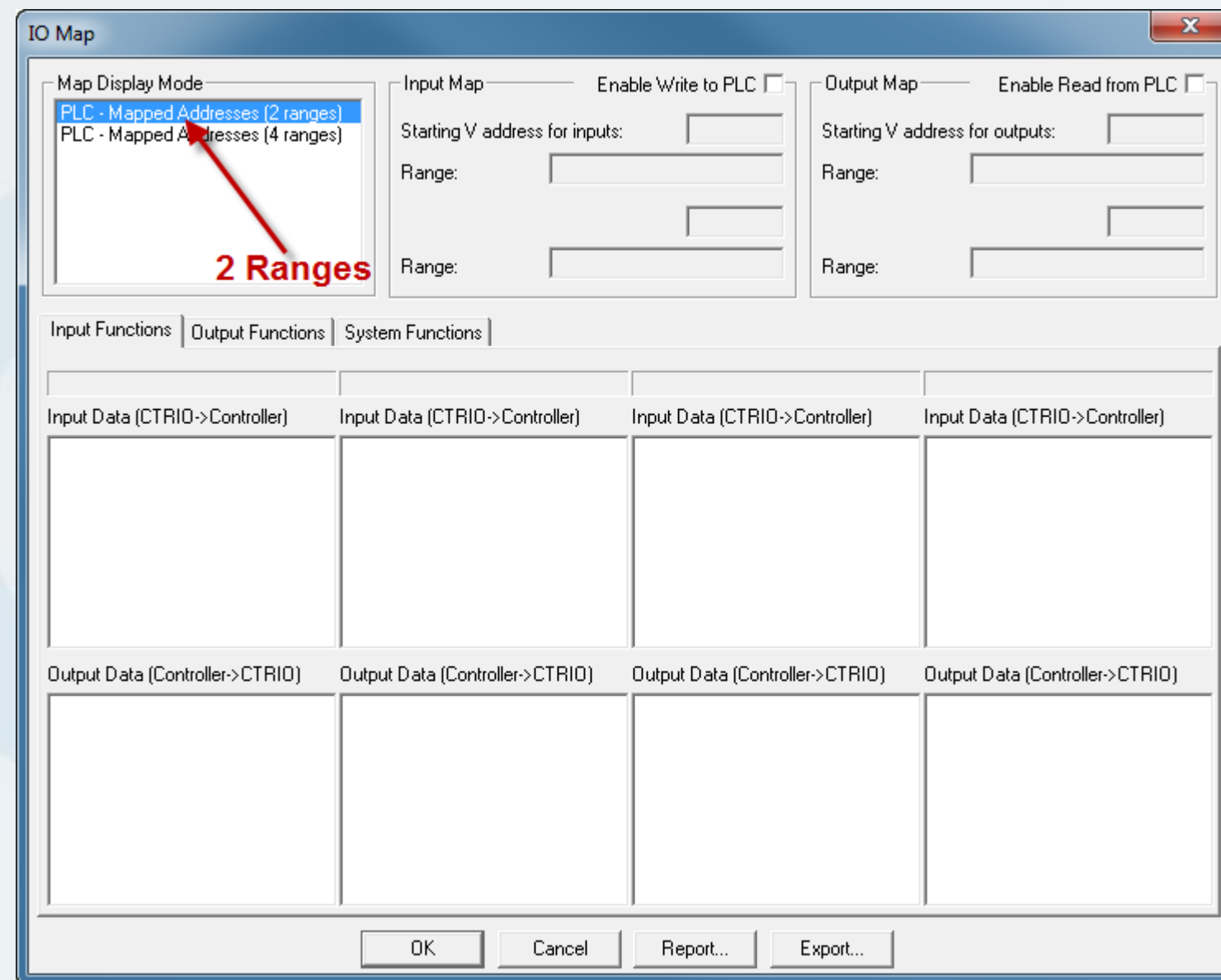
CTRIO Workbench – I/O Map Address Ranges – 7 of 28

Next we need to setup the PLC's memory addresses that the CTRIO module will be communicating. Click the 'I/O Map' button at the bottom of the CTRIO Workbench dialog window.



The 'Map Display Mode' has two choices for how the addressing can be used within the PLC. The addresses can be broken down into either 2 ranges or 4 ranges. Using 2 ranges allow us to address the I/O in 'word' and 'bit-of-word' formats. Using 4 ranges allow us to address in 'word' and 'Control Relay' formats.

In our example I have chosen to use the 2 ranges for 'Input Map' and 'Output Map' display mode.

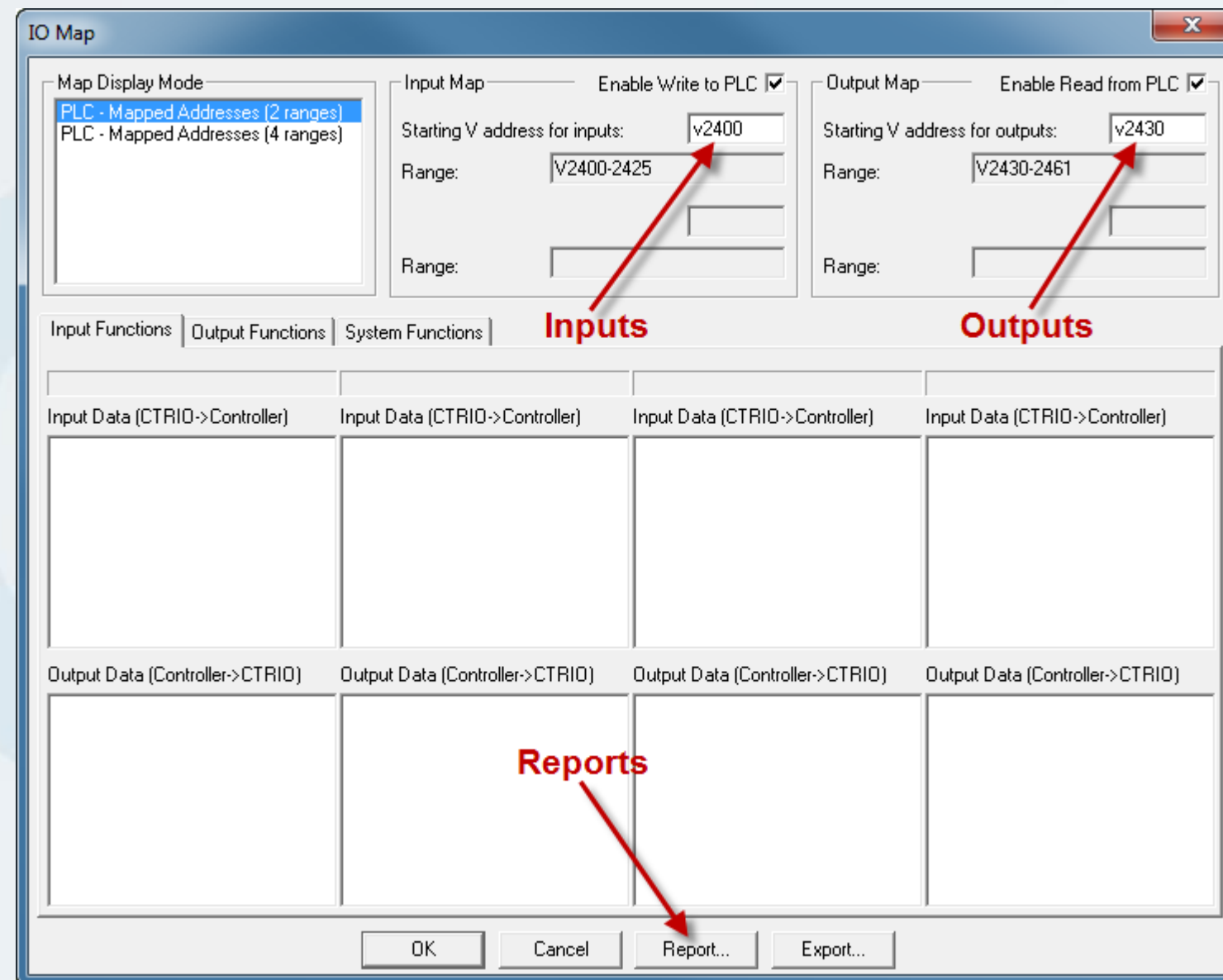


CTRIO Workbench – I/O Map Addresses – 8 of 28

In the IO Map dialog window I check the ‘Enable Write to PLC’ box and enter V2400 for the ‘Starting V address for inputs’, producing a range of V2400-2425. I check the ‘Enable Read from PLC’ box and enter V2430 for the ‘Starting V address for outputs’, producing a range of V2430-2461.

Once the Input and Output Map address ranges have been entered, the available functions for the Inputs, Outputs and System are shown under tabs at the lower area of the IO Map dialog window.

From the IO Map dialog window, we can print a ‘Report’ that shows all of the mapped I/O addresses and their functions, and use as a reference while developing the ladder logic.

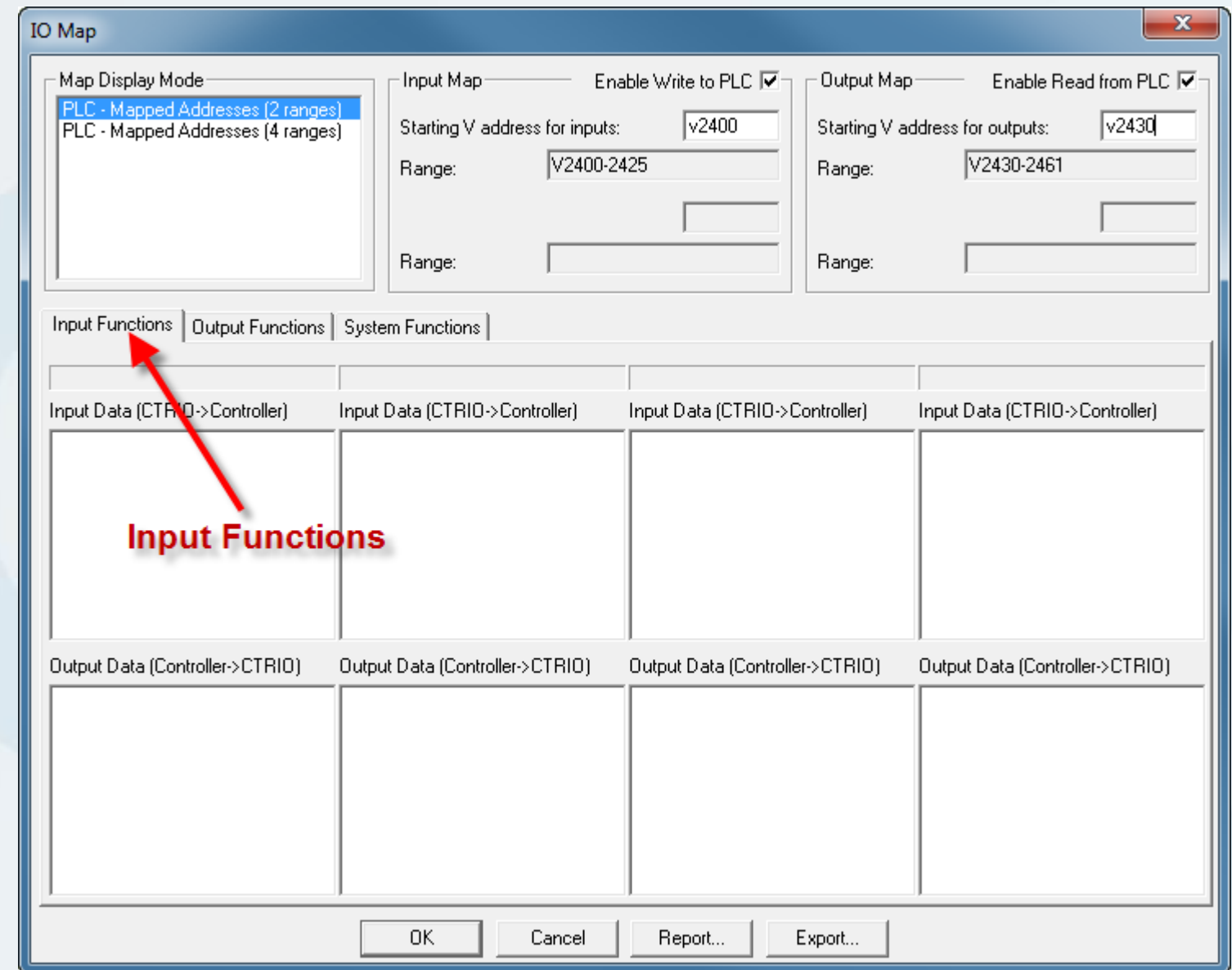


CTRIO Workbench – I/O Map Input Functions – 9 of 28

Under the ‘Input Functions’ tab there is no Input Data (CTRIO->Controller) or Output Data (Controller->CTRIO) shown or defined.

Although earlier in the ‘Configure IO’ dialog window I assigned physical ‘Input C’ as ‘Limit Out 0’ to use for our Homing profile, it becomes an internal function and is not communicated between the CTRIO module or the Controller, in our case a DL05 PLC.

In the next slide we will continue with the ‘Output Functions’ that are available to use in our ladder logic program.



CTRIO Workbench – I/O Map Output Functions – 10 of 28

The ‘Output Functions’ that have been assigned as part of the selections made include:

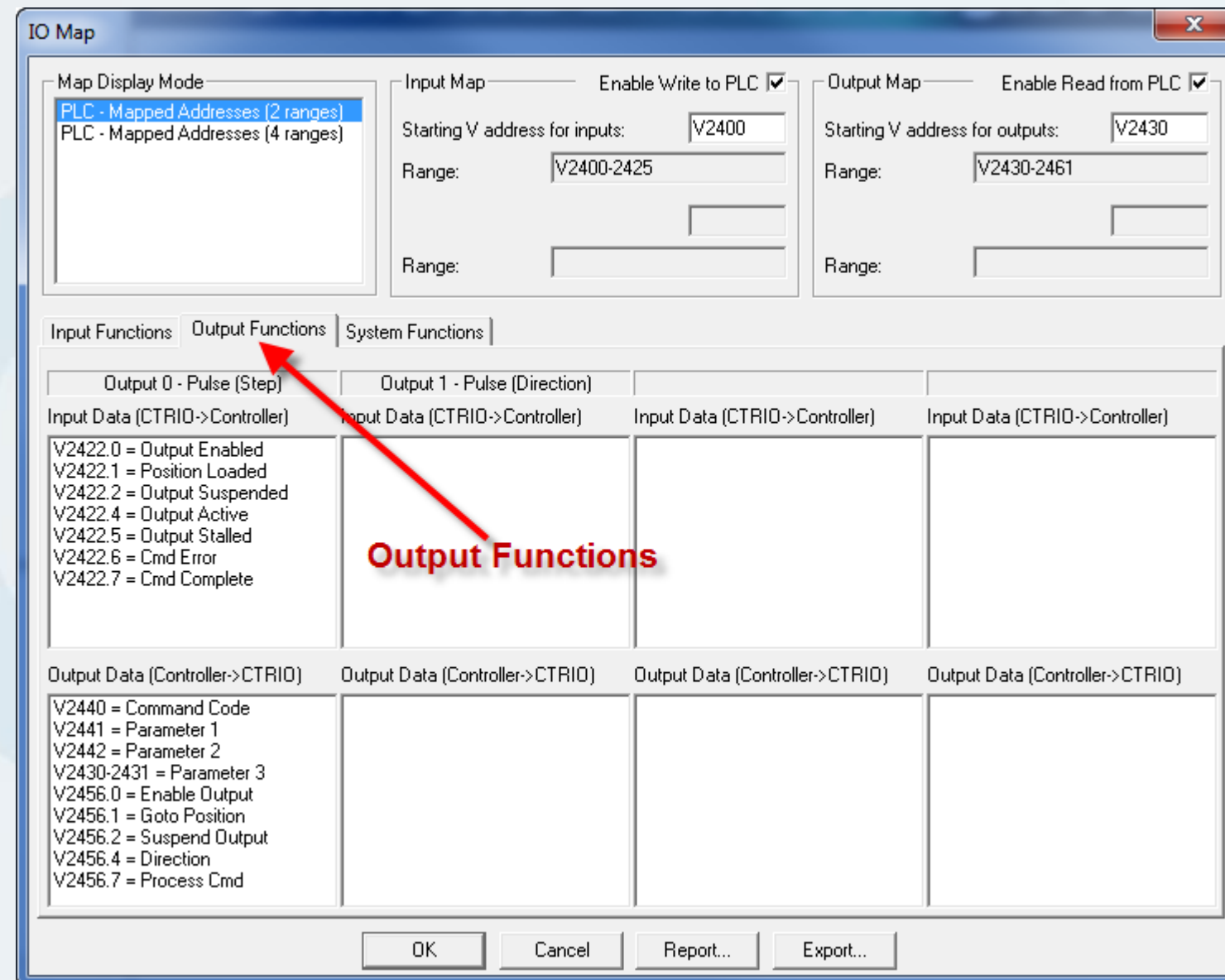
Output 0 – Pulse (Step)

Output 1 – Pulse (Direction)

Input Data (CTRIO->Controller):

- V2422.0 = Output Enabled, Out0_OutEnbld
- V2422.1 = Position Loaded, Out0_PosLoded
- V2422.2 = Output Suspended, Out0_OutSuspnd
- V2422.4 = Output Active, Out0_OutActiv
- V2422.5 = Output Stalled, Out0_OutStald
- V2422.6 = Cmd Error, Out0_CmdError
- V2422.7 = Cmd Complete, Out0_CmdCmplt

The Output Data (Controller->CTRIO) is continued on the next slide.



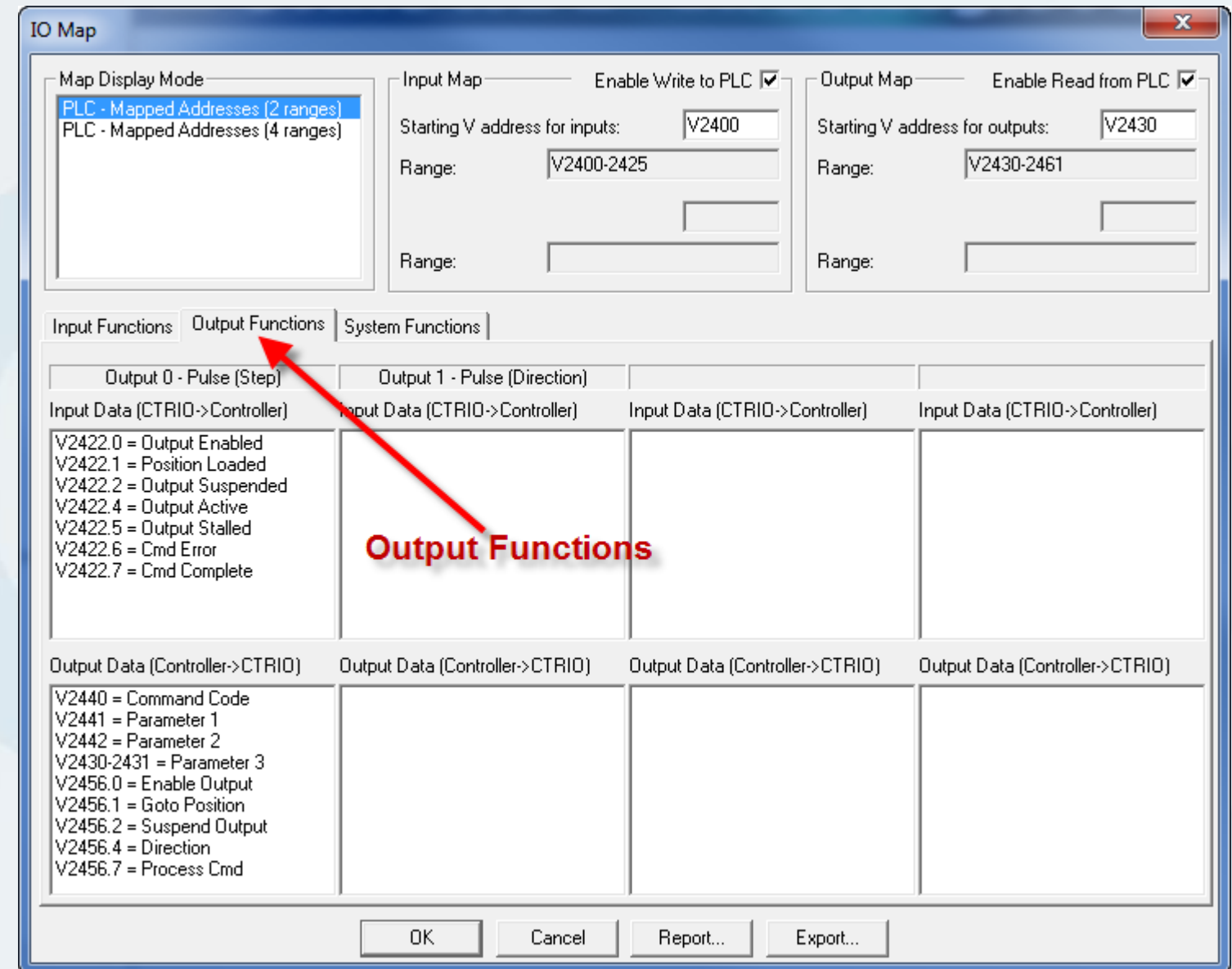
CTRIO Workbench – I/O Map Output Functions (Cont'd) – 11 of 28

Continuing with the 'Output Functions' that have been assigned as part of the selections made include:

Output Data (Controller->CTRIO):

- V2440 = Command Code, Out0_CmdCode
- V2441 = Parameter 1, Out0_Param1
- V2442 = Parameter 2, Out0_Param2
- V2430-2431 = Parameter 3, Out0_Param3
- V2456.0 = Enable Output, Out0_EnablOut
- V2456.1 = Goto Position, Out0_GotoPos
- V2456.2 = Suspend Output, Out0_SuspOut
- V2456.4 = Direction, Out0_Direction
- V2456.7 = Process Cmd, Out0_ProcCmd

The 'System Functions' is continued on the next slide.



CTRIO Workbench – I/O Map System Functions – 12 of 28

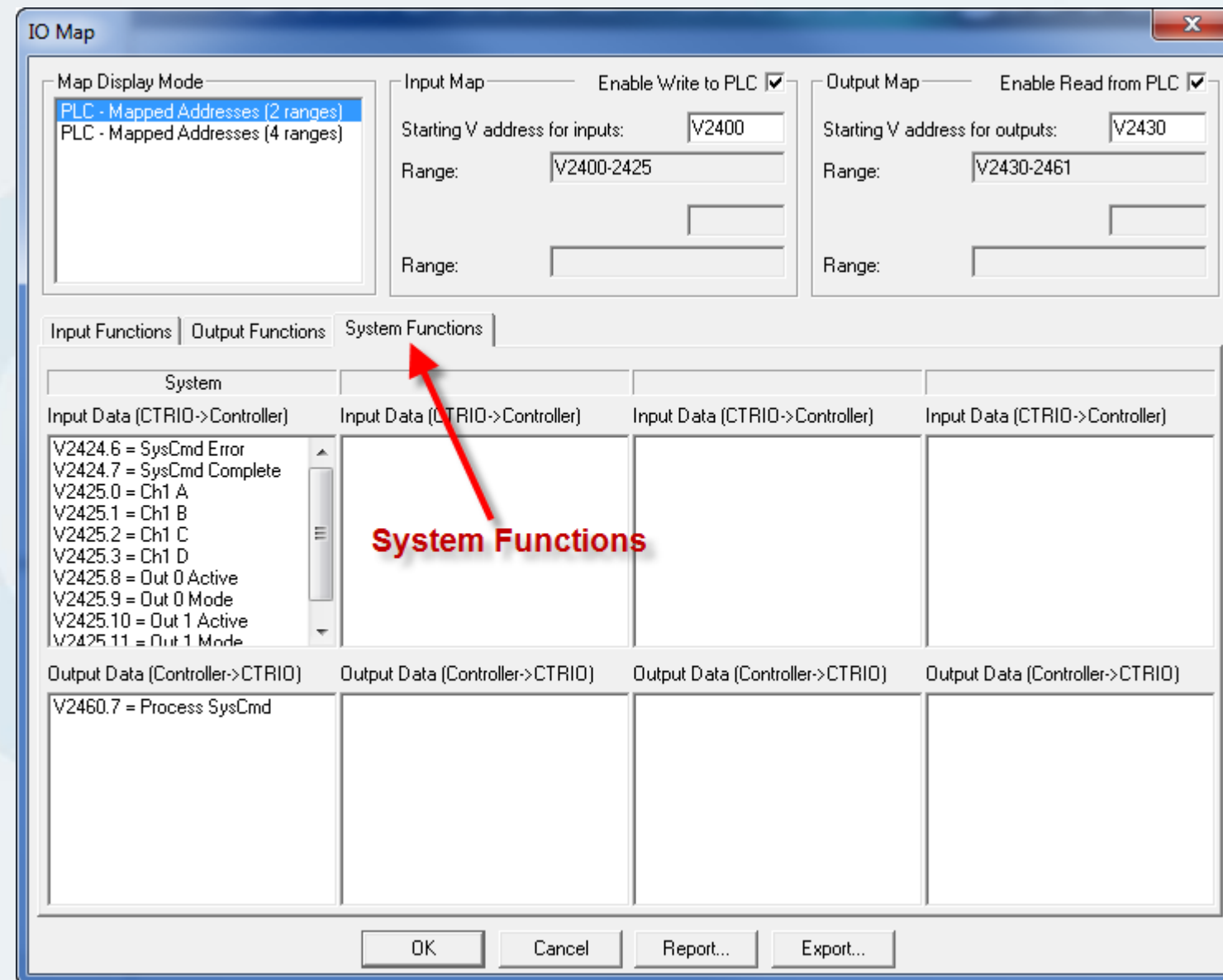
The ‘System Functions’ that have been assigned as part of the selections made include:

Input Data (CTRIO->Controller):

- V2424.6 = SysCmd Error, SysCmdError
- V2424.7 = SysCmd Complete, SysCmdComple
- V2425.0 = Ch1 A, Ch1A
- V2425.1 = Ch1 B, Ch1B
- V2425.2 = Ch1 C, Ch1C
- V2425.3 = Ch1 D, Ch1D
- V2425.8 = Out 0 Active, Out0_Active
- V2425.9 = Out 0 Mode, Out0_Mode
- V2425.10 = Out 1 Active, Out1_Active
- V2425.11 = Out 1 Mode, Out1_Mode

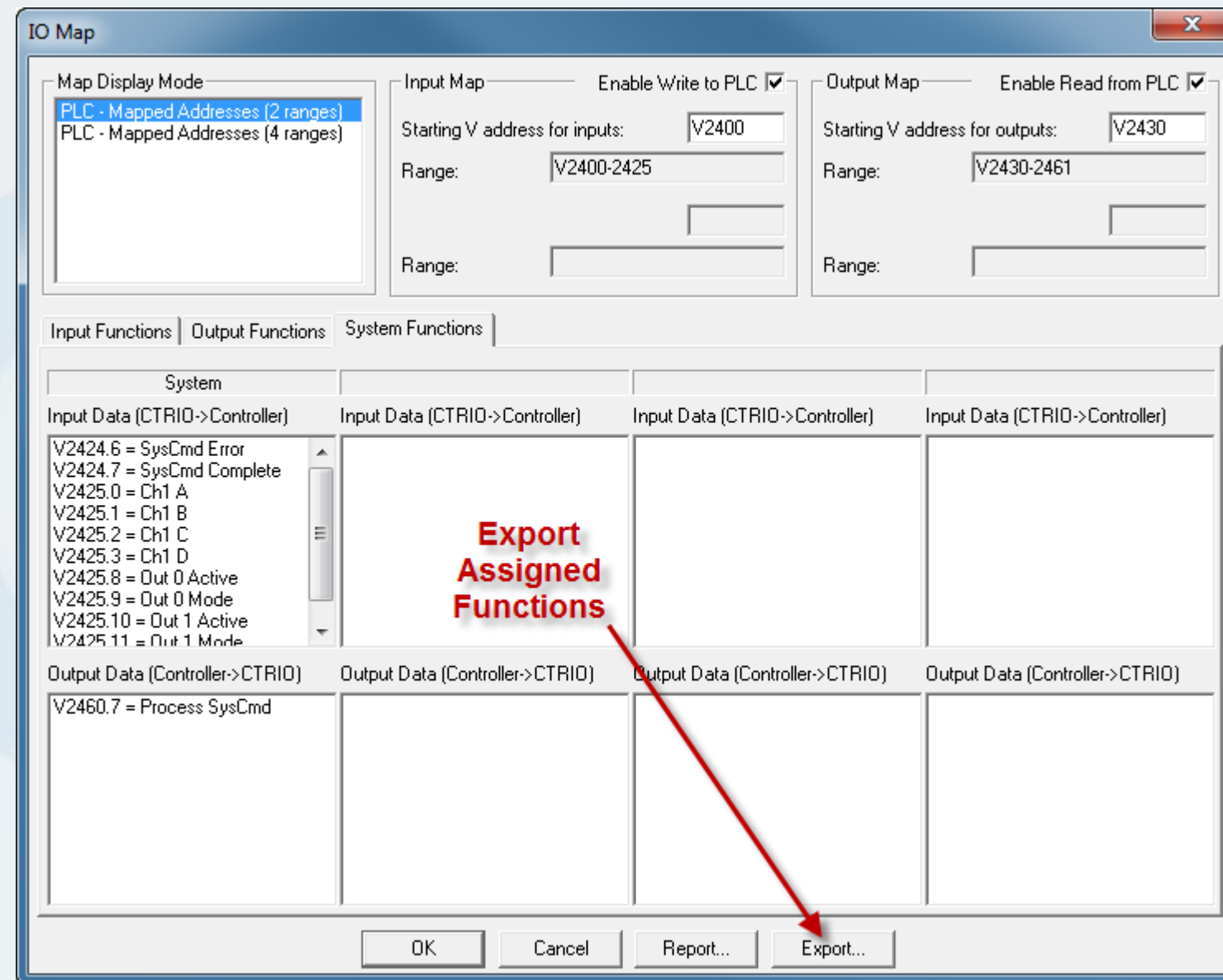
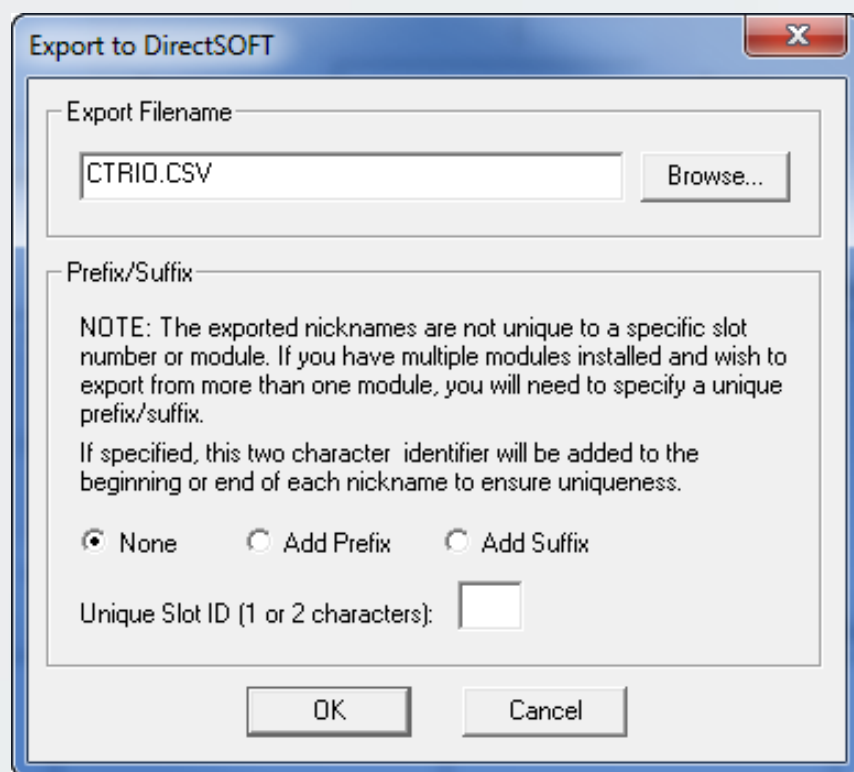
Output Data (Controller->CTRIO):

- V2460.7 = Process SysCmd, ProcSysCmd



CTRIO Workbench – Export Assigned Function Nicknames – 13 of 28

A 'CSV' (Comma Separated Values) file format of the assigned functions can be exported from the 'IO Map' dialog window and later imported into the DL05 PLC ladder logic program as part of the 'Element Documentation' and used for 'Nicknames'.



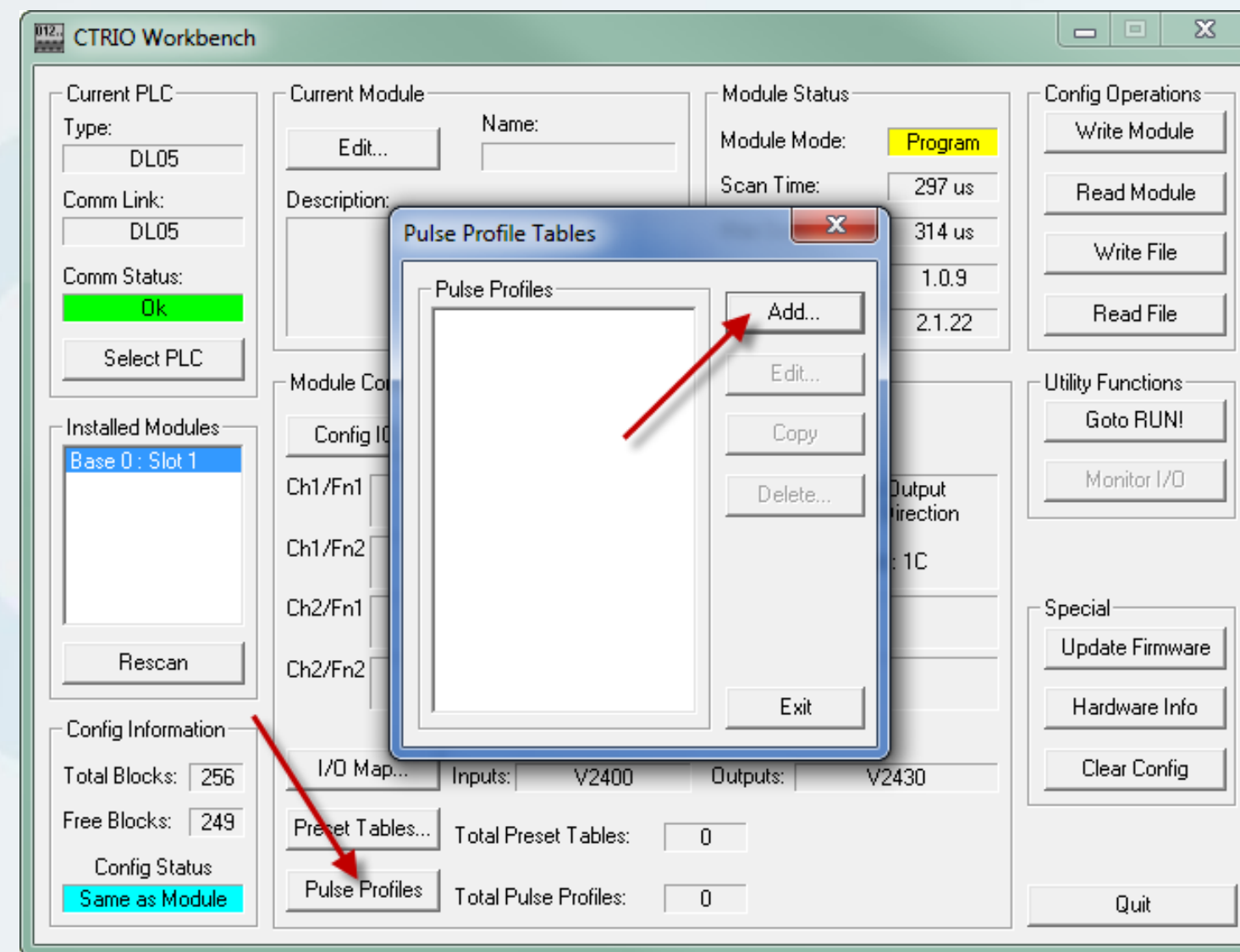
CTRIO Workbench – Create Pulse Profiles – 14 of 28

The next step I need to do is to create the various ‘Pulse Profiles’ that I will be using in our demonstration. To create the profiles, I click on the ‘Pulse Profiles’ button at the bottom of the CTRIO Workbench dialog window.

I click the ‘Add’ button in the ‘Pulse Profile Tables’ dialog window which will bring up the ‘Edit Pulse Profile’ as shown on the next series of slides.

My demonstration will make use of four different ‘Pulse Profiles’. Included are:

- Home Search
- Dynamic Velocity (Used for jogging.)
- Trapezoid
- S-Curve



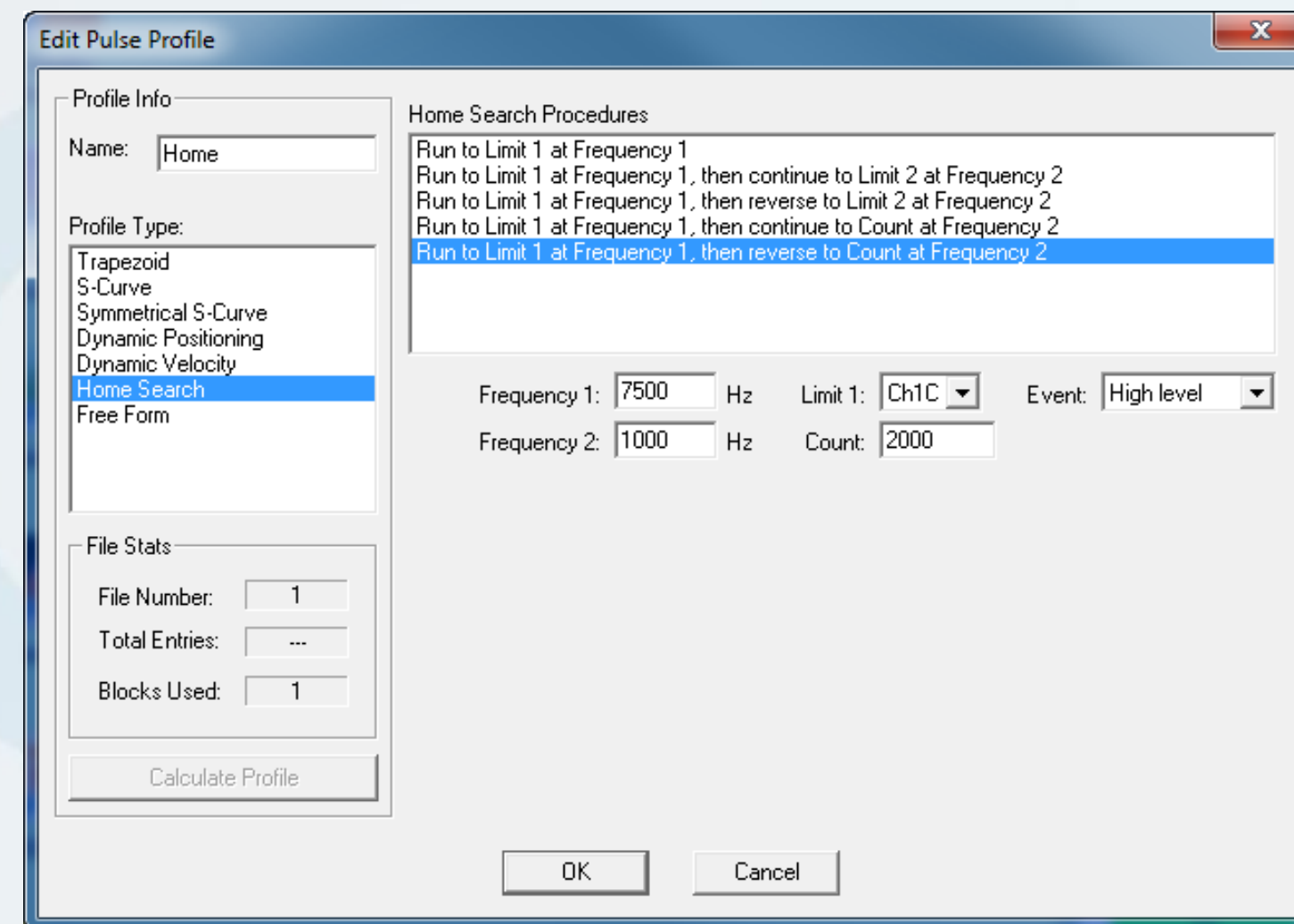
CTRIO Workbench – Home Search Profile – 15 of 28

The first profile I will create uses the ‘Home Search’ profile, and as the name implies, I will use it to home my linear leadscrew slide to a known position based on the actuation of a fixed proximity sensor from a metal target that is on the slide.

I give the profile the name ‘Home’ and select ‘Home Search’ from the ‘Profile Type’ list. The ‘File Number’ will default to ‘1’, this being the first profile that I am creating.

I decide to use the ‘Home Search Procedure’ that will ‘Run to Limit 1 at Frequency 1, then reverse to Count at Frequency 2’. I use 7,500 Hertz for Frequency 1 and 1,000 Hertz for Frequency 2.

Limit 1 is assigned to Channel 1C and I want the actuation to take place when the proximity sensor changes to a ‘High Level’.



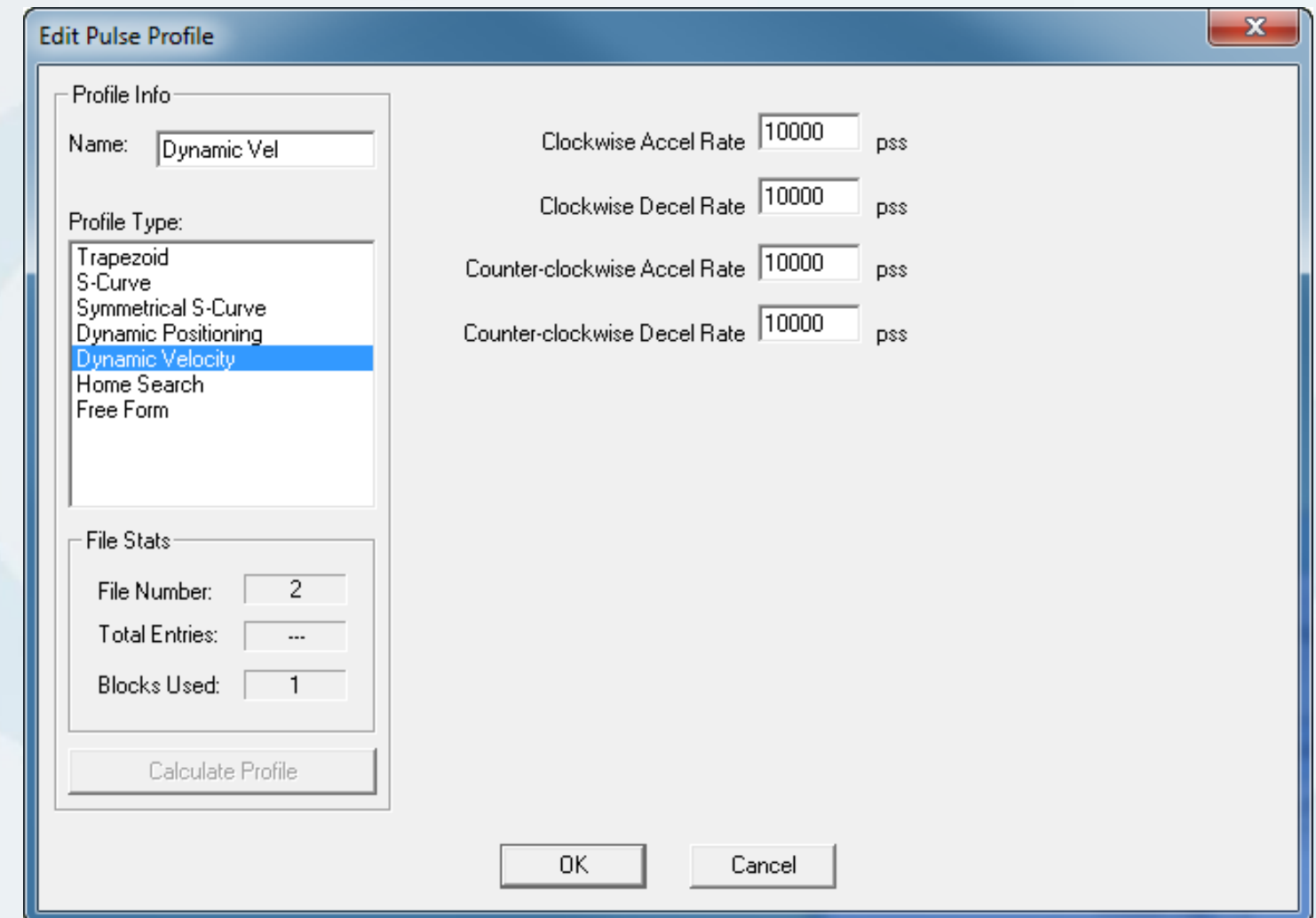
CTRIO Workbench – Dynamic Velocity Profile (Jogging) – 16 of 28

I use the Profile Type ‘Dynamic Velocity’ for my next profile and name it ‘Dynamic Vel’. The ‘File Number’ for this profile will be ‘2’. We will see later that the file numbers are used within the *DirectSOFT5*’s ladder logic *IBox* instructions to load the profile into the PLC’s CPU memory prior to executing the move profile.

Again, this profile will be used for jogging the slide axis both to the left and to the right, and is executed as long as the jog left or right push button on the *C-more* Micro-Graphic panel is pressed.

I use 10,000 pulse/second/second for the ‘Accel’ and ‘Decel’ rates in both the ‘Clockwise’ and ‘Counter-Clockwise’ directions.

These values can be adjusted to produce a slower response during jogging if desired.



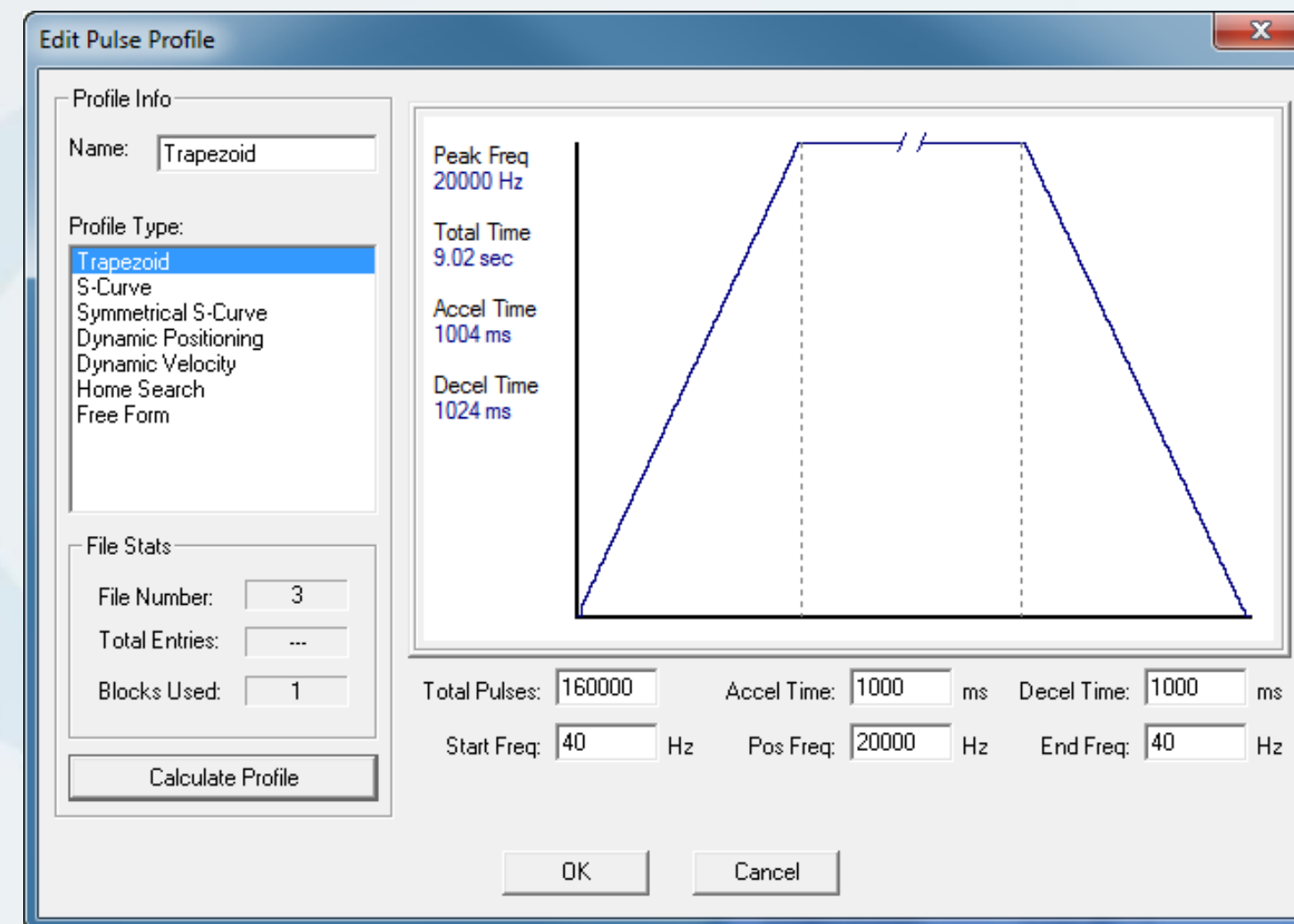
CTRIO Workbench – Trapezoid Profile – 17 of 28

The third profile I set up for my demonstration is the Trapezoid profile. This profile will produce a pre-determined move distance, and the ability to control how fast the step motor will accelerate up to the target speed and decelerate to a stop. I use a set time of 1,000 milliseconds to accelerate and decelerate to a maximum target ‘Pos Frequency’ of 20,000 Hertz.

I set the ‘Start’ and ‘End’ frequency for 40 Hertz (20 Hertz is the minimum).

I enter 160,000 for the ‘Total Pulses’, which if taken times 0.0000625 inches per step, the result will equal 10.00 inches of total linear travel.

I have created the Trapezoid profile to be slightly aggressive in accelerating to target speed and decelerating to a stop so it’s motion can be compared to the S-Curve profile which is next.



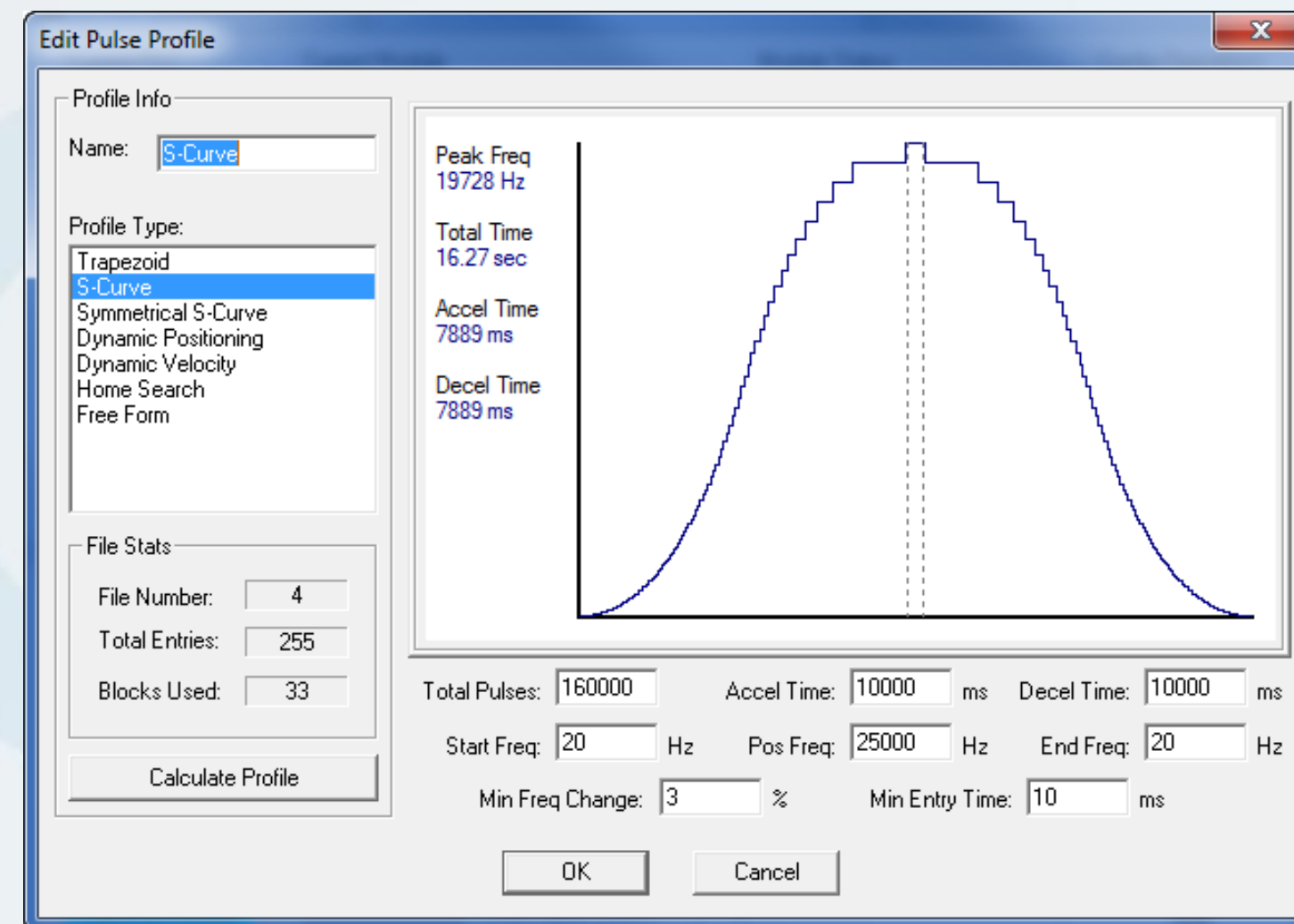
CTRIO Workbench – S-Curve Profile – 18 of 28

The S-Curve profile is identified as ‘File Number’ 4, with ‘Total Pulses’ equal to 160,000, representing 10 inches total travel as also used in the Trapezoid profile.

I use a set time of 10,000 milliseconds to accelerate and decelerate to a maximum target ‘Pos Frequency’ of 25,000 Hertz, and a ‘Start’ and ‘End’ frequency of 20 Hertz. I have left the default of 3% for the ‘Min Freq Change’ and 10 ms for the ‘Min Entry Time’.

Please notice in the calculated results that the ‘Peak Frequency’ does not reach the target of 25,000 Hertz. The ‘Accel’ and ‘Decel’ times could be reduced to achieve reaching the target if required.

The S-Curve profile is ideal in applications where we do not want the load subjected to vibrations or jarring motions.

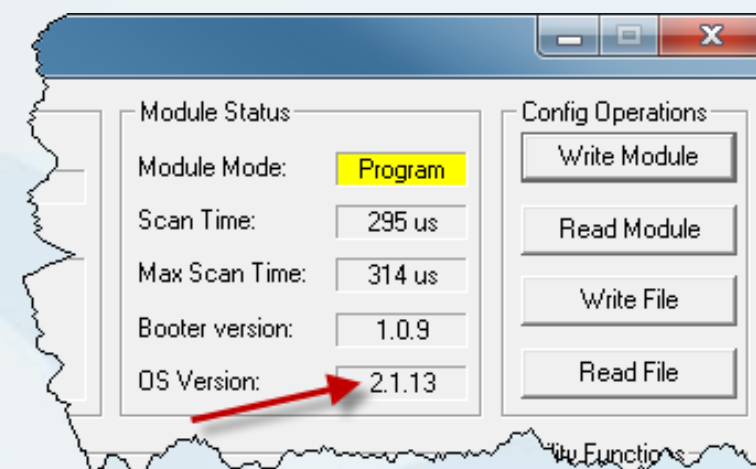


CTRIO Workbench – Update Firmware – 19 of 28

It is always recommended to use the latest ‘Firmware’ in the CTRIO module to take advantage of the latest enhancements and/or possible bug fixes.

The module’s existing firmware can be checked under ‘Module Status’ in the ‘CTRIO Workbench’ dialog window as ‘OS Version’. In the example shown here the existing firmware is OS Version 2.1.13.

To check the latest available firmware version, visit *AutomationDirect’s* Firmware Upgrade Web site page and click on the ‘H0-CTRIO’ shown in the list, which will take you to Host Engineering, Inc.’s Web site, or do directly to Host’s Web site. Click on ‘Firmware’ under Host’s Support category. The links are listed below for your convenience.



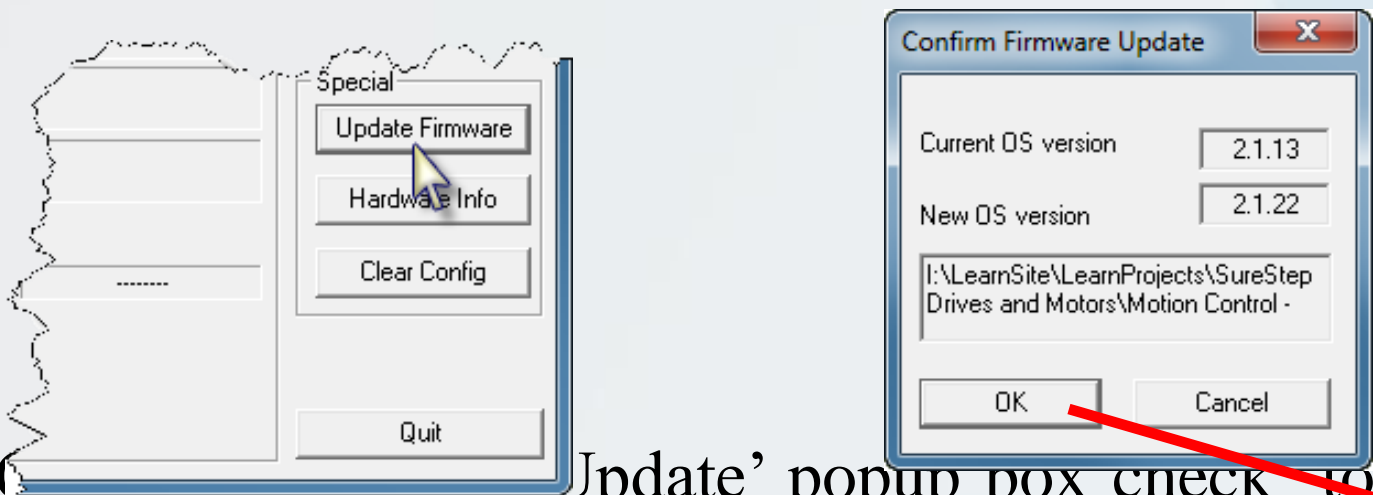
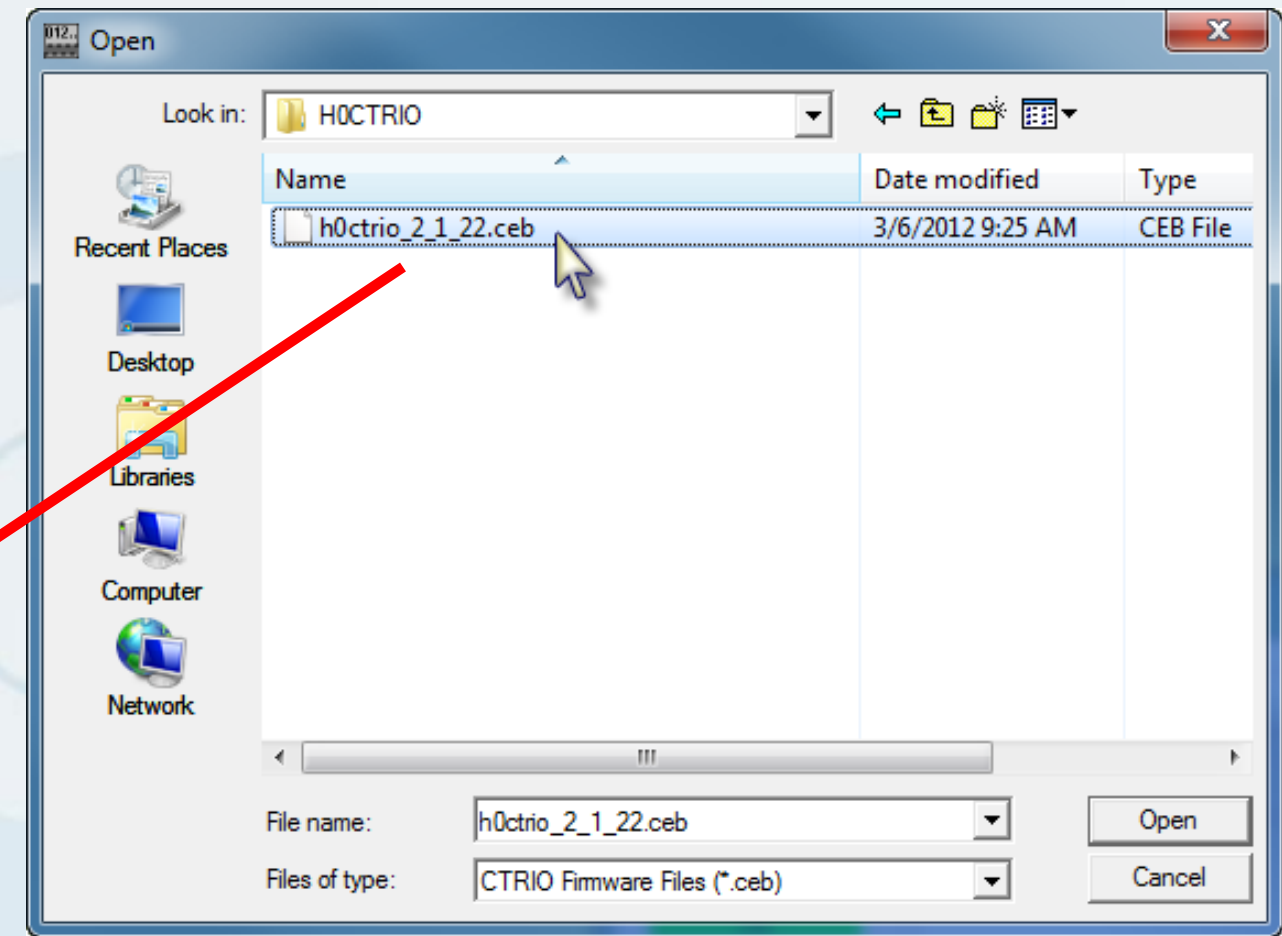
NOTE: Host Engineering, Inc., an *AutomationDirect* Federation Partner, is the manufacturer of the CTRIO module, and many other devices that are used to enhance the functionality of *AutomationDirect* products.

Link to *AutomationDirect’s* Firmware Upgrades Web site page: <http://bit.ly/KC3gcH>

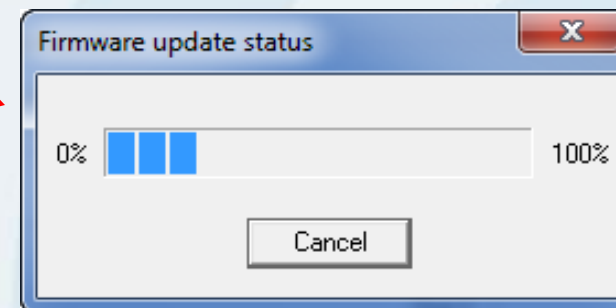
Link to Host Engineering’s Web site, click Firmware under Support: <http://bit.ly/Jyk0DI>

CTRIO Workbench – Update Firmware – 20 of 28

Once it is determined that there is a later OS Firmware Version available and it has been downloaded, click on the ‘Update Firmware’ button located in the lower right corner of the ‘CTRIO Workbench’ dialog window. Select the firmware ‘ceb’ file that will be used, and click the ‘Open’ button. The example here shows updating from version 2.1.13 to 2.1.22.



In the ‘Update’ popup box check to make sure the ‘New OS Version’ is the latest, and click ‘OK’. The update will take a few minutes.



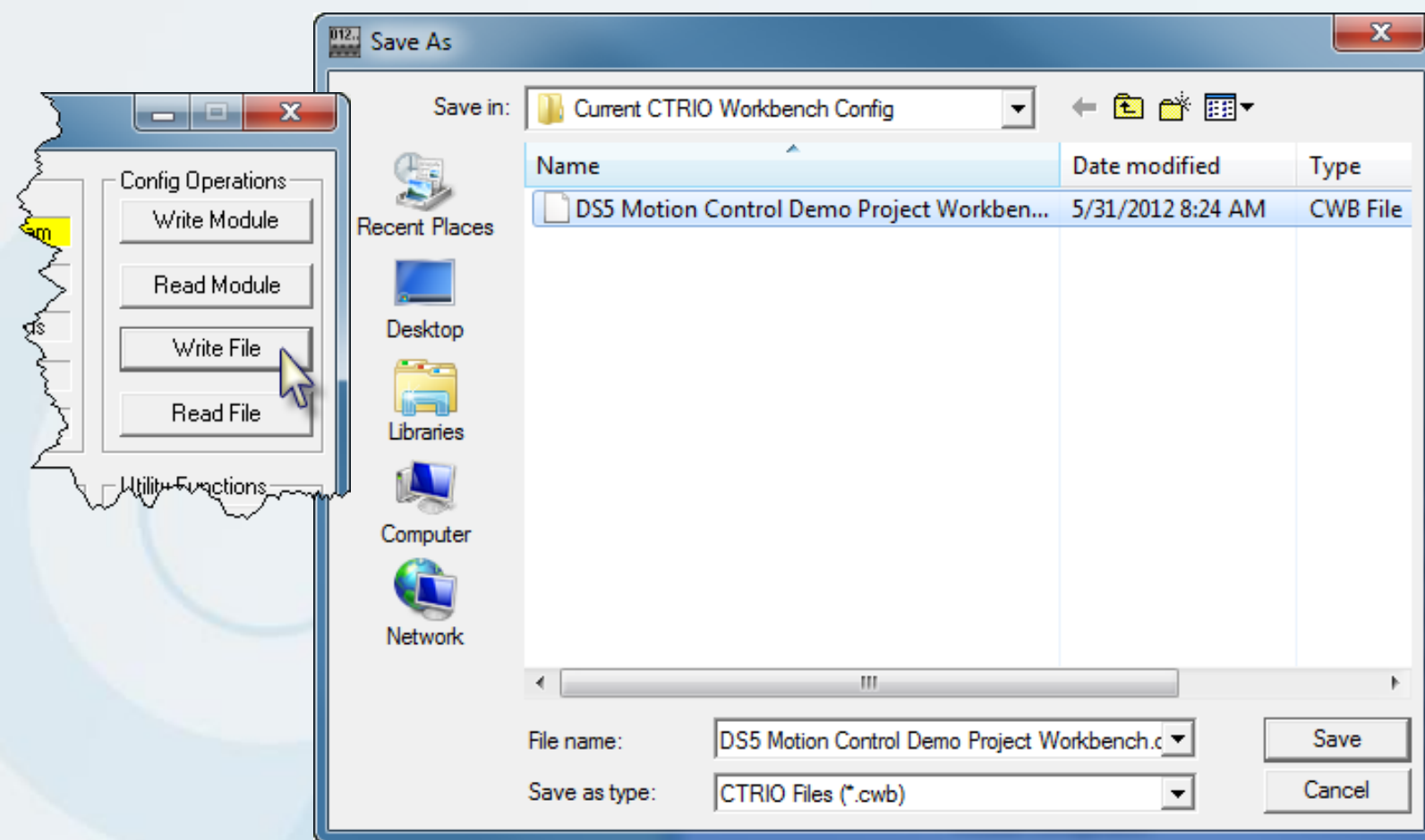
CTRIO Workbench – Write and Read ‘CWB’ Files – 21 of 28

Once we have all of our settings and parameters configured in the CTRIO Workbench utility, we can ‘Write’ the configuration to a ‘CWB’ file format so that it is saved and available as a backup copy for future use.

Likewise, if we have a previous configuration saved ‘CWB’ file, we can ‘Read’ the file into the CTRIO Workbench utility and then ‘Write’ it to the CTRIO module, while in ‘Program’ mode, as explained in the next slide.

I have made the ‘CWB’ configuration file for the demonstration unit covered in this video series available on the LEARN site.

The ‘CWB’ file is titled ‘motion control demo – ctrio workbench project.cwb’ and includes all of the settings and parameters covered in this video tutorial.



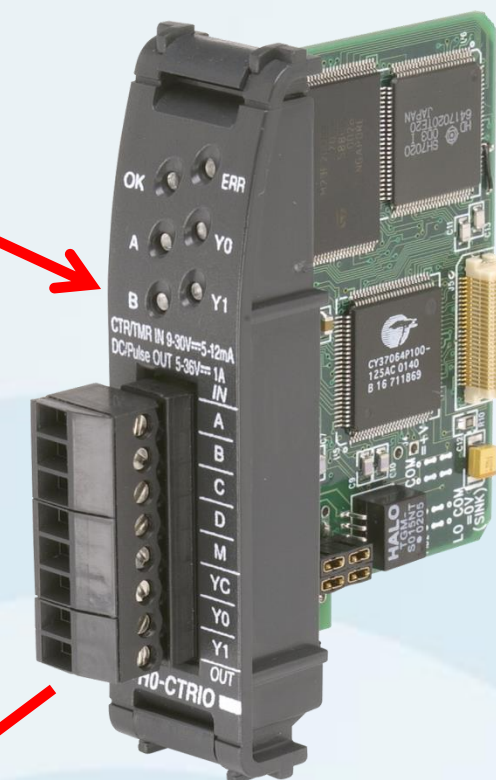
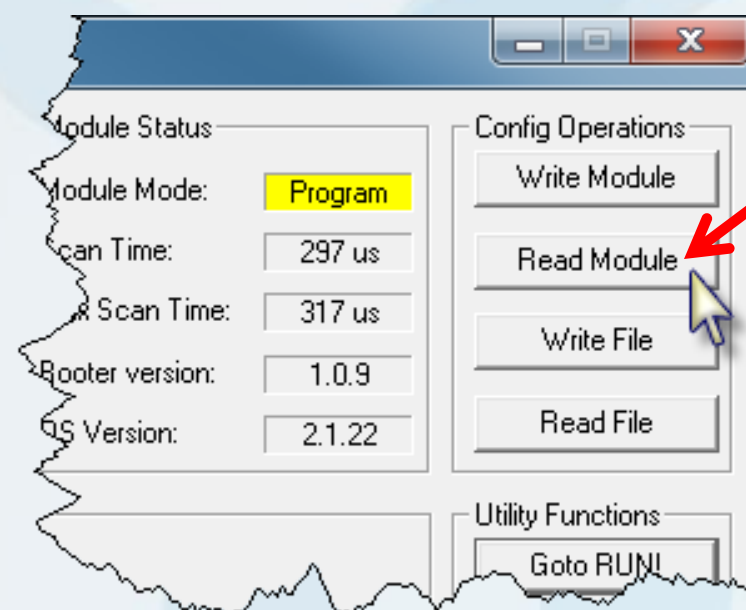
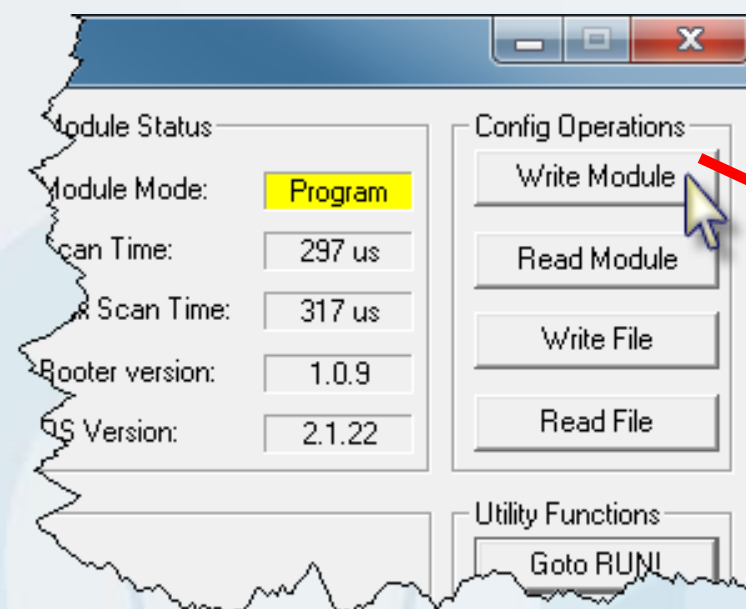
NOTE: ‘CWB’ is the file extension for the CTRIO Workbench file format.

CTRIO Workbench – Write and Read Module’s Configuration – 22 of 28

After all of our configuration elements are complete and saved, we next need to download the information into the CTRIO module by using the ‘Write Module’ button under the ‘Config Operations’ area located in the upper right corner of the CTRIO Workbench utility. The module needs to be in the ‘Program’ mode. This action will take place as soon as the button is clicked, and it takes a few seconds to complete.

Likewise, if we have a previous configuration saved in a CTRIO module, you can ‘Read’ the CWB file from the module by clicking on the ‘Read Module’ button, also located in the upper right corner of the CTRIO Workbench utility.

And you can do a ‘Write File’ to save the CWB configuration file, if it hasn’t previously been saved.



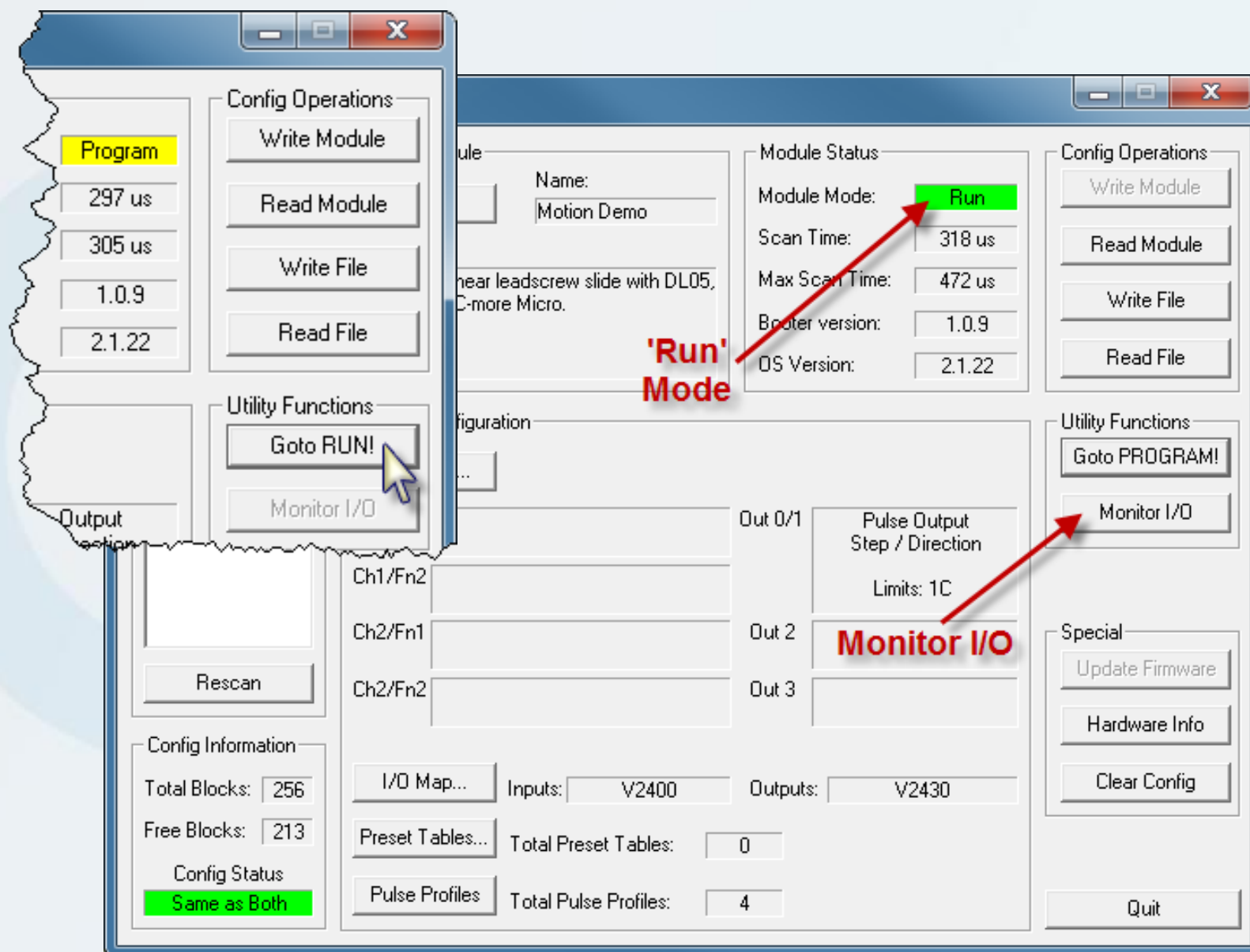
CTRIO Module H0-CTRIO

CTRIO Workbench – ‘Goto RUN!’ Mode – 23 of 28

With the CTRIO module fully configured, I am now ready to test my settings and parameters. I click on the ‘Goto Run!’ button under the ‘Utility Functions’ area on the right center of the CTRIO Workbench utility.

The ‘Module Mode’ indicator will now display ‘Run’ if the module has a valid configuration.

The ‘Monitor I/O’ button located on the middle right side of the CTRIO Workbench utility will now be available. Let’s test the configuration!



NOTE: The CTRIO module will not enter into the ‘Run’ mode if it does not have a valid configuration.

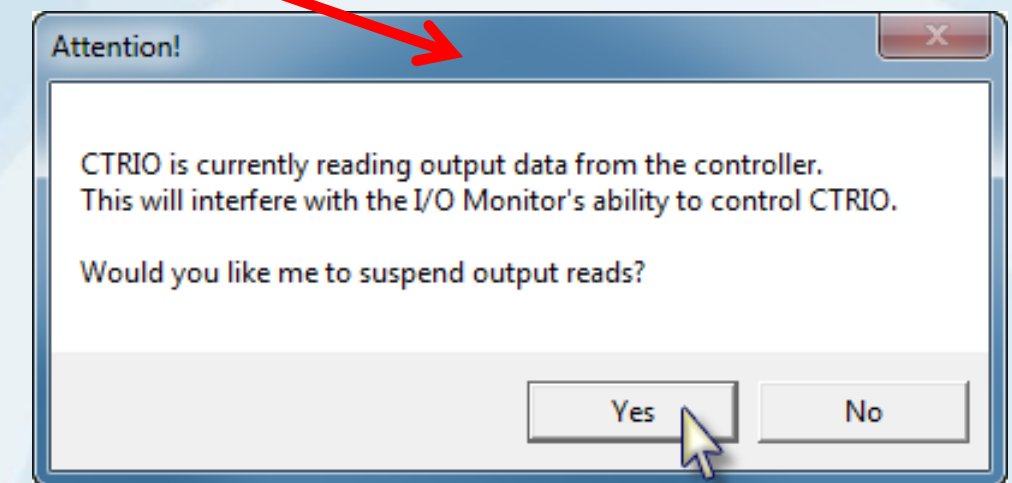
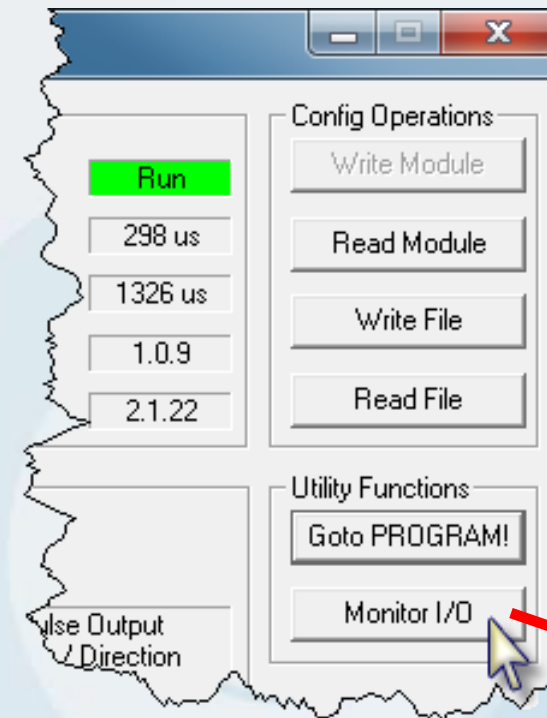
CTRIO Workbench – Monitor I/O – Startup – 24 of 28

The CTRIO Workbench utility has the ability to not only monitor the module's I/O, but also can be used to test the user's profiles. The 'Monitor I/O' dialog is accessible from the CTRIO Workbench dialog window when the module is in the 'Run' mode.

Safety! To prevent damage to equipment and/or possible injury to personnel, it is strongly suggested that the stepping motor be uncoupled from the load before entering into the 'Monitor I/O' mode. Un-expectant results could occur.

With the CTRIO module in 'Run' mode, I click on the 'Monitor I/O' button located under the 'Utility Functions' area of the CTRIO Workbench utility.

An 'Attention!' popup box will allow me the choice to suspend reading output data from the PLC controller and prevent interference with the Monitor I/O's ability to control the CTRIO, so I select 'Yes'.

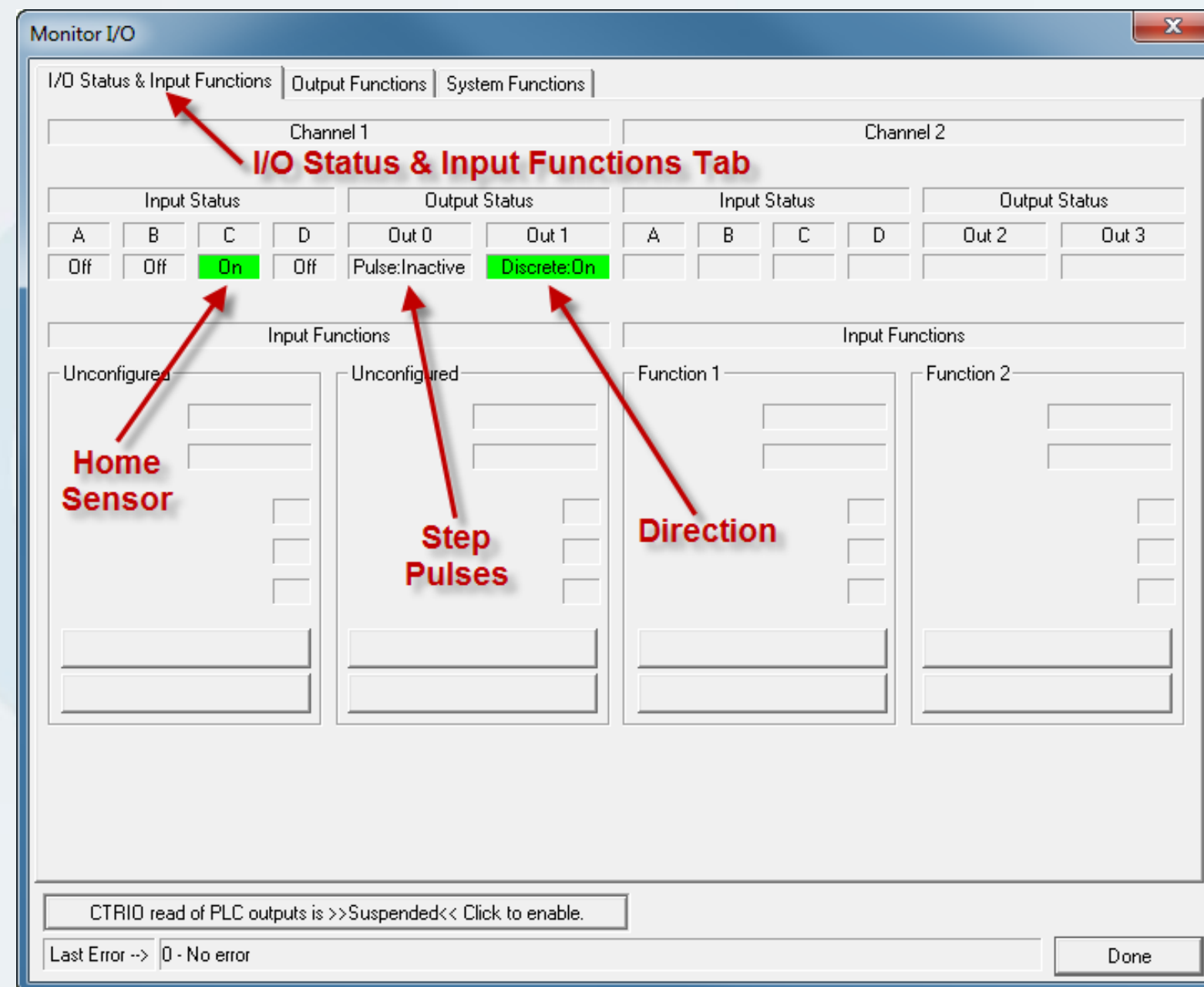


CTRIO Workbench – Monitor I/O – I/O Status & Input Functions – 25 of 28

Looking at the ‘I/O Status & Input Functions’ tab, and because I am only using ‘Channel 1’, I can see ‘Out 0’ has the ‘Pulse Inactive’ and ‘Out 1’ shows a ‘Discrete On’ condition at this time.

‘Out 0’ is my ‘Y0’ physical connection on the H0-CTRIO module that produces the step pulses as we discussed earlier, and ‘Out 1’ is my ‘Y1’ physical connection on the module that determines the stepping motor’s direction. Again, do not confuse ‘Y0’ and ‘Y1’ with the DL05 PLC’s output designations.

I am using just the ‘C’ channel as my ‘Output Limit 0’, so I can test it by toggling the ‘Home’ proximity sensor on and off by placing a piece of metal in front of the sensor’s target area.



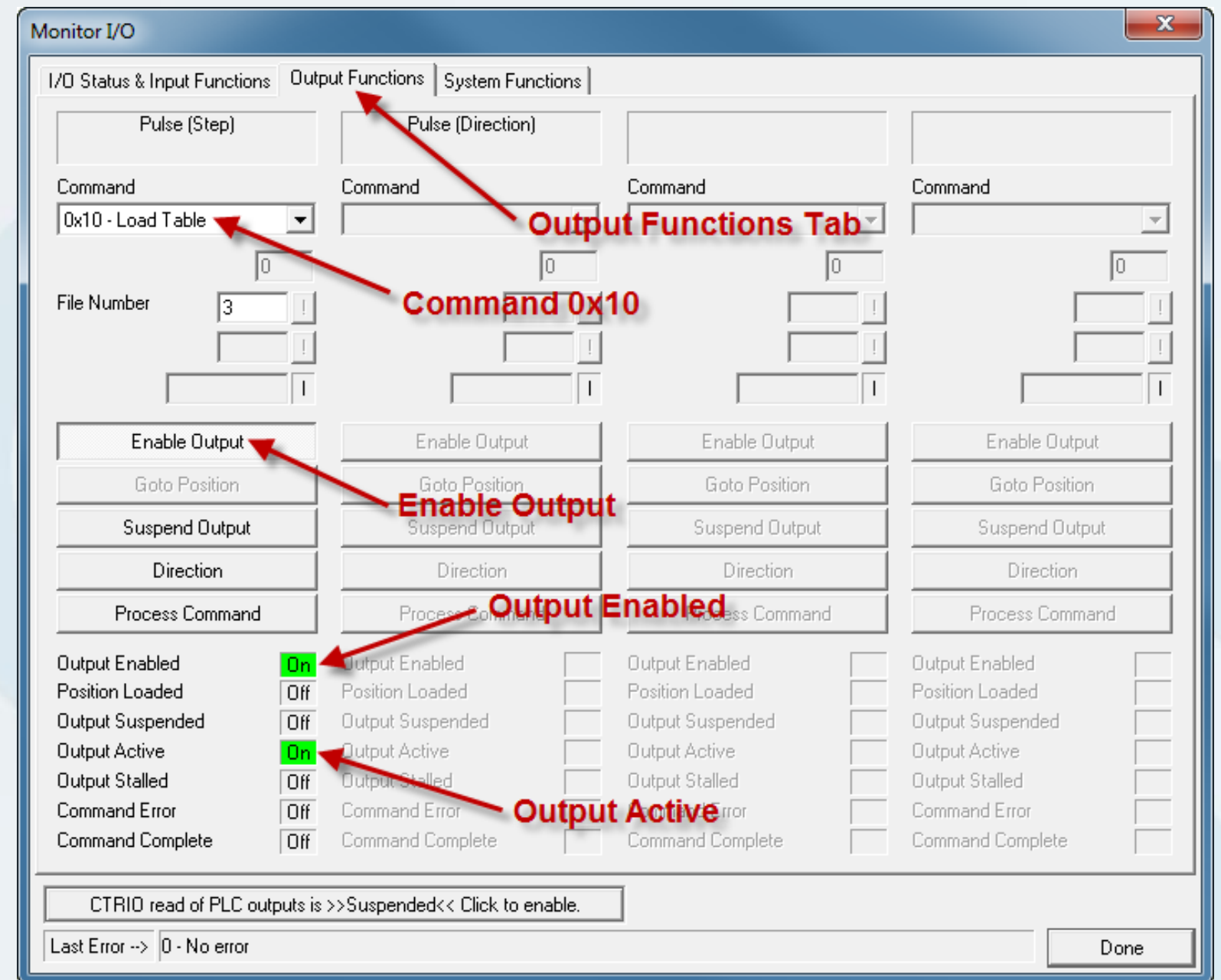
CTRIO Workbench – Monitor I/O – Output Functions – 26 of 28

The ‘Output Functions’ tab is where I can actually test the various ‘Profiles’ that I have created in the CTRIO Workbench utility.

For example, I can execute the ‘Trapezoid’ pulse profile, labeled as file #3, by first selecting ‘0x10 – Load Table’ under the ‘Command’ pull down menu. I then enter ‘3’ into the ‘File Number’ field. I click the ‘Process Command’ button and should see the ‘Command Complete’ bit turn ‘ON’. I then turn the ‘Process Command’ bit to ‘OFF’.

I leave the ‘Direction’ button as shown.

To execute the profile, I click the ‘Enable Output’ button and observe the ‘Output Enabled’ and ‘Output Active’ indicators are ‘ON’. When the profile is complete, the ‘Output Active’ indicator will turn ‘OFF’.

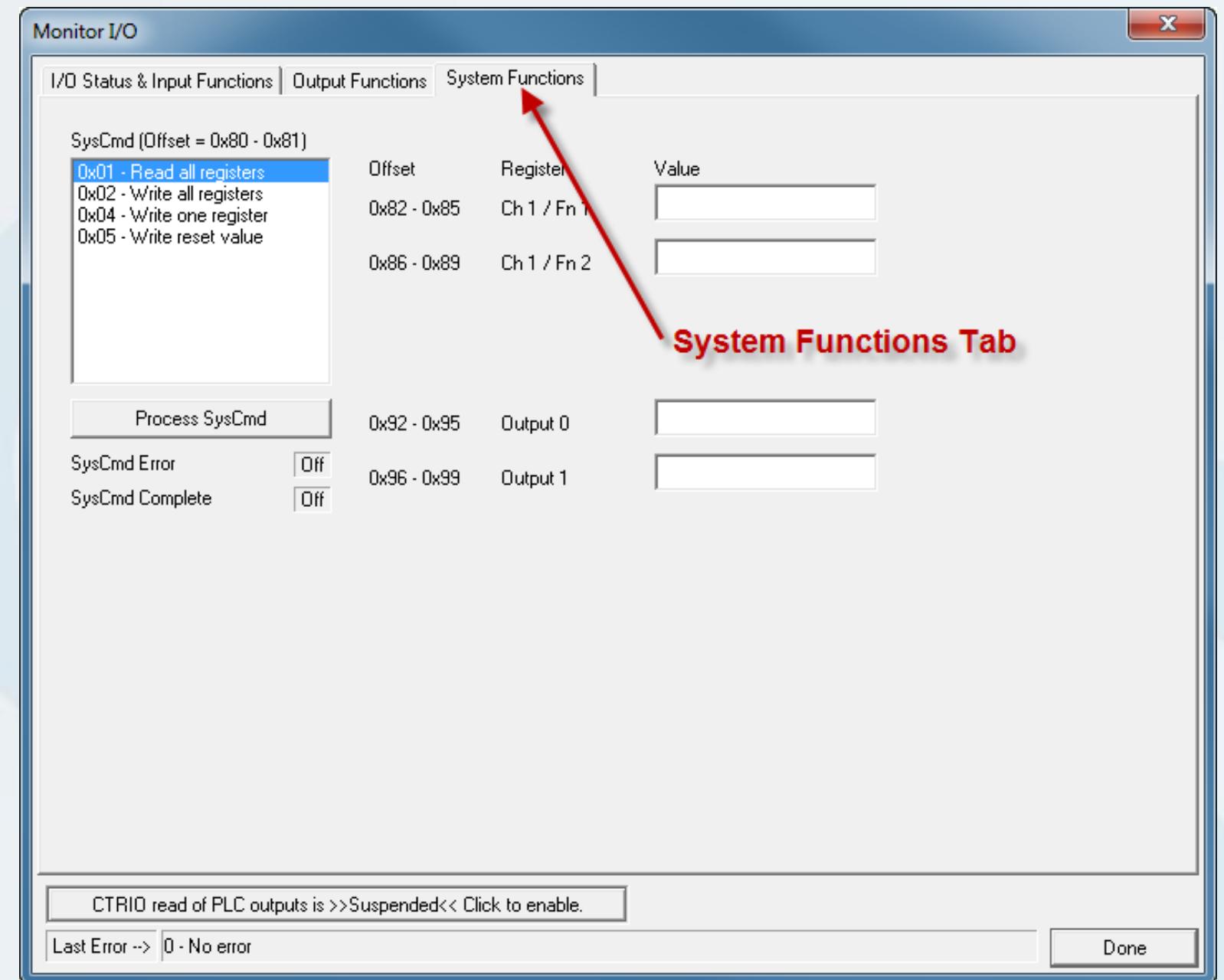


CTRIO Workbench – Monitor I/O – System Functions – 27 of 28

Under the ‘Systems Functions’ tab, this dialog window allows you to ‘Read’ from or ‘Write’ to the current input count, and the current output pulse count, within the following conditions:

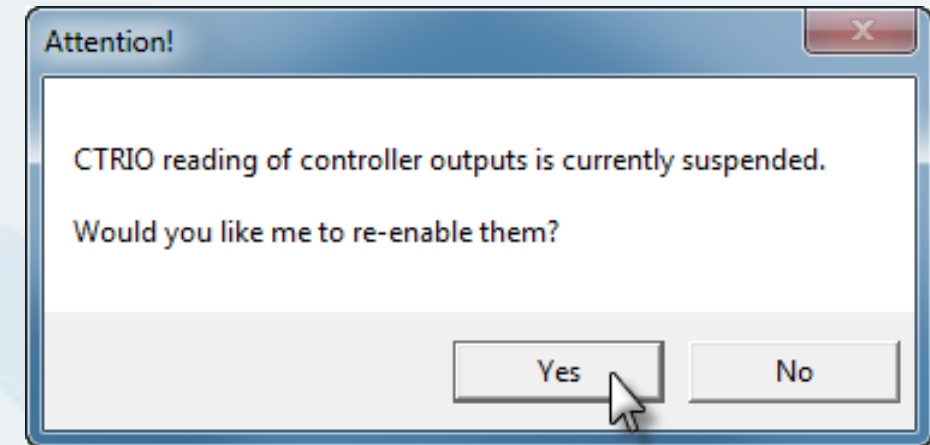
- The current input count can be read from or written to if the input is configured for a Counter or Quad Counter. Timer values are not accessible.
- The current output pulse count can be read from or written to only if the pulse output is running Dynamic Velocity or Dynamic Positioning profiles.

The reading from and writing to the CTRIO internal registers is accomplished using the *Direct*LOGIC ‘Read from Intelligent Module’ (RD) and ‘Write to Intelligent module’ (WT) instructions, respectively.



CTRIO Workbench – Monitor I/O – Done! – 28 of 28

When I am done monitoring and testing my configuration, I can click the ‘Done’ button in the lower right corner of the ‘Monitor I/O’ dialog window. A pop up message will tell me that the CTRIO reading of controller outputs is currently suspended and if it is OK to re-enable them. I click ‘Yes’ and I am taken back to the CTRIO Workbench utility dialog window.



NOTE: If during the use of the ‘Monitor I/O’ feature there is problem, an ‘Error Code’ will be displayed at the bottom of the CTRIO Workbench utility in the ‘Status Bar’ titled ‘Last Error’.



Error Code	Description
0	No error
100	Specified command code is unknown or unsupported
101	File number not found in file system
102	File type is incorrect for specified output function
103	Profile type is unknown
104	Specified input is not configured as a limit on this output
105	Specified limit input edge is out of range
106	Specified input function is unconfigured or invalid
107	Specified input function number is out of range
108	Specified preset function is invalid
109	Preset table is full
110	Specified table entry number is out of range
111	Specified register number is out of range
112	Specified register is in unconfigured input or output

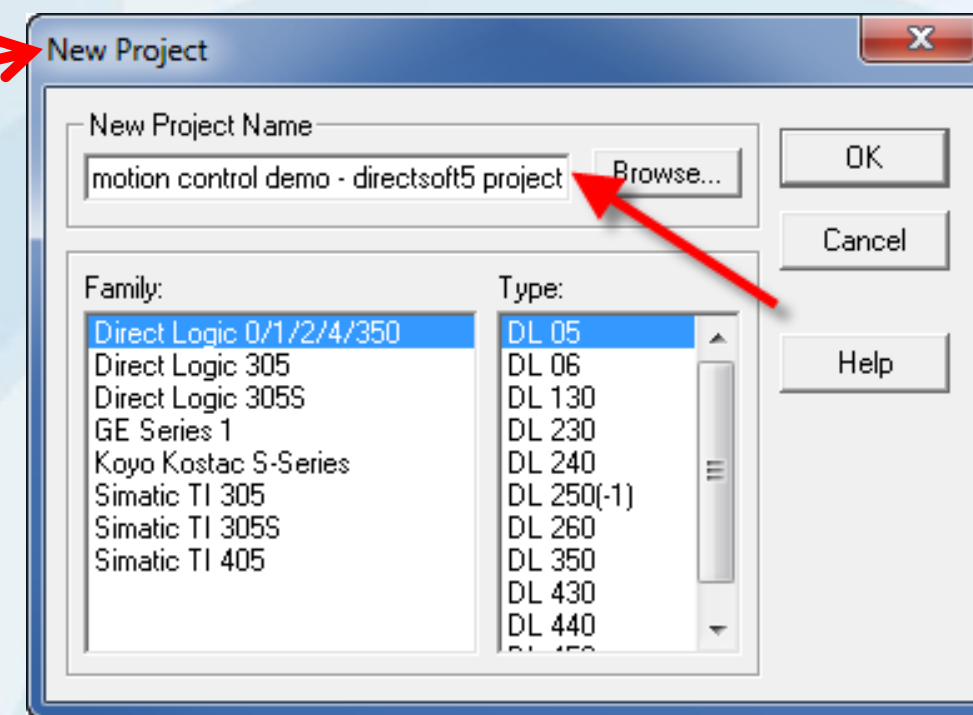
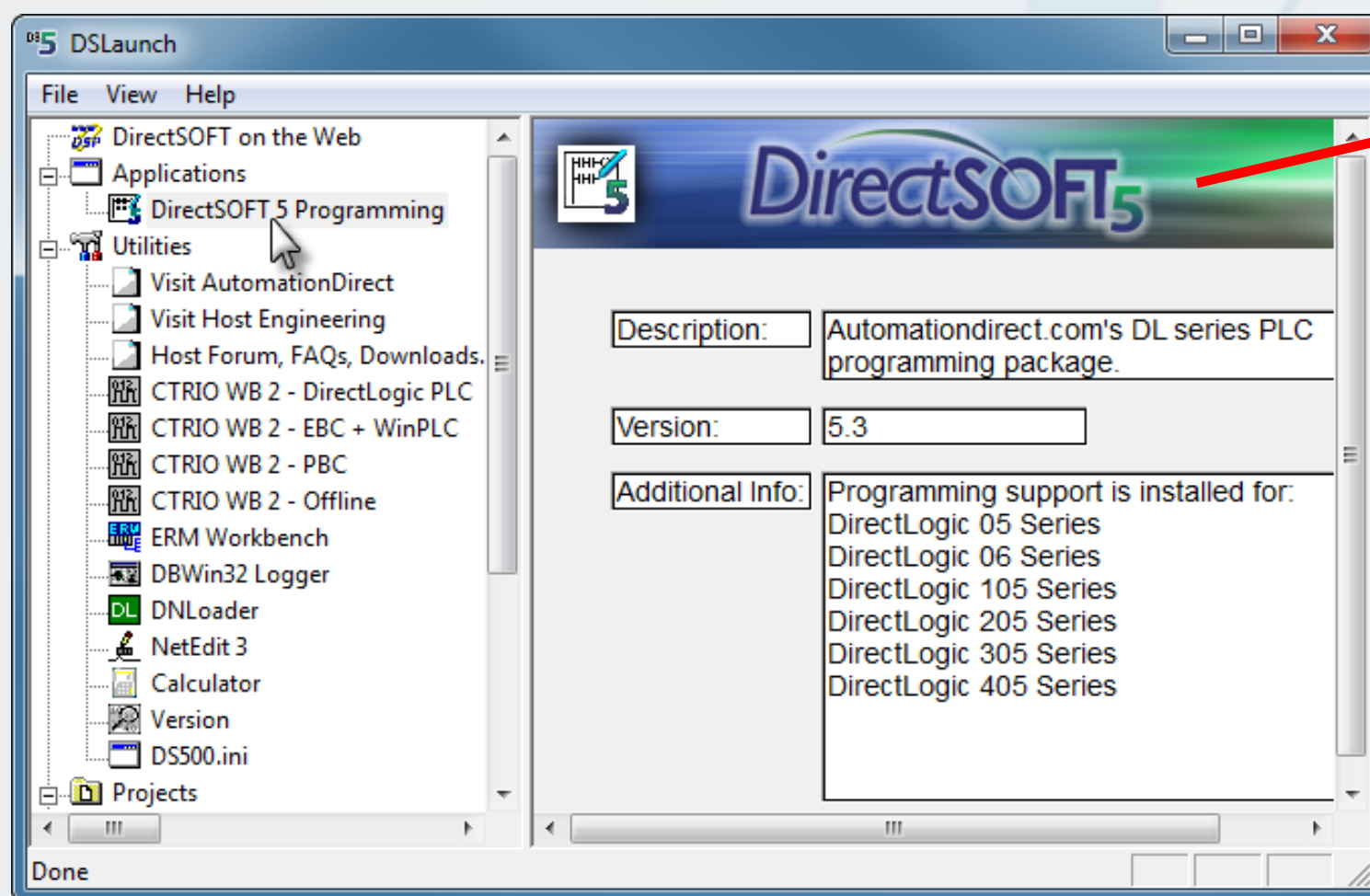
Motion Control

*DirectLOGIC Micro PLC/CTRIO Module
to SureStep Stepping System
with C-more Micro-Graphic Panel (HMI)*

Part 6 of 8 - *DirectSOFT5 Ladder Logic,
IBox CTRIO Configuration,
IBox CTRIO Load Profiles*

DirectSOFT5 – Ladder Logic and IBox Instructions – 1 of 10

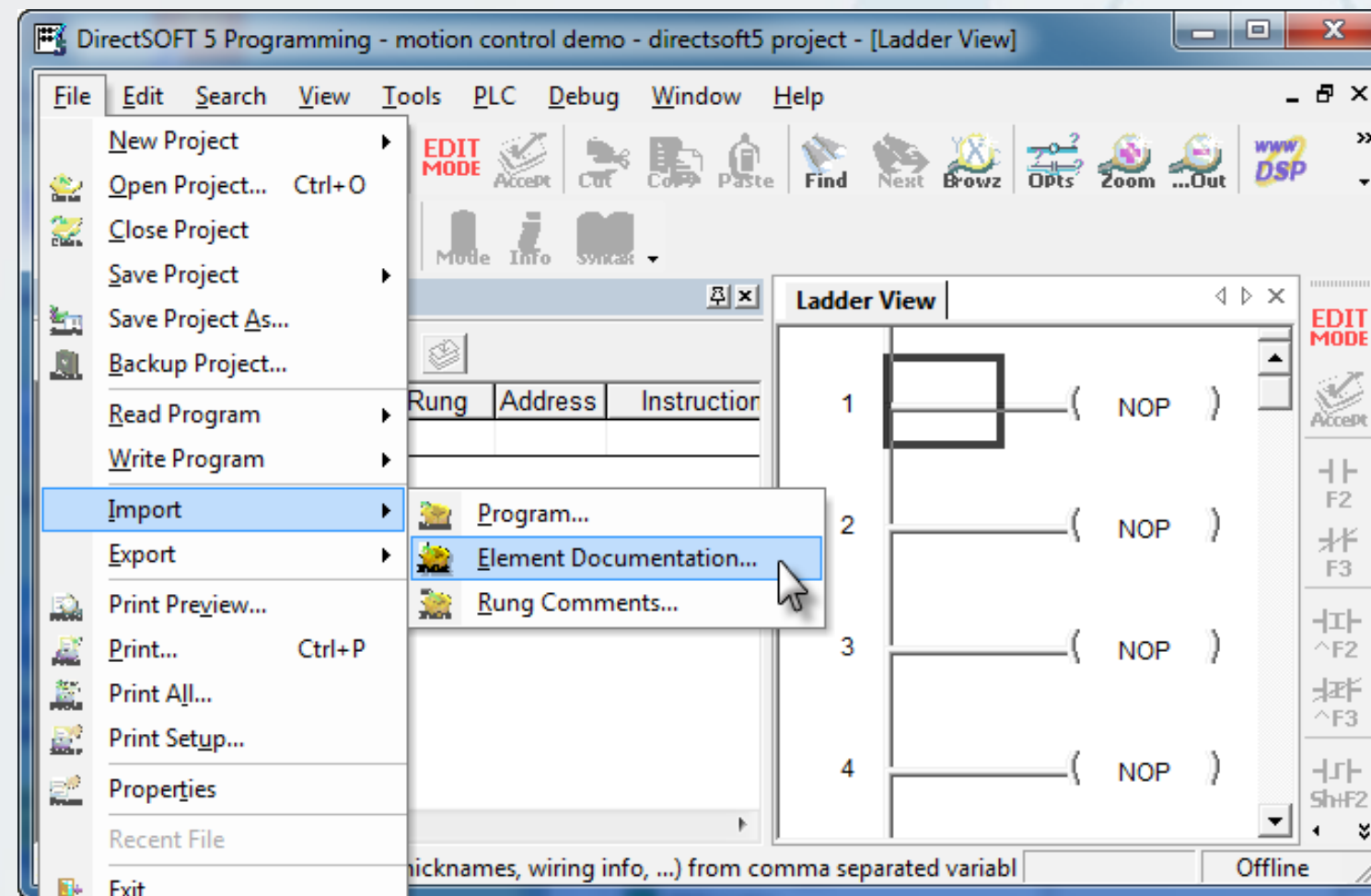
My next step is to create the *DirectSOFT5* ladder logic program that will consist of ladder logic elements and *IBox* instructions. The *IBox* instructions allow me to reduce my programming time by reducing the number of ladder logic rungs that would be required in the past. I start by opening the *DirectSOFT5* DSLaunch application and click on ‘DirectSOFT5 Programming’ under the ‘Applications’ folder in the menu tree. This brings up the ‘New Project’ dialog box. I enter my project name ‘motion control demo – directsoft5 project’ and select ‘DirectLogic 0/1/2/4/350’ for the ‘Family’ and ‘DL 05’ for the ‘Type’. I click ‘OK’.



DirectSOFT5 – Ladder Logic and IBox Instructions – 2 of 10

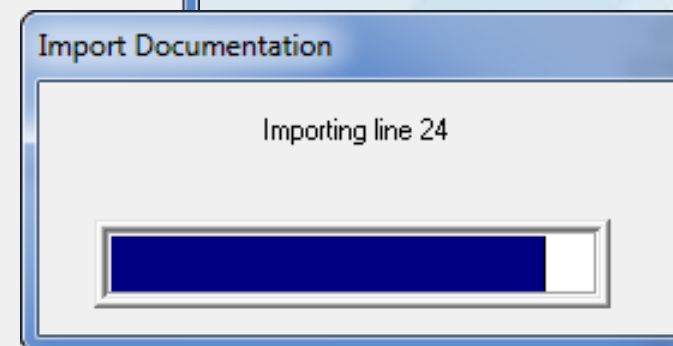
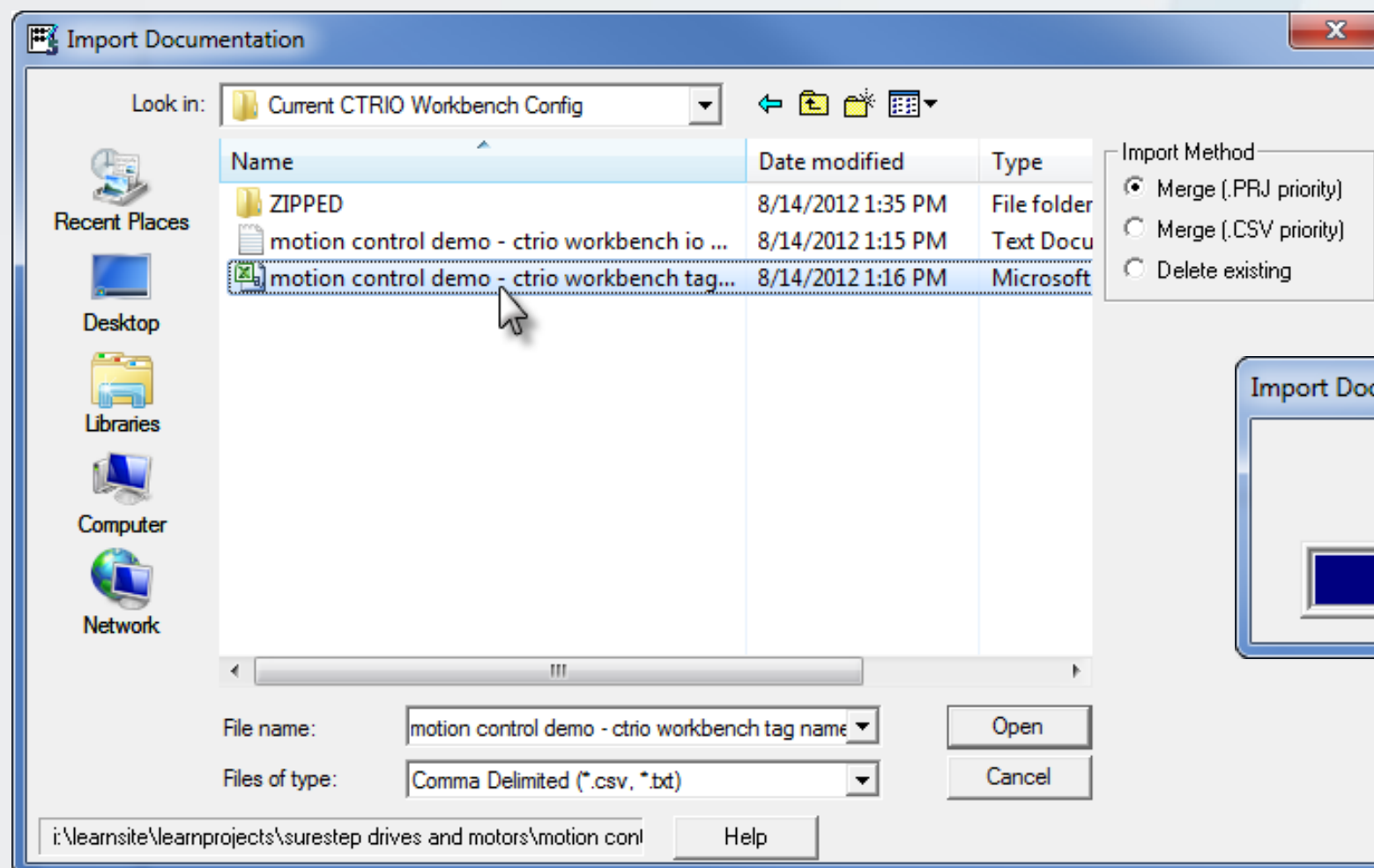
I can now Import the 'CSV' (Comma Separated Values) file format that I created in the CTRIO Workbench utility under the 'IO Map' dialog window. This will save time by eliminating the task of manually entering the various functional word and bit 'Nicknames' for the CTRIO inputs and outputs.

I open the 'Import' utility under the 'File' pull down menu and select 'Element Documentation'. This will take me to the 'Import Documentation' window that will allow me to select the 'CSV' file that I wish to import as explained in the next slide.



DirectSOFT5 – Ladder Logic and IBox Instructions – 3 of 10

From the ‘Import Documentation’ window I select the ‘motion control demo – ctrio workbench tag names.csv’ file that was created earlier. I make sure the ‘Import Method’ radio button for ‘Merge (.PRJ priority)’ is checked. This allows the new documentation data to be imported without overwriting any existing data. When I have completed my selections I click on the ‘Open’ button. A progress bar popup window will show the importing taking place, and after a few seconds, the ‘Import’ will be completed. The new ‘Nicknames’ can be viewed in the DS5 ‘Documentation Editor’ as seen here.



Ladder View Documentation Editor

Element	Nickname	Wiring Info
B2421.12		
B2421.13		
B2421.14		
B2421.15		
B2422.0	Out0_OutEnblId	Output Enabled
B2422.1	Out0_PosLoaded	Position Loaded
B2422.2	Out0_OutSuspd	Output Suspended
B2422.3		
B2422.4	Out0_OutActiv	Output Active
B2422.5	Out0_OutStald	Output Stalled
B2422.6	Out0_CmdError	Cmd Error
B2422.7	Out0_CmdCmplIt	Cmd Complete

DirectSOFT5 – Ladder Logic and IBox Instructions – 4 of 10

The first *IBox* instruction I use in my ladder logic is the ‘CTRIO Config’ (IB-1000). I use constant ‘K0’ for the ID number of the CTRIO module. The module is located in the only ‘Slot’ available with the DL05 PLC, so it is identified as constant ‘K1’ for ‘Slot 1’. I use V-memory register ‘V2300’ as the instruction’s ‘Workspace’ memory area. The radio button for ‘Local Base’ is selected for the CTRIO’s location. An explanation for the Input and Output assignments is continued on the next slide.

MOTION CONTROL DEMO

+++++

CTRIO

Configure the CTRIO module located in the DL05 expansion slot.
 The slot is identified as being in slot 1, so a constant K1 is used.
 V-memory is used for the workspace and should only be used once.
 V-memory for inputs into the CTRIO from the PLC is assigned in the range of V2400-V2425.
 V-memory for outputs from the CTRIO to the PLC is assigned in the range of V2430-V2461.

CTRIO Config	
CTRIO	IB-1000
CTRIO #	K0
Slot	Local K1
Workspace	V2300
Input	V2400 - V2425
Output	V2430 - V2461

CTRIO Config

CTRIO IB-1000

CTRIO # K0

Slot K1

Workspace V2300

CTRIO Location

Local Base

EBC (Connected via ERM)

Input V2400

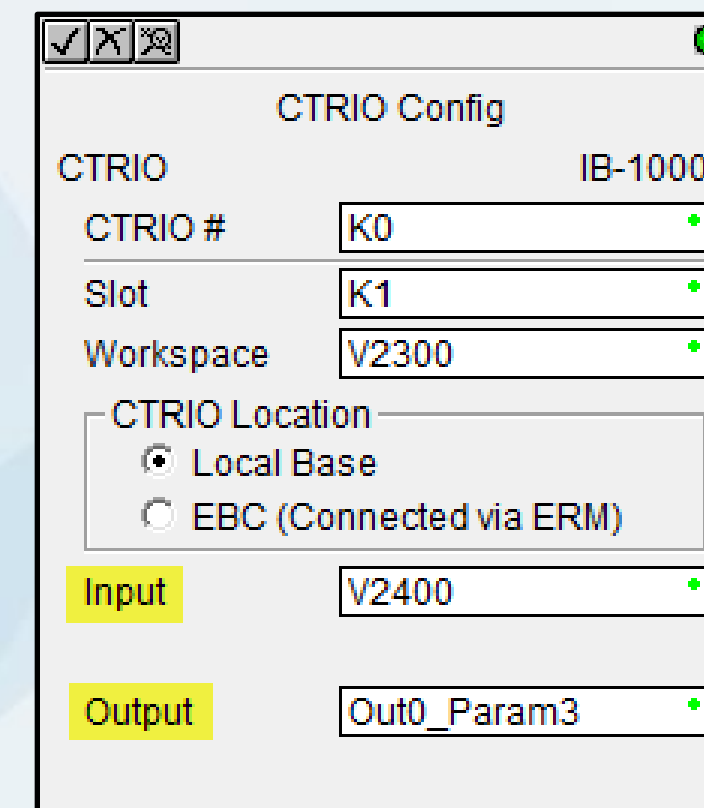
Output Out0_Param3

DirectSOFT5 – Ladder Logic and IBox Instructions – 5 of 10

Continuing the ‘CTRIO Config’ (IB-1000) instruction, recall that V-memory register ‘V2400’ was assigned in the CTRIO Workbench utility as the starting address for the ‘Input Map’ in the ‘I/O Map’ dialog box. I enter ‘V2400’ as my ‘Input’ starting address. The range for the V-memory inputs used in the CTRIO module is V2400 thru V2425.

I enter ‘V2430’ as my ‘Output’ starting address. Again recall that V-memory register ‘V2430’ was assigned in the CTRIO Workbench utility as the starting address for the ‘Output Map’ in the ‘I/O Map’ dialog box. The range for the V-memory outputs used in the CTRIO module is V2430 thru V2461.

You will notice that after the ‘CTRIO Config’ IBox is completed and you then re-open to edit, the output will show as ‘Out0_Param3’. This is because the imported ‘Nickname’ for the first Output V2430 is labeled ‘Out0_Param3’.




DirectSOFT5 – Ladder Logic and IBox Instructions – 6 of 10

I next start adding the ladder logic and *IBox* instructions that are used to ‘Load’ the various ‘Profiles’ that were created in the CTRIO Workbench utility. As an example, when the Home Axis push button is pressed on the *C-more* Micro-Graphic panel, a positive differential leading edge triggered one-shot contact (comes on for one CPU scan), is used to actuate the ‘CTRIO Load Profile’, (IB-1001) *IBox* instruction shown in the ladder rung below. The next slide explains the various parameters that are programmed into the ‘CTRIO Load Profile’ *IBox* instruction.

HOMING
 Load CTRIO file #1, homing profile created in CTRIO Workbench.
 The axis moves to the right until the home proximity sensor is actuated, then the axis reverses for a distance of 2000 pulses or a distance of 0.125 inches.
 A push button from a C-more Micro panel is used to initiate homing. A rising edge one-shot is used to have the IBox CTRLDPR instruction load the profile file.

C-more Micro
 Momentary
 Home Axis PB
 C0



CTRIO Load Profile	
CTRLDPR	IB-1001
CTRIO #	K0
Output #	K0
File #	K1
Workspace	V2301
Success	C10
Error	C11

DirectSOFT5 – Ladder Logic and IBox Instructions – 7 of 10

As with the ‘CTRIO Config’ *IBox* instruction, the CTRIO module is identified as module ‘0’, therefore ‘K0’ is entered for the CTRIO module ID number. The ‘Output #’ is set to ‘0’, so ‘K0’ is entered for this parameter. The ‘Output #’ specifies which CTRIO Output is to receive the profile. In my case this is ‘Output 0.’ I then enter the ‘File #’ of the predefined profile that I want loaded, which is ‘1’ for the Homing profile, so I enter ‘K1’.

I use V-memory register ‘V2301’ as the instruction’s ‘Workspace’ memory area. The ‘CTRIO Load Profile’ instruction includes two ‘flag’ bits that can be used to confirm that the instruction has successfully executed and there are no errors. I use internal control relays ‘C10’ and ‘C11’ as my flag bits.

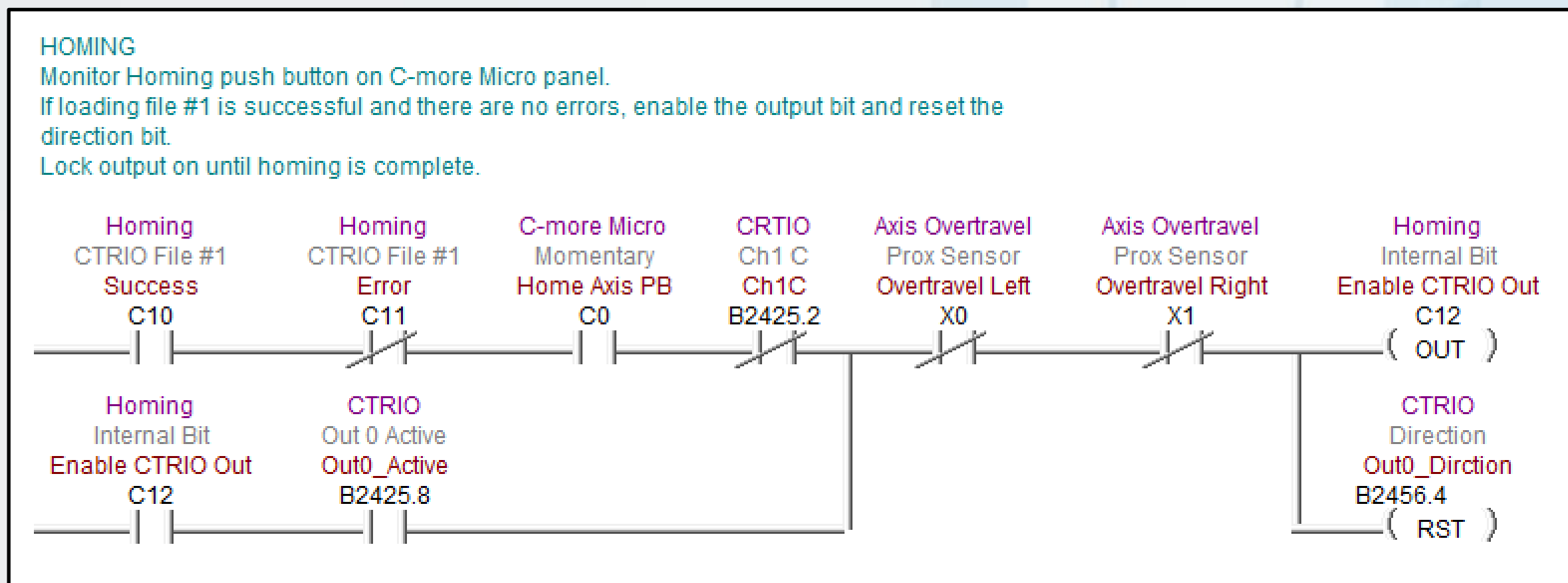
CTRIO Load Profile	
CTRLDPR	IB-1001
CTRIO #	K0
Output #	K0
File #	K1
Workspace	V2301
Success	C10
Error	C11



NOTE: Additional profiles for jogging, Trapezoid move, and the S-Curve move are done in the same manner using separate ‘CTRIO Load Profile’ *IBox* instructions. Keep in mind that the ‘Workspace’ register, ‘Success’ bit, and ‘Error’ bit assignments can not be the same for any of the *IBox* instructions.

DirectSOFT5 – Ladder Logic and IBox Instructions – 8 of 10

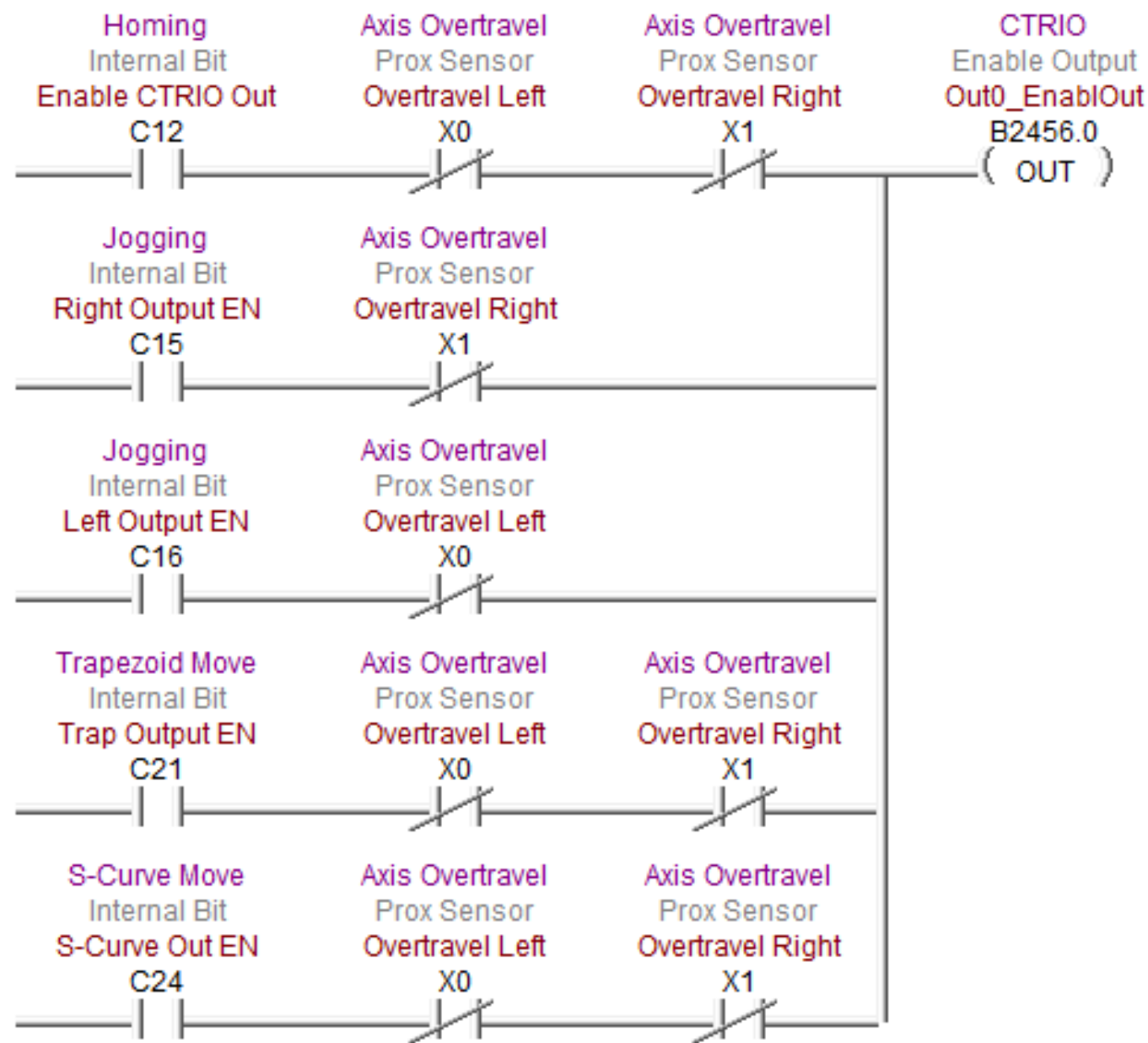
I now create the ladder logic seen below that enables the profile to execute by enabling the CTRIO output and also set the direction of the stepping motor. The following rung is used to ‘latch’ the ‘Homing’ signal with conditions that profile file #1 was loaded successfully with no errors, the axis is not on the homed sensor or at either overtravel limit sensor. If conditions are met, the C12 homing signal will be initiated along with the direction reset and the rung latched in through the ‘Out 0 Active’ signal bit ‘B2425.8’. When the move profile has completed, the ‘Out 0 Active’ contact, bit ‘B2425.8’, will open and drop the homing signal.



DirectSOFT5 – Ladder Logic and IBox Instructions – 9 of 10

ENABLE CTRIO OUTPUT

This is where each of the various moves that are done cause the CTRIO Enable Output to be turned on which allows the CTRIO to set the direction and provide pulses to the stepper motor driver.



Seen here is the rung of ladder logic that enables the CTRIO output for the various tasks that can be carried out, such as homing, jogging, Trapezoid move and the S-Curve move.

The ‘Out0_EnablOut’, bit B2456.0, is active when any of the five possible moves (Homing, Jog Right, Jog Left, Trapezoid Move, or S-Curve Move) are initiated. In our example, when ‘Homing’ internal relay ‘C12’ is true based on the logic conditions shown in the previous slide.

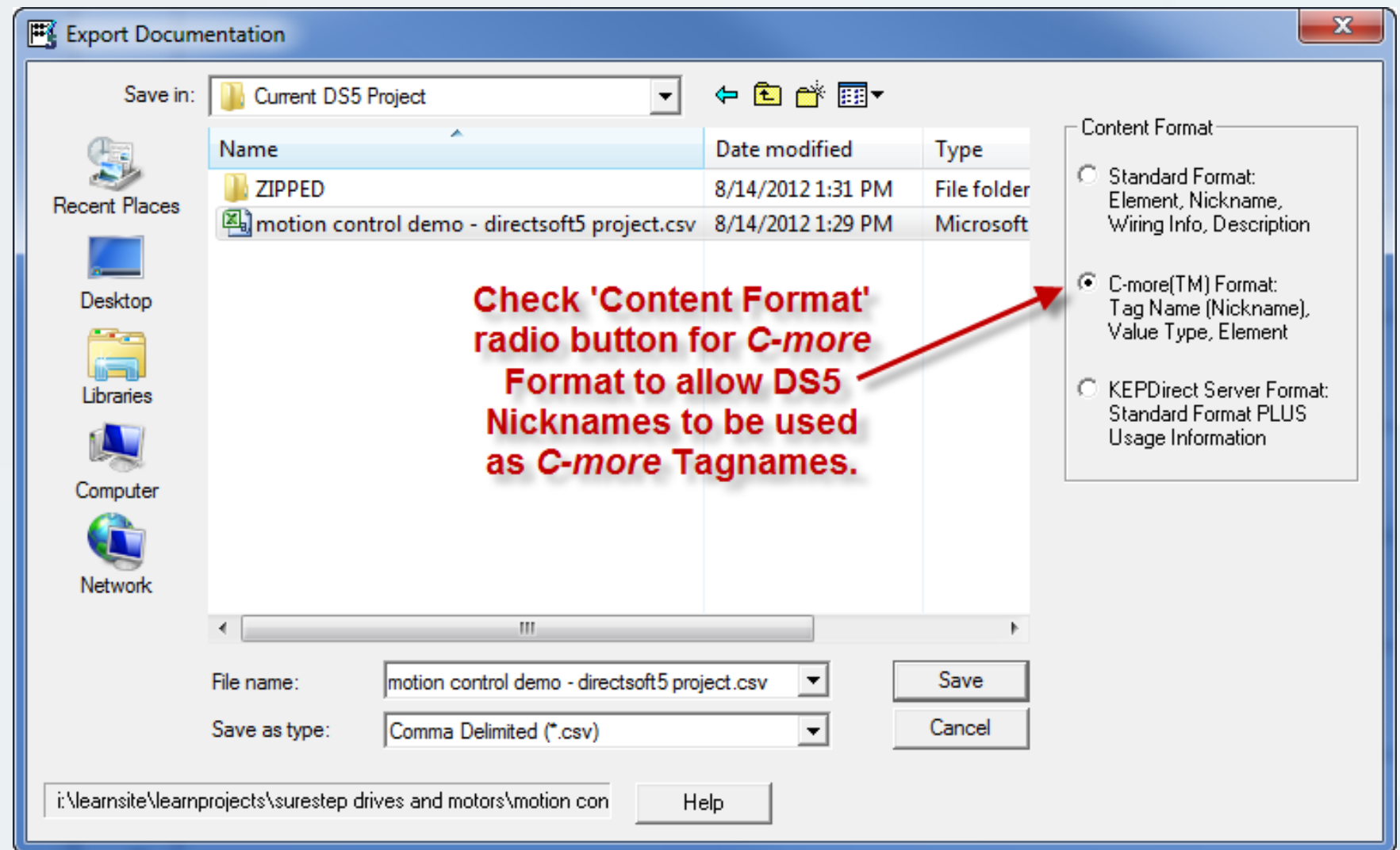
Notice each of the five possible profile moves also include overtravel signals from the proper left and/or right ‘Overtravel’ proximity sensors to disable the output if the linear leadscrew slide travels too far in either direction.

DirectSOFT5 – Ladder Logic and IBox Instructions – 10 of 10

The final task I will do after I have all of my ladder logic and *IBox* instructions programmed, all of my rungs commented for clarity, and all element ‘Nicknames’ documented, is to ‘Export’ the ‘Nickname’ data in a ‘CSV’ file format as Tag Names that I can then ‘Import’ into my *C-more* Micro project. This will save programming time and help eliminate typo errors.



NOTE: A complete commented *DirectSOFT5* project for the Motion Control demo presented here is available for downloading from the LEARN site. Look for the note below the video that mentions ‘take-away training PDF’s and Demo projects’.



Motion Control

*Direct*LOGIC Micro PLC/CTRIO Module
to *Sure*Step Stepping System
with *C-more* Micro-Graphic Panel (HMI)

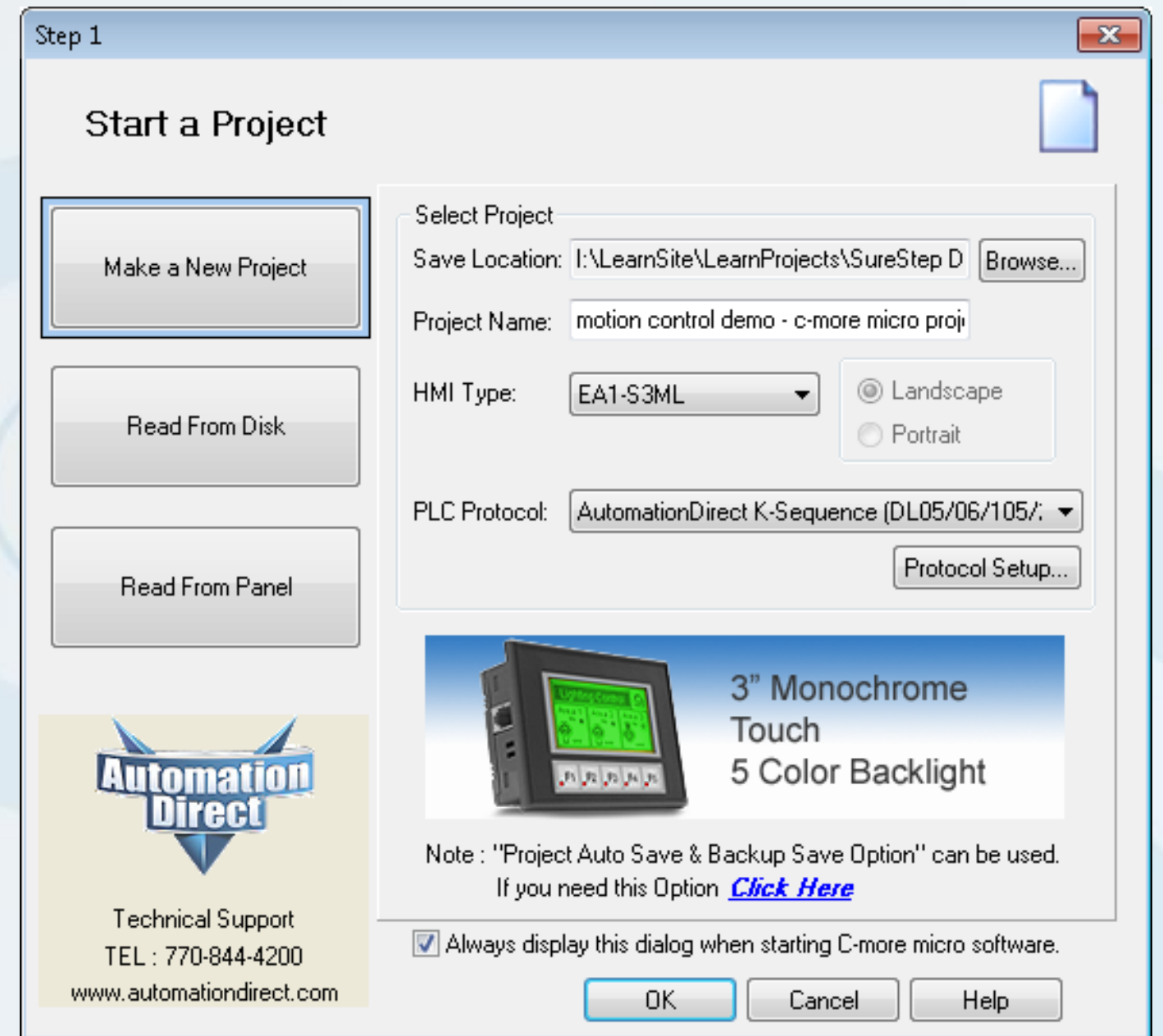
Part 7 of 8 - *C-more* Micro-Graphic
Panel Programming

C-more Micro-Graphic Panel (HMI) – 1 of 14

In the Motion Control demo, the *C-more* Micro-Graphic panel is used as my operator interface to jog the linear leadscrew slide axis left or right, home the axis, execute a Trapezoid move profile, and also execute an S-Curve move profile.

To create the project for the *C-more* Micro-Graphic panel that I am using in the Motion Control demo, I first open the *C-more* Micro application software, and select the ‘Make a New Project’ button. I give the project a name, ‘motion control demo – c-more micro project’. I select my Panel Type, ‘EA1-S3ML’, and then select the PLC protocol, ‘AutomationDirect K-Sequence (DL05/06/105/205/350/405)’. I then click ‘OK’.

This will open up the *C-more* Micro ‘Main Application Screen’ that includes the ‘Work Area’, ‘Navigation Window’, ‘Object List Window’, etc. as seen on the next slide.



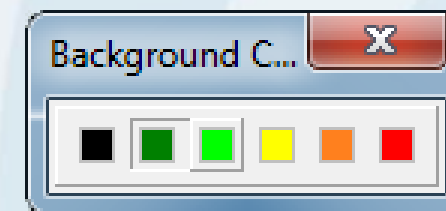
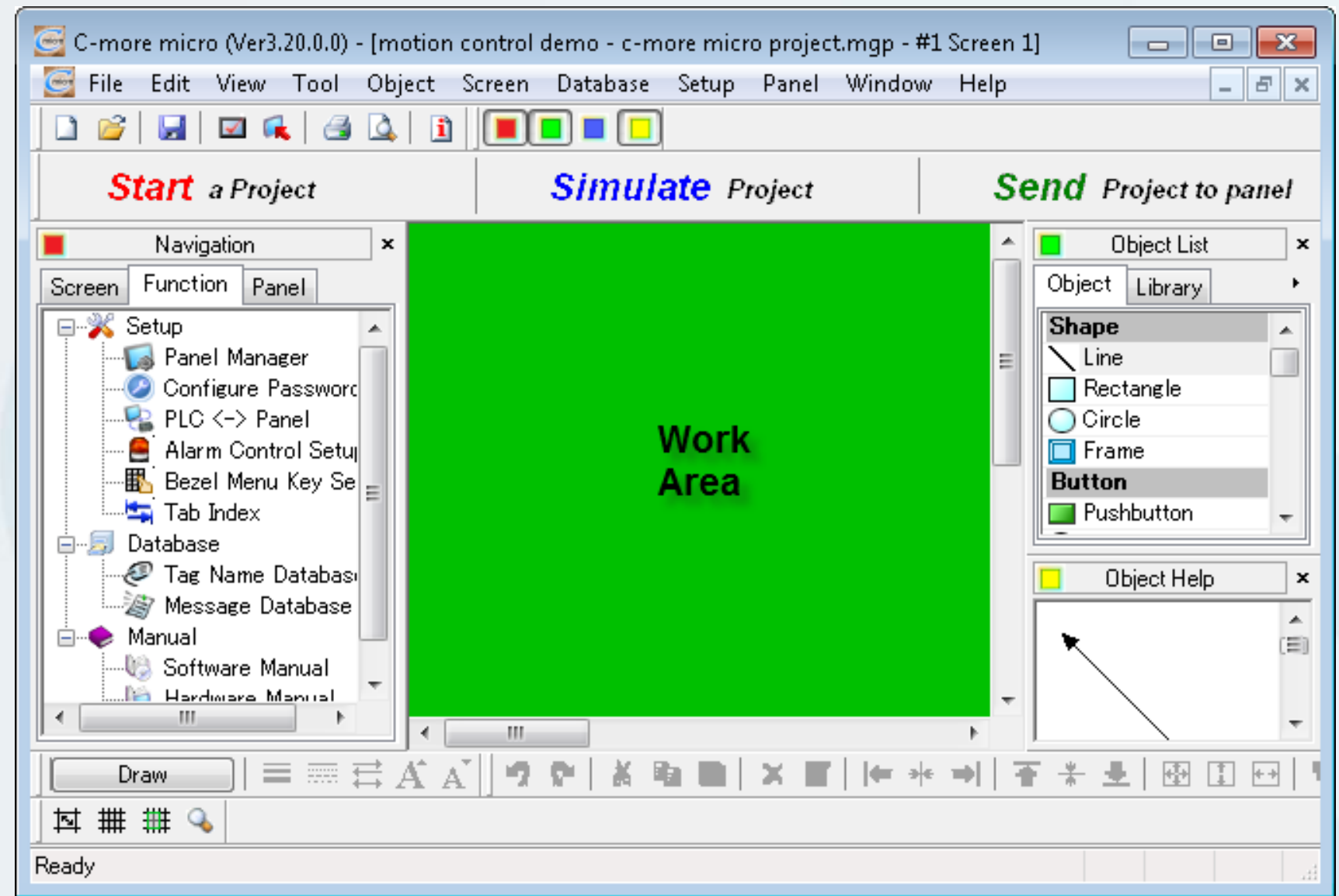
C-more Micro-Graphic Panel (HMI) – 2 of 14

The *C-more* ‘Main Application Screen’ is used to develop the various screens that I will use in my project. In my case I will only have one screen, so I decide to use the dark green ‘Backlight Color’.

I will use the ‘Work Area’ to place and adjust the position of the various objects that I will use as my operator devices.

The ‘Navigation Window’ has tabs that allow me to adjust my screens, work with various functions and features, and obtain information on the connected panel along with updating firmware.

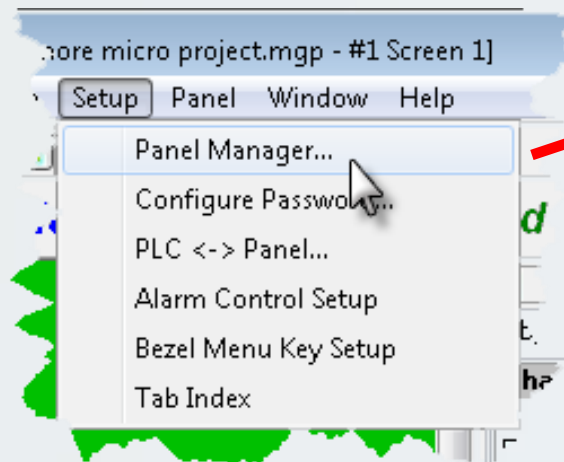
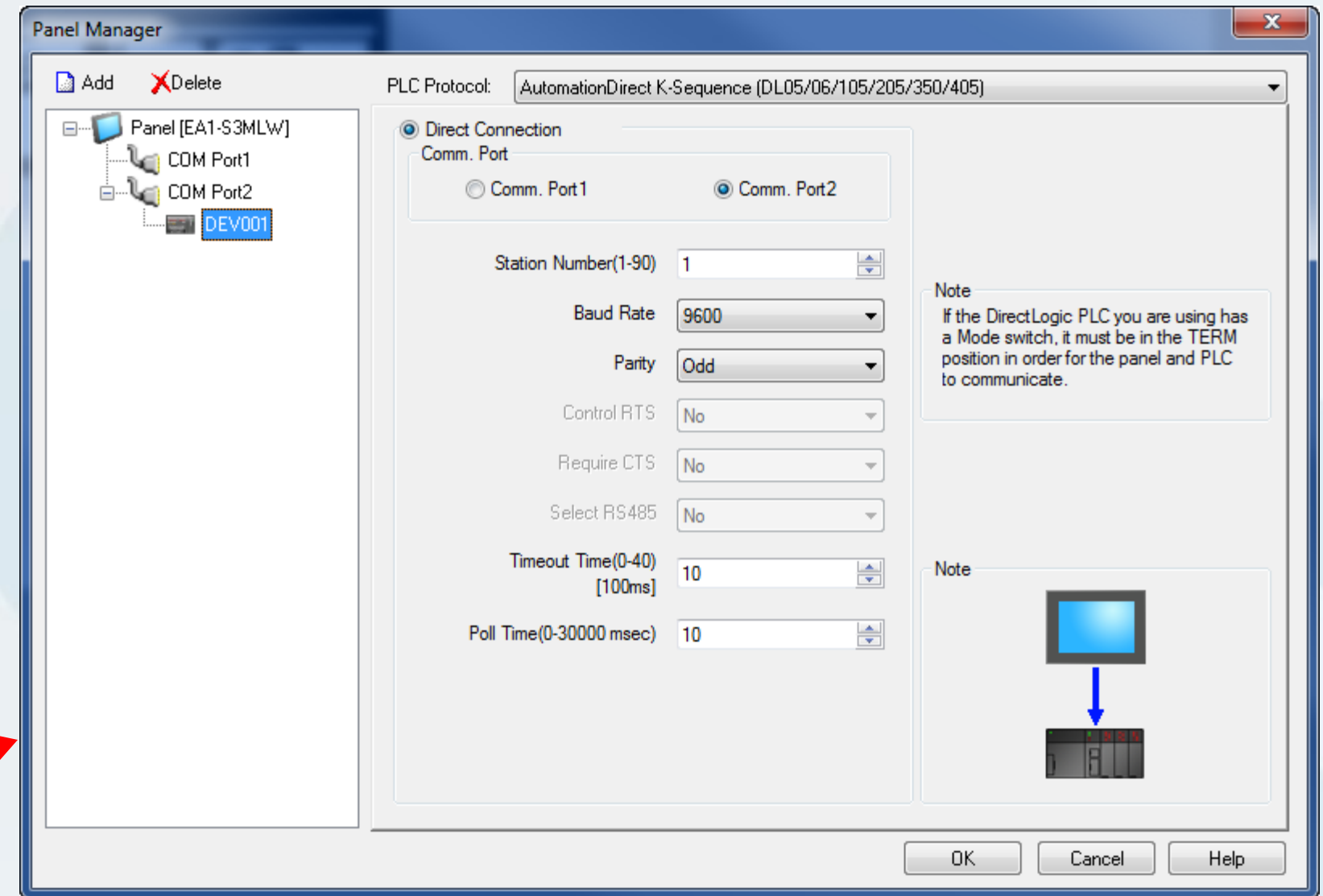
The ‘Object List Window’ gets me to the available standard objects and includes a library of predefined special objects, and includes user generated special objects.



C-more Micro-Graphic Panel (HMI) – 3 of 14

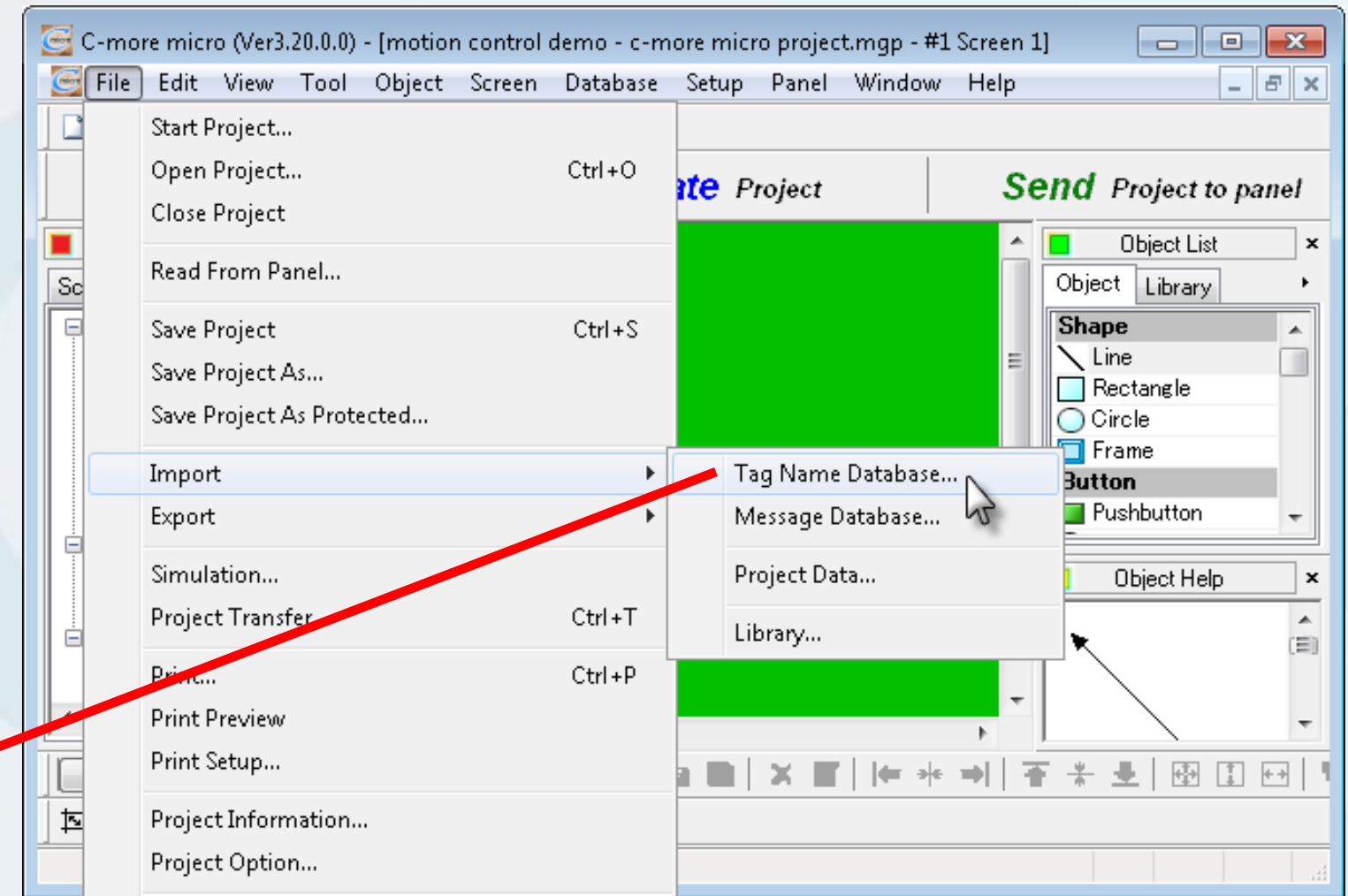
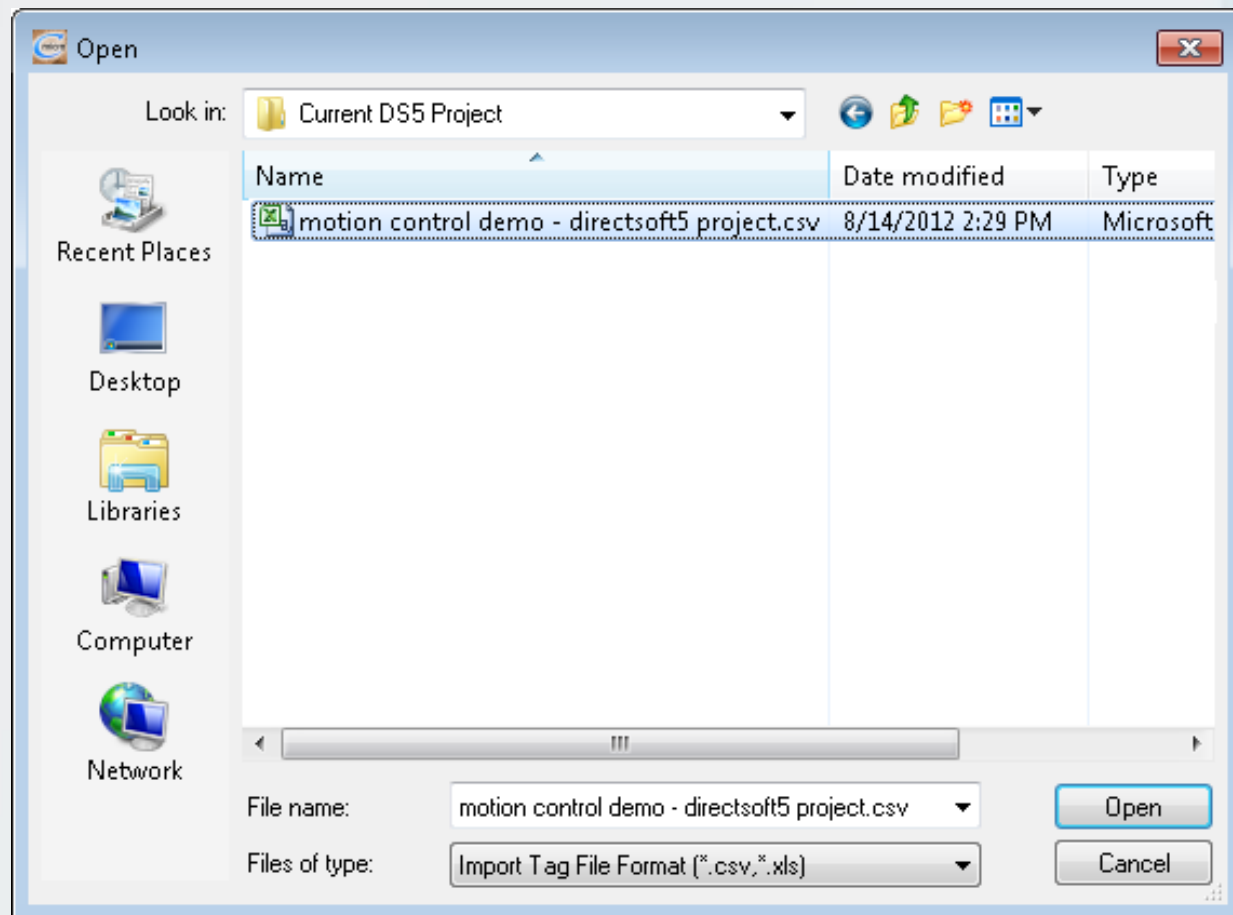
I will be using 'Comm. Port 2' on the C-more Micro-Graphic panel with the addition of the C-more 'Serial Port & Power Adapter', p/n EA-MG-SP1. This will allow me to communicate with the DirectLogic DL05 PLC that I am using in the Motion Control demo, and free up C-more's 'Comm. Port 1' for programming.

I open the 'Panel Manager' under the 'Setup' drop down menu, select the proper communications port, 'Comm. Port 2', use 'Station Number' 1, a 'Baud Rate' of 9600 with 'Parity' set to 'Odd'. The 'Timeout' and 'Poll' times are kept as '10ms'.



C-more Micro-Graphic Panel (HMI) – 4 of 14

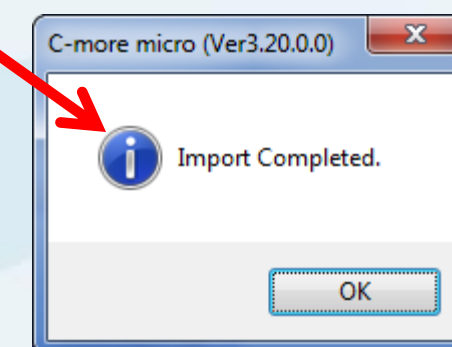
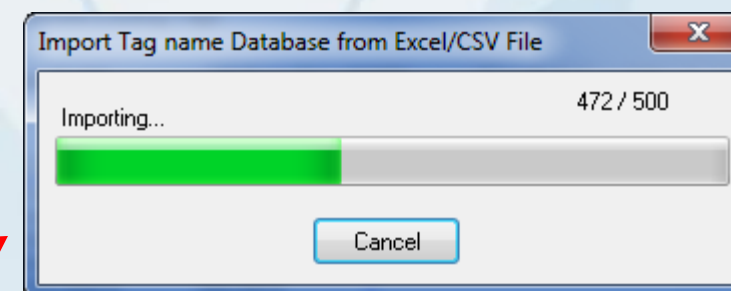
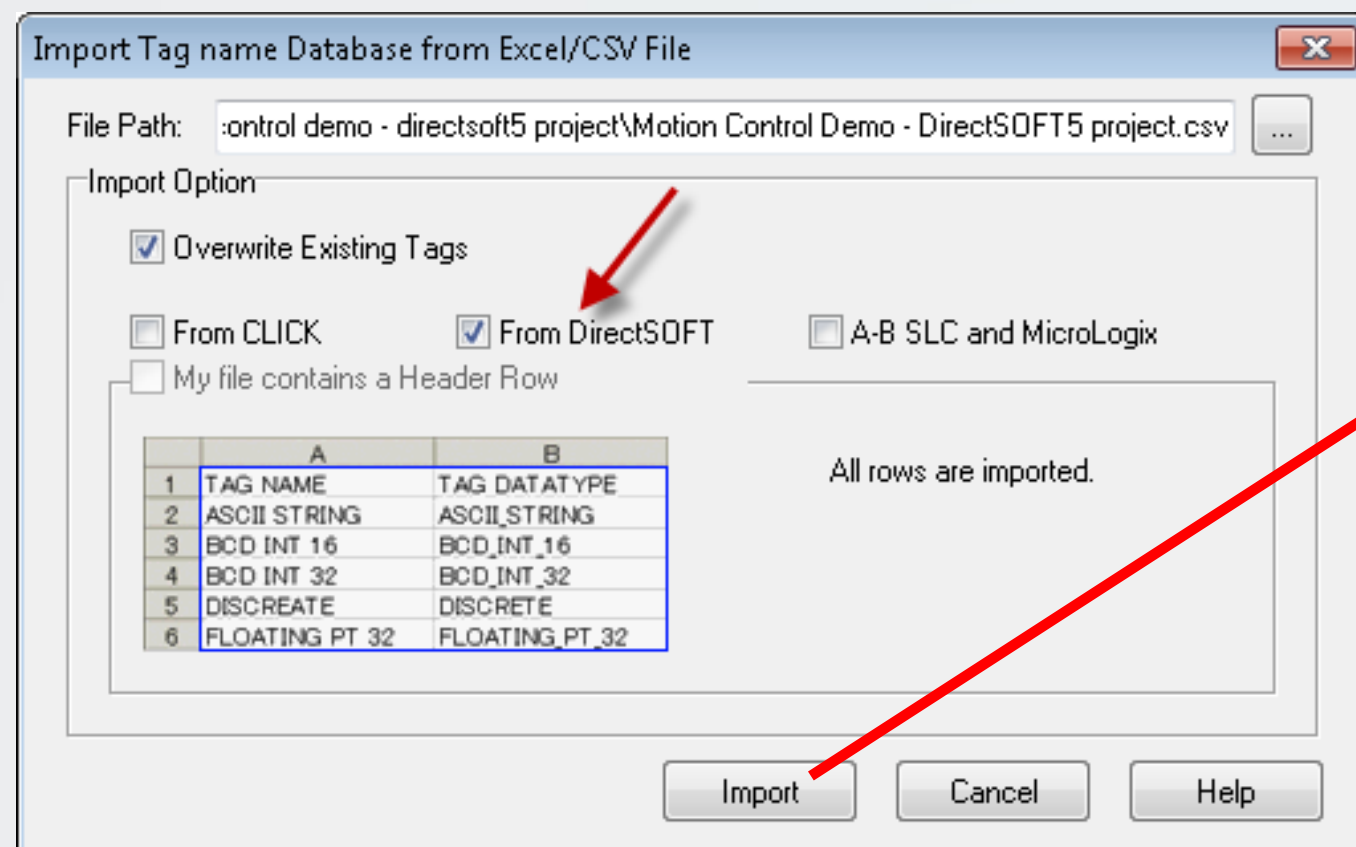
Next I will ‘Import’ the ‘Tag Names’ CSV file that I created with the *DirectSOFT5* programming software that I showed earlier. If you recall, I was able to ‘Export’ the DS5 ‘Nicknames’ with the *C-more* Tag Names radio button selected. I select the ‘motion control demo – directsoft5 project.csv’ file and click ‘Open’.



C-more Micro-Graphic Panel (HMI) – 5 of 14

The ‘Import Tag name Database from Excel/CSV File’ dialog window will pop up. Make sure under the ‘Import Option’ area that the ‘From *DirectSOFT*’ check box is checked. This allows the *C-more’s* Import function to treat the exported data from *DirectSOFT5* properly. I next click the ‘Import’ button.

All of the data records located in the ‘motion control demo – directsoft5 project.csv’ file will be stored in the *C-more’s* ‘Tag Name Database’ with a bar graph showing the progress. An ‘Import Completed’ message will be displayed when done.



C-more Micro-Graphic Panel (HMI) – 6 of 14

To check the newly imported Tag Names, I open the ‘Tag Name Database’ located under the ‘Database’ pull down menu in the *C-more* application programming software.

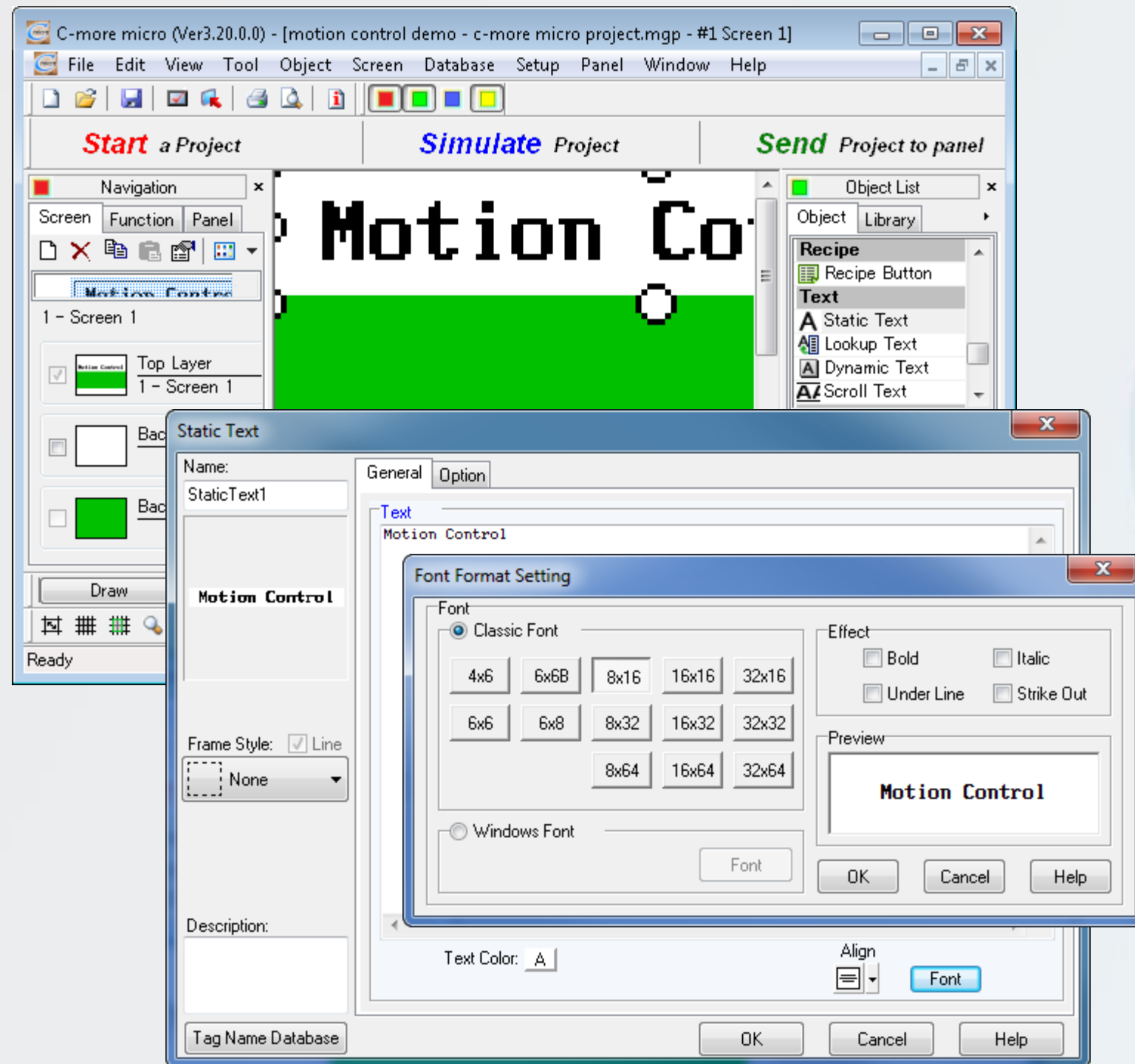
I can see that all of the ‘Nicknames’ I created within *DirectSOFT5*, and also the ‘Assigned Functions’ I exported from the *CTRIO* Workbench utility and then later imported into the *DS5* ‘Nicknames’, are ready for my use in programming the *C-more* Micro-Graphic panel.

There are also a couple of ‘System’ tag Names that are already predefined as <INTERNAL> to the *C-more* panel.

The screenshot shows the 'Tag Name Database' window with the following table:

No.	Tag Name	Data Type	PLC Address	Device Name	Attribute
1	SYS DISABLE USE F1+...	Discrete		<INTERNAL>	R/W
2	SYS GO TO SETUP ME...	Discrete		<INTERNAL>	R/W
3	OVERTRAVEL LEFT	Discrete	X0	DEV001	R/W
4	OVERTRAVEL RIGHT	Discrete	X1	DEV001	R/W
5	HOME AXIS PB	Discrete	C0	DEV001	R/W
6	JOG LEFT PB	Discrete	C1	DEV001	R/W
7	JOG RIGHT PB	Discrete	C2	DEV001	R/W
8	TRAPEZOID MOVE	Discrete	C3	DEV001	R/W
9	S-CURVE MOVE	Discrete	C4	DEV001	R/W
10	SUCCESS	Discrete	C10	DEV001	R/W
11	ERROR	Discrete	C11	DEV001	R/W
12	ENABLE CTRIO OUT	Discrete	C12	DEV001	R/W
13	SUCCESS2	Discrete	C13	DEV001	R/W
14	ERROR2	Discrete	C14	DEV001	R/W

C-more Micro-Graphic Panel (HMI) – 7 of 14

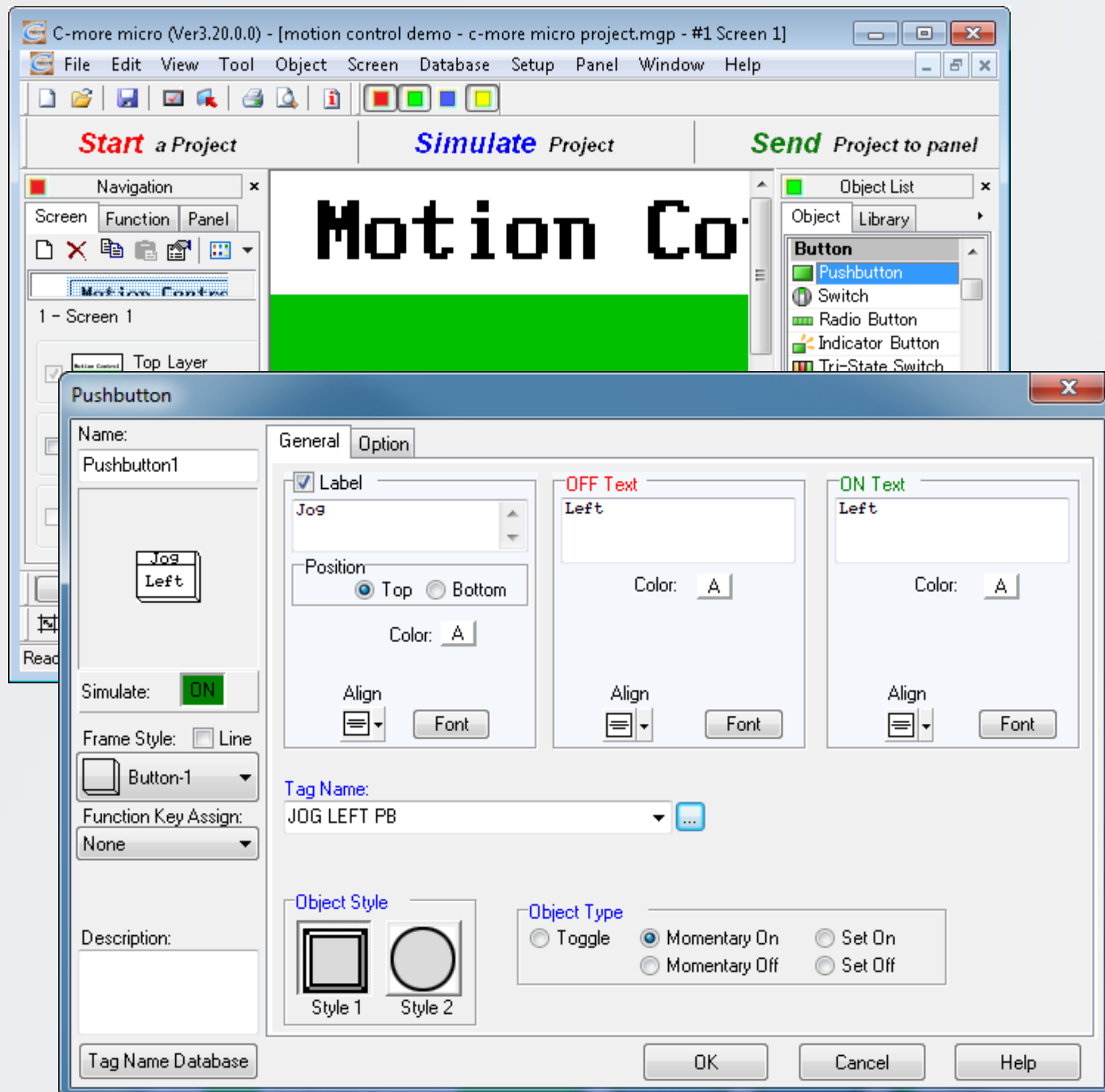


At this point I am ready to add objects to my *C-more* Micro-Graphic panel's screen. I start by adding a simple 'Static Text' object, which I title 'Motion Control', at the top my screen. This is used to identify my screen and also allows me to see which screen is in use if I were using multiple screens in my project application.

For my needs I type in 'Motion Control' for the 'Text', use a 'Frame Style' of 'None', select the center icon under 'Align' for my text alignment, and use a '8x16' for the 'Font Format Setting'.

Lastly I stretch the 'Static Text' object to fit at the top of the screen. The *C-more* Micro-Graphic panel total screen size is 128x64 pixels. I set the 'Static Text' to 128 pixels wide by 16 pixels high.

C-more Micro-Graphic Panel (HMI) – 8 of 14



I now locate the 'Pushbutton' object in the 'Library List' and click, drag, and drop it on the screen. The 'Pushbutton' dialog box will open.

I check the 'Label' box, type in 'Jog' with a 'Top Position', and in my case I type 'Left' for both the 'OFF' and 'ON' Text for displaying. I use the defaults for 'Color', 'Align' and 'Font'.

I choose 'Button-1' for the 'Frame Style', use 'Style 1' (square) for the 'Object Style', and check the 'Momentary On' radio button for the 'Object Type'.

I select my 'Tag Name' as 'JOG LEFT PB' and explain this in more detail in the next slide.

C-more Micro-Graphic Panel (HMI) – 9 of 14

Tag Name Database

Device Name: ALL Fill Down

Display System Tags Display Internal Tags Highlight Highlight Unused Tags

No.	Tag Name	Data Type	PLC Address	Device Name	Attribute
1	SYS DISABLE USE F1+...	Discrete		<INTERNAL>	R/W
2	SYS GO TO SETUP ME...	Discrete		<INTERNAL>	R/W
3	OVERTRAVEL LEFT	Discrete	X0	DEV001	R/W
4	OVERTRAVEL RIGHT	Discrete	X1	DEV001	R/W
5	HOME AXIS PB	Discrete	C0	DEV001	R/W
6	JOG LEFT PB	Discrete	C1	DEV001	R/W
7	JOG RIGHT PB	Discrete	C2	DEV001	R/W
8	TRAPEZOID MOVE	Discrete	C3	DEV001	R/W
9	S-CURVE MOVE	Discrete	C4	DEV001	R/W
10	SUCCESS	Discrete		DEV001	R/W
11	ERROR	Discrete		DEV001	R/W
12	ENABLE CTRIO OUT	Discrete		DEV001	R/W
13	SUCCESS2	Discrete		DEV001	R/W
14	ERROR2	Discrete		DEV001	R/W

Add... Edit... OK Cancel Help

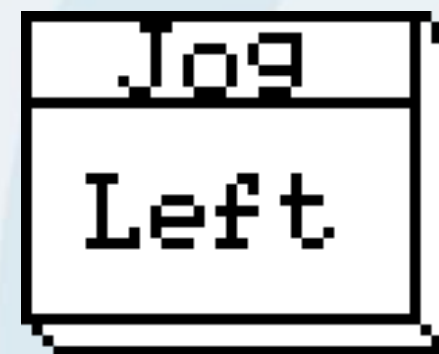
JOG LEFT PB

- CH1A
- CH1B
- CH1C
- CH1D
- ENABLE CTRIO OUT
- ERROR
- ERROR2
- ERROR3
- ERROR4
- HOME AXIS PB
- JOG LEFT PB
- JOG RIGHT PB
- LEFT OUTPUT EN
- OUTO_ACTIVE
- OUTO_CMDCMPLT
- OUTO_CMDERROR
- OUTO_DIRCTION
- OUTO_ENABLOUT
- OUTO_GOTOPOS
- OUTO_MODE
- OUTO_OUTACTIV
- OVERTRAVEL LEFT

The Tag Names that were imported earlier from the ‘CSV’ file that was created using *DirectSOFT5* can be brought up in the ‘Tag Name Database’, or chosen from a drop down list in the ‘Pushbutton’ dialog window ‘Tag Name’ setting.

Recall that the ‘JOG LEFT PB’ was assigned to PLC Address ‘C1’ in the *DirectSOFT5* ladder logic.

I continue adding the other ‘Pushbutton’ objects for my project’s Jog Right, Home Axis, Trapezoid Move, and S-Curve Move pulse profiles. I stretch/compress and position each object on the screen to make for a uniform look.



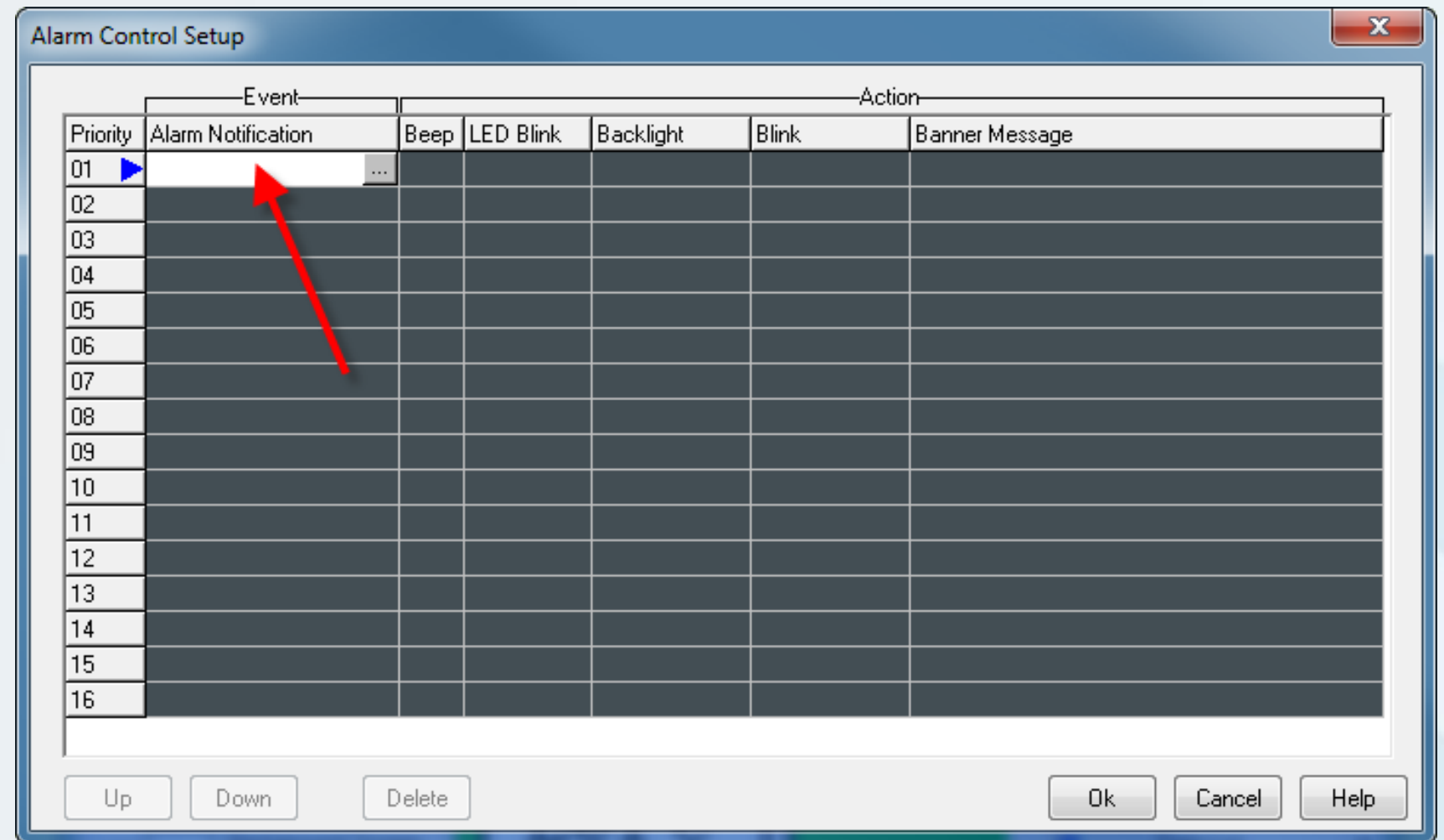
C-more Micro-Graphic Panel (HMI) – 10 of 14

Another benefit of using the C-more Micro-Graphic panel in our demonstration application is the ability to have alarm messages pop-up on the screen with both visible and audible signals if a problem is detected.

I use this feature to alert the operator to whenever one of the overtravel proximity sensors is actuated.

Bring up ‘Alarm Control Setup’ under the ‘Setup’ drop down menu. Under the ‘Event’ column for ‘Alarm Notification’ click in the first pull down box that is labeled ‘01’ under ‘Priority’.

This will bring up a second dialog window titled ‘Alarm Control Setup’ which is shown on the next slide.



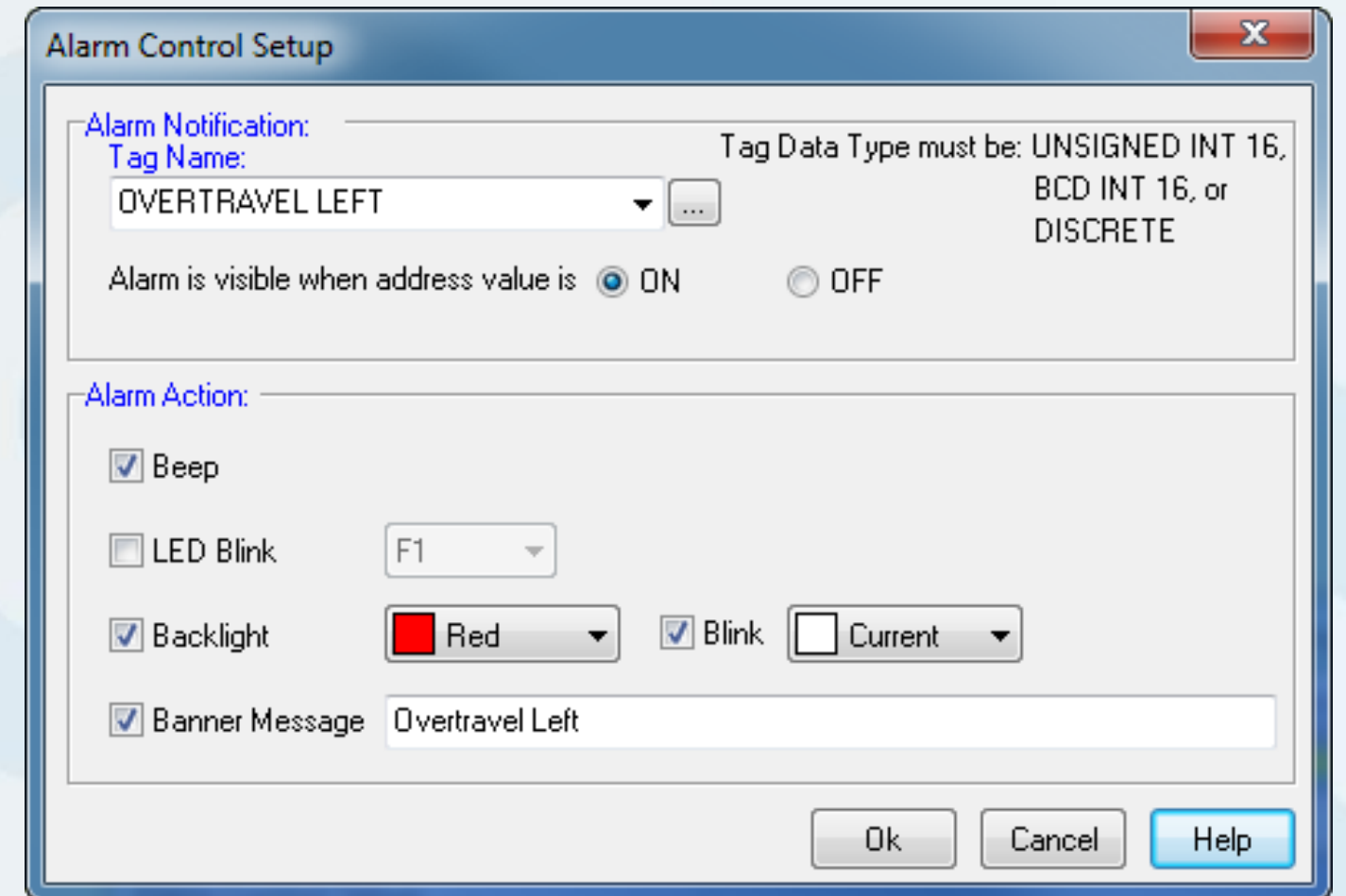
C-more Micro-Graphic Panel (HMI) – 11 of 14

I select the 'Tag Name' titled 'OVERTRAVEL LEFT' from the tag name database to use for my first alarm notification. I want the 'Alarm' to be visible when the address value is 'ON', so I check the 'ON' radio button.

I check the 'Beep' check box so I have an audible signal with the alarm, check the 'Backlight' check box and chose 'Red' with the 'Blink' check box checked, back to 'Current' backlight color.

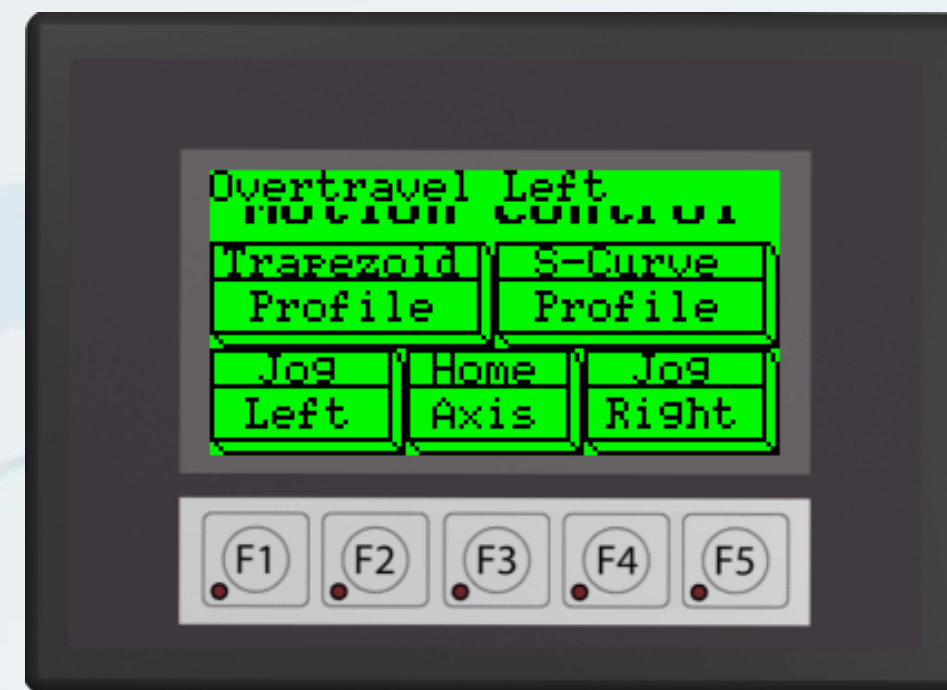
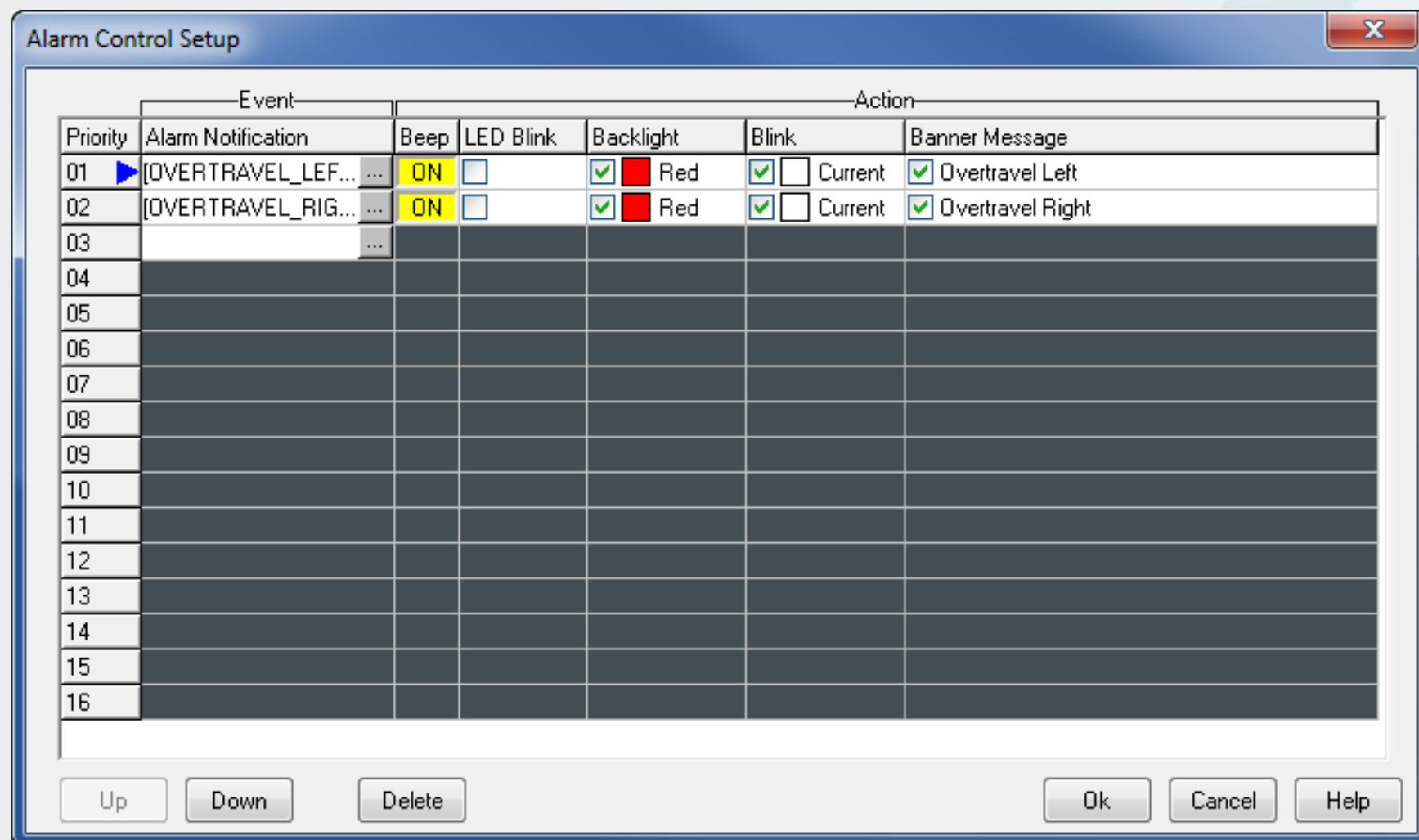
I check the 'Banner Message' check box and type in my alarm message that reads 'Left Overtravel'.

I click 'OK' when finished, and then create an 'Alarm Notification' for my next 'Priority', which will be number '2' for the 'OVERTRAVEL RIGHT' alarm message.



C-more Micro-Graphic Panel (HMI) – 12 of 14

When the alarm 'Tag Name' notification conditions are true, the screen will show the message in the upper area, blink back and forth from a green to a red background, and sound the beeper. This action will continue until the alarm condition is cleared.



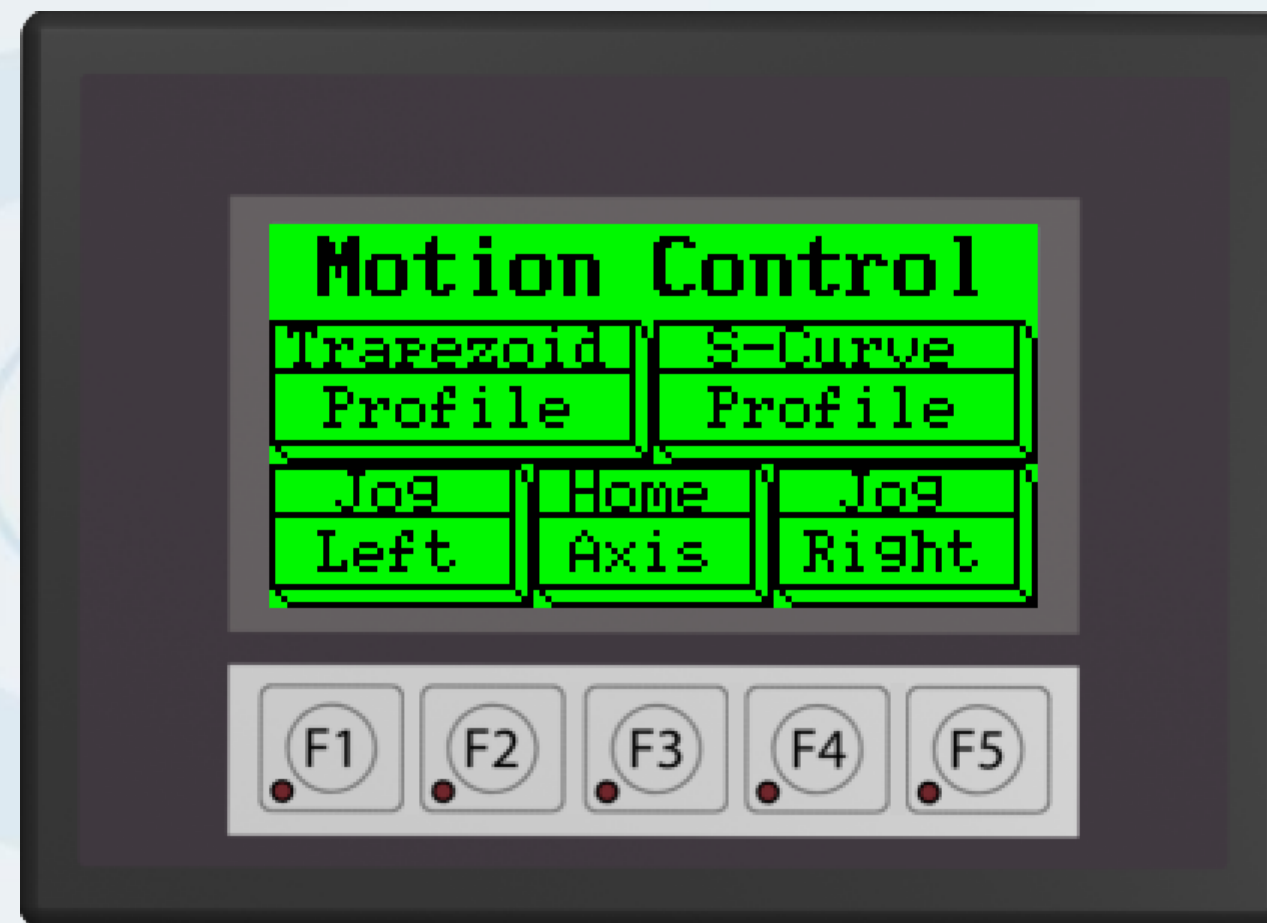
C-more Micro-Graphic Panel (HMI) – 13 of 14

Here is the final *C-more* Micro-Graphic panel layout that I use with the Motion Control demo. It is simple and to the point. The five basic moves can be executed with the individual push buttons that have been assigned in the *DirectSOFT5* ladder logic to execute the various Pulse Profile moves.

Again, I can home my axis, jog the axis left or right, execute a Trapezoid move, or execute an S-Curve move.

And I also have the ability to alert the operator to any alarm conditions through messages on the screen, background color changes, audible sound.

The *C-more* Micro-Graphic panel has much more capability for adding more features/enhancements to any application as needed.

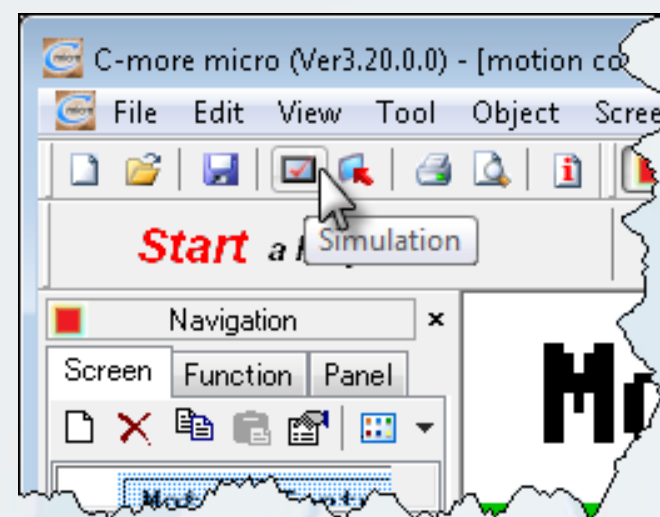


C-more Micro-Graphic Panel (HMI) – 14 of 14

Simulation: A great feature that is built-in to the *C-more* programming software is its ‘Simulation’ ability.

Click on the ‘Simulation’ icon and a representation of the *C-more* panel will be displayed along with a list of the various ‘Tag Names’ that are included in the project.

The ‘Simulation’ has the ability to control the various Tag Name bits and words by changing their states or values so that the operation of the panel can be tested.



Simulation

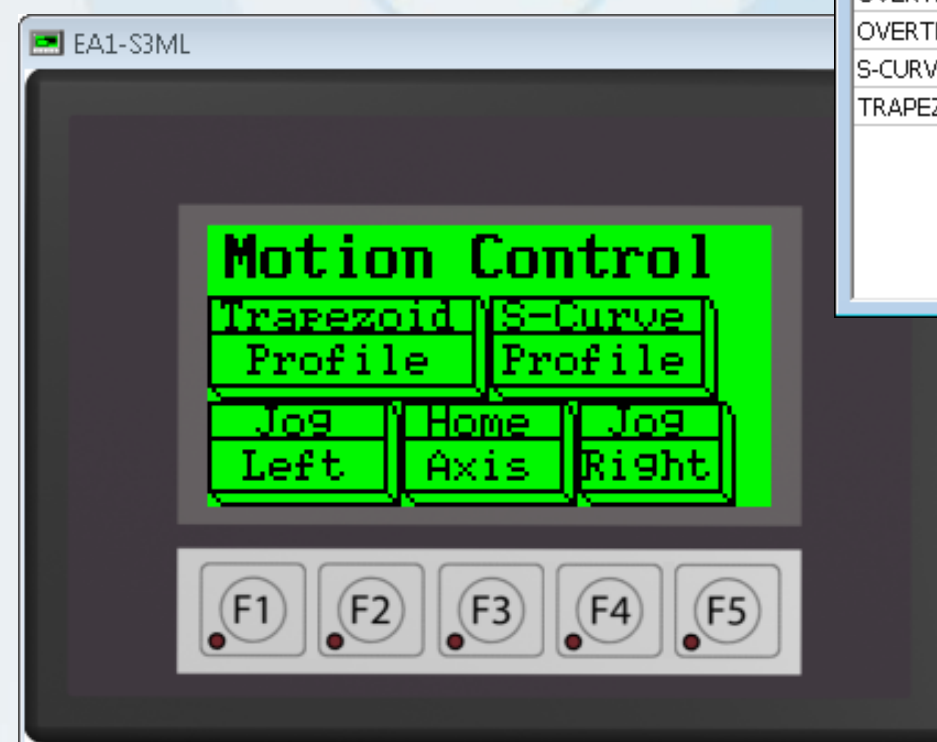
EXIT

Screen List

1 - Screen 1

Tag List

Tag Name	PLC Address	Data Type	Value
HOME AXIS PB	C0	Discrete	OFF
JOG LEFT PB	C1	Discrete	OFF
JOG RIGHT PB	C2	Discrete	OFF
OVERTRAVEL LEFT	X0	Discrete	OFF
OVERTRAVEL RIGHT	X1	Discrete	OFF
S-CURVE MOVE	C4	Discrete	OFF
TRAPEZOID MOVE	C3	Discrete	OFF



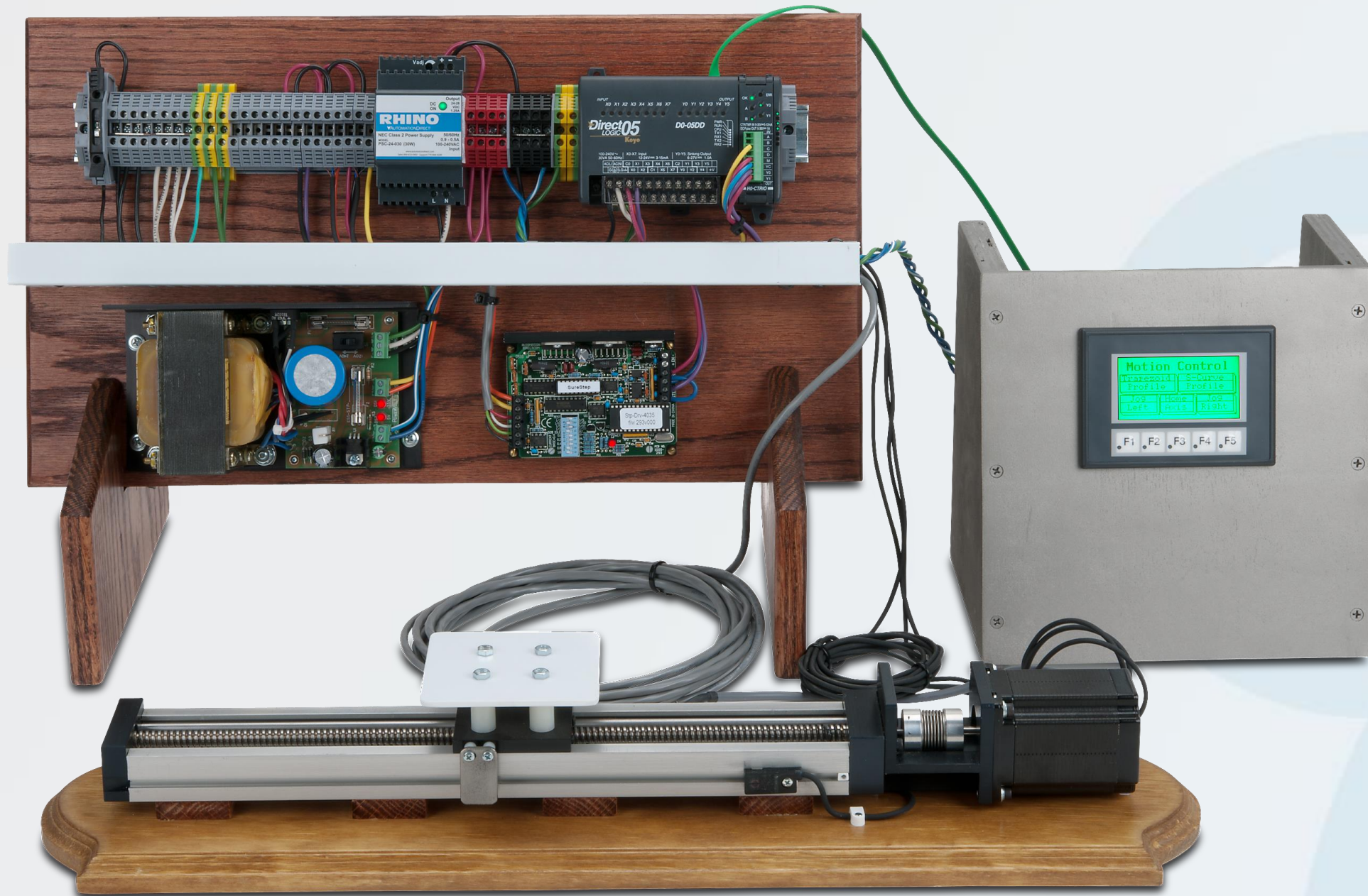
NOTE: The *C-more* Micro Web site has a series of ‘How to’ videos that detail the various features found in the *C-more* Micro-Graphic Programming Software.

Motion Control

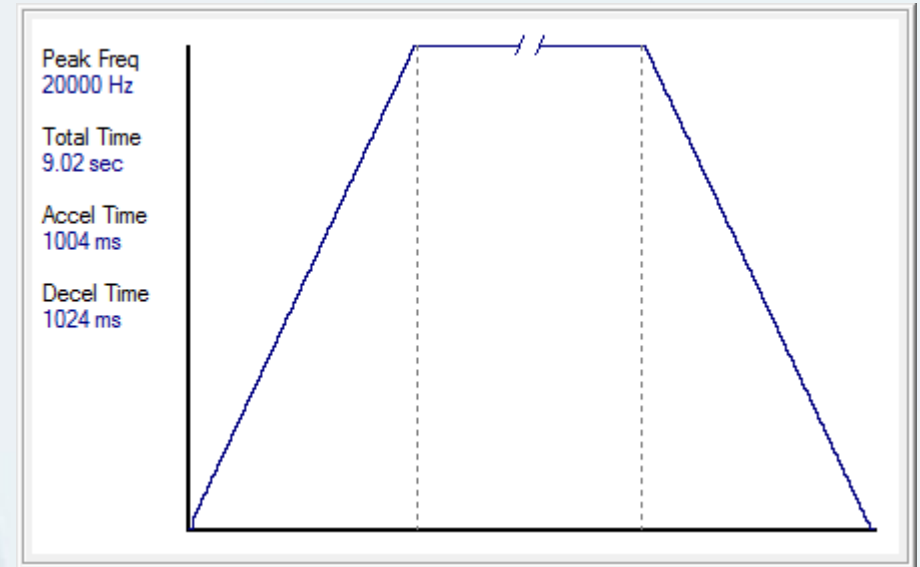
*Direct*LOGIC Micro PLC/CTRIO Module
to *Sure*Step Stepping System
with *C-more* Micro-Graphic Panel (HMI)

Part 8 of 8 - Demo - Jogging, Homing,
Trapezoid Profile & S-curve Profile

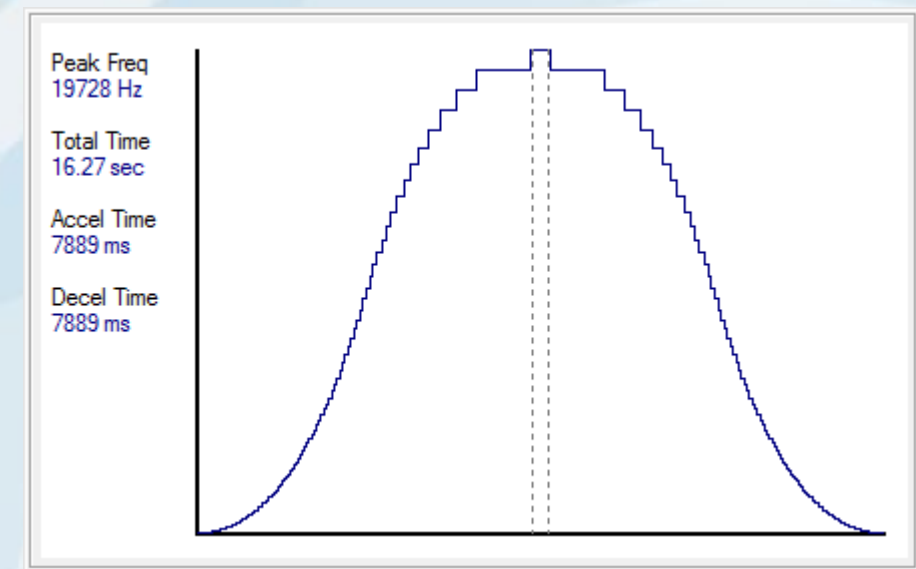
Demo – Jogging, Homing, Trapezoid Profile & S-curve Profile



Motion Control Demo



Trapezoid Profile



S-curve Profile

Link to learn.automationdirect.com Web site: <http://bit.ly/besLSz>

Available videos in this series on Motion Control.

Title	VID Number
Part 1 of 8 – Video Series Rundown & <i>SureStep</i> Product Lineup.	L-PC-DL-STP-001-1
Part 2 of 8 – <i>SureStep</i> Stepping System Control Methods.	L-PC-DL-STP-001-2
Part 3 of 8 – Typical Stepping System Applications & Linear Slide Demo Hardware.	L-PC-DL-STP-001-3
Part 4 of 8 – Wiring, CTRIO Jumper Settings & Drive DIP Switch Settings.	L-PC-DL-STP-001-4
Part 5 of 8 – Workbench Utility – Configure CTRIO Module & Create Motion Profiles.	L-PC-DL-STP-001-5
Part 6 of 8 – <i>DirectSOFT5</i> Ladder Logic, <i>IBox</i> CTRIO Configuration & <i>IBox</i> CTRIO Load Profile.	L-PC-DL-STP-001-6
Part 7 of 8 – <i>C-more</i> Micro-Graphic Panel Programming.	L-PC-DL-STP-001-7
Part 8 of 8 – Demo – Jogging, Homing, Trapezoid Profile & S-curve Profile.	L-PC-DL-STP-001-8

Please note.

Learn.AutomationDirect.com is an online streaming tutorial site offering training and information on a wide range of practical automation products.

THE LEARN.AUTOMATIONDIRECT.COM WEBSITE, AND THE TRAINING AND INFORMATION PROVIDED IN CONNECTION THEREWITH, IS SUPPLIED "AS IS". These video presentations and other documents are provided by our associates to assist others in learning the products we sell and service. We make no representation, warranty or guaranty, whether expressed, implied or statutory, regarding the LEARN.AUTOMATIONDIRECT.COM website on the training, information and the content, including without limitation, the implied warranties of merchantability or fitness for a particular purpose, and any representation, warranty or guaranty that the foregoing will be accurate, complete, uninterrupted error free or non-infringing, is suitable for your particular application, nor do we assume any responsibility for the use of this information in your application.

User suggestions, corrections and feedback are not only welcomed, but are essential to the maintenance of current content and the creation of new content. If there is a training idea, or correction to an existing presentation you would like us to consider, please complete and submit the suggestion form that is shown as a "[Suggestions](#)" link at the bottom of every page.

Thank you!