CTRIO High-Speed Counter Module

Manual Number: HX-CTRIO-M

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Notes

CTRIO High-Speed Counter User Manual

Please include the Manual Number and the Manual Issue, both shown below, when communicating with Technical Support regarding this publication.

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Publication History		
Issue	**Date**	**Description of Changes**
First Edition	9/01	Original
Rev. A	10/01	Corrections
Rev. B	8/02	Corrections
Second Edition	2/03	Added T1H-CTRIO and H4-CTRIO. Updated for CTRIO/Workbench version 2.
Rev. A	10/03	Added H0-CTRIO and flowcharts.
Rev. B	10/03	Corrections
Rev. C	03/11	Made corrections and updated manual.
Rev. D	02/13	Updated manual with new H0-CTRIO2 and H2-CTRIO2 information. Added Do-more PLC series data and examples. Updated CTRIO Workbench section with new pulse profiles available. Made minor corrections throughout manual.

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Introduction to the CTRIO & CTRIO2 Modules

Chapter 1

In This Chapter...

CTRIO and CTRIO2 Module Overview

CTRIO(2) modules are programmable high-speed discrete I/O modules that accept signals from encoders and discrete devices such as limit switches, and generate precision output signals for stepper control or other motion-related discrete functions. CTRIO(2) modules are coprocessors, having their own scan time and their own configurations. They have their own run mode and program mode, independent of the base controller.

H0-CTRIO(2) H2-CTRIO(2) H4-CTRIO T1H-CTRIO

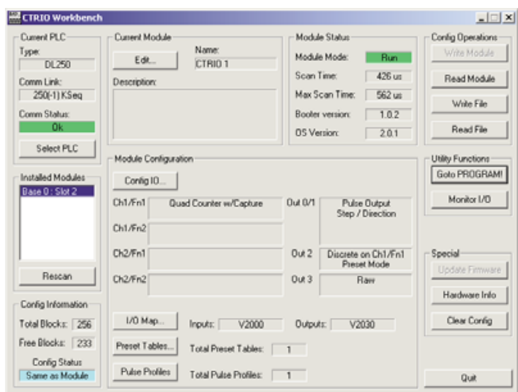
NOTE: *For ease of documentation purposes, CTRIO will be used to designate all four CTRIO modules (H0-CTRIO(2), H2-CTRIO(2), H4-CTRIO and T1H-CTRIO) when the functionality and/or description applies to all four modules.*

NOTE: *The T1H-CTRIO is only supported by the T1H-EBC, T1H-EBC100 and T1H-PBC.*

CTRIO Workbench

CTRIO Workbench is the utility used to configure the many functions available (listed below) for a CTRIO(2) module. CTRIO Workbench is used in one of two ways, depending on the base controller:

- **Do-more**: CTRIO Workbench is an integrated utility of Do-more Designer. The configuration becomes part of the CPU project and is stored in the CPU. The CPU will push the configuration to the installed CTRIO(2) module as appropriate.
- **Any other base controller**: CTRIO Workbench is a separate utility that communicates with a CTRIO(2) module through the base controller to configure the CTRIO(2). The configuration is stored in the CTRIO(2) and is a file that should also be stored on your computer. Configuring the CTRIO(2) is a process separate from programming the base controller.



CTRIO Configuration

The CTRIO(2) module configuration created with CTRIO Workbench will define the following:

<u>Inputs:</u>

1. Assign the input points
   - Quadrature encoder with AB or ABZ
   - Tachometer

- Discrete (unassigned)

2. Functions applied to discrete inputs
   - Simple discrete input
   - Pulse catch (high-speed discrete input with programmable filter)
   - Timing: edge timer (period), dual edge timer (time difference of two inputs)
   - Reset counts (Z input from encoder)
   - Capture counts (copy counts to a register)
   - Inhibit counting
3. Scaling of timing functions or encoder inputs

Outputs:

1. Assign the output points
   - Stepper control: Step/Direction or CW/CCW
   - Discrete
2. Pulse profiles for stepper outputs to follow
   - Trapezoid, S-curve, Symmetrical S-curve, Dynamic Position, Dynamic Velocity, Home
   - Dynamic Position Plus, Trapezoid Plus, Trapezoid with Limits (CTRIO2 only and CTRIO Workbench v2.2.0 required)
3. Associate output functions with inputs
   - Programmable Limit Switch or 'PLS' (CTRIO2 only and CTRIO Workbench v2.2.0 required)
   - Preset tables

CTRIO Functions

As mentioned above, the CTRIO(2) module supports five primary input functions: Counter, Quad Counter, Pulse Catch, Edge Timer, and Dual Edge Timer.
Three secondary input functions are also supported. These functions, Reset, Capture, and Inhibit, each modify the primary input functions in some way. Information is available about each of the primary and secondary functions in chapter 4.

The CTRIO module supports three primary output functions: Pulse train output for servo/stepper motor control, configurable for CW/CCW or step and direction, discrete output functions assigned to Counter/Timer input functions, and raw output control directly from the CPU interface program. Information is available about each of the output functions in chapter 5.

NOTE: *Before a CTRIO(2) will do anything, it must be configured, in run mode, and the memory must be mapped. Mapping the memory is not required when used with a Do-more CPU.*

Typical Counter Applications:

- High-speed cut to length operations using encoder input
- Pick-and-place or indexing functions controlling a stepper drive
- Dynamic registration for web material control
- Accurate frequency counting for speed control with onboard scaling
- Positioning (e.g. flying punch)
- PLS - programmable limit switch functions for packaging, gluing or labeling
- Stepper motor drive control
- Valve control
- Rate monitoring for speed and/or flow

Support Systems for the CTRIO Modules

The CTRIO modules are compatible with several CPU-slot interfaces. Consideration must be given to the firmware versions of the CPU-slot interfaces to assure their compatibility with the CTRIO. (See Chapter 2 for CPU/CTRIO compatibility listings). Multiple CTRIO modules can reside in the same base provided that the backplane power budget is adequate.

Support Systems for the H0-CTRIO(2):

You can use the H0-CTRIO(2) module in:

- ***Direct***LOGIC 05/06 PLC systems

Support Systems for the H2-CTRIO(2):

You can use the H2-CTRIO module in:

- ***Direct***LOGIC 205 PLC systems (D2-240, D2-250-1 or D2-260)
- DL205 WinPLC systems (H2-WPLCx-xx)
- PC-based control strategies using the H2-EBC interface module
- Hx-ERM networks using the H2-EBC interface module
- Profibus systems using the H2-PBC slave interface module
- Do-more PLC systems (H2-DM1, H2-DM1E)

Support Systems for the H4-CTRIO:

You can use the H4-CTRIO module in:

- ***Direct***LOGIC 405 PLC systems (D4-450 only)
- PC-based control strategies using the H4-EBC interface module
- Hx-ERM networks using the H4-EBC interface module

Support Systems for the T1H-CTRIO:

You can use the T1H-CTRIO module in:

- PC-based control strategies using the T1H-EBC interface module
- Profibus systems using the T1H-PBC slave interface module
- Hx-ERM networks using the T1H-EBC interface module

CTRIO Specifications

General	
Module Type	Intelligent
Modules Per Base	Limited only by power consumption
I/O Points Used	None, I/O map directly in PLC memory (V-memory for DirectLOGIC PLCs and data structures for Do-more PLCs) or PC control access
Field Wiring Connector	Standard removable terminal block
Internal Power Consumption	400 mA Max at +5V from Base Power Supply (H2, H4, T1H-CTRIO) 275 mA Max at +5V from Base Power Supply (H2-CTRIO2) 250 mA at +5V from Base Power Supply (H0-CTRIO(2)) (All I/O in ON State at Max Voltage/Current)
Operating Environment	32°F to 140°F (0°C to 60°C), Humidity (non-condensing) 5% to 95%
Manufacturer	Host Automation Products, LLC
Isolation	2500V I/O to Logic, 1000V among Input Channels and All Outputs (H0, H2, H4, T1H-CTRIO) 1500V I/O to Logic, 1000V among Input Channels and All Outputs (H0, H2-CTRIO2)

CTRIO Input Specifications	
Inputs (H2, H4, T1H-CTRIO, H2-CTRIO2)	8 pts. sink/source 100 kHz Max (H2, H4, T1H-CTRIO) 8 pts. sink/source 250 kHz Max (H2-CTRIO2)
Inputs (H0-CTRIO(2))	4 pts. sink/source 100 kHz Max (H0-CTRIO) 4 pts. sink/source 250 kHz Max (H0-CTRIO2)
Minimum Pulse Width	5 µsec (H0, H2, H4, T1H-CTRIO) 0.5 µsec (H0, H2-CTRIO2)
Input Voltage Range	9-30 VDC
Maximum Voltage	30 VDC
Input Voltage Protection	Zener Clamped at 33 VDC
Rated Input Current	8 mA typical, 12 mA maximum
Minimum ON Voltage	9.0 VDC
Maximum OFF Voltage	2.0 VDC
Minimum ON Current	5.0 mA (9 VDC required to guarantee ON state)
Maximum OFF Current	2.0 mA
OFF to ON Response	Less than 3 µsec (H0, H2, H4, T1H-CTRIO) Less than 0.5 µsec (H0, H2-CTRIO2)
ON to OFF Response	Less than 3 µsec (H0, H2, H4, T1H-CTRIO) Less than 0.5 µsec (H0, H2-CTRIO2)

CTRIO Input Resources	
Counter/Timer (H2, H4, T1H-CTRIO, H2-CTRIO2)	4, (2 per each 4 input channel group); supports 2 quadrature counters max.
Counter/Timer (H0-CTRIO(2))	2, (2 per single 4 input channel); supports 1 quadrature counter max.
Resource Options	1X, 2X, or 4X Quadrature, Up or Down Counter, Edge Timer, Dual Edge Timer, Input Pulse Catch, Reset, Inhibit, Capture
Timer Range/ Resolution	±4.2 billion (32 bits); 1 µsec
Counter Range	±2.1 billion (32 bits or 31 bits + sign bit)

CTRIO Specifications

CTRIO Output Specifications	
Outputs (H2, H4, T1H-CTRIO, H2-CTRIO2)	4 pts, independently isolated, current sourcing or sinking FET Outputs: open drain and source with floating gate drive
Outputs (H0-CTRIO(2))	2 pts, isolated, either both current sourcing or both current sourcing FET Outputs: open drain and source with floating gate drive
Pulse Output Control Range	20 Hz to 25 kHz (H0, H2, H4, T1H-CTRIO) 20 Hz to 250 kHz (H0, H2-CTRIO2)
Voltage range	5VDC - 36VDC (H0, H2, H4, T1H-CTRIO, H2-CTRIO2)
Maximum voltage	36VDC (H0, H2, H4, T1H-CTRIO, H2-CTRIO2)
Output clamp voltage	60VDC (H0, H2, H4, T1H-CTRIO)
Maximum load current	1.0A (H0, H2, H4, T1H-CTRIO) 1.0A at 23°C, 0.5A at 60°C (H2-CTRIO2) 0.5A at 23°C, 0.33A at 60°C (H0-CTRIO2)
Maximum load voltage	33VDC (H0-CTRIO2) 36VDC (H0, H2, H4, T1H-CTRIO, H2-CTRIO2)
Maximum leakage current	100µA
Inrush current	1A for 10ms (H0-CTRIO2) 2A for 10ms (H2-CTRIO2) 5A for 20ms (H0, H2, H4, T1H-CTRIO)
OFF to ON response	less than 3µsec (H0, H2, H4, T1H-CTRIO, H0-CTRIO2) less than 1µsec (H2-CTRIO2)
ON to OFF response	less than 3µsec (H0, H2, H4, T1H-CTRIO, H0-CTRIO2) less than 1µsec (H2-CTRIO2)
ON state V drop	$\leq$ 0.3V (H0, H2, H4, T1H-CTRIO) $\leq$ 0.45V (H2-CTRIO2)
External power supply	for loop power only, not required for internal module function*
Overcurrent protection	15A max (H0, H2, H4, T1H-CTRIO) Self resetting overcurrent protection (H0-CTRIO2)
Thermal shutdown	Tjunction = 150°C
Overtemperature reset	Tjunction = 130°C
Duty cycle range	1% to 99% in 1% increments (default = 50%) (H0, H2, H4, T1H-CTRIO) 0.1% to 99.9% in 0.1% increments (H0, H2-CTRIO2)
Configurable Presets a) single b)multiple	a) each output can be assigned one preset, or b) each output can be assigned one table of presets, one table can contain max. 128 presets, max. predefined tables = 255

CTRIO Output Resources	
Pulse output / Discrete outputs (H2, H4, T1H-CTRIO, H2-CTRIO2)	Pulse outputs: 2 channels (2 outputs per each channel) Discrete outputs: 4 pts.
Pulse output / Discrete outputs (H0-CTRIO(2))	Pulse outputs: 1 channel (2 outputs per single channel) Discrete outputs: 2 pts.
Resource Options	**Pulse outputs:** pulse/direction or cw/ccw; Profiles:Trapezoid, S-Curve, Symmetrical S-Curve, Dynamic Positioning, Dynamic Velocity, Home Search, Free Form, Dynamic Positioning Plus (CTRIO2),Trapezoid Plus (CTRIO2), Trapezoid w/Limits (CTRIO2), Velocity Mode, Run to Limit Mode, Run to Position Mode **Discrete outputs:** configurable for set, reset, pulse on, pulse off, toggle, reset count functions (assigned to respond to Timer/Count input functions). **Raw mode:** Direct access to discrete outputs from user application program
Target Position Range	±2.1 billion (32 bits or 31 bits + sign bit)

H0-CTRIO(2) LED Indicators

H0-CTRIO(2) LED Descriptions	
OK	Module OK
ERR	User Program Error
A	Ch1 F1 Resource State
B	Ch1 F2 Resource State
Y0 - Y1	Output Status

H0-CTRIO(2) LED Diagnostic Definitions		
OK	**ERR**	**Description**
ON	OFF	RUN Mode
ON	ON	Hardware Failure
Blinking	Blinking	Boot Mode - Used for Field OS Upgrades
Blinking	OFF	Program Mode
OFF	Blinking	Module Self-diagnostic Failure
OFF	ON	Module Error Due to Watchdog Timeout
OFF	OFF	No Power to Module

H0-CTRIO(2) LED Diagnostic Definitions	
A	Blinks when Channel 1 Function 1 is counting or timing
B	Blinks when Channel 1 Function 2 is counting or timing
Y0 - Y1	Follow actual output state; ON = output is passing current

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H2-CTRIO(2) LED Indicators

H2-CTRIO(2) LED Descriptions	
OK	Module OK
ER	User Program Error
1A	Channel 1 Status
2A	Channel 2 Status
0 - 3	Output Status

H2-CTRIO(2) LED Diagnostic Definitions		
OK	**ER**	**Description**
ON	OFF	RUN Mode
ON	ON	Hardware Failure (H2-CTRIO)
		Not Used (H2-CTRIO2)
Blinking	Blinking	Boot Mode - Used for Field OS Upgrades
Blinking	OFF	Program Mode
OFF	Blinking	Module Self-diagnostic Failure (Blinks may be coded by counts)
OFF	ON	Module Error Due to Watchdog Timeout
OFF	OFF	No Power to Module

H2-CTRIO(2) LED Diagnostic Definitions	
1A /2A	
Blinking 7 times per second	Input is Configured as Counter and is Changing
Following State of Input	Input is not Configured as Counter
0 - 3	
Follow actual output state; ON = output is passing current	

H4-CTRIO LED Indicators

H4-CTRIO LED Descriptions	
OK	Module OK
ER	User Program Error
1A - 1D	Ch1A - Ch1D Input Status
2A - 2D	Ch2A - Ch2D Input Status
(Ch1) F1 - F2	Ch1 Resource State
(Ch2) F1 - F2	Ch2 Resource State
Y0 - Y3	Output Status

H4-CTRIO LED Diagnostic Definitions		
OK	**ER**	**Description**
ON	OFF	RUN Mode
Blinking	Blinking	Boot Mode - Used for Field OS Upgrades
Blinking	OFF	Program Mode
OFF	Blinking	Module Self-diagnostic Failure
OFF	ON	Module Error Due to Watchdog Timeout
OFF	OFF	No Power to Module
TB		User Terminal Block is not Properly Installed

H4-CTRIO LED Diagnostic Definition	
1A - 1D	Follow actual input state / Ch1
2A - 2D	Follow actual input state / Ch2
(Ch1) F1	blinks when Channel 1 Function 1 is counting or timing
(Ch1) F2	blinks when Channel 1 Function 2 is counting or timing
(Ch2) F1	blinks when Channel 2 Function 1 is counting or timing
(Ch2) F2	blinks when Channel 2 Function 2 is counting or timing
Y0 - Y3	Follow actual output state; ON = output is passing current

***NOTE:** Due to the multiplexed design of the DL405 LED matrix, OFF state LEDs may appear to blink ON slightly. This is to be expected and does not necessarily indicate a transient condition of the function corresponding to the LED.*

T1H-CTRIO LED Indicators

T1H-CTRIO LED Descriptions	
OK	Module OK
ER	User Program Error
CH1	Channel 1 Status
CH2	Channel 2 Status
1A - 1D	Channel 1 A-D Input Status
2A - 2D	Channel 2 A-D Input Status
Y0 - Y3	Output Status

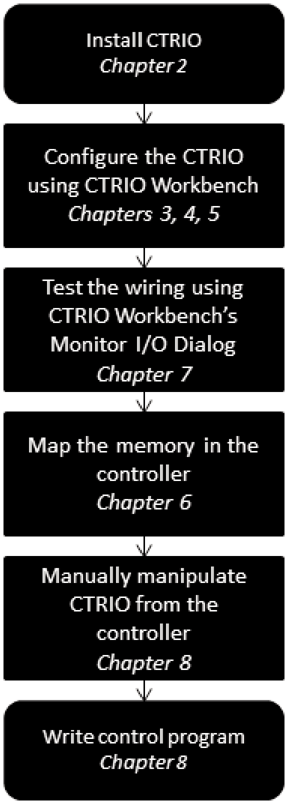
T1H-CTRIO LED Diagnostic Definitions		
OK	**ER**	**Description**
ON	OFF	RUN Mode
ON	ON	Hardware Failure
Blinking	Blinking	Boot Mode - Used for Field OS Upgrades
Blinking	OFF	Program Mode
OFF	Blinking	Module Self-diagnostic Failure
OFF	ON	Module Error Due to Watchdog Timeout
OFF	OFF	No Power to Module

T1H-CTRIO LED Diagnostic Definitions	
CH1	Blinks when Channel 1 Function 1 is counting or timing
CH2	Blinks when Channel 2 Function 1 is counting or timing
Y0 - Y3	Follow actual output state; ON = output is passing current

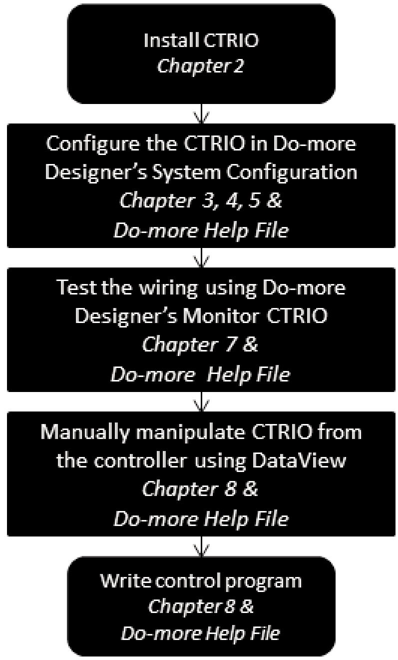
CTRIO Module Workflow Diagram

The following workflow diagrams show the steps needed, with their associated chapters in this manual, to install a CTRIO module into your system.

DirectLOGIC, WinPLC or EBC



Do-more



Notes:

INSTALLATION AND FIELD WIRING

CHAPTER 2

In This Chapter...

Installing the H0-CTRIO(2) Module

The H0-CTRIO(2) module is compatible with *Direct*LOGIC DL05 and DL06 PLCs. Consideration must be given to the firmware versions of the PLCs to assure their compatibility with the H0-CTRIO(2). (see chart below).

The H0-CTRIO(2) module plugs into any option card slot of any DL05 and DL06 PLC.

For installation instructions, refer to the:

- DL05 or DL06 User Manual (D0-USER-M or D0-06USER-M)

The first time you power-up the CTRIO module, you should see the OK LED blinking. The blinking LED indicates that the module is in program mode.

CPU and CTRIO Compatibility Chart

PLC CPU	Firmware	*Direct*SOFT5
H0-CTRIO(2)		
DL05	v. 4.60 or later	v. 4.0, Build 16 or later
DL06	v. 1.40 or later	v. 4.0, Build 16 or later

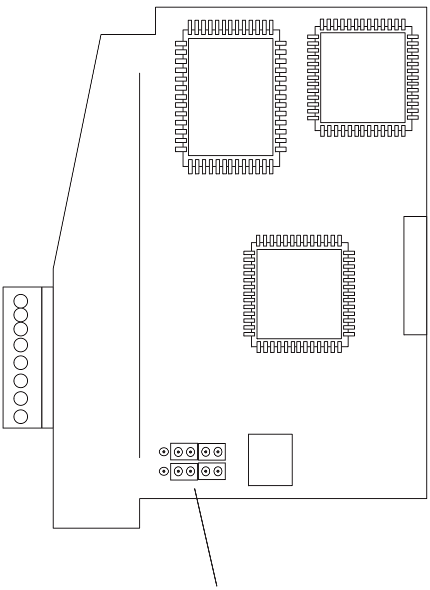
Updated firmware versions can be downloaded from our web site at *www.automationdirect.com*

NOTE: *CTRIO Workbench Version 2.2.0 is required for the H0-CTRIO2.*

Setting H0-CTRIO(2) Jumpers

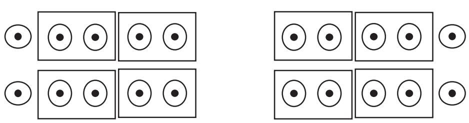
The module's internal jumpers must be set to the High Side Common position for high side switching (sourcing) outputs or to the Low Side Common position for low side switching (sinking) outputs. The sink/source jumper selection sets both outputs to the same option. Source operation is the factory default setting.

H0-CTRIO



Jumper Selections

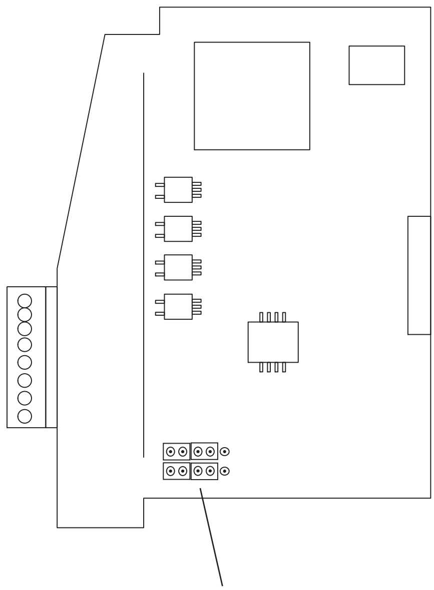
Sourcing Outputs | **Sinking Outputs**



High Common position for switching the high side of a DC load.

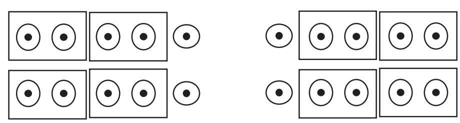
Low Common position for switching the low side of a DC load.

H0-CTRIO2



Jumper Selections

Sourcing Outputs | **Sinking Outputs**

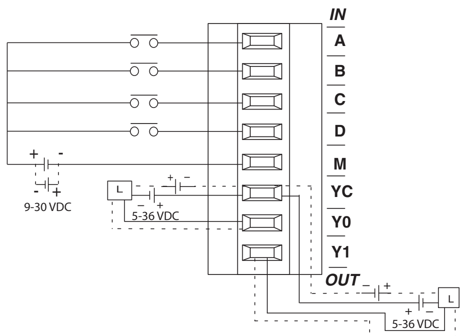


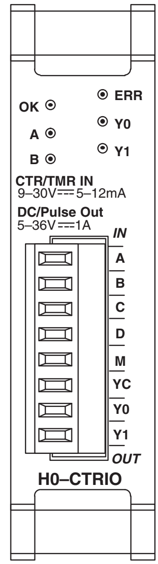
High Common position for switching the high side of a DC load.

Low Common position for switching the low side of a DC load.

Wiring the H0-CTRIO(2) Module

The H0-CTRIO(2) module has one input channel, consisting of 4 optically isolated input points (pts. A-D on common M). The inputs can be wired to either sink or source current. The module has 2 optically isolated output points (pts. Y0-Y1 on common 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 (see the diagram to the right and the schematic on page 2-8). Source operation is the factory default setting for the outputs.





The module is configured, using CTRIO Workbench, to accommodate the user's application. The function of each input (counting, timing, reset, etc.) and output (pulse output, discrete output, etc.) is defined in the configuration of the module.

Refer to Chapters 4 and 5 to determine what input and output configurations are possible.

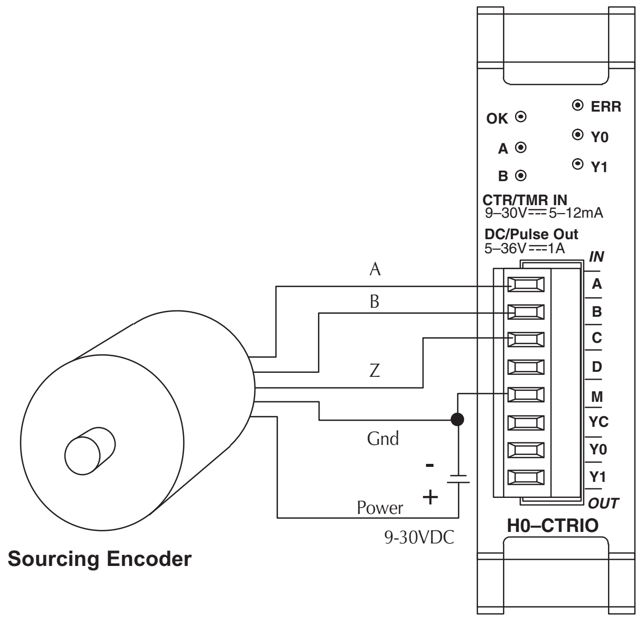
NOTE: *Field device wiring must be compatible with the module configuration.*

See the notes below for further details about power source considerations, circuit polarities, and field devices. Also, refer to the specifications on pages 1-5 and 1-6 for more information.

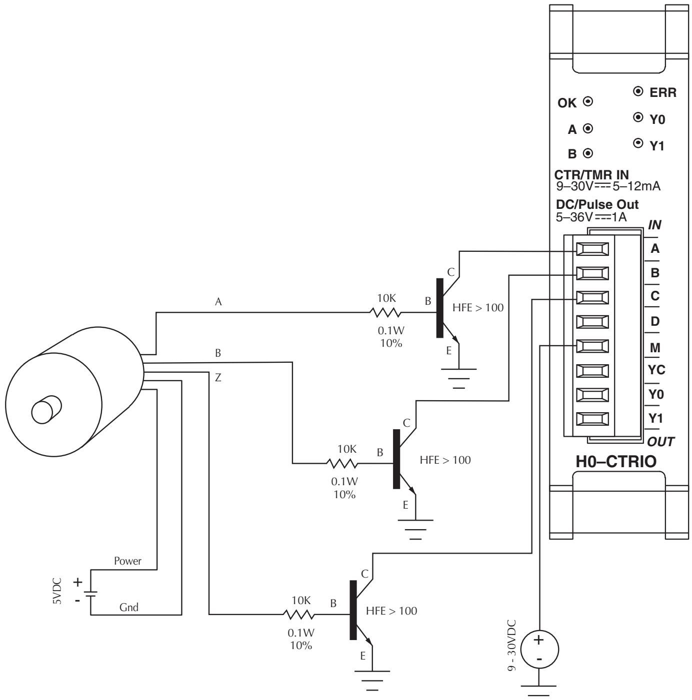
NOTES:

1. **Inputs (A, B, C, and D) require user-provided 9-30VDC power sources. Terminal M is the commons for the inputs. Maximum current consumption is 12mA per input point.**
2. **Polarity of the input power sources (shown above) can be reversed. Consideration must be given, however, to the polarity of the field device. Many field devices are designed for only one polarity and can be damaged if power wiring is reversed.**
3. **The maximum allowable current per output circuit is 1A.**

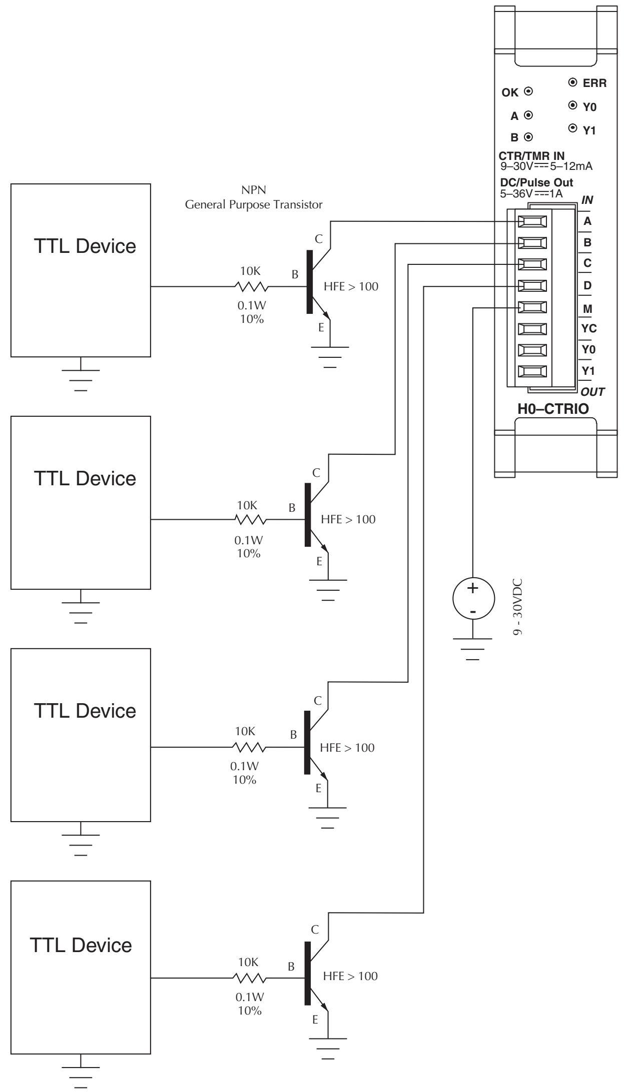
H0- CTRIO(2) Quadrature Encoder Wiring Example



H0-CTRIO(2) TTL Quadrature Encoder Field Wiring

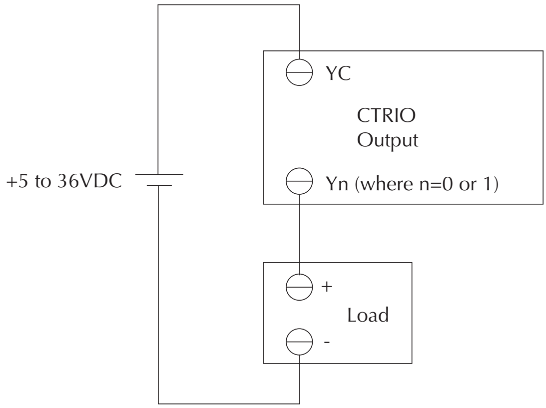


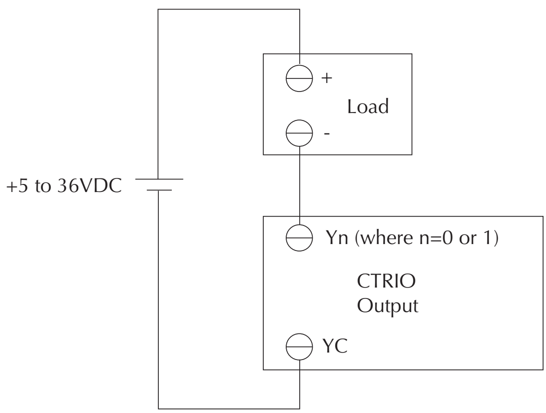
H0- CTRIO(2) TTL Input Wiring



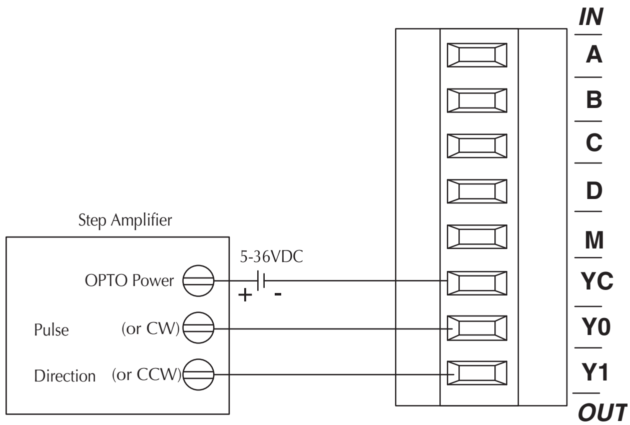
H0- CTRIO(2) Output Wiring Schematic

See page 2-3 for locating and setting the jumpers





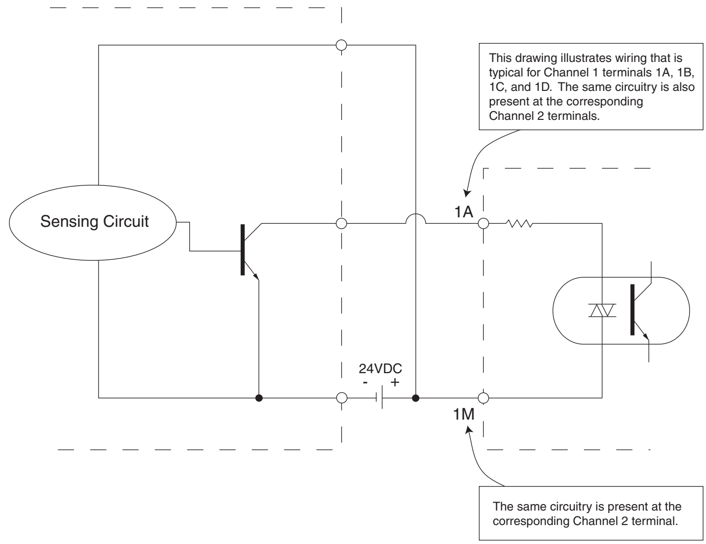
H0-CTRIO(2) Stepper/Servo Drive Wiring Example



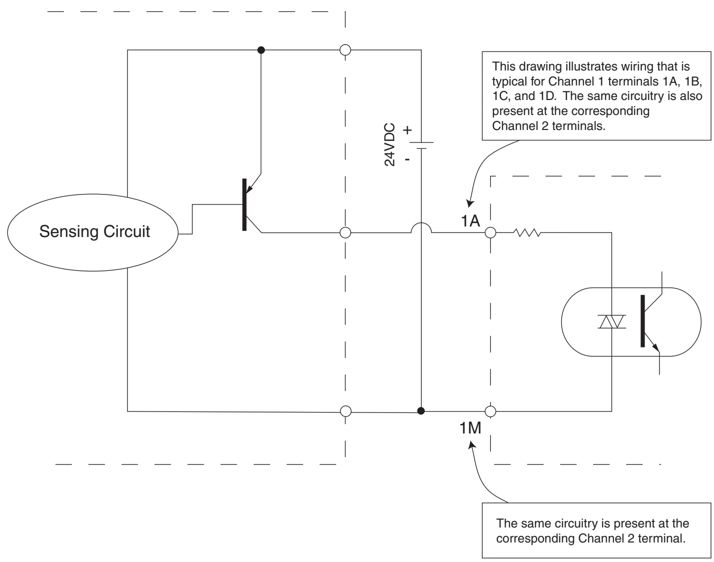
See page 2-3 for locating and setting the jumpers

Solid State Input Device Wiring to the H0-CTRIO(2) Module

NPN Field Device



PNP Field Device



Installing the H2-CTRIO(2) Module

The H2-CTRIO(2) module is compatible with Do-more CPUs and several DL205 CPU-slot interface devices. Consideration must be given to the firmware version of the CPU to assure their compatibility with the H2-CTRIO(2). (see chart below).

The H2-CTRIO(2) module plugs into any I/O slot of any Do-more or ***Direct***LOGIC 205 base except slot 0 when using a ***Direct***LOGIC PLC. Slot 0 is also not allowed if using the H2-CTRIO and a WinPLC or H2-PBC controller. However, slot 0 is available for the H2-CTRIO(2) module when using the H2-EBC interface devices (Slot 0 is the I/O slot adjacent to the CPU). The H2-CTRIO(2) cannot be used in DL205 local expansion bases or in Serial Remote I/O bases.

For installation instructions, refer to the:

- DL205 User Manual (D2-USER-M) if using a ***Direct***LOGIC PLC
- DL205 Installation and I/O Manual (D2-INST-M) if using a WinPLC, EBC, Profibus slave interface module
- Do-more H2 series PLC Harware User Manual (H2-DM-M) if using a Do-more PLC

The first time you power-up the CTRIO module, you should see the OK LED blinking. The blinking LED indicates that the module is in program mode.

CPU and CTRIO Compatibility Chart

CPU-slot Device	Firmware	Hardware	*Direct*SOFT5	Slot Restrictions
H2-CTRIO(2)				
D2-240	v. 3.22 or later	-	v. 3.0C, Build 71 or later	any I/O slot except 0
D2-250	v. 1.56 or later	-	v. 3.0C, Build 71 or later	any I/O slot except 0
D2-250-1	v. 3.5 or later	-	v. 3.0C, Build 71 or later	any I/O slot except 0
D2-260	v. 1.2 or later	-	v. 4.0 or later	any I/O slot except 0
H2-WinPLC	-	xK or later	-	any I/O slot except 0
H2-EBC	v. 2.1.357 or later	-	-	prior to Rev 9A any I/O slot except 0; Rev 9A or later any I/O slot
H2-PBC	-	-	-	prior to Rev 4A any I/O slot except 0; Rev 4A or later any I/O slot
Do-more	Any	Any	N/A	None

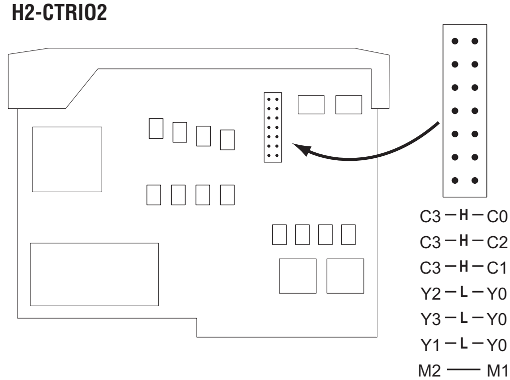
Updated firmware versions can be downloaded from our web site at
www.automationdirect.com

SPECIAL NOTE: For applications requiring multiple CTRIO modules, *Direct*LOGIC CPUs, and dynamic access (in ladder logic) to CTRIO data, we recommend using the D2-250-1 or D2-260 CPU. These CPUs support Bit-of-Word addressing, 32 bit math instructions and have adequate memory for multiple CTRIO applications.

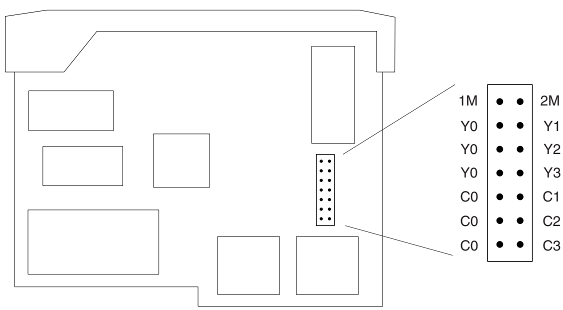
Setting H2-CTRIO(2) Jumpers

Jumpers are provided to connect input commons or outputs/output commons. Use of these jumpers is not necessary to set up the CTRIO module. The jumpers are provided solely for convenience in wiring.

H2-CTRIO2



H2-CTRIO



H2-CTRIO(2) Jumper Functions		
H2-CTRIO	**H2-CTRIO2**	**Function**
1M-2M		Install jumper to internally connect the input commons 1M and 2M in order to reduce wiring if appropriate.
Y0-Y1		Install jumper(s) to internally connect Y0 to other Y terminals in order to reduce wiring if appropriate. Connect wire at Y0.
Y0-Y2		
Y0-Y3		
C0-C1		Install jumper(s) to internally connect C0 to other C terminals in order to reduce wiring if appropriate. Connect wire at C0.
C0-C2		
C0-C3		
	C3-C0	Install jumper(s) to internally connect C3 to other C terminals in order to reduce wiring if appropriate. Connect wire at C3.
	C3-C1	
	C3-C2	

Wiring the H2-CTRIO(2) Module

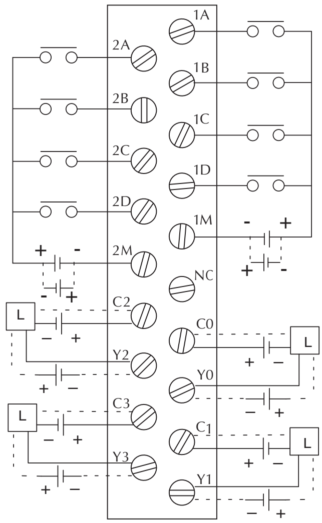
The H2-CTRIO(2) module has two independent input channels, each consisting of 4 optically isolated input points (pts. 1A-1D on common 1M and pts. 2A-2D on common 2M). The inputs can be wired to either sink or source current.

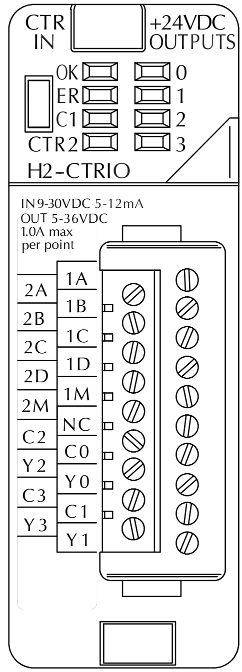
The module has 4 optically isolated output points (pts. Y0-Y3 with isolated commons C0-C3, respectively). The outputs must be wired so positive current flows into Cn terminal and then out of the Yn terminal (see the diagram below and the schematic on page 2-19).

Remember that the internal jumpers can be used to connect the input commons or outputs/output commons together.

The module is configured, using CTRIO Workbench, to accommodate the user's application. The function of each input (counting, timing, reset, etc.) and output (pulse output, discrete output, etc.) is defined in the configuration of the module.

Refer to Chapters 4 and 5 to determine what input and output configurations are possible.





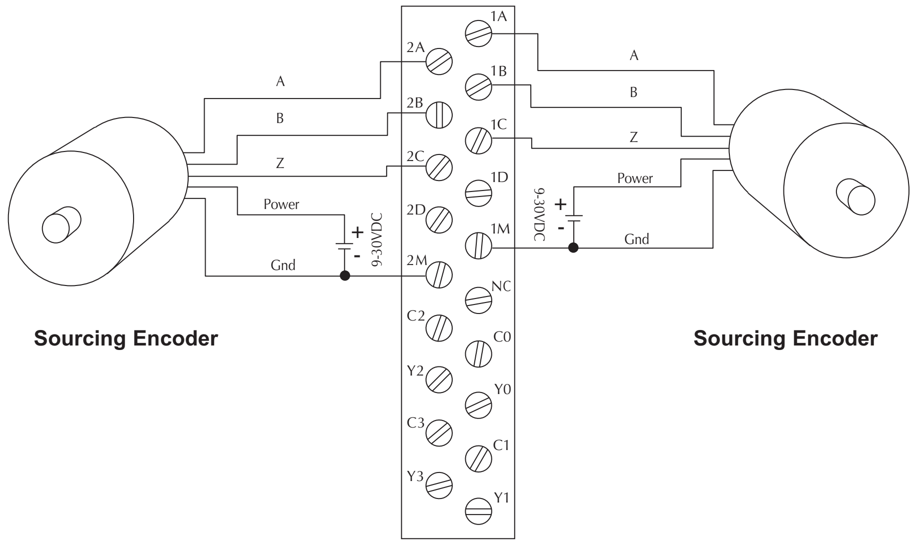
NOTE: *Field device wiring must be compatible with the module configuration.*

See the notes below for further details about power source considerations, circuit polarities, and field devices.

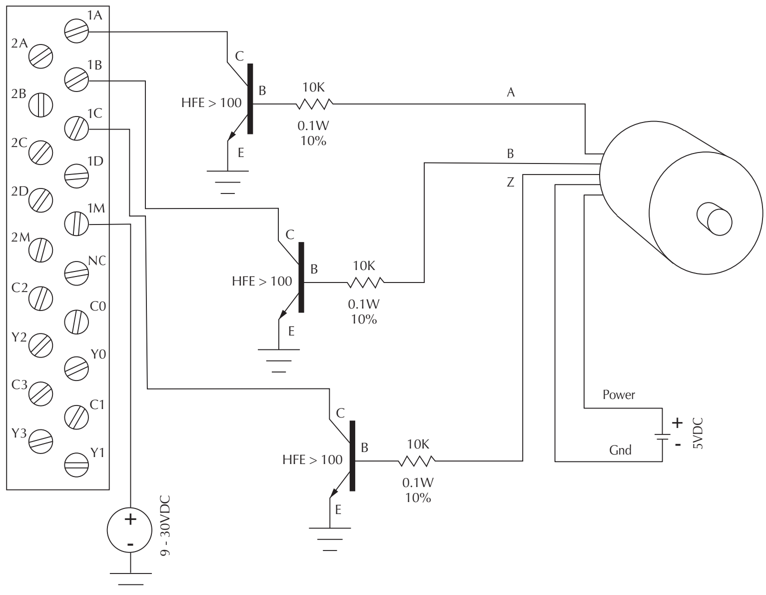
NOTES:

1. **Inputs (1A, 1B, 1C, 1D and 2A, 2B, 2C, 2D) require user-provided 9-30VDC power sources. Terminals 1M and 2M are the commons for Channel 1 and Channel 2 inputs. Maximum current consumption is 12mA per input point.**
2. **Polarity of the input power sources (shown above) can be reversed. Consideration must be given, however, to the polarity of the field device. Many field devices are designed for only one polarity and can be damaged if power wiring is reversed.**
3. **Outputs have one polarity only (as shown above) and are powered by user-provided 5-36VDC power sources. The maximum allowable current per output circuit is 1A for the H2-CTRIO and 1A at 23°C or 0.5A at 60°C for the H2-CTRIO2.**

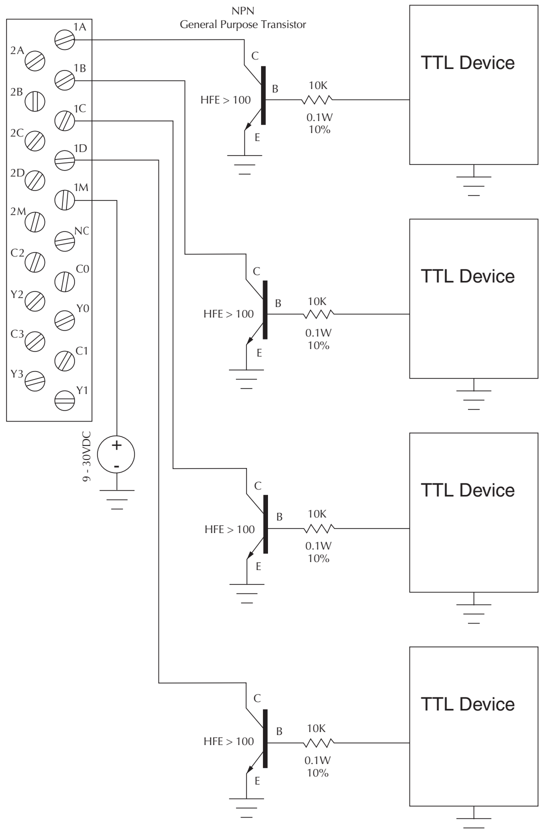
H2- CTRIO(2) Quadrature Encoder Wiring Example



H2-CTRIO(2) TTL Quadrature Encoder Field Wiring

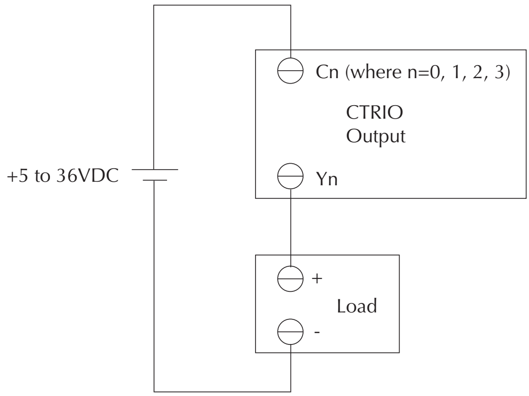


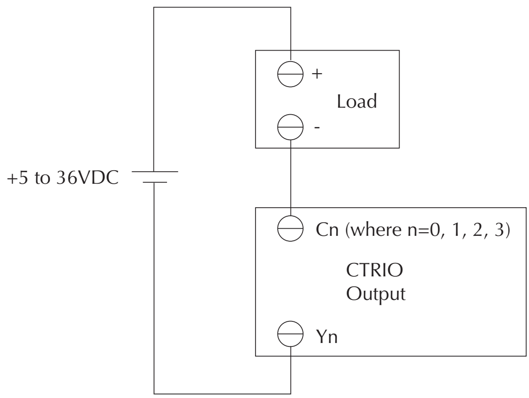
H2-CTRIO(2) TTL Input Wiring



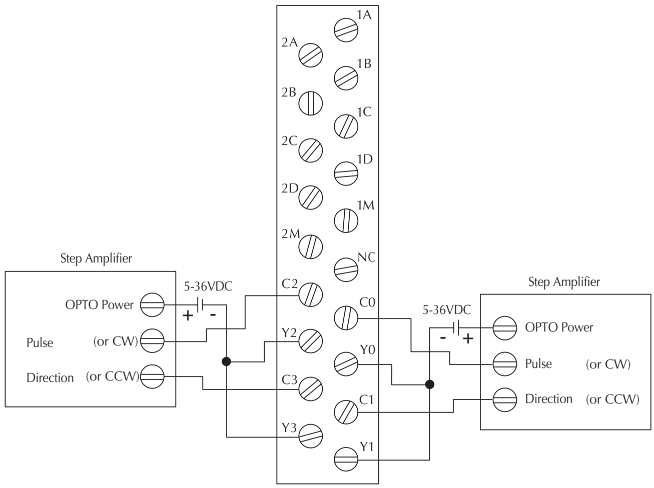
H2- CTRIO(2) Output Wiring Schematic

The CTRIO outputs are individually isolated DC switches that can be used to break the high or the low side of a DC load.





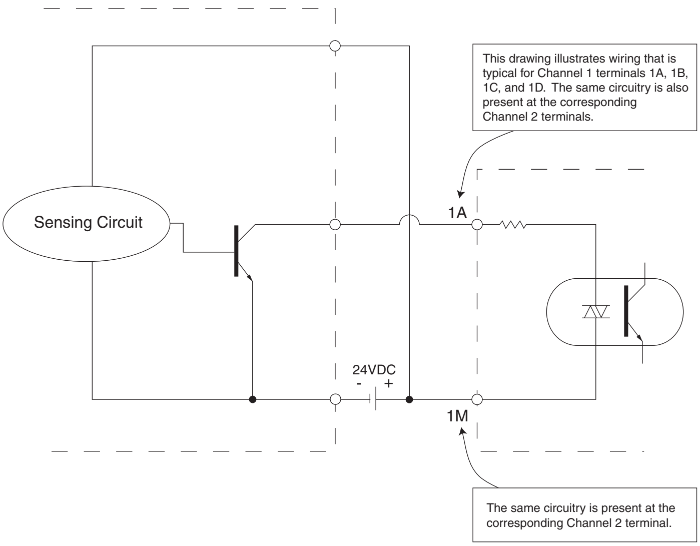
H2-CTRIO(2) Stepper/Servo Drive Wiring Example



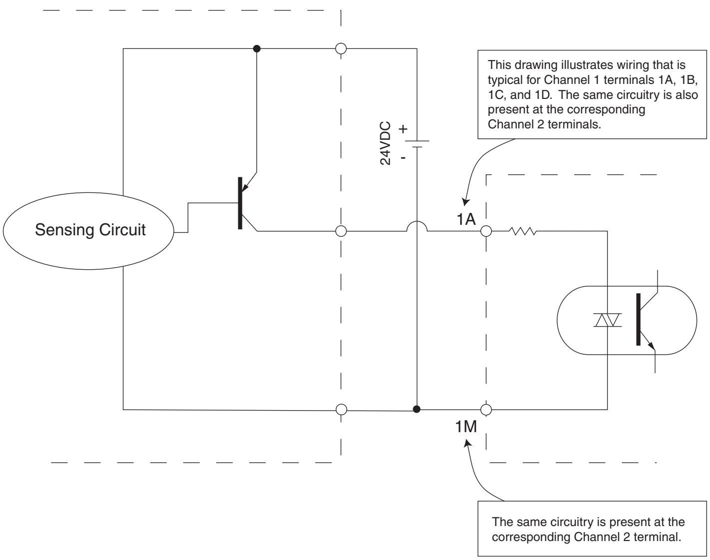
This example assumes that the Step Amplifier interface to be optocoupler LEDs (common anodes at the "OPTO Power" terminal) with internal current limiting resistors.
This is a standard method, but you must consult you step amplifier documentation to ensure that this method is applicable.

Solid State Input Device Wiring to the H2-CTRIO(2) Module

NPN Field Device



PNP Field Device



Installing the H4-CTRIO

The H4-CTRIO module is compatible with two DL405 CPU-slot interface devices. Consideration must be given to the firmware versions of the CPU-slot interfaces to assure their compatibility with the H4-CTRIO. (see chart below).

The H4-CTRIO module plugs into any I/O slot of any ***Direct***LOGIC 405 base. H4-EBCs support the use of the H4-CTRIO in DL405 local expansion bases. The H4-CTRIO cannot be used in Serial Remote I/O bases.

For installation instructions, refer to the:

- DL405 User Manual (D4-USER-M) if using a ***Direct***LOGIC PLC
- DL405 Installation and I/O Manual (D4-INST-M) if using an H4-EBC interface

The first time you power-up the CTRIO module, you should see the OK LED blinking. The blinking LED indicates that the module is in program mode.

CPU and CTRIO Compatibility Chart

CPU-slot Device	Firmware	Hardware	***Direct***SOFT32
D4-450	April 2000 or earlier: H8 (CISC) v. 2.00 SH (RISC) v. 1.500 May 2000 or later: H8 (CISC) v. 2.00 SH (RISC) v. 2.500	-	v. 4.0, Build 16 or later
H4-EBC	2.1.328 or later	v. 4F or later	-

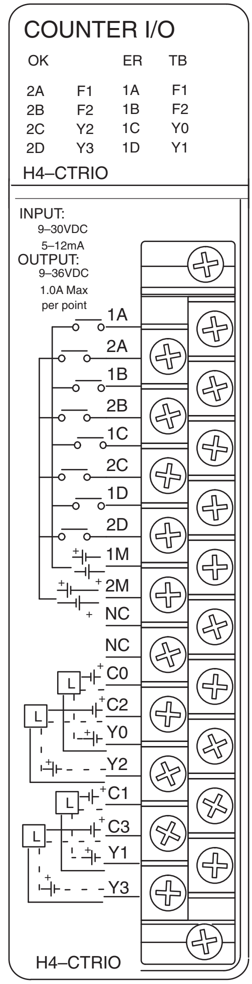
Updated firmware versions can be downloaded from our web site at *www.automationdirect.com*

Wiring the H4-CTRIO Module

The H4-CTRIO module has two independent input channels, each consisting of 4 optically isolated input points (pts.1A-1D on common 1M and pts. 2A-2D on common 2M). The inputs can be wired to either sink or source current.

The module has 4 optically isolated output points (pts.Y0-Y3 on isolated commons C0-C3, respectively). The outputs must be wired so that positive current flows into Cn terminal and then out of the Yn terminal(see the diagram below and the schematic on page 2-25).

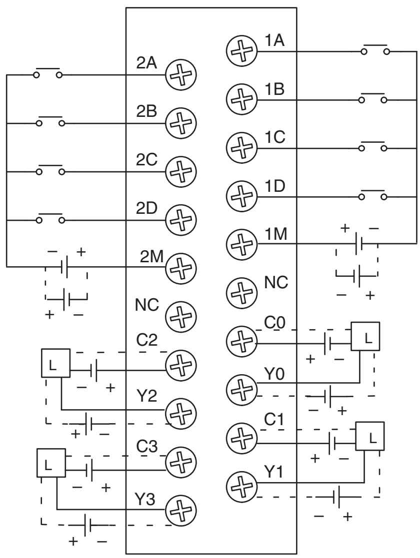
The module is configured, using CTRIO Workbench, to accommodate the user's application. The function of each input (counting, timing, reset, etc.) and output (pulse output, discrete output, etc.) is defined in the configuration of the module.



Refer to Chapters 4 and 5 to determine what input and output configurations are possible.

***NOTE:** Field device wiring must be compatible with the module configuration.*

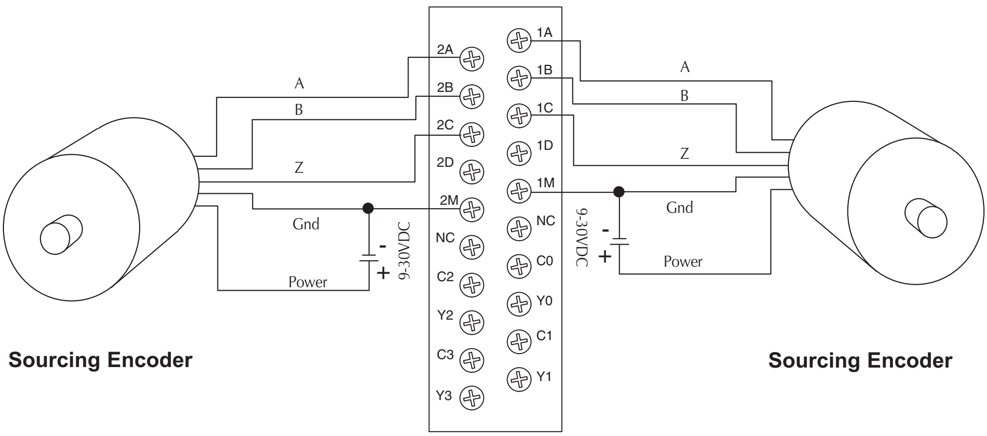
See the notes below for further details about power source considerations, circuit polarities, and field devices. Also, refer to the specifications on pages 1-5 and 1-6 for more information.



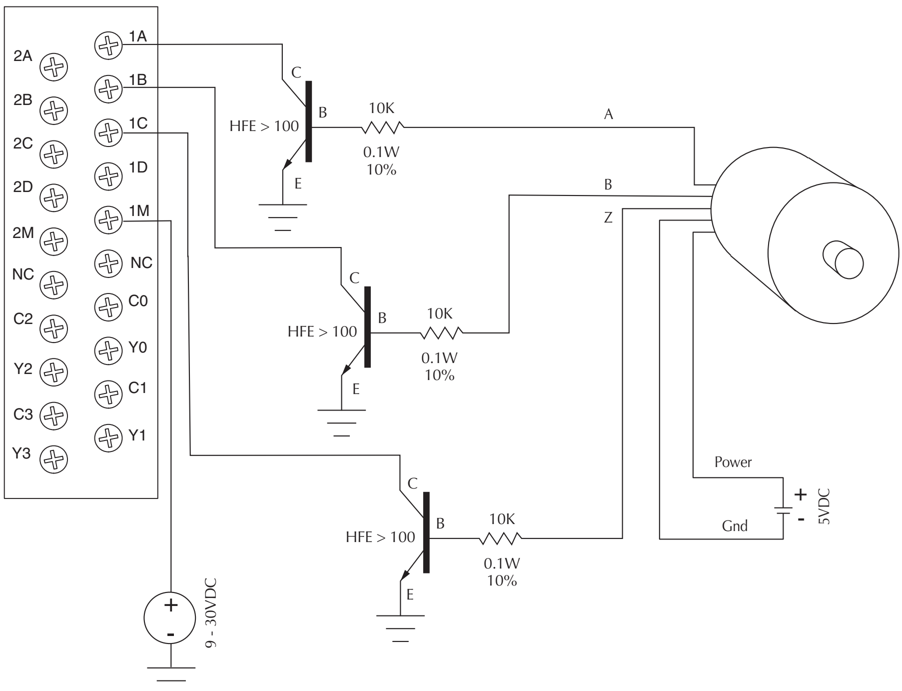
NOTES:

1. **Inputs (1A, 1B, 1C, 1D and 2A, 2B, 2C, 2D) require user-provided 9-30VDC power sources. Terminals 1M and 2M are the commons for Channel 1 and Channel 2 inputs. Maximum current consumption is 12mA per input point.**
2. **Polarity of the input power sources (shown above) can be reversed. Consideration must be given, however, to the polarity of the field device. Many field devices are designed for only one polarity and can be damaged if power wiring is reversed.**
3. **Outputs have one polarity only (as shown above) and are powered by user-provided 5-36VDC power sources. The maximum allowable current per output circuit is 1A.**

H4-CTRIO Quadrature Encoder Wiring Example

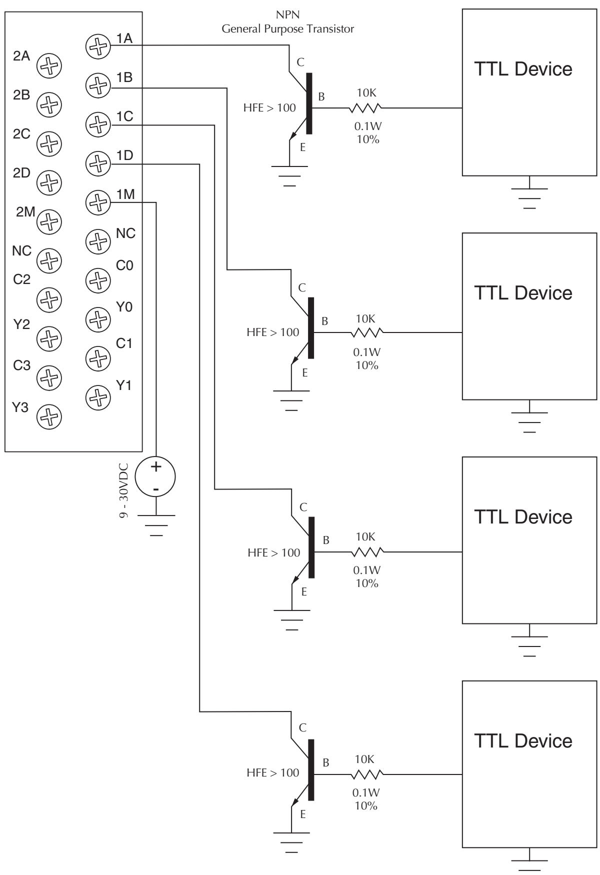


H4-CTRIO TTL Quadrature Encoder Field Wiring



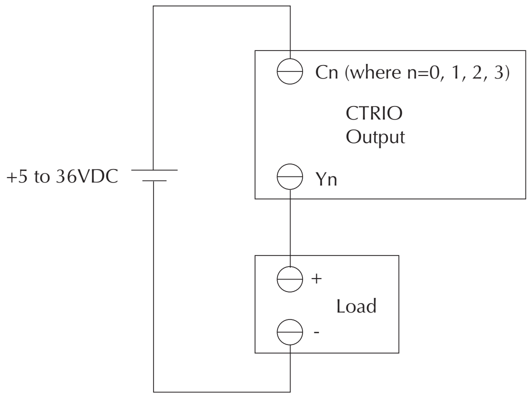
2

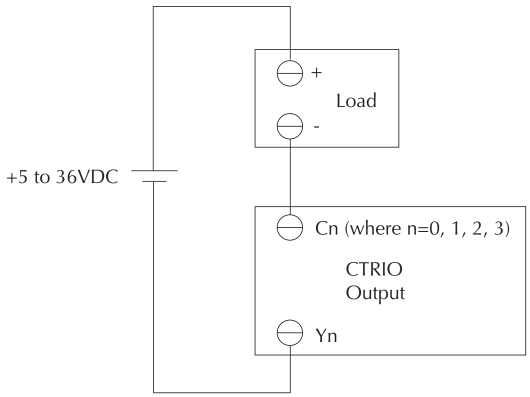
H4-CTRIO TTL Input Wiring



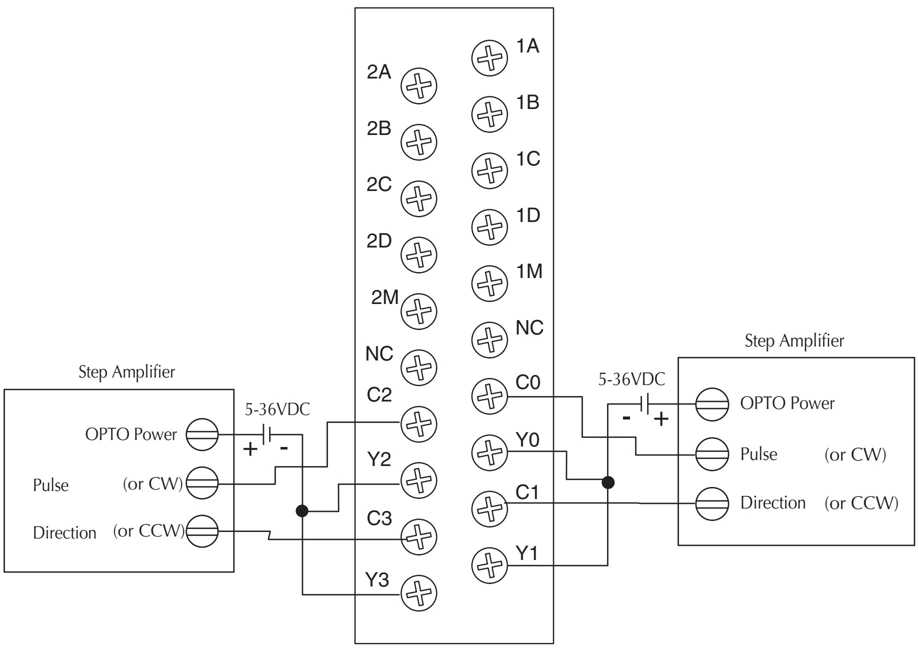
H4-CTRIO Output Wiring Schematic

The CTRIO outputs are individually isolated DC switches that can be used to break the high or the low side of a DC load.





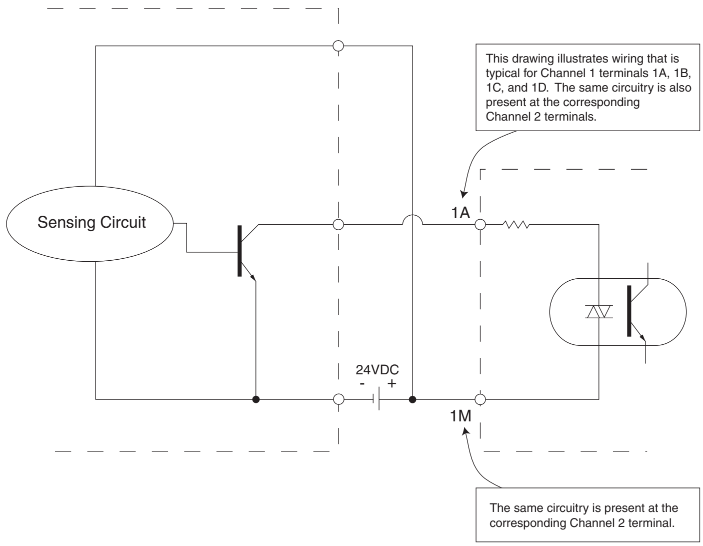
H4-CTRIO Stepper/Servo Drive Wiring Example



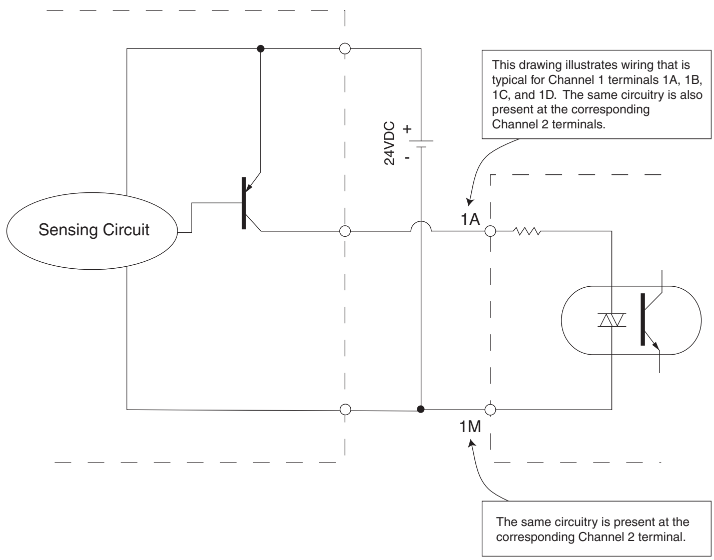
This example assumes that the Step Amplifier interface to be optocoupler LEDs (common anodes at the “OPTO Power” terminal) with internal current limiting resistors.
This is a standard method, but you must consult you step amplifier documentation to ensure that this method is applicable.

Solid State Input Device Wiring to the H4-CTRIO Module

NPN Field Device



PNP Field Device



Installing the T1H-CTRIO

The T1H-CTRIO module is compatible with several Terminator I/O Network interface devices. Consideration must be given to the firmware versions of the Network interfaces to assure their compatibility with the T1H-CTRIO. (see chart below).

The T1H-CTRIO module plugs into any valid I/O slot in a Terminator I/O system. The T1H-CTRIO cannot be used in Serial Remote I/O bases (T1K-RSSS).

For installation instructions, refer to the:

- Terminator I/O Installation and I/O Manual (T1K-INST-M)

The first time you power-up the CTRIO module, you should see the OK LED blinking. The blinking LED indicates that the module is in program mode.

CPU and CTRIO Compatibility Chart

CPU-slot Device*	Firmware	Hardware
T1H-EBC	v. 1.0.444 or later	v. 2I or later
T1K-PBC	v. 1.1.10 or later	v. 2D or later

Updated firmware versions can be downloaded from our web site at *www.automationdirect.com*

NOTE: *The T1H-CTRIO is only supported by the T1H-EBC, T1H-EBC100 and T1H-PBC.*

Wiring the T1H-CTRIO Module

The T1H-CTRIO module has two independent input channels, each consisting of 4 optically isolated input points (pts. 1A-1D on common 1M and pts. 2A-2D on common 2M). The inputs can be wired to either sink or source current.
The module has 4 optically isolated output points (pts. Y0-Y3 on isolated commons C0-C3, respectively). The outputs must be wired so that positive current flows into Cn terminal and then out of the Yn terminal. (see the diagram on the following page and the schematic on page 2-34)

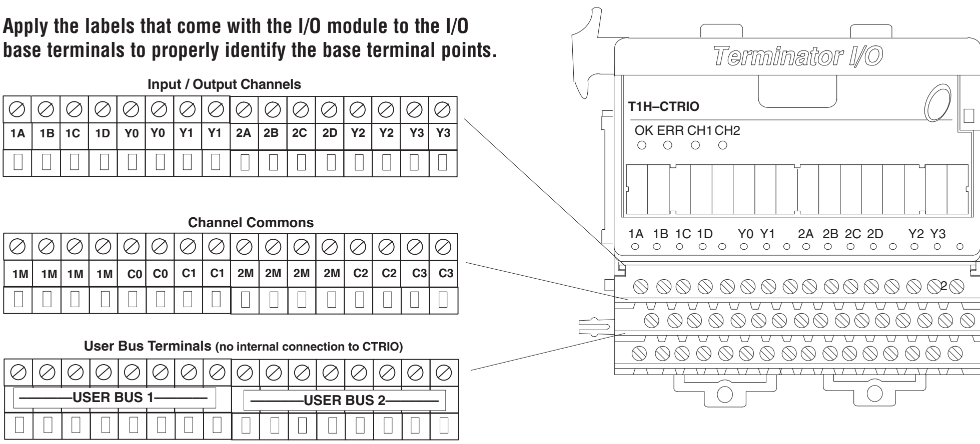
The module is configured, using CTRIO Workbench, to accommodate the user's application. The function of each input (counting, timing, reset, etc.) and output (pulse output, discrete output, etc.) is defined in the configuration of the module.

Refer to Chapters 4 and 5 to determine what input and output configurations are possible.

NOTE: *Field device wiring must be compatible with the module configuration.*

See the notes below for further details about power source considerations, circuit polarities, and field devices. Also, refer to the specifications on pages 1-5 and 1-6 for more information.

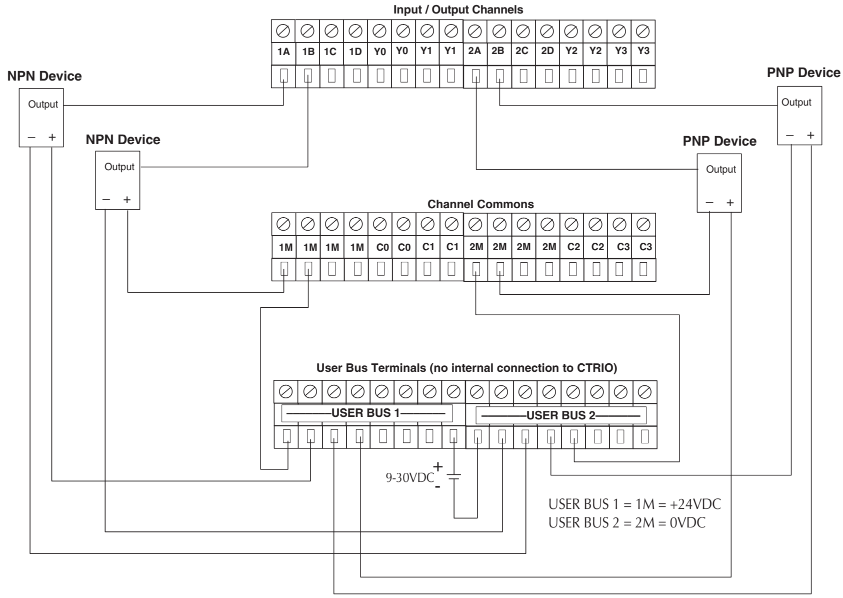
Apply the labels that come with the I/O module to the I/O base terminals to properly identify the base terminal points.



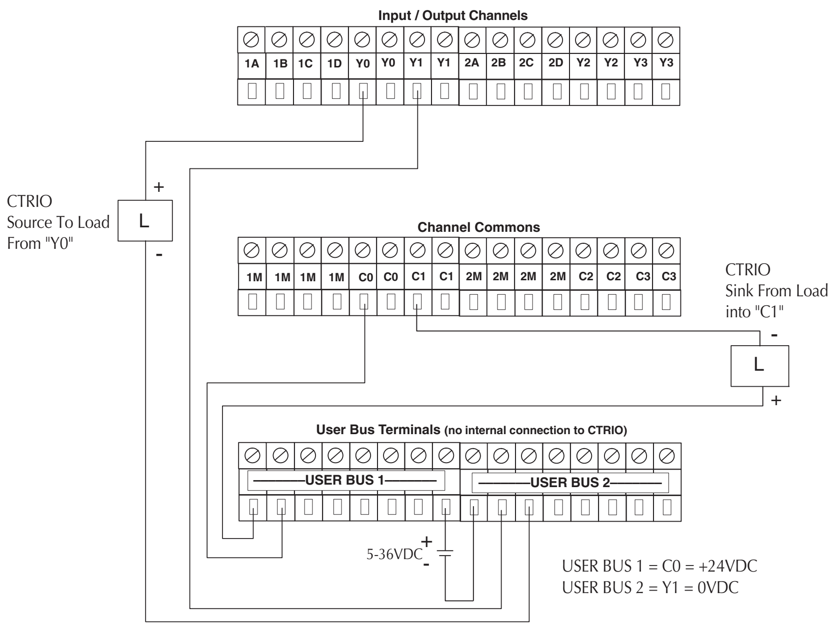
NOTES:

1. **Inputs (1A, 1B, 1C, 1D and 2A, 2B, 2C, 2D) require user-provided 9-30VDC power sources. Terminals 1M and 2M are the commons for Channel 1 and Channel 2 inputs. Maximum current consumption is 12mA per input point.**
2. **Polarity of the input power sources can be reversed. Consideration must be given, however, to the polarity of the field device. Many field devices are designed for only one polarity and can be damaged if power wiring is reversed.**
3. **Outputs have one polarity only and are powered by user-provided 5-36VDC power sources. The maximum allowable current per output circuit is 1A.**
4. **User Bus 1 and User Bus 2 are each an independent 8 wiring terminal bus. They can be used for additional power rail connections.**

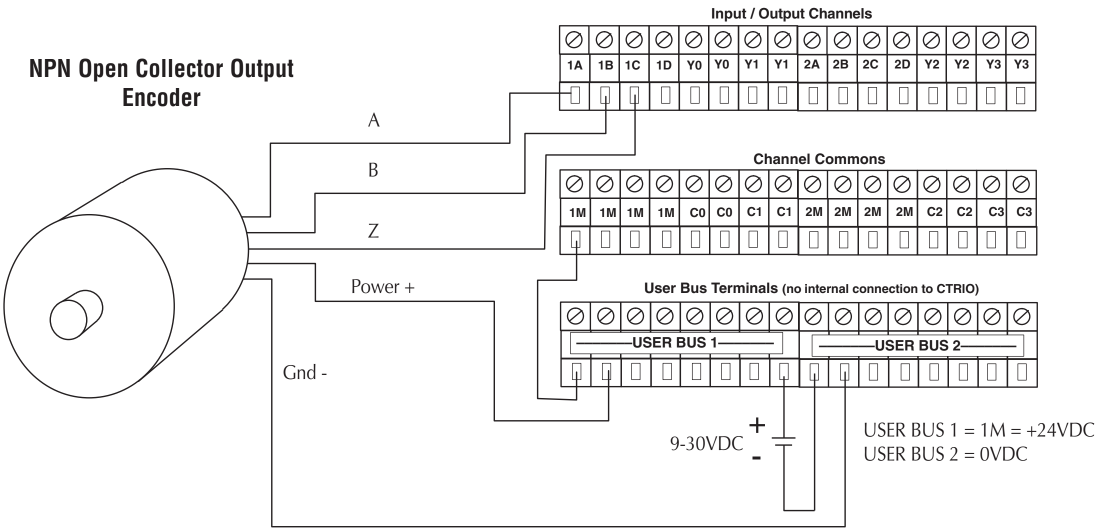
T1H-CTRIO Input Field Wiring



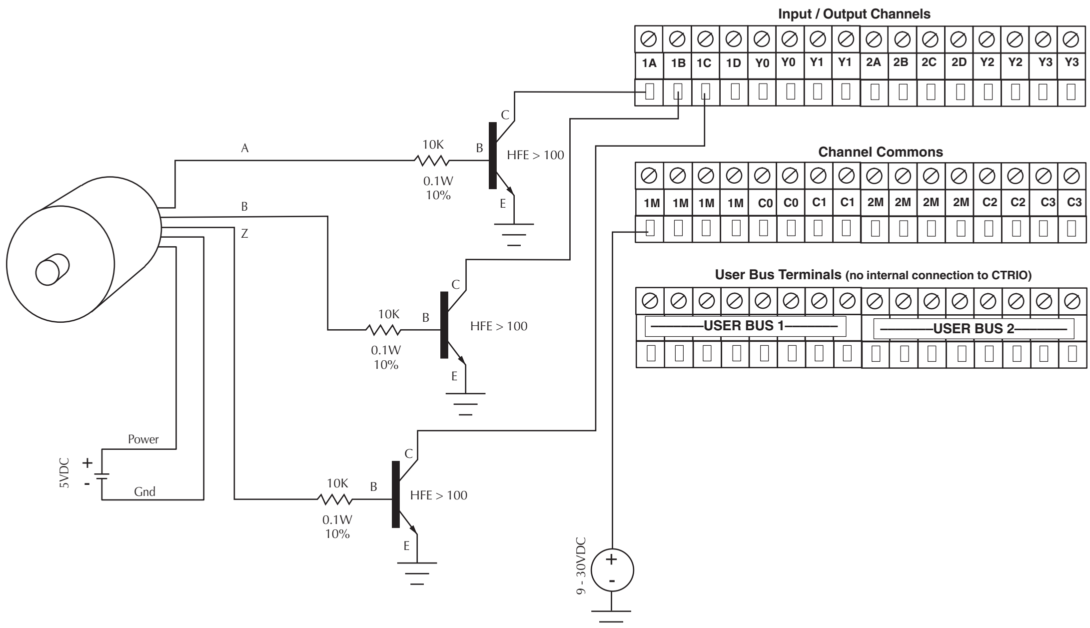
T1H-CTRIO Output Field Wiring



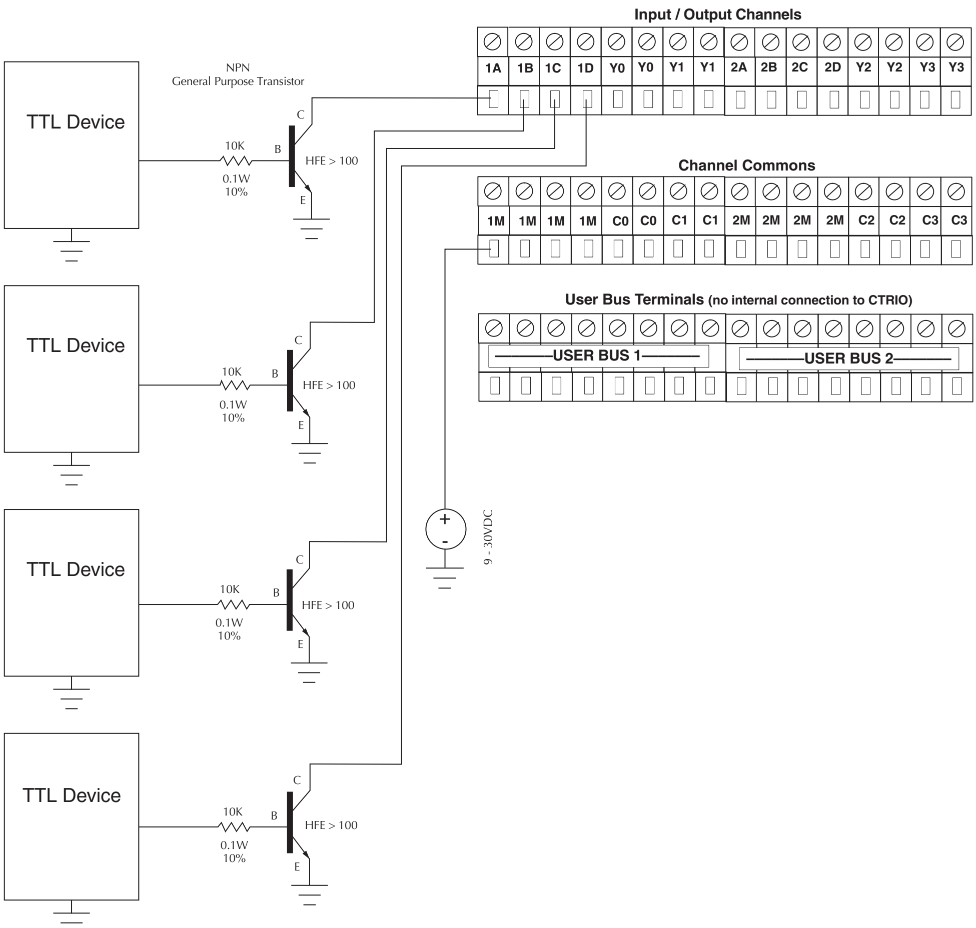
T1H-CTRIO Quadrature Encoder Wiring Example



T1H-CTRIO TTL Quadrature Encoder Field Wiring

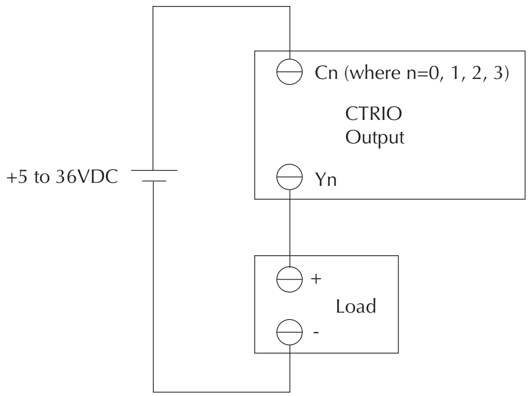


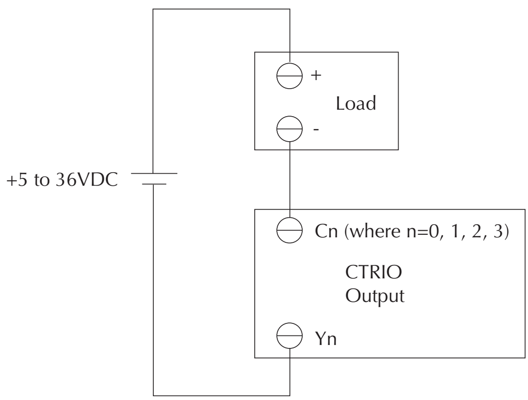
T1H-CTRIO TTL Input Wiring



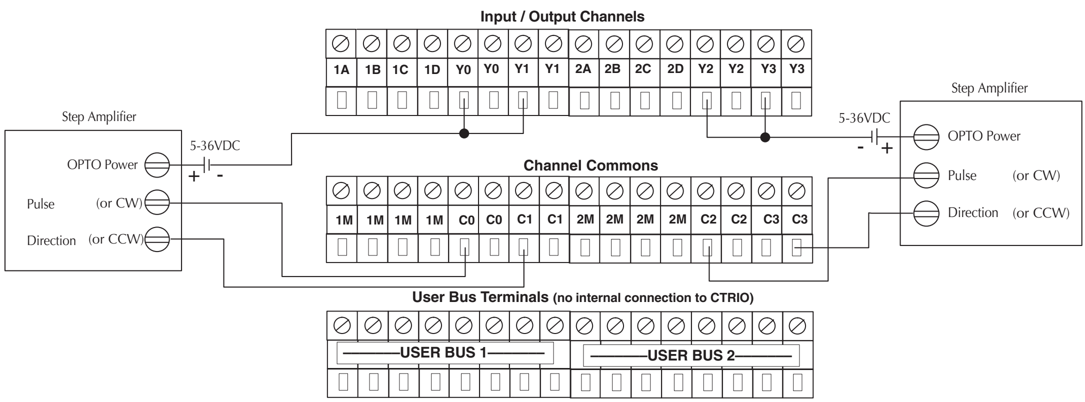
T1H-CTRIO Output Wiring Schematic

The CTRIO outputs are individually isolated DC switches that can be used to break the high or the low side of a DC load.





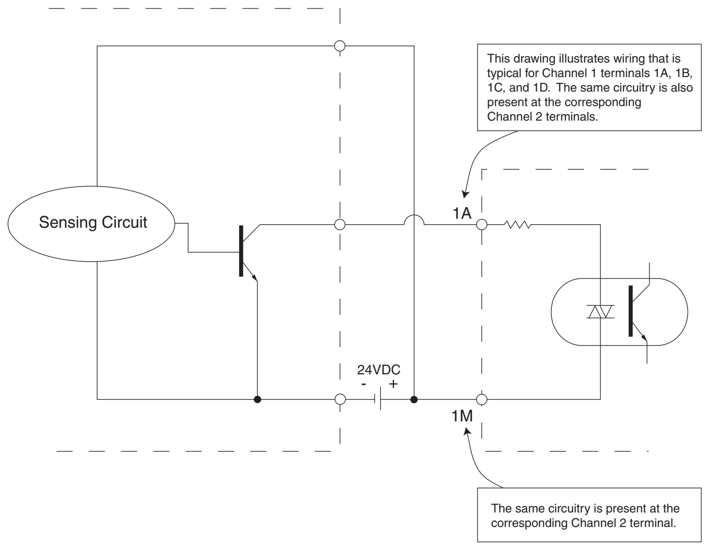
T1H-CTRIO Stepper/Servo Drive Wiring Example



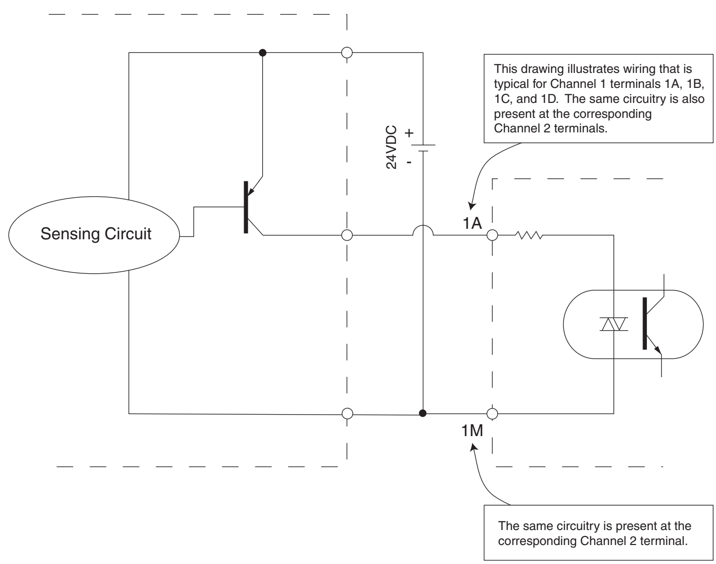
This example assumes that the Step Amplifier interface to be optocoupler LEDs (common anodes at the “OPTO Power” terminal) with internal current limiting resistors.
This is a standard method, but you must consult you step amplifier documentation to ensure that this method is applicable.

Solid State Input Device Wiring to the T1H-CTRIO Module

NPN Field Device



PNP Field Device



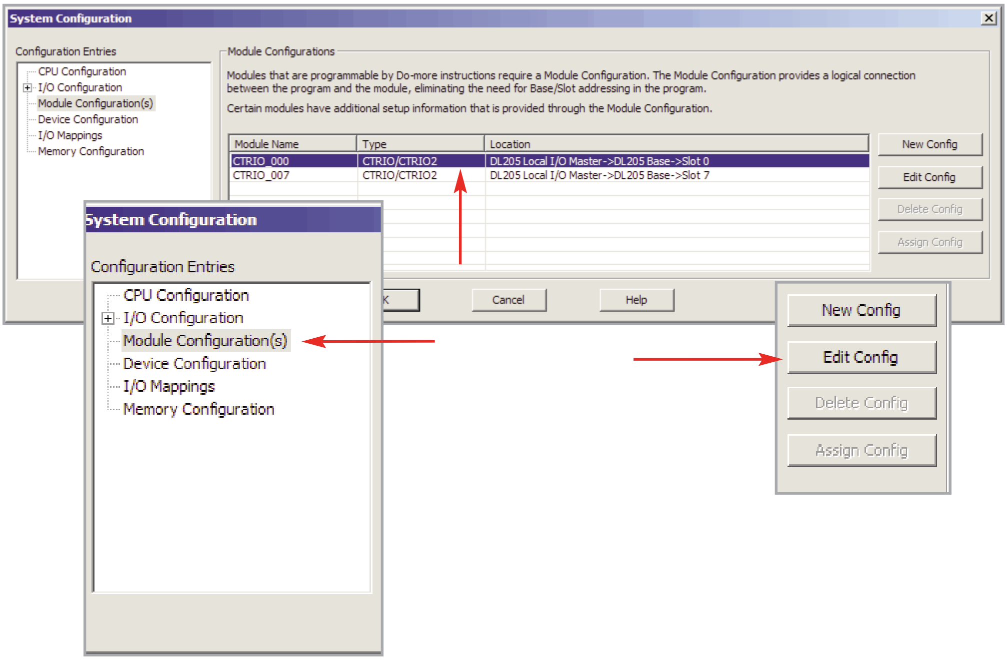
Introduction to CTRIO Workbench

Chapter 3

In This Chapter...

Configuring a CTRIO Module for Do-more CPUs

With Do-more CPUs, the CTRIO Workbench software utility is not used. The functionality of CTRIO Workbench is integrated into the Module Configuration for the CTRIO module. To access it in Do-more Designer, open the System Configuration page, select Module Configuration from the directory on the left, then find the CTRIO module you are configuring in the list provided. Click the module to select it, then select Edit Config.



If you are using a Do-more CPU, the rest of this chapter does not pertain to you. See the following chapters for information on configuring the inputs and outputs of your module using Do-more Designer.

What is CTRIO Workbench?

CTRIO Workbench is the software utility you will use to configure the CTRIO module's inputs and outputs. Workbench also lets you setup the CTRIO's built-in scaling function that will scale signals to desired engineering units, switch between the CTRIO's Program mode and Run mode, monitor I/O status and functions, and have diagnostic control of module functions.

NOTE:** CTRIO Workbench Version 2.2.0 is required for the Hx-CTRIO2. Download the latest version of the CTRIO Workbench utility at no charge from the Host Engineering Web site: **www.hosteng.com.

Installing CTRIO Workbench

The CTRIO Workbench utility installs directly from its executable file. Double click on the Setup.exe icon. The install shield will step you through the installation process. The utility installs into C:\HAPTools directory. Find shortcuts to CTRIO Workbench from the Windows Start Menu under All Programs>AutomationDirect Tools.

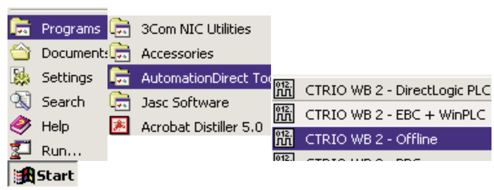
Getting Started with CTRIO Workbench

Several paths are available to start CTRIO Workbench. All users will find CTRIO Workbench at Start>Programs>AutomationDirect Tools>CTRIO Workbench. ***Direct***SOFT5 users will find CTRIO Workbench in the Utilities section of the DSLaunch Window.

Offline CTRIO Configuration

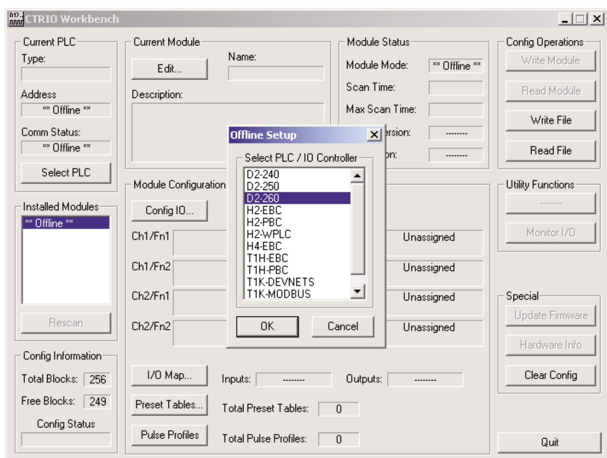
A complete CTRIO configuration file (.cwb) can be created Offline. (Refer to chapter 6 for offline addressing guidelines for some of the interface devices.)

To launch the CTRIO Workbench 2 Offline version, go to Start>Programs>AutomationDirect Tools>CTRIO WB2 - Offline.



In the Workbench Offline window shown to the right, click on the Select PLC button. Select desired PLC or interface device.

The only limitations in the Offline version are that you cannot access Monitor I/O and that you cannot connect to the CTRIO from the Offline utility. Save the configuration file to disk and connect to the CTRIO using the appropriate Workbench support version, then write the file to the CTRIO.

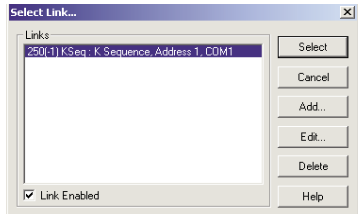


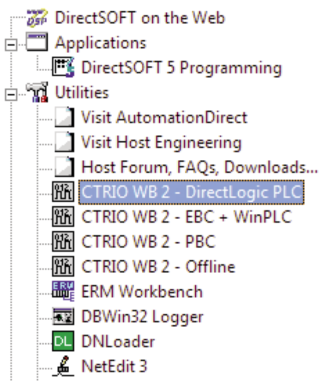
Online CTRIO Configuration

To configure the CTRIO module Online, a CTRIO must be installed in the PLC base or Terminator I/O system, and the system power must be on. Your PC communicates with the CTRIO module through the PLC or interface device port.

*Direct*SOFT5 Users

You will need to connect your PC to the CPU, DCM or ECOM module. If you are linked to your CPU through *Direct*SOFT5, CTRIO Workbench will start via the existing link. If you are "disconnected" from your PLC and start CTRIO Workbench, you will be prompted to establish a link to your CTRIO module.

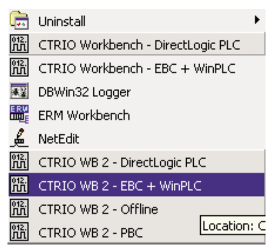




*Direct*SOFT5 users will find CTRIO Workbench in the DSLaunch Window's Utilities section.

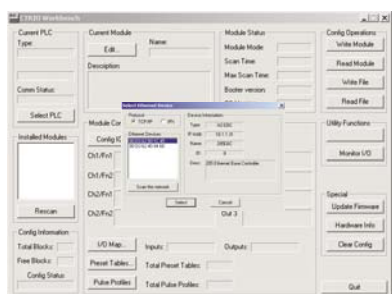
WinPLC, EBC and PLC>ERM>EBC Users

You will need to connect your PC to the RJ45 Ethernet port on the WinPLC or EBC interface device directly or via hub, switch,etc. (Connect to the ST-style fiber optic port on the Hx-EBC-F units.)



Access the WinPLC and EBC support version at Start>Programs>AutomationDirect Tools>CTRIO Workbench or in the *Direct*SOFT5 Launch Window Utilities menu. Then select the appropriate Workbench version.

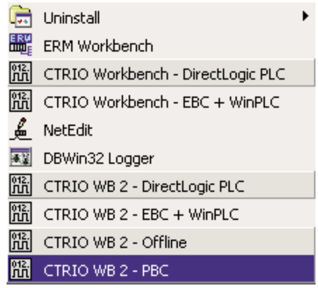
You will be prompted to establish an Ethernet link to your CTRIO module.



NOTE: *WinPLCs will need to be given an IP address before connecting with Workbench.*
EBCs will need to have an address selected by DIP Switch or via NetEdit before connecting with Workbench.

PBC, DEVNETS and MODBUS Users

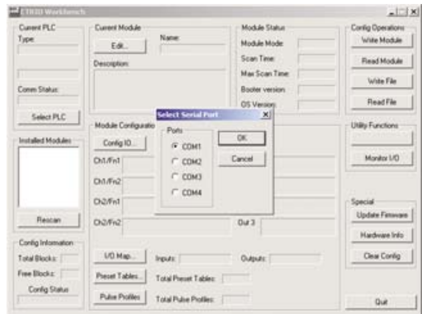
You will need to connect your PC to the RJ12 serial port on the PBC, DEVNETS or MODBUS interface device.



Access the various support versions at Start>Programs>AutomationDirect Tools>CTRIO Workbench or in the ***Direct***SOFT5 Launch Window Utilities menu. Then select the appropriate Workbench version.

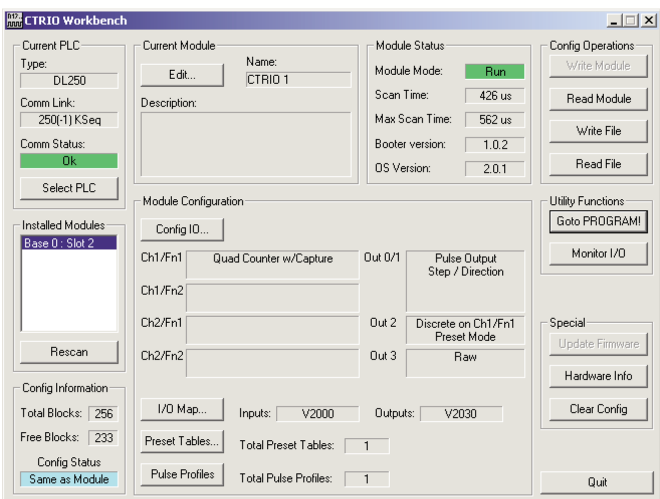
You will be prompted to establish a serial link to your CTRIO module.

Select the PC serial port Workbench will use to connect to the CTRIO module.

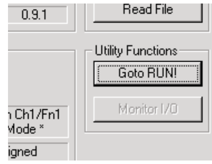


Successful On-line Connection

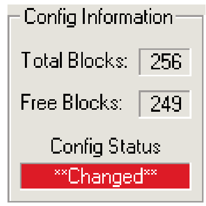
Once you are connected to your CTRIO module, you will enter the main window of CTRIO Workbench. Here, you select the CTRIO module you wish to configure by clicking on its slot number in the “Installed Modules” box. You will be able to enter Workbench’s Configuration dialog, and after successfully configuring the module you will be able to toggle the CTRIO module between Program Mode and Run Mode and enter the Monitor I/O dialog.



Module Modes of Operation



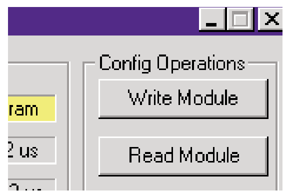
On the CTRIO Workbench main window, a single button toggles between Run Mode and Program Mode. The Module Mode indicator will tell you which mode your module is in. You can make configuration changes in either Run Mode or Program Mode, but to save your configuration to the module, you must click “Write Module” which is only active in Program Mode.



In the lower left corner of the main Workbench dialog, is the Config Status indicator. If the current configuration is different from the CTRIO and different from any saved files, the indicator will display the word “Changed.” If the current configuration has been written to the module or a file, the message will read “Same as Module,” “Same as File,” or “Same as Both.”

Program Mode - Configuring the CTRIO Module

After the configuration is created or changed in CTRIO Workbench, it must be “written” to the CTRIO module. This is accomplished by returning to the main CTRIO Workbench window and clicking on “Write Module.”



If the configuration was created using Workbench Offline version, you must connect your PC to the CTRIO module through the CPU/controller and write the configuration to the module.

***NOTE:** Entering program mode takes the CTRIO module offline. Input pulses are not read or processed in Program mode, and all outputs are disabled. CPUs will hold last value in memory while the CTRIO is in Program Mode.*

Run Mode - Start Processing I/O Pulses with the CTRIO Module

Selecting Run Mode causes the CTRIO module to begin processing pulses based on the I/O configuration you created.

In Run mode the CTRIO Workbench utility also allows you to monitor and verify the proper operation of inputs and outputs. You can see the count change, reset, etc. using the Monitor I/O dialog. Monitor I/O is very useful for debugging and commissioning of a new system. See chapter 7 for information on Monitor I/O.

The CTRIO mode follows the CPU mode. If the CPU is placed in Run Mode, the CTRIO module will also enter Run Mode. If the CPU is placed in STOP or PROGRAM Mode, the CTRIO will enter Program Mode. The CTRIO also responds to mode changes made in Workbench and can be placed in Run Mode while the CPU is in Stop or Program Mode. The CTRIO module responds to the most recent change whether performed in Workbench or from the CPU.

***NOTE:** The CTRIO module will not enter Run Mode if it does not have a valid configuration.*

CONFIGURING THE INPUTS

CHAPTER 4

In This Chapter...

Configure I/O Dialog Overview

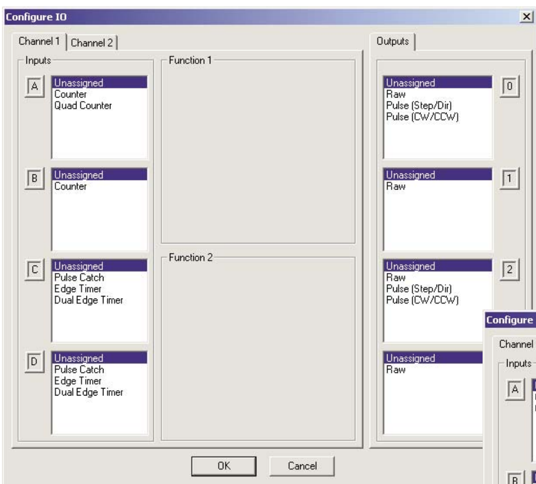
The Configure I/O dialog is the location where input and output functions are assigned to the module. The choice of input and output functions determines which options are available.

The input and output function boxes prompt you with selections for supported functions. The configuration software disallows any unsupported selections.

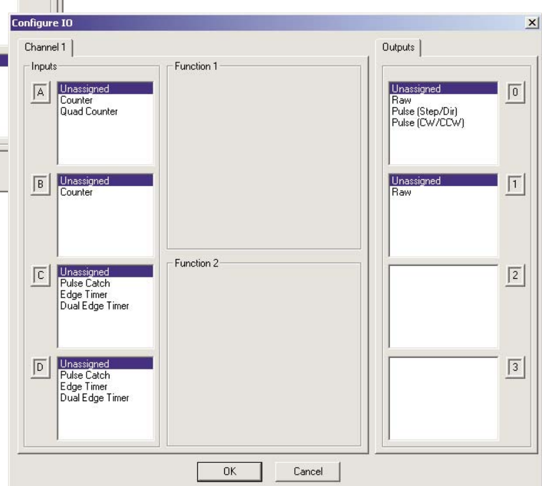
For DirectLOGIC users, from the main CTRIO Workbench window, click on the “Go to PROGRAM Mode” button (if in RUN Mode). Then, click on the “Config I/O” button to arrive at a dialog shown below. Notice that the window has a tab for each input Channel.

NOTE: *You don’t have to be in PROGRAM mode to enter the Configure I/O dialog, however you must be in PROGRAM mode to save the configuration to the CTRIO module.*

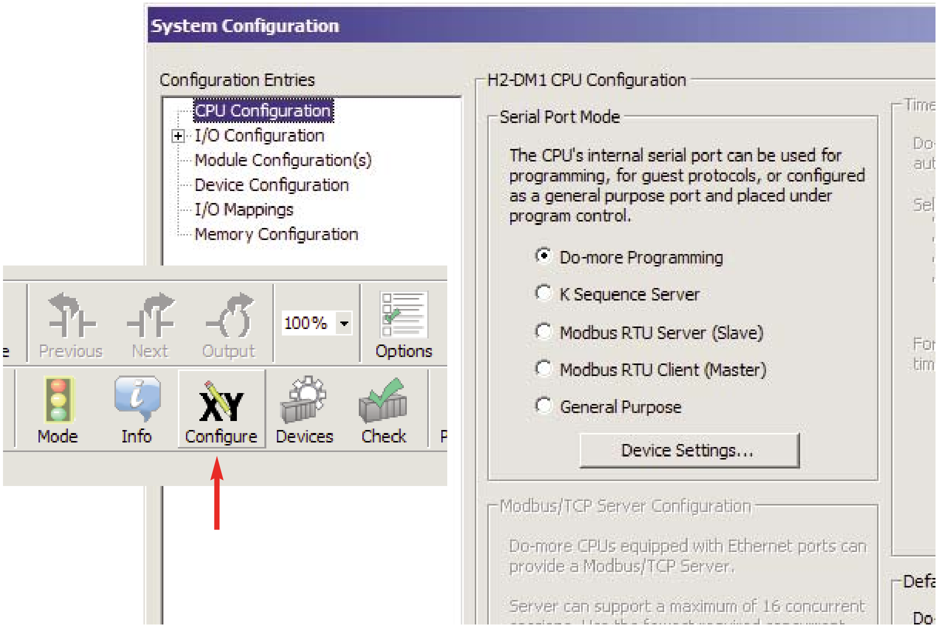
H2, H4, T1H-CTRIO, H2-CTRIO2 Configure I/O Dialog



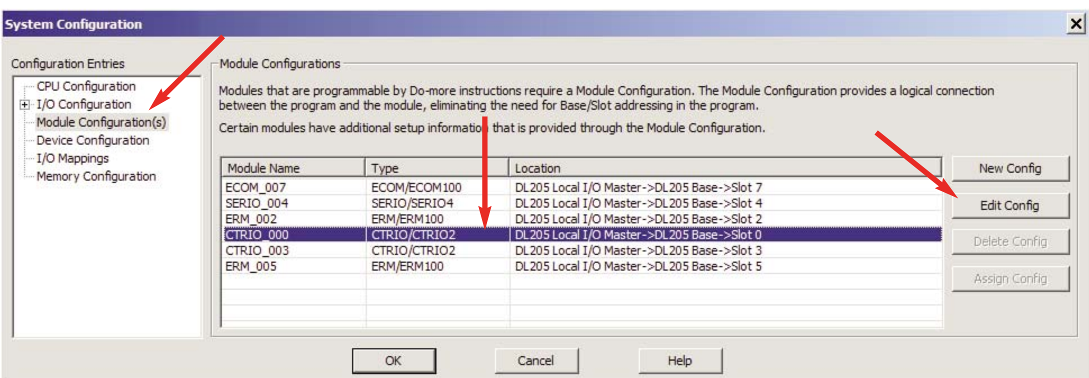
H0-CTRIO(2) Configure I/O Dialog



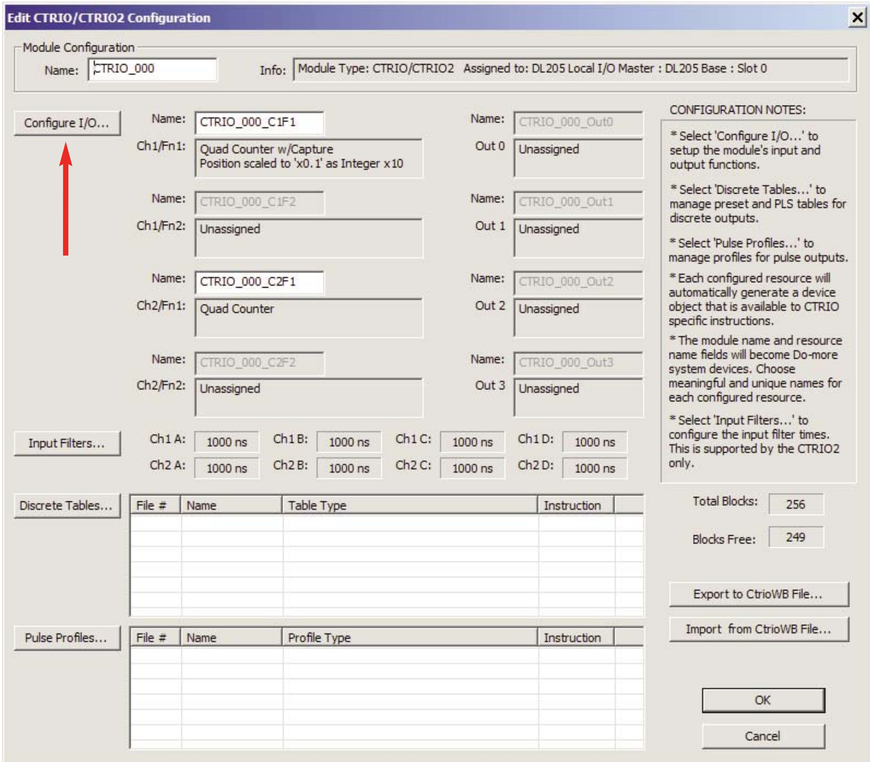
For Do-more users, the Workbench options have been built into the Do-more Designer software. The configuration dialog is found by first opening the System Configuration window by selecting the "XY Configure" button in the main toolbar.



With the System Configuration page open, select the Module Configuration(s) page from the lefthand column. On this page, highlight the desired CTRIO module and click Edit Config.



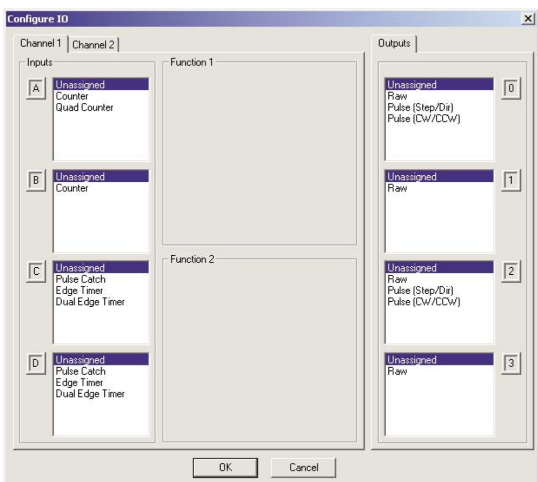
Now the Edit CTRIO/CTRIO2 Configuration window should be open, click the "Configure I/O..." button.



You should now have the Configure I/O window open, similar to the one shown here, with a tab for each input Channel.

The input options are listed by function. Four boxes labeled A, B, C, and D correspond to the input terminals on the face of the module (1A-1D or 2A-2D; A-D for the H0-CTRIO(2)).

The Output functions are listed as 0, 1, 2, and 3. These numbers correspond to the markings beside the module's output terminals (Y0-Y3; Y0-Y1 for the H0-CTRIO(2)).



For DirectLOGIC users, be sure to write the changes to the module from Workbench when the configuration is complete. For example, you might click on "Counter" in the "A" box, then OK to return to the main Workbench window. Once you arrive back at the main window, you must click "Write Module" to save your selection to the module. The module will need to be in Program Mode to perform the Write Module operation. If you do not perform the Write Module operation (or a Write File operation) your configuration will be lost upon quitting Workbench. This applies to all changes to the module configuration.

For Do-more users, the "Write Module" button does not exist because the Module Configuration dialog stores the CTRIO's configuration as a permanent part of the Do-more controller's System Configuration.

Input Function Selections

Supported Functions

The input channels offer the same configuration options. The module supports five primary input functions:

- Counter
- Quadrature Counter
- Pulse Catch
- Edge Timer
- Dual Edge Timer

Each of the primary functions uses one or two input terminals for making connections to field devices (plus a common). Combinations of the listed functions are possible. The configuration dialog disallows any unsupported configurations.

Three secondary input functions are also supported:

- Reset
- Capture
- Inhibit

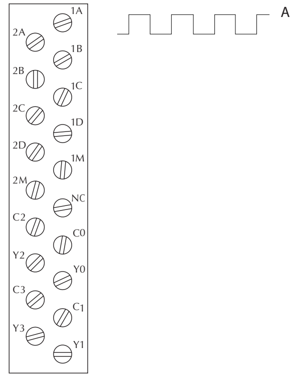
Each secondary input modifies the primary input functions in some way and uses one input terminal. (Limit Out 0 and Limit Out 2 input functions are only available for use when the outputs are set to pulse output mode).

Discrete Outputs Pre-Assigned to Input Functions

CTRIO discrete outputs can be assigned to the Counter, Timer and Pulse Catch input functions within the Configure I/O dialog. The outputs respond to presets assigned by the user in the Preset Tables dialog. The presets are assigned based on the scaled value of an input, or the raw value if it has no scaled value. The CTRIO's four outputs can all be assigned to one function, or they can be grouped within functions and within channels in any manner selected by the user. See Chapter 5 for more information on using Preset Tables.

Counter Function

The CTRIO module supports up or down counting using single-ended encoders (or other single-ended pulse sources) as inputs. Encoders, proximity sensors, etc., can be connected to input A and/or input B on either channel or both channels. The C and D inputs are available to modify the A and B inputs. The C and D inputs can be used for Reset, Inhibit, or Capture. These functions are explained later in this chapter. The CTRIO discrete output(s) can be assigned to the Counter function using the Preset Tables dialog. Refer to “Creating and Using the Output Tables” section in Chapter 5 for details.

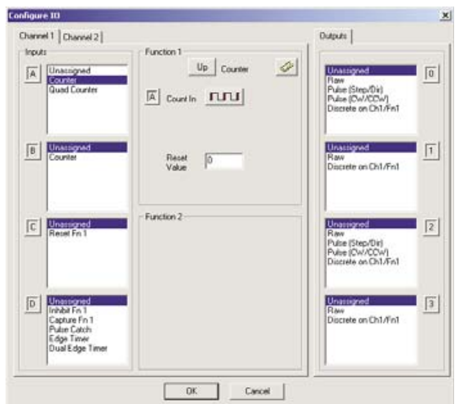


***NOTE:** To insure proper operation, the field device wiring and the configuration must be compatible. For wiring information see Chapter 2.*

The module’s four input terminals are represented by the A, B, C, and D boxes on the left side of this dialog. If you are wiring your counter input to terminal 1A, you will want to select the Channel 1 tab near the top of this window and click “Counter” in box A.

At this point, you have four decisions to make regarding your input at 1A.

1. Select count up or count down. A button, in the Function 1 box, toggles between Up and Down counting. Click the button labeled “Up” (or “Down”) to see the change to the opposite count direction.



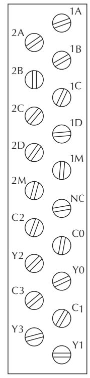
2. Each input pulse is counted, but you are free to designate whether you want the count to register on the rising edge of the pulse, the falling edge, or both. The button with the graphical representation of a pulse toggles between these choices.

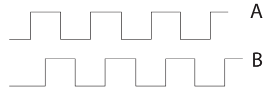
3. The Reset value is assigned by clicking and typing a value in the data input field. This value is for hardwired resets. When the hardwired reset is activated, the count value returns to the reset value.

4. The last remaining decision to be made is about scaling. Clicking the button with the ruler symbol starts the Scaling Wizard. We discuss the scaling wizard later in this chapter. The Scaling Wizard is intelligent in that it offers scaling options that are appropriate for your input selections.

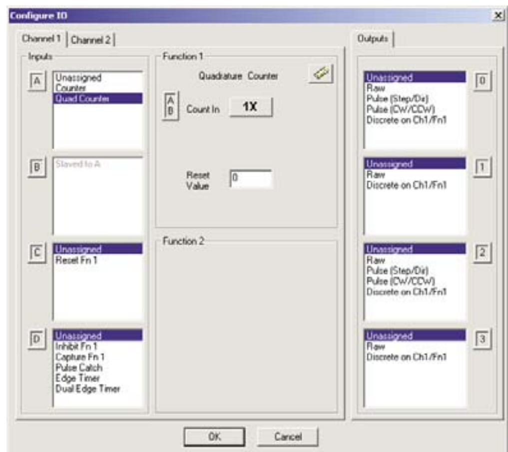
Quad Counter

The CTRIO module supports quadrature counting using quadrature encoders as inputs. Connect your encoder to input A and input B on either channel. A second quadrature encoder can be connected to the other channel. The C and D inputs are available to control the quadrature input counting. The C and D inputs can be used for Reset, Inhibit, or Capture. These functions are explained later in this chapter. The CTRIO discrete output(s) can be assigned to the Quad Counter function using the Preset Tables dialog. Refer to “Creating and Using the Output Tables” section in Chapter 5 for details.





NOTE: *To insure proper operation, the field device wiring and the configuration must be compatible. For wiring information see Chapter 2.*



Notice that the module’s four input terminals are represented by the A, B, C, and D boxes on the left side of this dialog. If you are wiring your quadrature counter inputs to terminal 1A and 1B, you will need to select the Channel 1 tab near the top of this window and click “Quad Counter” in box A. Notice that input B is now slaved to input A.

At this point, you have three decisions to make regarding your quadrature input.

1. A multiplier can be applied to the quadrature input to increase its resolution. Select “1x”, “2x”, or “4x.” [1X = pulses processed on leading edge of input A, 2X = pulses are processed on both edges of input A, 4X = pulses processed on both edges of input A and both edges of input B.]

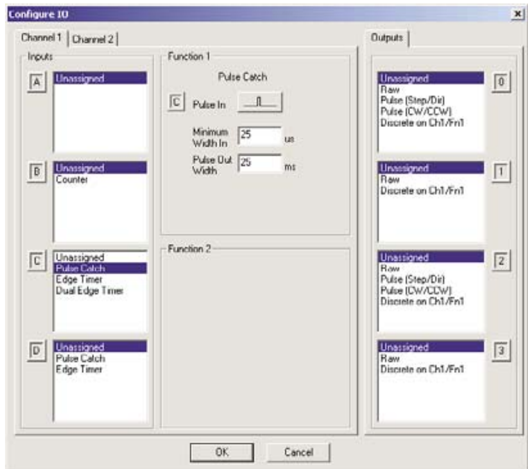
2. The “Reset Value” is assigned by clicking in the data input field and typing in a value. When the count is reset, using any of the reset methods, the count value returns to the Reset Value. The reset options are described in more detail later in this chapter.

3. The last remaining decision to be made is about scaling. Clicking the button with the ruler symbol starts the Scaling Wizard. The Scaling Wizard is intelligent in that it offers only those scaling options that are appropriate for your input selections. We discuss the scaling wizard in greater detail later in this chapter.

Pulse Catch

The CTRIO "Pulse Catch" function allows a very short duration pulse to be qualified and lengthened to a time period long enough to guarantee that it is seen by the CPU. CPU scans necessarily vary with the length and complexity of the user's program. A scan frequency of several milliseconds, or more, is common. A pulse that lasts less than one millisecond, is typically hard to catch during the CPU scan.

The CTRIO module's Pulse Catch function sees the fast incoming signal and holds its status in a status bit until the CPU can see it. A discrete output(s) can also be tied to follow the Pulse Catch input.



NOTE: *To insure proper operation, the field device wiring and the configuration must be compatible. For wiring information see Chapter 2.*

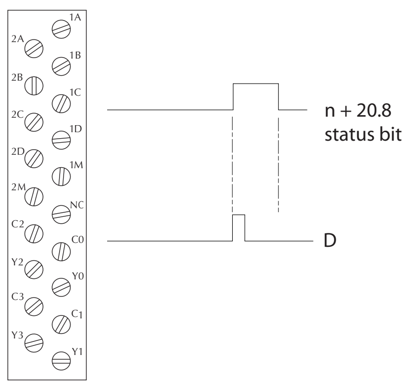
Notice that the module's four input terminals are represented by the A, B, C, and D boxes on the left side of this dialog. If you are wiring your input to terminal 1C, you will need to select the Channel 1 tab near the top of this window and click Pulse Catch in box C.

Three selections must be made in conjunction with the Pulse Catch option.

1. First, a decision must be made whether to look for the rising edge of the pulse or the falling edge of the pulse. This is a critical decision. Careful attention should be paid to the type of output the field device generates. If the signal voltage is normally low, but a short duration pulse sends the signal to the ON state, you will want to trigger off the rising edge, and vice versa.

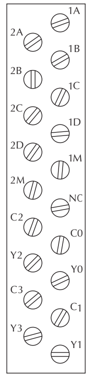
2. The second decision you will need to make is the minimum pulse width you want to capture. Transients below this width will not be recorded. Set this value by typing the desired value in the "Minimum Width In" field.

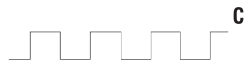
3. The final decision to be made is the length of pulse the CTRIO module should send in response to the input pulse. Make this setting by typing in the desired value in the "Pulse Out Width" field.



Edge Timer

The Edge Timer measures the time from the rising edge of one pulse to the rising edge of the next pulse, or the rising edge of one pulse to the falling edge of the same pulse, or the falling edge of one pulse to the falling edge of the next pulse. Encoders, proximity sensors, etc., can be connected to input C and/or input D on either channel or both channels. The CTRIO discrete output(s) can be assigned to the Timer function using the Preset Tables dialog. Refer to “Creating and Using the Output Tables” section in Chapter 5 for details.

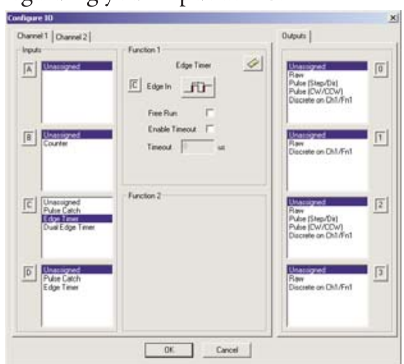




NOTE: *To insure proper operation, the field device wiring and the configuration must be compatible. For wiring information see Chapter 2.*

Notice that the module’s four input terminals are represented by the A, B, C, and D boxes on the left side of this dialog. If you are wiring your input to terminal 1C, you will need to select the Channel 1 tab near the top of this window and click Edge Timer in box C.

At this point, you have four decisions to make regarding your input at 1C.



1. First, designate the pulse edges you want to measure between. There are four choices. You can measure the time from the leading edge of the upward pulse to the leading edge of the next upward pulse, or from the trailing edge of an upward pulse to the trailing edge of the next upward pulse, or from the leading edge of an upward pulse to the trailing edge of the same pulse, or, finally, from the leading edge of a downward pulse to the trailing edge of the same downward pulse.

The last option could be restated as timing from the trailing edge of an upward pulse to the rising edge of the next upward pulse.

2. The “Free Run” option is assigned by clicking in the appropriate box. If your application calls for velocity measurements to be taken at the commencement of some event, do not use Free Run. If your application calls for velocity measurement on a continuous (moving average) basis, you should use Free Run.

3. The “Enable Timeout” option is assigned by clicking in the appropriate box and specifying a Timeout period. Once the timer is enabled, the Timeout Bit is set if the time that it takes the CTRIO to see the configured input edge exceeds the specified Timeout Period. Also, if the time before the CTRIO sees the next configured edge exceeds the specified Timeout Period, the Timeout bit is set. More information about the Timeout function can be found in chapter 6.

4. The last remaining decision to be made is about scaling. Clicking the button with the tape measure symbol starts the Scaling Wizard. We discuss the scaling wizard later in this chapter. The Scaling Wizard is intelligent in that it offers scaling options that are appropriate for your input selections.

Dual Edge Timer

The Dual Edge Timer is designed to measure from a pulse edge on one incoming signal to a pulse edge on another incoming signal. The user selects whether to measure between rising edges, falling edges, etc. The choices are summarized in the tables below. The CTRIO discrete output(s) can be assigned to the Dual Edge Timer function using the Preset Tables dialog. Refer to “Creating and Using the Output Tables” section in Chapter 5 for details.

Dual Edge Timer at Function 1
Rising edge of C to rising edge of D
Rising edge of C to falling edge of D
Falling edge of C to rising edge of D
Falling edge of C to falling edge of D

Dual Edge Timer at Function 2
Rising edge of D to rising edge of C
Rising edge of D to falling edge of C
Falling edge of D to rising edge of C
Falling edge of D to falling edge of C

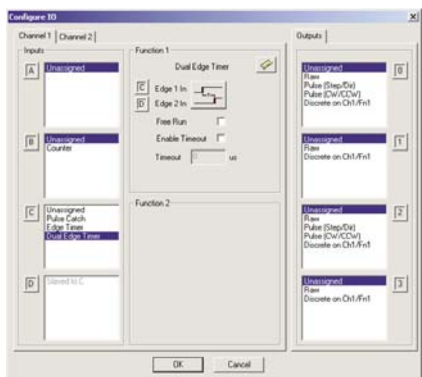
NOTE: *To insure proper operation, the field device wiring and the configuration must be compatible. For wiring information see Chapter 2.*

Notice that the module’s four input terminals are represented by the A, B, C, and D boxes on the left side of this dialog. If you are wiring your inputs to terminals 1C and 1D, you will need to select the Channel 1 tab near the top of this window and click Dual Edge Timer in box C or D.

At this point, you have four decisions to make regarding your input at 1C or 1D.

1. First, designate the pulse edges you want to measure between.

2. The “Free Run” option is assigned by clicking in the appropriate box. If your application calls for velocity measurements to be taken at the commencement of some event, do not use Free Run. If your application calls for velocity measurement on a continuous basis, you should use Free Run.

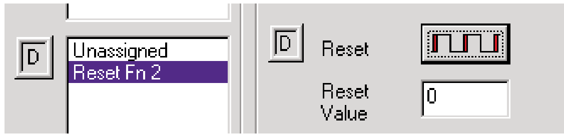


3. The “Enable Timeout” option is assigned by clicking in the appropriate box and specifying a Timeout period. Once the timer is enabled, the Timeout Bit is set if the time that it takes the CTRIO to see the configured l input edge exceeds the specified Timeout Period. Also, if the time before the CTRIO sees the next configured edge exceeds the specified Timeout Period, the Timeout bit is set. More information about the Timeout function can be found in chapter 6.

4. The last remaining decision to be made is about scaling. Clicking the button with the tape measure symbol starts the Scaling Wizard. We discuss the scaling wizard later in this chapter. The Scaling Wizard is intelligent in that it offers scaling options that are appropriate for your input selections.

Reset 1 and Reset 2 (Hard Resets for Counters Only)

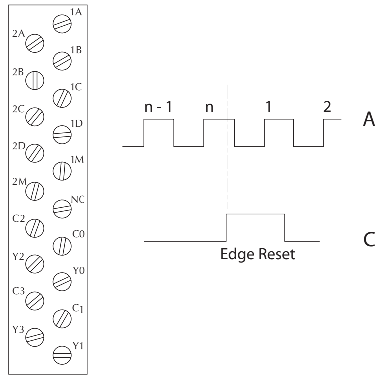
“Reset 1” is available only if you have selected a Counter or Quad Counter as the primary function. For example, if you have chosen either counter function (single-ended or quadrature) on terminal 1A, you will have an option of using terminal 1C for a hard reset signal. Other options are available on terminal 1D. Those options are Capture and Inhibit (see next page).



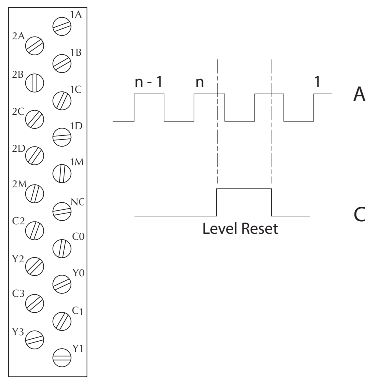
Reset 2 is available if you have selected to use terminal 1B for a counter input. Reset 2 will reset the counter connected to terminal 1B.

Two distinct types of hard resets are available. One is an edge reset. The other is a level reset. The Edge Reset sets the current count to zero on the specified edge (rising or falling) of the reset pulse (see upper example). The Level Reset resets the count to zero (as long as the reset pulse is held high (or low depending on configuration). When the reset pulse disappears, the count resumes (see lower example).

If the Reset options are not available in the Configure I/O dialog, then you have selected input functions that do not use the reset modifier.



NOTE: *Reset 1 and Reset 2 represent hard-wired inputs to terminal C or D. An appropriate field device must be connected to the designated terminal to perform the reset function.*



Soft Resets

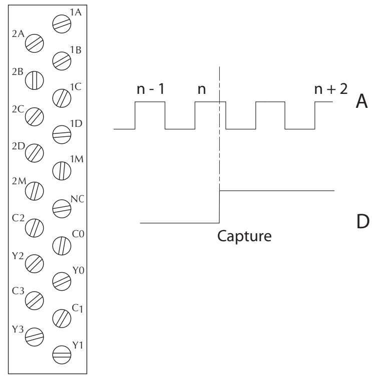
Soft resets are available by turning on the appropriate control bit in your control program (Counters only) or by using the Reset Count function within a Discrete Output Preset Table configuration (Counters/Timers). Counter control bit resets are always level resets, meaning they hold the count at zero until the reset bit is turned off.

Capture 1

"Capture 1" is available only if you have selected a Counter or Quad Counter as the primary function. For example, if you have chosen either counter function on terminal 1A, you will have an option of using terminal 1D for a capture signal.

Capture 1 "snapshots" the current count into the 2nd DWord register (Parameter 2). The Capture feature is available with a single-ended Counter on input A or a Quad Counter on inputs A and B.

NOTE: *Capture 1 represents a hard-wired input to terminal D. An appropriate field device must be connected to the designated terminal to perform the capture function.*

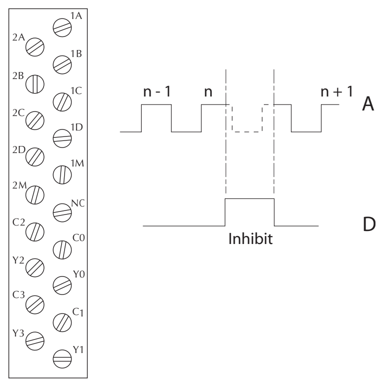


Inhibit 1

"Inhibit 1" is available only if you have selected a Counter or Quad Counter as the primary function. For example, if you have chosen either counter function on terminal 1A, you will have an option of using terminal 1D for an inhibit signal.

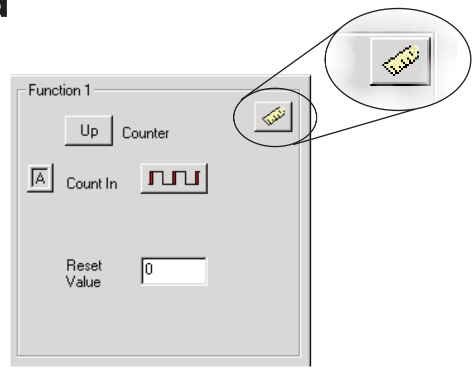
The "Inhibit 1" signal prevents the CTRIO from counting pulses. The Inhibit feature is available with the "A" Counter or Quad Counter on each channel.

NOTE: *Inhibit 1 represents a hard-wired input to terminal D. An appropriate field device must be connected to the designated terminal to perform the inhibit function.*



Introduction to the Scaling Wizard

Scaling raw signals to engineering units is accomplished using the Scaling Wizard. Start the Scaling Wizard by clicking the ruler button on the Configure I/O dialog. This button appears only after you select one of the Counter or Timer functions.

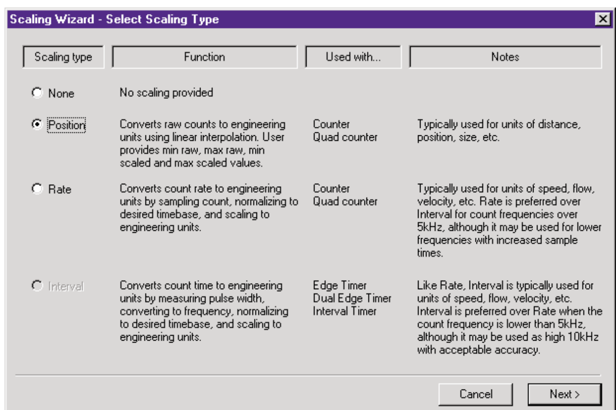


The Scaling Wizard options are different for the Counter functions as compared with the Timer functions. “Position” and “Rate” scaling are available when you select a Counter function. “Interval” scaling is available when you select a Timing function.

We will step through the dialogs used for each scaling type. Substitute appropriate values to set up scaling for your application.

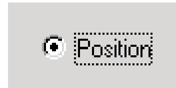
Scaling Wizard Examples for Counter Functions

On the counter Scaling Wizard, you can select None, Position, or Rate. No scaling is accomplished if the None button is selected. Position scaling is appropriate for measuring distance, position, or size. Rate scaling is appropriate for velocity, RPM, flow, or similar rate based measurements. You may want to read the Notes and other information before leaving this window.

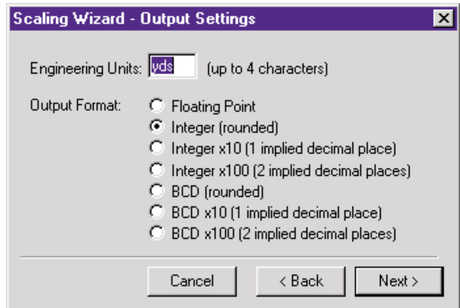


Position Scaling (Counter)

To select Position Scaling, click the radio button beside the word Position. Now, click Next to move to the Output Settings dialog.

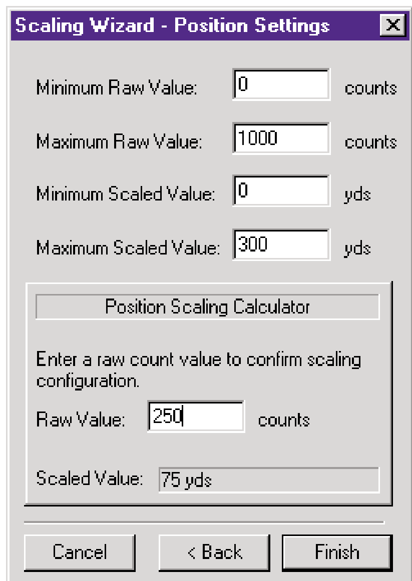


On the Output Settings dialog, you will notice the field for engineering units. Enter an appropriate value for Position Scaling, for example yards, feet, meters, cubic inches, etc. Seven data types are available including BCD (to make values more easily used by *Direct*LOGIC PLCs).



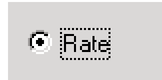
Click Next, to open the Position Settings dialog. It is here that you enter the span of raw counts that equates to a span of engineering units.

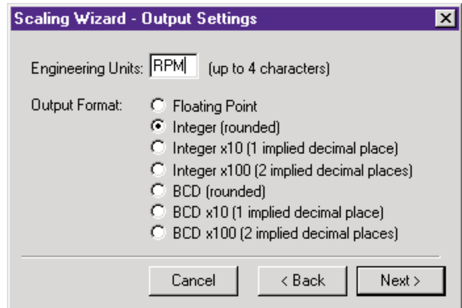
This window contains a calculator to double check the meaning of your Position Settings. Enter a value into the Raw Value field to see the equivalent value in engineering units.



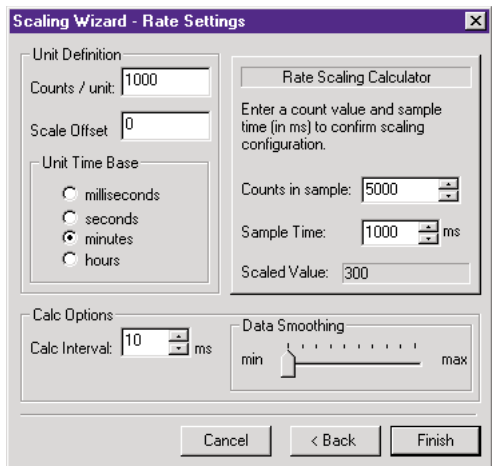
Rate Scaling (Counter)

To select Rate Scaling, click the radio button beside the word Rate. Now, click Next to move to the Output Settings dialog.





On the Output Settings dialog, you will notice the field for engineering units. Enter an appropriate value for Rate Scaling, for example RPM, fps, flow, etc. Seven data types are available including BCD (to make values more easily used by DirectLOGIC PLCs).



Click Next, to open the Rate Settings dialog. It is here that you enter the counts per unit of time and the time base. A scale offset is also provided to adjust the result by a constant amount.

This window contains a calculator to double check your Rate Settings. Enter a value into the Raw Value field to see the equivalent value in engineering units.

As an example, let's say you have a 1,000 pulse/revolution encoder, and you want to use it to measure RPM (of the encoder shaft). You would enter "1,000" for the Counts/unit and "minutes" as the Time Base. A check using the calculator (over a sample time of 1,000 ms = 1 second) reveals that 5,000 counts equals 300RPM.

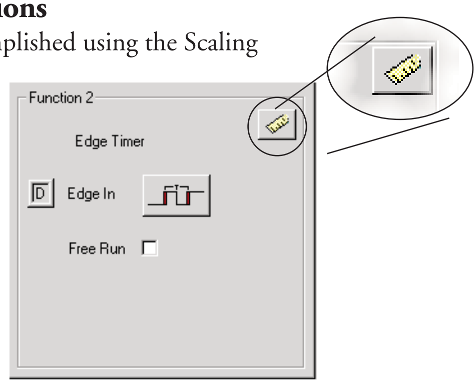
5000 counts/1000 counts per rev = 5 revolutions;

5 revolutions/1 sec x 60 sec/1 minute= 300 RPM

Data Smoothing allows rolling averages to be taken to calculate a value. Min = 1 sample, max = 25 samples in the rolling average.

Using the Scaling Wizard with Timer Functions

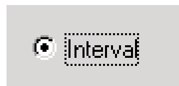
Scaling raw signals to engineering units is accomplished using the Scaling Wizard. Start the Scaling Wizard by clicking the ruler button on the Configure I/O dialog. This button appears only after you select one of the Counter or Timer functions.



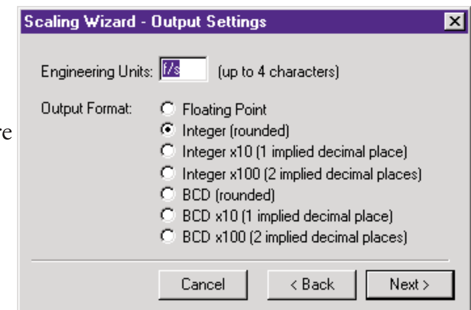
4

Interval Scaling (Timer)

To select Interval Scaling, click the radio button beside the word Interval. Now, click Next to move to the Output Settings dialog.



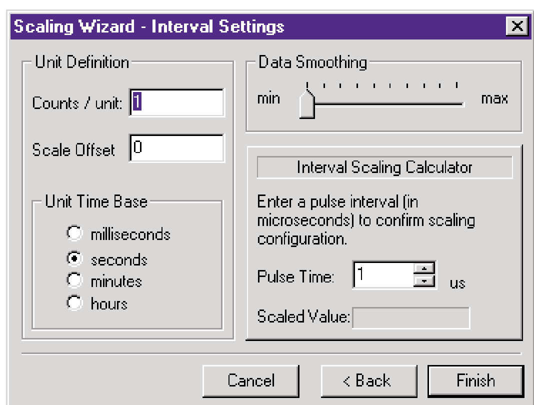
On the Output Settings dialog, you will notice the field for engineering units. Enter an appropriate value for Interval Scaling, for example RPM, fps, flow, etc. Seven data types are available including BCD (to make values more easily used by *Direct*LOGIC PLCs).



Click Next, to open the Interval Settings dialog. It is here that you enter the counts per unit of time and the time base. A scale offset is also provided to adjust the result by a constant amount.

This window contains a calculator to double check the meaning of your Rate Settings. Enter a value into the Raw Value field to see the equivalent value in engineering units.

Data Smoothing allows rolling averages to be taken to calculate a value. Min = 1 sample, max = 25 samples in the rolling average.



CHAPTER 5

CONFIGURING THE OUTPUTS

In This Chapter...

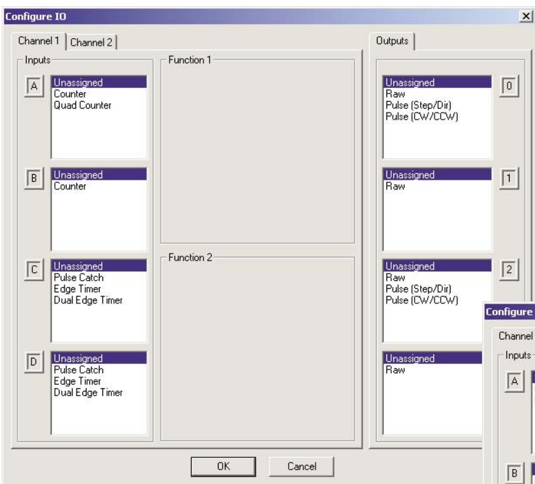
Configure I/O Dialog Overview

The Configure I/O dialog is the location where input and output functions are assigned to the module. The choice of input and output functions determines which options are available.

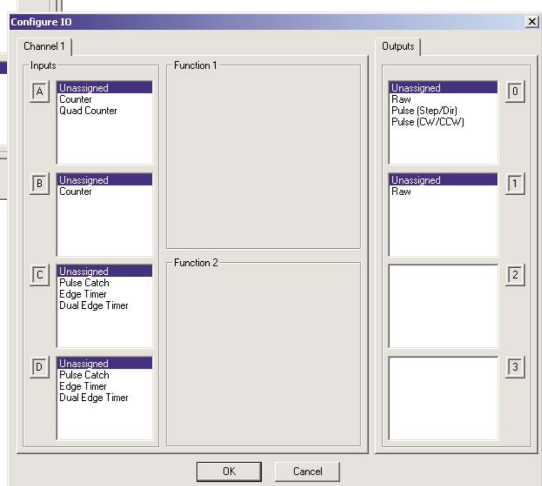
The input and output function boxes prompt you with selections for supported functions. The configuration software disallows any unsupported selections.

For DirectLOGIC users, from the main CTRIO Workbench window, click on the “Go to PROGRAM Mode” button (if in RUN Mode). Then, click on the “Config I/O” button to arrive at a dialog shown below. Notice that the window has a tab for each input Channel. Channel 1 and Channel 2 offer the same configuration options. Remember that the H0-CTRIO(2) only has one input channel.

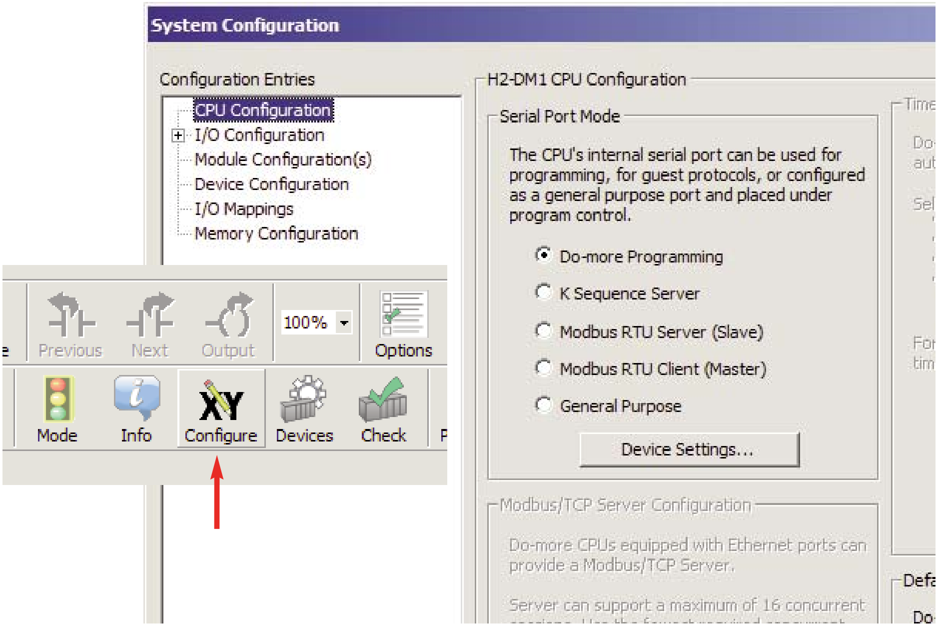
H2, H4, T1H-CTRIO, H2-CTRIO2 Configure I/O Dialog



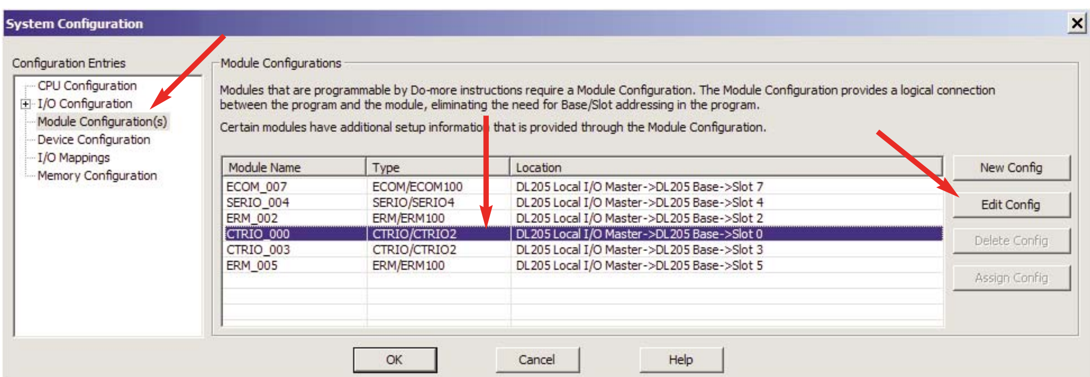
H0-CTRIO(2) Configure I/O Dialog



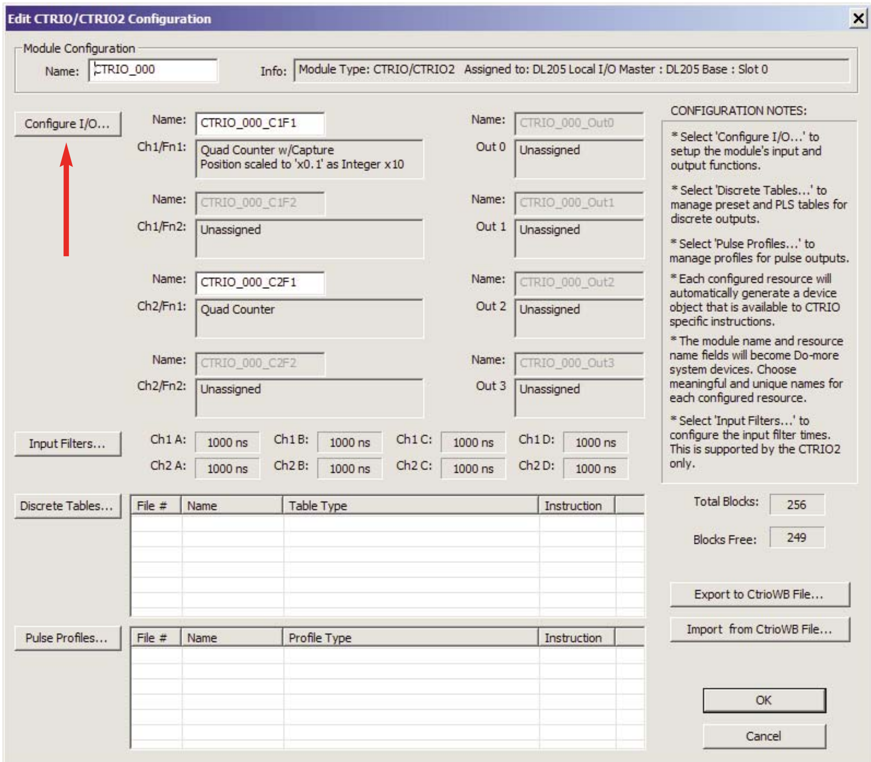
For Do-more users, the Workbench options have been built into the Do-more Designer software. The configuration dialog is found by first opening the System Configuration window by selecting the “XY Configure” button in the main toolbar.



With the System Configuration page open, select the Module Configuration(s) page from the lefthand column. On this page, highlight the desired CTRIO module and click Edit Config.



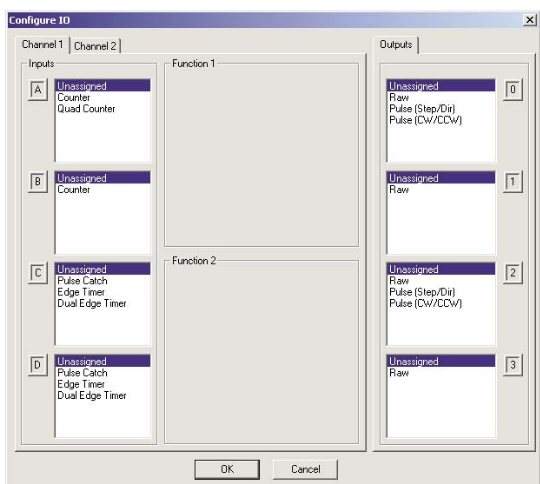
Now the Edit CTRIO/CTRIO2 Configuration window should be open, click the “Configure I/O...” button.



You should now have the Configure I/O window open, similar to the one shown here, with a tab for each input Channel.

The input options are listed by function. Four boxes labeled A, B, C, and D correspond to the input terminals on the face of the module (1A-1D or 2A-2D; A-D for the H0-CTRIO(2)).

The Output functions are listed as 0, 1, 2, and 3. These numbers correspond to the markings beside the module's output terminals (Y0-Y3; Y0-Y1 for the H0-CTRIO(2)).



For DirectLOGIC users, be sure to write the changes to the module from Workbench when the configuration is complete. For example, you might click on “Discrete Output” in the “0” box, then OK to return to the main Workbench window. Once you arrive back at the main window, you must click “Write Module” to save your selection to the module. The module will need to be in Program Mode to perform the Write Module operation. If you do not perform the Write Module operation (or a Write File operation) your configuration will be lost upon quitting Workbench. This applies to all changes to the module configuration.

For Do-more users, the “Write Module” button does not exist because the Module Configuration dialog stores the CTRIO's configuration as a permanent part of the Do-more controller's System Configuration.

Output Function Selections

Supported Functions

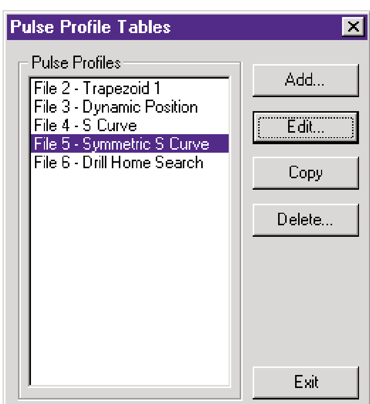
The module supports four output functions:

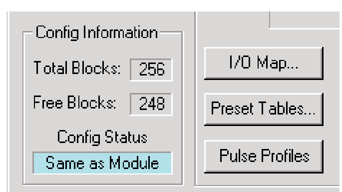
- Raw
- Pulse (Step/Direction)
- Pulse (CW/CCW)
- Discrete Ch(1,2)/Fn(1,2)

Each function uses one or two output terminals for making connections to field devices (plus a common). Combinations of the listed functions are possible. The configuration dialog disallows any unsupported configurations.

CTRIO Memory Usage: Pulse Profiles and Preset Tables

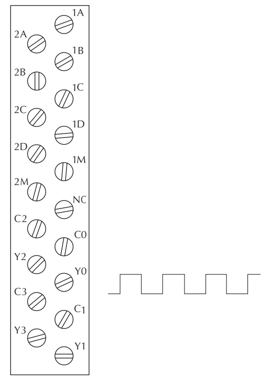
CTRIO configuration software can create a maximum of 255 predefined Pulse Profiles. The total number of Pulse Profiles available is 255 minus the number of predefined Preset Tables. Pulse Profiles and Preset Tables are saved as File 1 through File 255. The module has 256 Total Blocks of memory allocated for Pulse Profiles and Preset Tables usage. The number of memory blocks used varies between Pulse Profiles and Preset Tables.





Raw Output

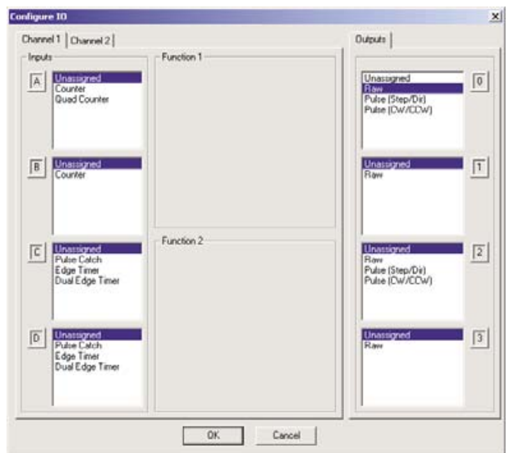
The CTRIO module supports Raw output mode. This mode allows the CPU/controller program to have direct access to the module's output points. Each output can be configured for Raw output mode and each will have a unique control bit.



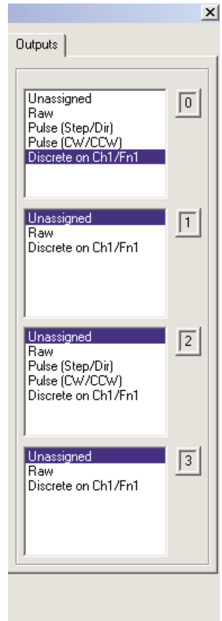
NOTE: *To insure proper operation, the field device wiring and the configuration must be compatible. For wiring information see Chapter 2.*

Refer to "Output Control Bit Definitions (Raw Mode)" on page 6-5 for Raw output control bit addressing.

The module's output terminals are represented by the 0, 1, 2, and 3 boxes (0 and 1 for the H0-CTRIO(2)) on the right side of this dialog.



Discrete Outputs



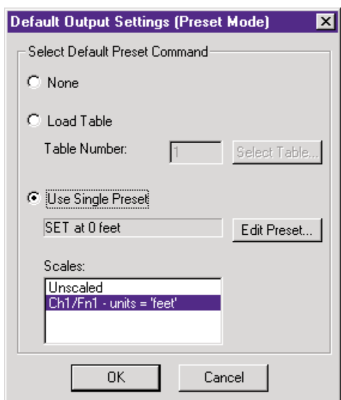
The CTRIO module has four discrete outputs numbered Y0-Y3 (Y0-Y1 for the H0-CTRIO(2)). The outputs respond to presets assigned by the user in the Configure I/O dialog.

The presets are assigned based on the scaled value of an input, or the raw value if it has no scaled value. The four outputs can all be assigned to one function, or they can be grouped within functions and within channels in any manner selected by the user.

To assign output presets, begin by selecting the ouput on the Configure I/O dialog. The outputs are identified based on terminal number. In the example to the right, output terminal "0" is designated for a discrete output.

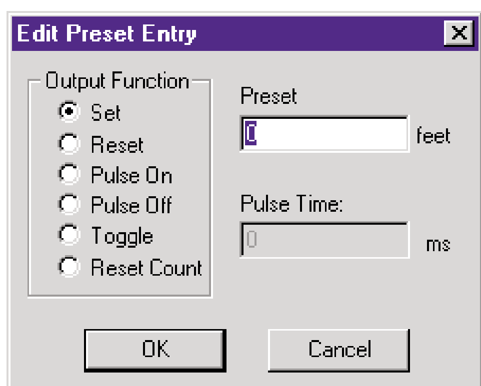
Once the output selection is made, a new button appears on the Configure I/O dialog. The button is labeled as shown to the right. The leading numeral represents the number of the output terminal. Clicking on the Preset button causes the Default Output Settings dialog to pop up. Default settings are loaded on power-up.

On the Output Settings dialog, select "Use Single Preset." We will discuss Preset Tables later in this chapter. Now, click OK to arrive at the Edit Preset Entry dialog.



Six output functions are available (as shown in the figure below). Set the preset value in engineering units if the signal has been scaled. Set the preset value in raw count if the signal has not been scaled. We discuss scaling in chapter 4. Pulse ON and Pulse OFF require a Pulse Time setting. The Pulse Time is set in msec (1,000 sec = 1 msec)

Output Function Definitions	
Set	Writes output ON (maintained)
Reset	Writes output above OFF
Pulse On	Writes output ON for specified time
Pulse Off	Writes output OFF for specified time
Toggle	Changes state of output
Reset Count	Resets the count to Preset Value



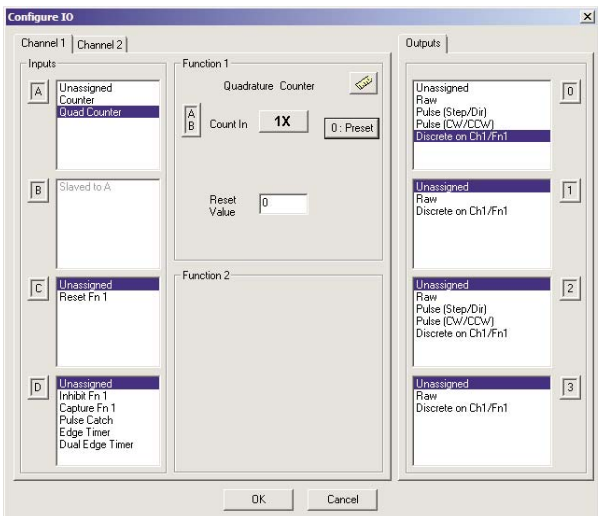
Creating and Using the Programmable Limit Switch (CTRIO2 only)

A Programmable Limit Switch (PLS) is a discrete output table used to turn an output ON or OFF at multiple points across an input's range.

The PLS function is only available in the Hx-CTRIO2. A PLS table must be created in the CTRIO module configuration. Once created, it can be edited using the configuration application or for Do-more systems, it can be edited using the PLS instructions in ladder. For greater flexibility when using Do-more systems, create PLS tables in the CTRIO module configuration then populate their entries (up to 128) from ladder. If using the ladder instructions, run them after a power cycle to regenerate the tables.

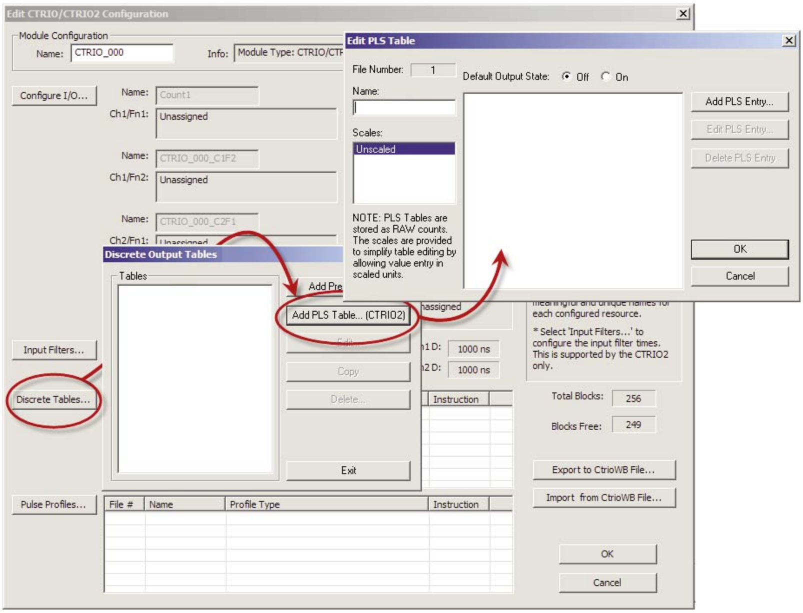
5

To use a PLS table, an output must be configured as a discrete output paired with a counter or timer input function. For example, Channel 1 inputs A and B could be configured for quadrature counting, which would be Channel1Function1. Output 0 could be configured as Discrete on Ch1/Fn1. When a PLS table is loaded for Output 0, the CTRO2 will monitor the input value for Ch1/Fn1 (Channel1 quad counter) and Output 0 will be the output turned ON and OFF by the table.

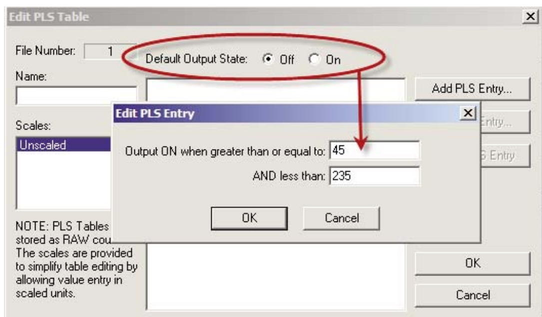


NOTE: *Since a CTRIO Output's function is fixed in the configuration, an output cannot be changed programmatically to reference a different input function. This specific change requires a configuration change and project transfer.*

To create a PLS table, from the EditCTRIO/CTRIO2 Configuration window click Discrete Tables then select Add PLS Table (as seen on following page). Name the table and if the PLS entries will be populated from ladder in Do-more, leave the table empty and click OK. Otherwise, use the buttons on the right to build and modify a PLS table. If an input channel has scaling, it will show in the Scales list, and entries can optionally be entered in scaled units after selecting the appropriate entry in the Scales list.



The table entries are very simple. Select a default value for the discrete output, the output will be in this state if the input is not within a defined range. Add an entry for each range of input values where the output should be in the opposite state.



NOTE: *Unlike a preset table, events in a PLS table can occur in any order, even simultaneously.*

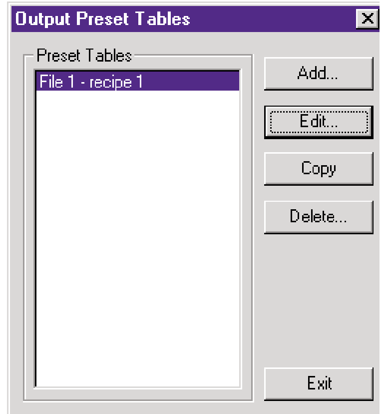
In ladder, use the CTRIO Table Load (CTTBLLD) instruction to load the table for an output. Loading the table could take multiple scans. When CTTBLLD's On Success indication becomes true, set the output's .EnableOutput structure member to begin using the table.

For more detailed information, see the Do-more Designer help file topics for CTRIO Module Configuration, CTTBLADD, CTTBLCLR, CTTBLEDT and CTTBLLD.

Creating and Using the Output Preset Tables

Preset tables can be used only when the corresponding input is configured for a timer or quad/counter that is not scaled or if a counter is set to Position scaling.

For DirectLOGIC users, click the Preset Tables button on the main Workbench dialog. This will open the Output Preset Tables dialog. To create a new table, click Add (or Edit). This will open the Edit Preset Table dialog.

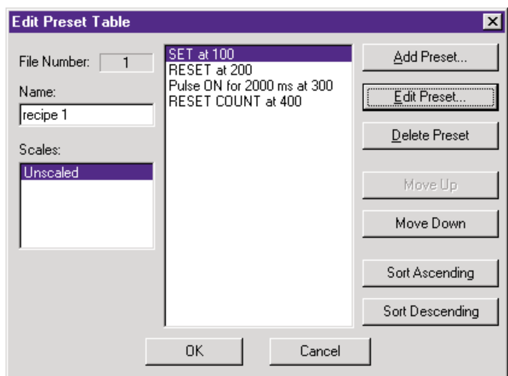


For Do-more users, from the Edit CTRIO/CTRIO2 Configuration page, click the “Discrete Tables...” button. This will open the Discrete Output Tables dialog. To create a new table, click Add (or Edit). This will open the Edit Preset Table dialog.

Build a Preset Table by adding preset entries one at a time. Click Add Preset (or Edit Preset) to open the Edit Preset Entry dialog.

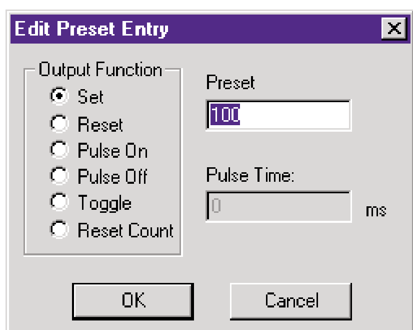
***NOTE:** The preset tables work similiar to an event drum, not a programmable limit switch. For example, in the Edit Preset Table dialog below, the output is SET at count 100. Once the output is SET, if the count drops below 100, the output will not go OFF, it will remain SET. Once a step is complete, the focus is on the next step and that step only.*

On the Edit Preset Entry dialog, select one of the six Output Functions. Set the preset value in engineering units if the signal has been scaled. Set the preset value in raw count if the signal has not been scaled. We discuss scaling elsewhere in this chapter. Pulse ON and Pulse OFF require a Pulse Time setting.



The Pulse Time is set in ms (1,000 ms = 1 sec). For a description of the Output Functions see page 5-6.

To set a particular table as the default table, use the Default Output Settings dialog described on page 5-6.

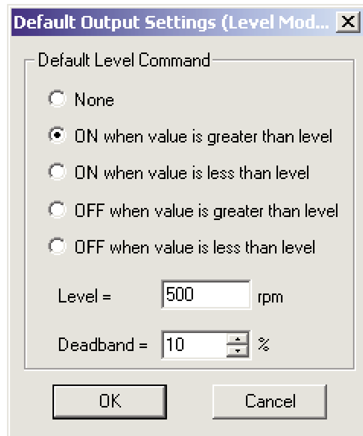


Using the Discrete Outputs in Level Mode

If a Counter or Timer function is scaled to produce a rate, alarm level settings can be used to trigger discrete outputs at values predetermined by the user.

Click the Level button on the Configure I/O dialog. This will open the Default Output Settings (Level Mode)dialog.

The alarm level is set within the Default Output Settings (Level Mode) dialog.

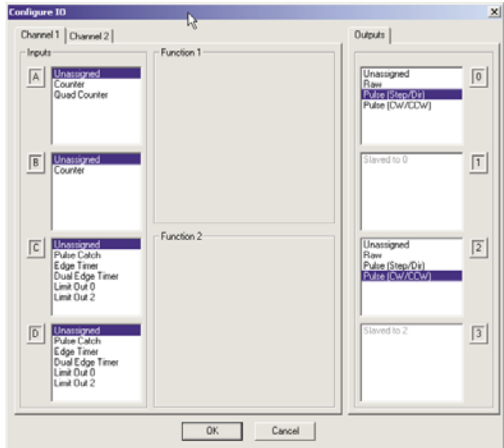


Also, a deadband percentage (in tenths of a percent) can be set to prevent the output from changing too frequently (chattering) near the Rate Level threshold.

"ON when greater" condition example:
Consider a Discrete Output set to turn ON when a level gets to 500 rpm with a 10% deadband. The output will turn ON when the level gets to 100. If the level drops, the output will stay on until the level drops below 450 rpm, where it will turn OFF.

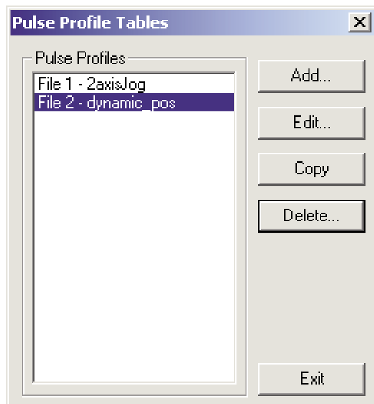
"OFF when less" condition example:
Consider a Discrete Output set to turn "OFF when less"at 500. When the level gets to 500, the output turns OFF. If the level rises again, the output will stay OFF until the level gets to 550, where it will turn ON.

Pulse Outputs



The CTRIO module offers up to two axes of motion control (Y0 and Y1 as an axis and/or Y2 and Y3 as an axis). The H0-CTRIO(2) has one axis of motion control (Y0 and Y1). The outputs can be configured for CW/CCW, or step and direction operation. The outputs respond to profiles defined by the user and called by the user control program. The following pulse profiles are supported:

- Trapezoid
- S-Curve
- Symetrical S-Curve
- Dynamic Positioning
- Dynamic Velocity
- Home Search
- Free Form
- Dynamic Positioning Plus (CTRIO2)
- Trapezoid Plus (CTRIO2)
- Trapezoid w/ Limits (CTRIO2)

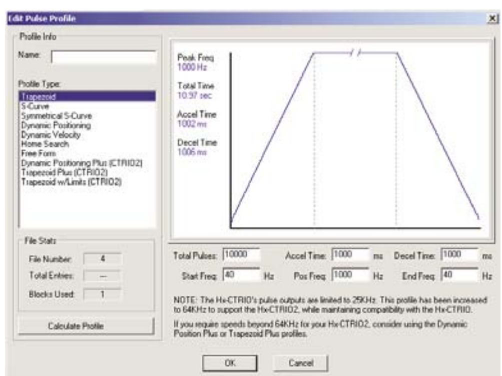


There are three additional pulse profiles that are available to use that are not created using the Pulse Ouput Profiles Tables. These profiles: Velocity Mode, Run to Limit Mode and Run to Position Mode are discussed at the end of this chapter.

Creating Pulse Output Profile Tables

For DirectLOGIC users, click the Pulse Profiles button on the main Workbench dialog.

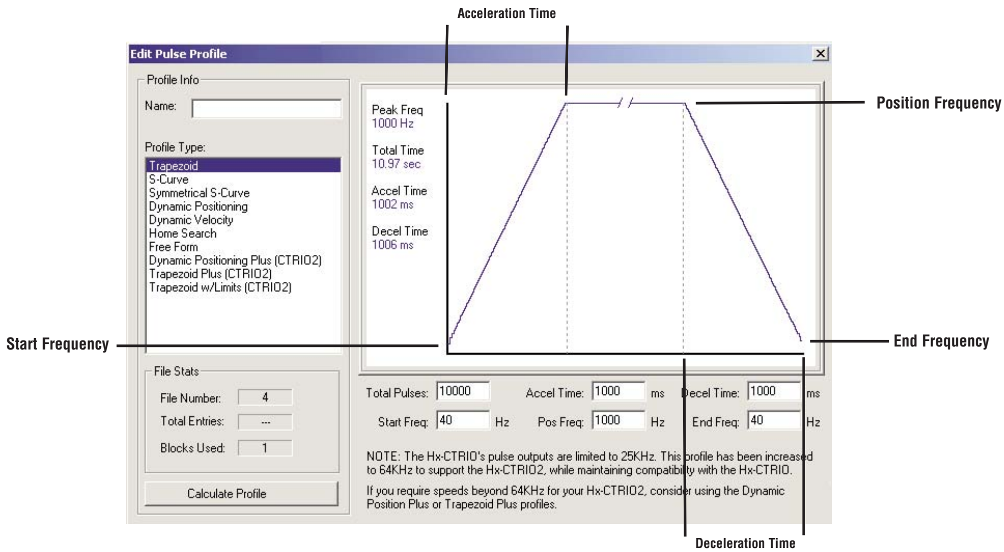
For Do-more users, click the "Pulse Profiles..." button from the Edit CTRIO/CTRIO2 Configuration window. This will open the Pulse Profiles Tables dialog. To create a new profile, click Add (or Edit). This will open the Edit Pulse Profile dialog.



On the Edit Pulse Profile dialog, select one of the ten Pulse Profile Types.This dialog is used to name and define the pulse profile parameters. The various parameter fields contain typical default values. The configuration software will disallow any invalid parameter entries.

Trapezoid Profile

The Trapezoid profile changes the velocity in a linear fashion from the specified Start Frequency until the specified target Position Frequency is reached. During decelerating, the velocity changes in a linear fashion from the specified Position Frequency until the specified End Frequency and Total Pulses is reached.



Total Pulses: The total amount of output pulses that will be generated during the Trapezoidal profile.

Accel Time: The amount of time required for the Start Frequency to ramp up the Position Frequency.

Decel Time: The amount of time required for the Position Frequency to ramp down to the End Frequency.

Start Freq: The frequency at which the Trapezoidal profile will begin.

Pos Freq: The target frequency to which the Start Frequency rises.

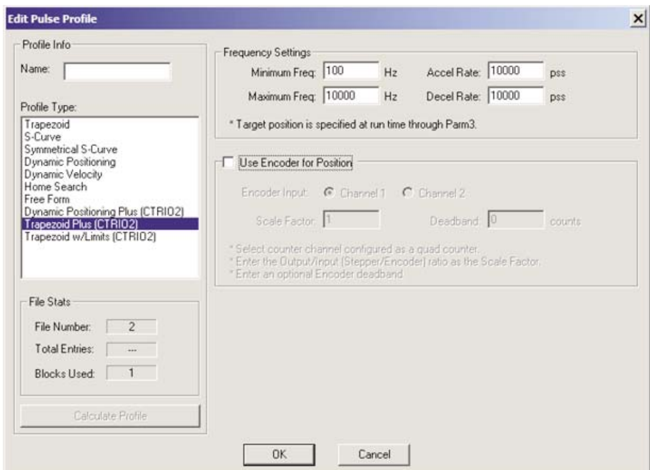
End Freq: The frequency to which the Position Frequency falls.

Trapezoid Plus Profile

The Trapezoid Plus profile is only available when using an Hx-CTRIO2. See Trapezoid description for a general description of this profile. The profile resembles Trapezoid Profile, but has four additional features:

1. The target position is a variable (parameter 3) set by the base controller, instead of a constant specified in the profile.
2. The profile can be asymmetrical. (Accel and Decel rates are separate)
3. Encoder Feedback can be added, useful for correcting excessive lash or slippage in the system.
4. Allows output rates up to 250kHz.

When Use Encoder for Position is enabled, the target position is specified in units of the encoder. Encoder feedback determines when deceleration of a move should begin and determines when the move should stop. If Scale Factor is set incorrectly, the output could overshoot the target position, or start decelerating too soon.



Minimum Freq: The frequency at which the profile will begin and end.

Maximum Freq: The maximum steady state frequency the profile can attain during a move.

Accel Rate: The rate at which the output frequency will increase at the start of the profile.

Decel Rate: The rate at which the output frequency will decrease at the end of the profile.

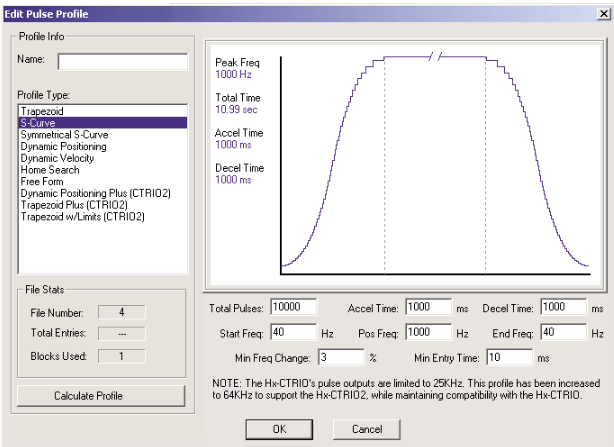
Encoder Input: Select the channel where the encoder is connected. The inputs for the encoder (A&B) must be configured for Quad Counter.

Scale Factor: This is the output to input resolution (stepper/encoder) ratio. In other words, if the stepper motor being used is a 1000 ppr (pulses per revolution) and the encoder is 800 ppr, then the scale factor would be 1000/800 = 1.25.

Deadband: This is the number of position counts away from the target position that causes no action. This can reduce "hunting" or "ringing" as the profile attempts to get to the target position. Be sure to include a deadband when the encoder has a higher resolution than the stepper.

S-Curve Profile

The S-Curve profile can be used for applications that are sensitive to sudden changes in position or velocity, resulting with vibrations or jerky reactions. The S-Curve profile provides more controlled acceleration and deceleration periods than the Trapezoidal profile by increasing the transistion times.



Total Pulses: The total amount of output pulses that will be generated during the Trapezoidal profile.

Accel Time: The amount of time required for the Start Frequency to ramp up the Position Frequency.

Decel Time: The amount of time required for the Position Frequency to ramp down to the End Frequency.

Start Freq: The frequency at which the Trapezoidal profile will begin.

Pos Freq: The target frequency to which the Start Frequency rises.

End Freq: The frequency to which the Position Frequency falls.

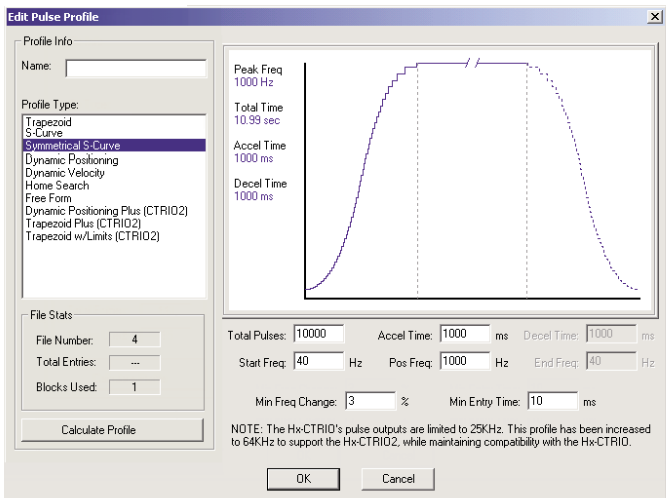
Min Freq Change: The amount of calculated frequency change that must take place before stepping to the next frequency.

Min Entry Time: The amount of time spent in each step.

Symmetrical S-Curve Profile

The Symmetrical S-Curve profile can also be used for applications that are sensitive to sudden changes in position or velocity, resulting with vibrations or jerky reactions. The Symmetrical S-Curve provides more controlled acceleration and deceleration periods than a Trapezoidal profile by increasing the transistion times.

The S-Curve and Symmetrical S-Curve profiles differ in that the Symmetrical S-Curve has symmetrical acceleration and deceleration profiles. The Decel Time and End Frequency are determined by the Accel Time and Start Frequency. The Symmetrical S-Curve uses less memory than the S-Curve profile.



Total Pulses: The total amount of output pulses that will be generated during the Trapezoidal profile.

Accel Time: The amount of time required for the Start Frequency to ramp up the Position Frequency. This also represents the deceleration time.

Start Freq: The frequency at which the Trapezoidal profile will begin. This also represents the end frequency.

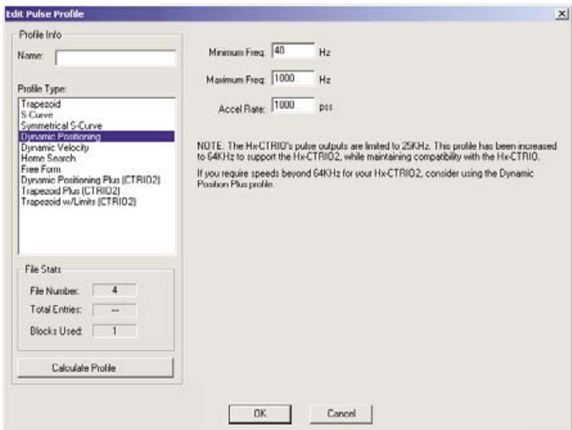
Pos Freq: The target frequency to which the Start Frequency rises.

Min Freq Change: The amount of calculated frequency change that must take place before stepping to the next frequency

Min Entry Time: The amount of time spent in each step.

Dynamic Positioning Profile

The Dynamic Positioning profile is a trapezoidal profile with identical acceleration/deceleration rates and identical starting/stoping frequencies. The maximum target frequency is specified. The target position (# of output pulses) is located in a memory register in the CPU/controller. Once the position is reached, the output is disabled and a new target position can be specified in the memory register.



Accel Rate: The rate at which the Minimum Frequency will to ramp up the Maximum Frequency. This sets the deceleration rate as well.

Minimum Freq: The frequency at which the profile will begin.

Maximum Freq: The target frequency to which the Minimum Frequency rises.

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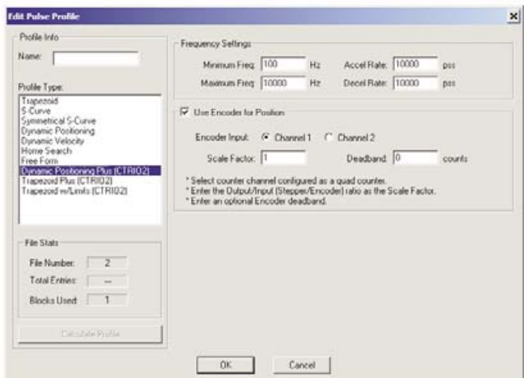
Dynamic Positioning Plus Profile

The Dynamic Positioning Plus profile is only available when using an Hx-CTRIO2. The profile resembles Dynamic Position, but adds two features:

1. The profile can be asymmetrical. (Accel and Decel Rates are separate)
2. Encoder Feedback can be added, useful for correcting excessive lash or slippage in the system.

When Use Encoder for Position is enabled, the target position is specified in units of the encoder. Encoder feedback determines when deceleration of a move should begin and determines when the move should stop.

See Dynamic Position for a general description of this profile.



Minimum Freq: The frequency at which the profile will begin and end.

Maximum Freq: The maximum steady state frequency the profile can attain during a move.

Accel Rate: The rate at which the output frequency will increase at the start of the profile.

Decel Rate: The rate at which the output frequency will decrease at the end of the profile.

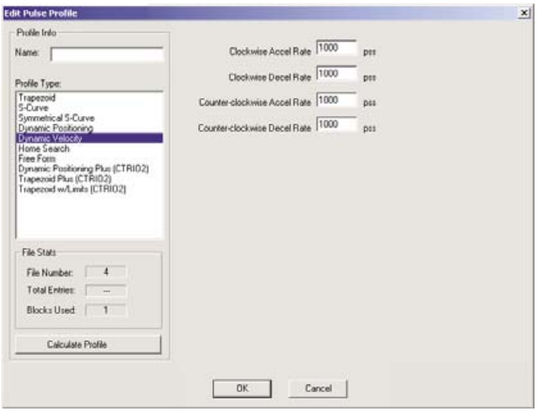
Encoder Input: Select the channel where the encoder is connected.

Scale Factor: This is the output to input resolution (stepper/encoder) ratio. In other words, if the stepper motor being used is a 1000 ppr (pulses per revolution) and the encoder is 800 ppr, then the scale factor would be 1000/800 = 1.25.

Deadband: This is the number of position counts away from the target position that causes no action. This can reduce "hunting" or "ringing" as the profile attempts to get to the target position. Be sure to include a deadband when the encoder has a higher resolution than the stepper.

Dynamic Velocity Profile

The Dynamic Velocity profile is a trapezoidal profile with the direction acceleration and deceleration rates specified. The target velocity is located in a memory register in the CPU/controller. Once the CPU/controller initiates the profile, output pulses will be generated at the target velocity until the CPU/controller disables the output pulses.



Clockwise Accel Rate: The clockwise rate at which the output will ramp up from 0pss to the target velocity that is specified in the CPU/controller memory register.

Clockwise Decel Rate: The clockwise rate at which the output will ramp down from the target velocity that is specified in the CPU/controller memory register to 0pss.

Counter-Clockwise Accel Rate: The counter-clockwise rate at which the output will ramp up from 0pss to the target velocity that is specified in the CPU/controller memory register.

Counter-Clockwise Decel Rate: The counter-clockwise rate at which the output will ramp down from the target velocity that is specified in the CPU/controller memory register to 0pss.

Home Search Profile

The Home Search profile is used to "*find the home position*", which is usually a reference point to which the object being moved can return upon command at any time during or after the execution of a positioning profile.

There are several Home Search routines to choose from, all with the option to designate whether you want Limit 1 and/or Limit 2 (a CTRIO discrete input) to register on the rising edge, falling edge, high level or low level signal. Limit 1 and Limit 2 can be the opposite edges of the same physical CTRIO input.

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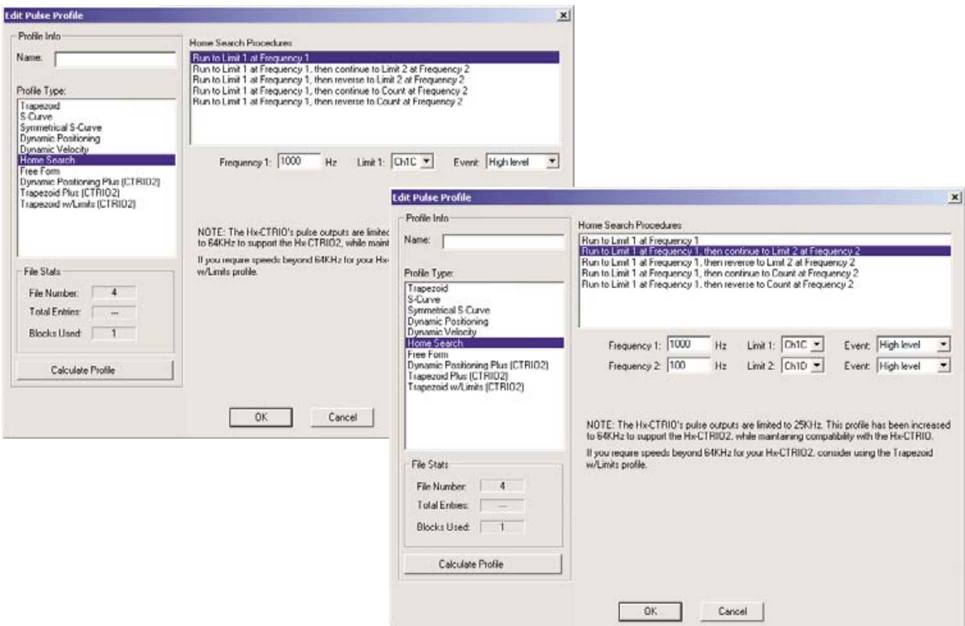
NOTE: *The Home Search profile requires that CTRIO inputs C and/or D are configured for Limit Out 0 or Limit 2. This is done using the Configure I/O dialog.*



Frequency 1: The frequency at which the Home Search will begin.

Limit 1: Home Search Frequency 1 will run to CTRIO input Limit 1 and stop unless Frequency 2 is enabled.

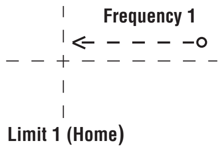
Frequency 2: (if enabled) Once Limit 1 is reached, the pulse output will continue at Frequency 2 until CTRIO Limit 2 is reached or pulse Count is reached at Frequency 2.

Limit 2: (if enabled) Home Search Frequency 2 will run to CTRIO input Limit 2 and stop.

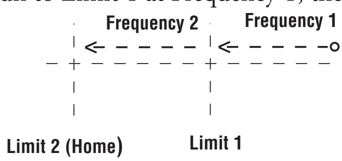
Count: (if enabled) The number of output pulse counts generated at Frequency 2 before terminating.

Home Search Routines

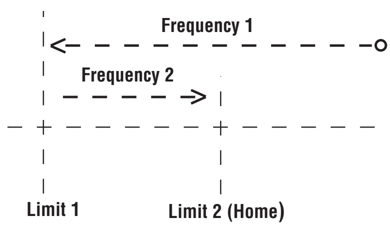
1. Run to Limit 1 at Frequency 1.



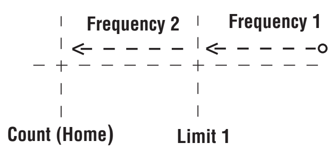
2. Run to Limit 1 at Frequency 1, then continue to Limit 2 at Frequency 2.



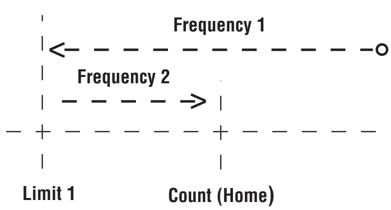
3. Run to Limit 1 at Frequency 1, then reverse to Limit 2 at Frequency 2.



4. Run to Limit 1 at Frequency 1, then continue to Count at Frequency 2.



5. Run to Limit 1 at Frequency 1, then reverse to Count at Frequency 2.



Trapezoid with Limits Profile

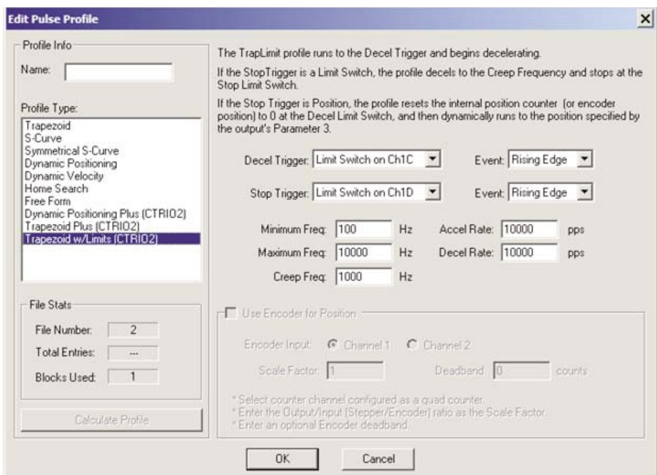
The Trapezoid with Limits profile is only available when using an Hx-CTRIO2. The profile is a homing routine similar to Home Search but has five additional features:

1. The profile is trapezoidal (has linear accel and decel rates), allowing for faster homing routines without stalling the stepper.
2. The profile can be asymmetrical. (Accel and Decel rates are separate)
3. Encoder Feedback can be added, useful for correcting excessive lash or slippage in the system.
4. Allows output rates up to 250kHz.
5. When Stop Trigger is position, it is a variable (parameter 3), set by the base controller.

***NOTE:** When using an input channel as the Stop Trigger with this profile, the Stop Trigger must be beyond the first limit in the same direction. The output cannot change direction to reach the second limit. Use Home Search if the output must Reverse to Limit 2.*

The Trapezoid with Limits profile offers several routines using a Decel Trigger and Stop Trigger. Specify the Decel Trigger as the rising or falling edge of a CTRIO2 input. The Stop Trigger can be a position relative to the Decel Trigger, the opposite edge of the Decel Trigger or the rising or falling edge of another CTRIO2 input.

***NOTE:** The Trapezoid with Limits profile requires that CRTIO2 inputs C and/or D are configured for Limit Out X, where X is the output channel being used.*



Decel Trigger: The CTRIO2 input to use as the Decel Trigger. Hitting this limit during the move will either reset counts to 0 (if Stop Trigger is position) or initiate deceleration to the Creep Frequency (if Stop Trigger is a CTRIO2 input).

Event: The edge of the limit switch to use as the Decel Trigger.

Stop Trigger: The CTRIO2 input or position that stops the output. If Position is selected, Parameter 3 defines the target position. This is relative to 0, which is clocked in when the Decel Trigger's Event condition is met. Position can be positive or negative.

Event: The edge of the limit switch to use as the Stop Trigger.

Minimum Freq: The frequency at which the profile will begin and end.

Maximum Freq: The maximum steady state frequency the profile can attain during a move.

Accel Rate: The rate at which the output frequency will increase at the start of the profile.

Decel Rate: The rate at which the output frequency will decrease when Decel Trigger is reached.

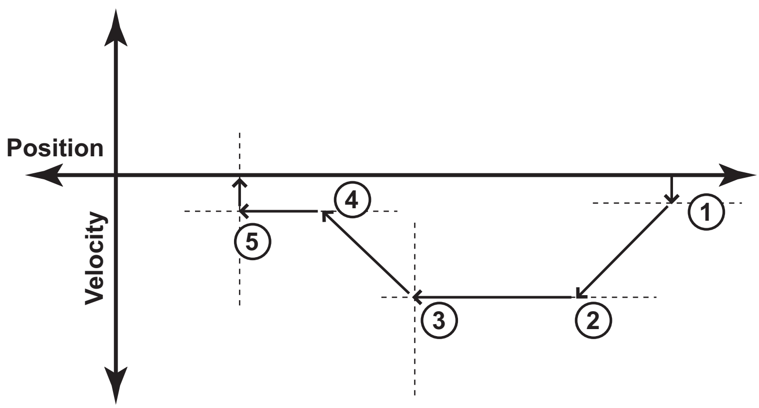
Creep Freq: The (slower) rate to use between the Decel Trigger and the Stop Trigger.

Encoder Input: Select the channel where the encoder is connected.

Scale Factor: This is the output to input resolution (stepper/encoder) ratio. In other words, if the stepper motor being used is a 1000 ppr (pulses per revolution) and the encoder is 800 ppr, then the scale factor would be 1000/800 = 1.25.

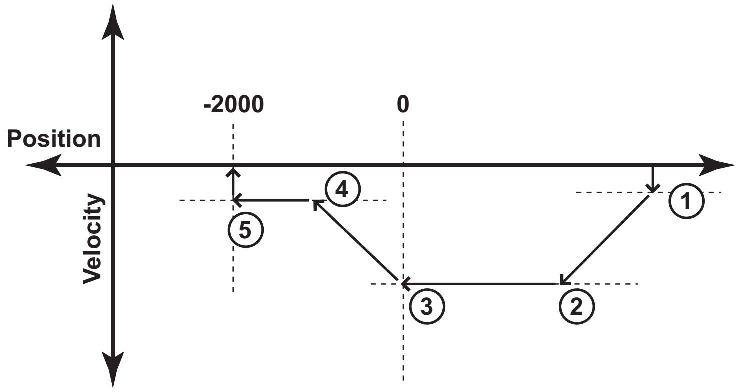
Deadband: This is the number of position counts away from the target position that causes no action. This can reduce "hunting" or "ringing" as the profile attempts to get to the target position. Be sure to include a deadband when the encoder has a higher resolution than the stepper.

Example: Trapezoid with Limits using a limit switch for the Stop Trigger.



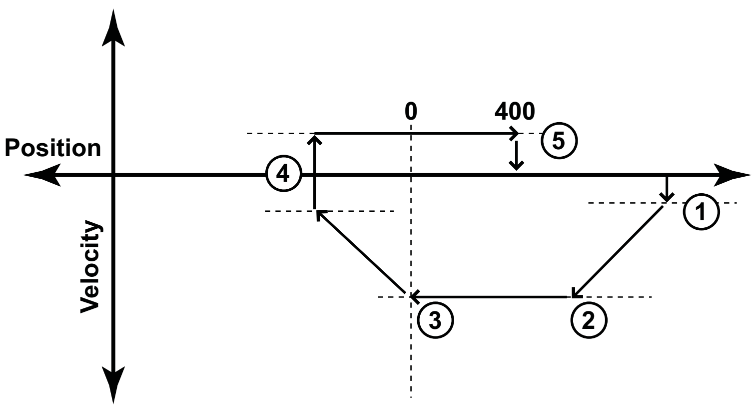
1. Move starts at the Minimum Freq and accelerates at Accel Rate.
2. Acceleration ends at Maximum Freq and move continues at Maximum Freq.
3. When the Decel Trigger is reached, the position register is zeroed out and the output begins to slow down at Decel Rate.
4. Deceleration ends at Creep Freq and the move continues towards the Stop Trigger, a limit switch.
5. When the Stop Trigger is reached, the output stops.

Example: Trapezoid with Limits using a position for the Stop Trigger. The Stop Trigger position does not require change of direction.



1. Move starts at the Minimum Freq and accelerates at Accel Rate.
2. Acceleration ends at Maximum Freq and move continues at that rate.
3. When the Decel Trigger is reached, the position register is zeroed out and the output begins to slow down at Decel Rate.
4. Deceleration ends at Creep Freq and the move continues towards the Stop Trigger, a position relative to the Decel Trigger. The Stop Trigger is the position -2000 in this example.
5. When the Stop Trigger is reached, the output stops.

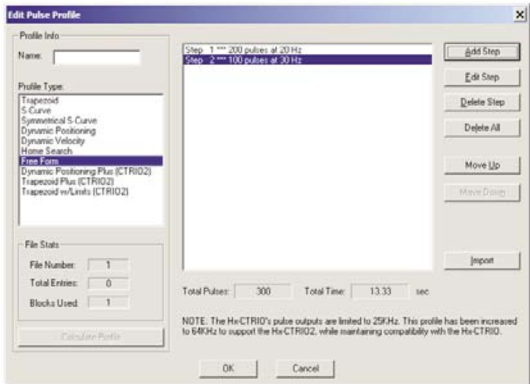
Example: Trapezoid with Limits using a position for the Stop Trigger. The Stop Trigger position requires change of direction.



1. Move starts at the Minimum Freq and accelerates at Accel Rate.
2. Acceleration ends at Maximum Freq and move continues at that rate.
3. When the Decel Trigger is reached, the position register is zeroed out and the output begins to slow down at Decel Rate.
4. Deceleration ends at Minimum Freq and the move changes direction to move back towards the Stop Trigger, a position relative to the Decel Trigger.
5. When the Stop Trigger is reached (position 400 in this example), the output stops.

Free Form Profile

The Free Form profile allows for stepping between output frequencies with no acceleration or deceleration ramps. Profiles, up to 256 steps, can be imported from a CSV file.



Total Pulses: Provided by the utility, the total number of output pulses that will be generated during the profile.

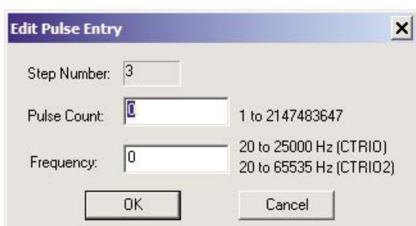
Total Time: The total time required for the profile to run to completion.

Import: Opens a dialog that allows importing a CSV file. Importing the CSV replaces the existing entries. A CSV file used to create the profile seen above would look like:

200,20

100,30

Add or Edit Step: Will invoke the Edit Pulse Entry dialog seen below. This window will allow you to modify or create pulse entries.



- Pulse Count: The number of pulses to generate for this step.
- Frequency: The frequency of pulses during this step.

Additional Pulse Profiles

Three additional pulse profiles are available to use that are *not* defined or created using the Pulse Profiles Table dialog, however the output(s) must be configured for Pulse (Step/Direction) or Pulse (CW/CCW) using the Configure I/O dialog. The profile parameters are stored in the CPU/controller memory registers. The profiles are briefly described below and will be discussed in detail in Chapter 6. With all three profiles, the output is a step response output to the specified target frequency, thus no acceleration/deceleration parameters are configured.

Velocity Mode: User specifies the target frequency, pulse train duty cycle and the step count. Once initiated, the output will begin pulsing at the target frequency and continue until the step count is reached. With a step count of 0xFFFFFFFF, the pulse output will continue indefinetly until the control program disables the output.

Run to Limit Mode: User specifies target frequency and pulse train duty cycle. A CTRIO module input (C or D) must be configured as a Limit input. When the Limit is reached the pulse output is disabled.

Run to Position Mode: User specifies target frequency, pulse train duty cycle and target position. The current position is obtained from the specified Input Function (i.e. Quadrature counter). When the current position reaches the specified target position, the pulse output is disabled. The comparing of the current and target position can be based on “greater than or equal to” or “less than” values.

Hx-CTRIO2 with Do-more

In addition to the profiles in this manual, when an Hx-CTRIO2 is used with Do-more, Axis Mode instructions are also available. With Axis Mode, it is not necessary to store profiles in the CTRIO2. Instead, profile parameters are specified in a CTAXCFG (CTRIO2 Axis Configuration) instruction. Then other Axis Mode instructions call for motion from the module, which carries out their requests while adhering to the CTAXCFG parameters. Axis Mode instructions also have stage control options for the complete or error events. Stage programming tends to be well suited to motion applications, which are often sequential processes.

Do-more CTRIO2 Axis Mode instructions:

- CTRIO2 Axis Configuration (CTAXCFG)
- CTRIO2 Axis Run Dynamic Position (CTAXDYNP)
- CTRIO2 Axis Run Dynamic Velocity (CTAXDYNV)
- CTRIO2 Axis Run Trapezoid (CTAXTRAP)
- CTRIO2 Axis Run Trapezoid with Limits (CTAXLIMT)
- CTRIO2 Axis Jog (CTAXJOG)

See Do-more Designer help file for more information.

CHAPTER 6

PROGRAM CONTROL

In This Chapter...

Do-more and Program Control

Much of Chapter 6 of this manual does not apply to applications using Do-more as the controller. The section, Pulse Output Profiles (functional descriptions of the various pulse profiles), should be useful to Do-more users as these profiles are available on Do-more as well. However, Do-more users using a CTRIO2 also have Axis Mode profiles available. Each is controlled by a dedicated ladder instruction. Please see Do-more Designer help file for more information on Axis Mode instructions for the CTRIO2.

One of the goals of the development of Do-more was to simplify use of modules such as the CTRIO(2). When used with Do-more, Program Control is handled natively using memory structures and dedicated ladder instructions. There is no CTRIO Memory Map to configure. With Do-more, different CTRIO(2) registers are accessed through data structures, or using the ladder instructions: CTRIO Read Register (CTREGRD) and CTRIO Write Register (CTREGWR).

The data structures and other registers are automatically created when the module is added and relevant features are selected in the CTRIO(2)'s configuration. The data structures have names such as $CTRIO_000_C1F1.AtResetValue. The structure name is broken down as follows:

$CTRIO_000_C1F1.AtResetValue

$ - corresponds to a system address
CTRIO - signifies that this structure pertains to a CTRIO module
000 - is the default designator for a CTRIO module in slot 0
C1F1 - corresponds to input Channel 1, Function 1 (Out0 would refer to Output 0)
.AtResetValue - is the structure member chosen, in this particular case the value will go HIGH when the CTRIO count has been reset to the configured reset value.

Using the DataView tool of Do-more Designer, a list of possible structure members for a configured CTRIO module is shown below.

Function Level Structures

$ctrio_002_c1f1.

- $CTRIO_002_C1F1.AtResetValue
- $CTRIO_002_C1F1.CountCaptured
- $CTRIO_002_C1F1.EnableCapture
- $CTRIO_002_C1F1.fReg1
- $CTRIO_002_C1F1.fReg2
- $CTRIO_002_C1F1.iReg1
- $CTRIO_002_C1F1.iReg2
- $CTRIO_002_C1F1.Reset

Output Level Structures

$CTRIO_002_Out0.

- $CTRIO_002_Out0.AtPosition
- $CTRIO_002_Out0.AtVelocity
- $CTRIO_002_Out0.Direction
- $CTRIO_002_Out0.GotoPosition
- $CTRIO_002_Out0.OutputActive
- $CTRIO_002_Out0.OutputEnabled
- $CTRIO_002_Out0.OutputPosition
- $CTRIO_002_Out0.OutputStalled
- $CTRIO_002_Out0.OutputSuspend
- $CTRIO_002_Out0.OutputVelocity

Module Level Structures

Element

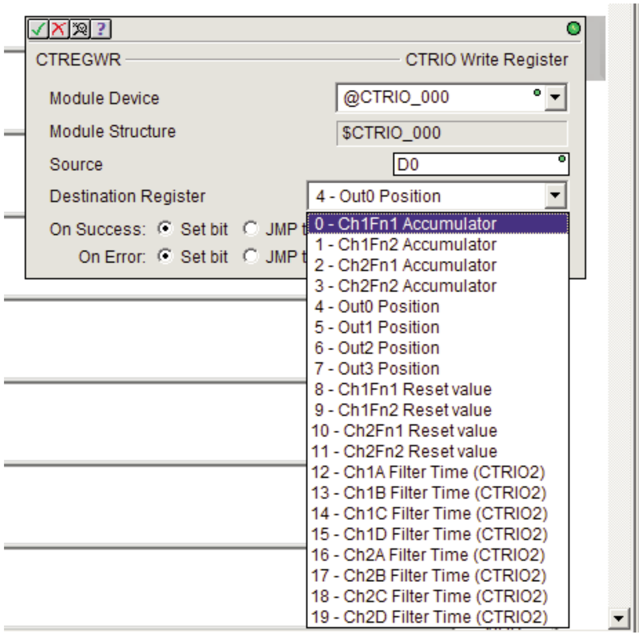
$CTRIO_000.

- $CTRIO_000.Ch1A
- $CTRIO_000.Ch1B
- $CTRIO_000.Ch1C
- $CTRIO_000.Ch1D
- $CTRIO_000.Ch2A
- $CTRIO_000.Ch2B
- $CTRIO_000.Ch2C
- $CTRIO_000.Ch2D
- $CTRIO_000.ErrorCode
- $CTRIO_000.InputState
- $CTRIO_000.MaxScanTime
- $CTRIO_000.Mode
- $CTRIO_000.Out0DiscEnabled
- $CTRIO_000.Out0DiscOn
- $CTRIO_000.Out0PulseActive
- $CTRIO_000.Out0Type
- $CTRIO_000.Out1DiscEnabled
- $CTRIO_000.Out1DiscOn
- $CTRIO_000.Out1PulseActive
- $CTRIO_000.Out1Type
- $CTRIO_000.Out2DiscEnabled
- $CTRIO_000.Out2DiscOn
- $CTRIO_000.Out2PulseActive
- $CTRIO_000.Out2Type
- $CTRIO_000.Out3DiscEnabled
- $CTRIO_000.Out3DiscOn
- $CTRIO_000.Out3PulseActive
- $CTRIO_000.Out3Type
- $CTRIO_000.OutputState
- $CTRIO_000.ScanTime

A list of CTRIO data structures and their definitions can be found in Do-more Designer help file topics for the CTRIO instructions.

Registers not available through structures are accessed using the two ladder instructions, CTREGRD and CTREGWR. An example of the CTREGWR instruction is shown here

For a list of registers available through these instructions, see Do-more Designer help topics DMD0526 and DMD0527.



Input Memory Map for Data Transfers from CTRIO to DL CPUs

The following table shows which memory locations are used for memory transfers from the CTRIO module to the CPU. The starting memory location is defined by the user in the I/O Map within CTRIO Workbench. If you are using the *Direct*LOGIC CPU, you will use the memory address offsets in the second column. If you are using an H2-WinPLC, EBC, PBC, MODBUS, or DEVNETS in the CPU slot, you will use the non-PLC offsets in column one.

Data Type and Offset WinPLC, EBC, PBC, DEVNETS, MODBUS	Address for Inputs (DirectLOGIC)	Definition	Format	Bytes
dwX0	n+0	Ch 1/Fn 1 Parameter 1	DWord	4
dwX1	n+2	Ch 1/Fn 1 Parameter 2	DWord	4
dwX2	n+4	Ch 1/Fn 2 Parameter 1	DWord	4
dwX3	n+6	Ch 1/Fn 2 Parameter 2	DWord	4
dwX4	n+10	Ch 2/Fn 1 Parameter 1	DWord	4
dwX5	n+12	Ch 2/Fn 1 Parameter 2	DWord	4
dwX6	n+14	Ch 2/Fn 2 Parameter 1	DWord	4
dwX7	n+16	Ch 2/Fn 2 Parameter 2	DWord	4
bX0...7 bX8...15	n+20	Ch 1/Fn 1 Status (Low Byte) Ch 1/Fn 2 Status (High Byte)	Word	2
bX16...23 bX24...31	n+21	Ch 2/Fn 1 Status (Low Byte) Ch 2/Fn 2 Status (High Byte)	Word	2
bX32...39 bX40...47	n+22	Output 0 Status (Low Byte) Output 1 Status (High Byte)	Word	2
bX48...55 bX56...63	n+23	Output 2 Status (Low Byte) Output 3 Status (High Byte)	Word	2
bX64..71 bX72...79 bx80...87 bx88 95	n+24	System Functions Read/Write CTRIO Internal Registers (see p. 6-6 for bit definitions)	DWord	4

44 Total Bytes

Input (n) Parameter Definitions

Parameter values are in Decimal format.

Configured Function from CTRIO Workbench	Parameter 1 Contents DWORD	Parameter 2 Contents DWORD
Non-scaled Counter	Raw Input Value	Not Used
Scaled Counter	Scaled Value (pos. or rate)	Raw Value
Non-scaled Counter with Capture	Raw Value	Captured Value
Scaled Counter with Capture	Scaled Value (pos. or rate)	Captured Value
Non-scaled Timer	Previous Time (us)	In Progress Time (us)
Scaled Timer	Scaled Interval (rate)	In Progress Time (us)
Pulse Catch	Not Used	Not Used

***NOTE:** For **Direct**SOFT users: the **I/O Map** dialog displays the exact memory locations in use by the CTRIO module. Within the I/O Map dialog you can print out a report of memory loctions in use.*

Input Function Status Bit Definitions

Input function offsets are listed in the order of Ch1/Fn1, Ch1/Fn2, Ch2/Fn1, Ch2/Fn2

Ch(x)/Fn(x) Status Bits (transfers from CTRIO to CPU)	Bit Offsets: WinPLC, EBC, PBC, DEVNETS, MODBUS	V-memory Offsets DirectLOGIC PLCs
Count Capture Complete Bit	0, 8, 16, 24	20.0, 20.8, 21.0, 21.8
Timer Capture Start	0, 8, 16, 24	20.0, 20.8, 21.0, 21.8
Timer Capture Complete (Timing) OR At Reset Value (Counting)	1, 9, 17, 25	20.1, 20.9, 21.1, 21.9
Timer “Timed Out” Bit	2, 10, 18, 29	20.2, 20.10, 21.2, 21.10
Pulse Catch Output Pulse State	0, 8, 16, 24	20.0, 20.8, 21.0, 21.8
Pulse Catch Start	1, 9, 17, 25	20.1, 20.9, 21.1, 21.9

Output Status Bit Definitions (for Preset Table Control)

Output Status Offsets are listed in the order of the Output 0 - Output 3.

Output(x) Status Bits (transfers from CTRIO to CPU)	Bit Offsets: WinPLC, EBC, PBC, DEVNETS, MODBUS	V-memory Offsets DirectLOGIC PLCs
Command Error	38, 46, 54, 62	22.6, 22.14, 23.6, 23.14
Command Complete	39, 47, 55, 63	22.7, 22.15, 23.7, 23.15

Output Status Bit Definitions (Pulse Output)

Output Status Offsets are listed in the order of the Output 0/1, 2/3.

Status Bit CTRIO to CPU	Bit Offsets: WinPLC, EBC, PBC, DEVNETS, MODBUS	V memory Offsets from Input Start (octal)
Output Enabled	32, 48	22.0, 23.0
Position Loaded	33, 49	22.1, 23.1
Output Suspended	34, 50	22.2, 23.2
Output Active	36, 52	22.4, 23.4
Output Stalled	37, 53	22.5, 23.5
Command Error	38, 54	22.6, 23.6
Command Complete	39, 55	22.7, 23.7

Output Memory Map for Data Transfers from DL CPUs to CTRIO

The following table shows which memory locations are used for memory transfers from the CPU module to the CTRIO. The starting memory location is defined by the user in the I/O Map within CTRIO Workbench. If you are using a *Direct*LOGIC CPU, you will use the memory address offsets in the second column. If you are using a WinPLC, EBC, PBC, DEVNETS or MODBUS interface, you will use the non-PLC offsets in column one.

Data Type and Offset: WinPLC, EBC, PBC, DEVNETS, MODBUS	Address for Inputs (DirectLOGIC)	Definition	Format	Bytes
dwY0	n+0	Output 0 Parameter 3	DWord	4
dwY1	n+2	Output 1 Parameter 3	DWord	4
dwY2	n+4	Output 2 Parameter 3	DWord	4
dwY3	n+6	Output 3 Parameter 3	DWord	4
wY0	n+10	Output 0 Command	Word	2
wY1	n+11	Output 0 Parameter 1	Word	2
wY2	n+12	Output 0 Parameter 2	Word	2
wY3	n+13	Output 1 Command	Word	2
wY4	n+14	Output 1 Parameter 1	Word	2
wY5	n+15	Output 1 Parameter 2	Word	2
wY6	n+16	Output 2 Command	Word	2
wY7	n+17	Output 2 Parameter 1	Word	2
wY8	n+20	Output 2 Parameter 2	Word	2
wY9	n+21	Output 3 Command	Word	2
wY10	n+22	Output 3 Parameter 1	Word	2
wY11	n+23	Output 3 Parameter 2	Word	2
bY0...7 bY8...15	n+24	Ch 1/Fn 1 Control (Low Byte) Ch 1/Fn 2 Control (High Byte)	Word	2
bY16...23 bY24...31	n+25	Ch 2/Fn 1 Control (Low Byte) Ch 2/Fn 2 Control (High Byte)	Word	2
bY32...39 bY40...47	n+26	Output 0 Control (Low Byte) Output 1 Control (High Byte)	Word	2
bY48...55 bY56...63	n+27	Output 2 Control (Low Byte) Output 3 Control (High Byte)	Word	2
bX64..71 bX72...79 bx80...87 bx88 95	n+30	System Functions Read/Write CTRIO Internal Registers (see p. 6-6 for bit definitions)	DWord	4

52 Total Bytes

Output (n) Parameter Definitions (Parameters are in decimal format)

Configured Profile from CTRIO Workbench	Parameter 1 Contents WORD	Parameter 2 Contents WORD	Parameter 3 Contents DWORD
Trapezoid/Trapezoid with Limits	File # of stored profile	Not Used	Not Used
S-Curve, Symmetrical S-Curve	File # of stored profile	Not Used	Not Used
Dynamic Positioning/Positioning Plus	File # of stored profile	Not Used	Target Position

Configured Profile from CTRIO Workbench	Parameter 1 Contents WORD	Parameter 2 Contents WORD	Parameter 3 Contents DWORD
Dynamic Velocity	File # of stored profile	Not Used	Target Velocity
Home Search	File # of stored profile	Not Used	Not Used
Trapezoid Plus	File # of stored profile	Not Used	Target Position
Free Form	File # of stored profile	Not Used	Not Used

NOTE: *For **Direct**SOFT users: the I/O Map dialog displays the exact memory locations in use by the CTRIO module. Within the I/O Map dialog you can print out a report of memory loctions in use.*

Output (n) Parameter Definitions (Parameters are in decimal format unless specified)

Profiles Completely Controlled by User Program	Parameter 1 Contents WORD	Parameter 2 Contents WORD	Parameter 3 Contents DWORD
Velocity Mode	Initial Frequency	Duty Cycle	Number of Pulses (Hex)
Run to Limit Mode	Initial Frequency	Input Edge / Duty Cycle(Hex)	Not Used
Run to Position mode	Initial Frequency	Input Function Comparison and Duty Cycle (Hex)	Input Function Comparison Value

Input Function Control Bit Definitions

Input function offsets are listed in the order of Ch1/Fn1, Ch1/Fn2, Ch2/Fn1, Ch2/Fn2

Ch(n)/Fn(n) Control Bits (transfers from CPU to CTRIO)	Bit Offsets: WinPLC, EBC, PBC, DEVNETS, MODBUS	V-memory Offsets DirectLOGIC PLCs
Enable Count Capture	0, 8, 16, 24	24.0, 24.8, 25.0, 25.8
Enable Timer Capture	0, 8, 16, 24	24.0, 24.8, 25.0, 25.8
Enable Pulse Catch	0, 8, 16, 24	24.0, 24.8, 25.0, 25.8
Reset	1, 9, 17, 25	24.1, 24.9, 25.1, 25.9

Output Control Bit Definitions (for Preset Table Control)

Output Control Offsets are listed in the order of the Output 0 - Output 3.

Output(n) Control Bits (transfers from CPU to CTRIO)	Bit Offsets: WinPLC, EBC, PBC, DEVNETS, MODBUS	V-memory Offsets DirectLOGIC PLCs
Enable Output	32, 40, 48, 56	26.0, 26.8, 27.0, 27.8
Process Command	39, 47, 55, 63	26.7, 26.15, 27.7, 27.15

Output Control Bit Definitions (Pulse Output)

Pulse output control Offsets are listed in the order of Outputs 0/1, 2/3.

Output Control Bit transfers from CPU to CTRIO	Bit Offsets: WinPLC, EBC, PBC, DEVNETS, MODBUS	V memory Offsets from Output Start (octal)	Read as:
Enable Output	32, 48	26.0, 27.0	Level
Go to Position	33, 49	26.1, 27.1	Rising Edge
Suspend Output	34, 50	26.2, 27.2	Level
Direction	36, 52	26.4, 27.4	Level
Process Command	39, 55	26.7, 27.7	Rising Edge

Output Control Bit Definitions (Raw Mode)

Output Control Offsets are listed in the order of the Output 0 - Output 3.

Output(n) Control Bits (transfers from CPU to CTRIO)	Bit Offsets: WinPLC, EBC, PBC, DEVNETS, MODBUS	V-memory Offsets DirectLOGIC PLCs
Enable Output	32, 40, 48, 56	26.0, 26.8, 27.0, 27.8

System Functions Status Bit Definitions

From Table on page 6-2, *Direct*LOGIC Offset (n+24)

Status Bits (transfers from CTRIO to CPU)	V-memory Offsets DirectLOGIC PLCs
System Command Error	24.6
System Command Complete	24.7
Ch1 A	25.0
Ch1 B	25.1
Ch1C	25.2
Ch1D	25.3
Ch2 A	25.4
Ch2 B	25.5
Ch2 C	25.6
Ch2 D	25.7
Out 0 Active	25.8
Out 0 Mode	25.9
Out 1 Active	25.10
Out 1 Mode	25.11
Out 2 Active	25.12
Out 2 Mode	25.13
Out 3 Active	25.14
Out 3 Mode	25.15

System Functions Control Bit Definitions

From Table on page 6-4, *Direct*LOGIC Offset (n+30)

Control Bits (transfers from CPU to CTRIO)	V-memory Offsets DirectLOGIC PLCs
Process System Command	30.7

I/O Map Dialog

The I/O Map dialog is accessible from the main Workbench dialog. On the main Workbench dialog, click the button labeled I/O Map.

The I/O Map dialog divides the controller I/O memory used by the CTRIO module into three groups: Input Functions, Output Functions and System Functions.

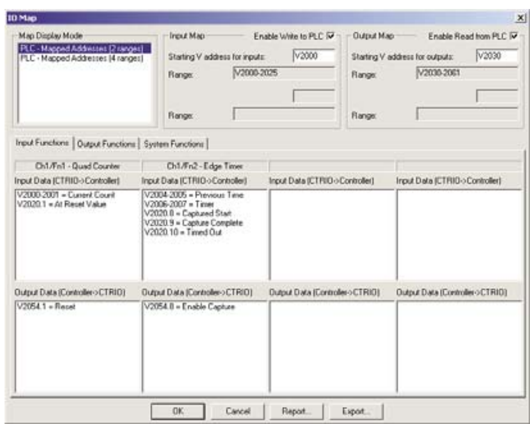
Just below the Map Display Mode field, you will see tabs to switch between Input Functions, Output Functions and System Functions.

Click on the Input Functions tab or Output Functions tab to display the CTRIO module's assigned input or output functions (quad counter, pulse catch, pulse out, discrete out, etc.). For each input and/or output function assigned, the I/O Map dialog displays the Input Data (CTRIO > Controller) addresses and Output Data (Controller > CTRIO) addresses based on the Map Display Mode and the starting I/O addresses specified. The memory map addresses displayed correspond to the offset addresses shown in the tables on the previous pages.

Click on the System Functions tab to display the System Functions addressing. The command bits are used when reading from and writing to the CTRIO's internal registers. The other bits can be used to monitor the status of each individual I/O point on the module.

I/O Map with *Direct*LOGIC PLC (2 ranges mode)

When using the CTRIO module with a *Direct*LOGIC PLC, enter the starting V memory location for the inputs and outputs in the appropriate fields at the top of the I/O Map dialog. In the I/O Map dialog shown below, note that the Input, Output and Systems Functions addresses shown are in word and bit-of-word formats. Thus, word and bit-of-word addressing will need to be used in the ladder logic program to address the CTRIO's control and status words/bits.



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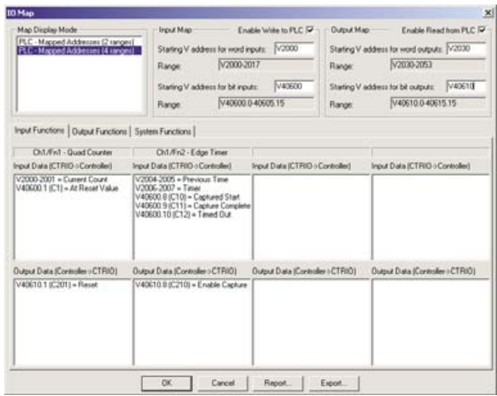
I/O Map with *Direct*LOGIC PLC (4 ranges mode)

When using the CTRIO module with a *Direct*LOGIC PLC in 4 ranges mode, enter the starting V-memory location for the *word* inputs and outputs and the starting V memory location for the *bit* inputs and outputs. Control relays (V40600 range) would usually be used for bit control.

In the I/O Map dialog below, note that Input, Output and Systems Functions addresses shown are in word and Control Relay formats. Thus, word and Control Relay addressing will need to be used in the ladder logic program to address the CTRIO control and status words/bits. Remember that the CTRIO will consume the address ranges listed in all four range fields.



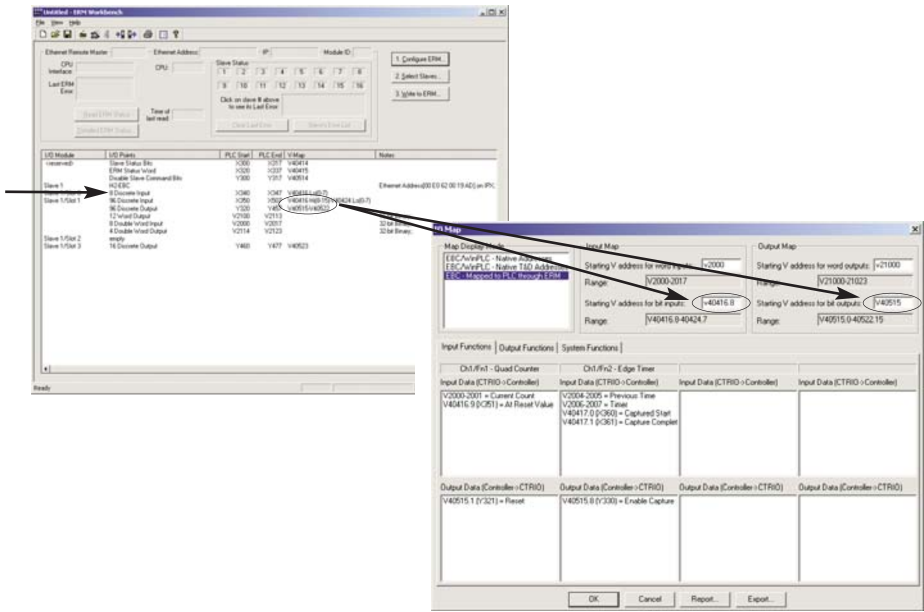
NOTE: *This mode exists specifically for using the CTRIO with the D2-240 CPU. If not using the D2-240 CPU, then use the 2 ranges mode mentioned on the previous page.*

I/O Map with *Direct*LOGIC PLC with CTRIO in ERM/EBC Network

When using the CTRIO module with a *Direct*LOGIC PLC with the CTRIO module in an ERM/EBC network, first configure the ERM network using the ERM Workbench utility. Then, from ERM Workbench, enter the CTRIO's starting input and output V-Map addresses into the CTRIO Workbench's I/O Map starting V memory location for the *bit* inputs and outputs.

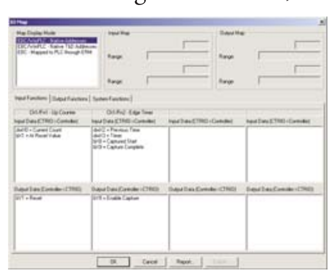
NOTE: *If there is an 8-pt. discrete I/O module preceeding the CTRIO module in the EBC base, enter the the appropriate starting V-memory bit I/O address in CTRIO Workbench with a V40xxx.8 address as shown in I/O Map example below to the right. This corrects the word offset created by the 8-pt. discrete I/O module. In the example below to the left, note that V40416 Hi(**8**-15) is the starting ERM Workbench CTRIO input V-Map location due to the 8-pt. discrete input module preceeding the CTRIO module.*

See Note Above



I/O Map with EBC/WinPLC

When using the CTRIO module in an EBC/WinPLC system (non PLC system), the addressing will be shown as Native EBC/WinPLC addresses or if using Think & Do, the addressing can be shown as Native Think & Do addresses. Just click on the desired mode in the Map Display Mode field. The 8-pt module offset described in the note above does not apply to EBC/WinPLC or EBC/Think&Do systems.

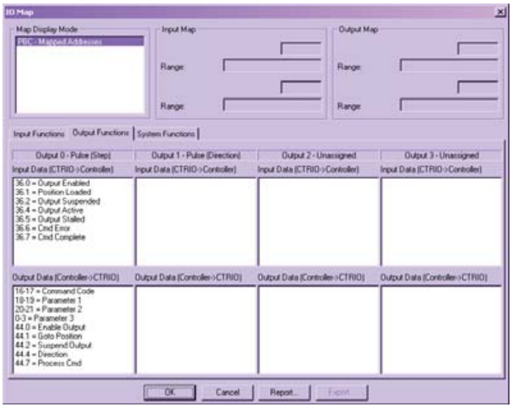


I/O Map with an H2-PBC or T1H-PBC Profibus DP Controller

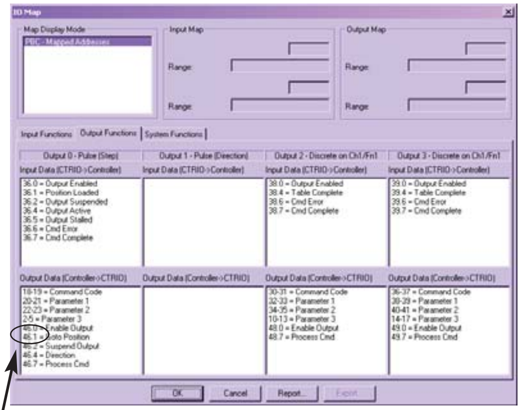
When using the CTRIO module with an H2-PBC or T1H-PBC native Profibus addressing will be displayed in the I/O Map as shown below.

For the T1H-PBC, the first two output bytes of memory are automatically reserved for the Hot Swap base-rescan feature. The H2-PBC does not support the Hot Swap feature.

H2-PBC I/O Map



T1H-PBC I/O Map



Note that output bytes 0-1 are reserved for the Hot Swap base rescan feature.

Creating an offline file for H2/T1H-CTRIO module

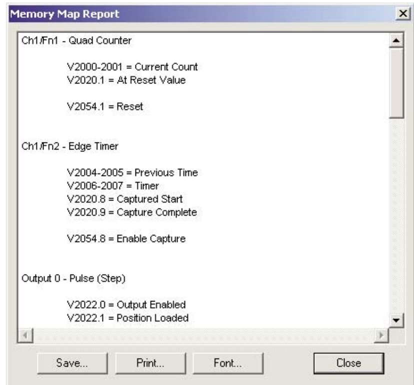
For the T1H-PBC, enter a 2 byte Output Offset to accommodate memory used by the Hot Swap base-rescan feature. This does not apply to an H2-PBC system. The example shown below assumes the T1H-CTRIO module is the first module in the system.

The CTRIO modules consume 44 bytes of input memory and 52 bytes of output memory. The maximum amount of I/O memory per H2/T1H-PBC station is 244 input bytes and 242 output bytes. You may need to refer to the Profibus User Manuals (H2-PBC-M / T1H-PBC-M) for information on bytes used by discrete and/or analog I/O modules to be able to determine the appropriate Starting input and output byte offset addresses for the CTRIO module.

For the T1H-PBC, enter a 2 byte Output Offset to accomodate memory used by the Hot Swap base-rescan feature.

Printing a Memory Map Report

You can print an I/O Memory Map Report from the I/O Map dialog or save as a (.txt) file. Click on the Report button located near the bottom of the I/O Map dialog to display the Memory Map Report dialog.



The addresses listed in the Memory Map Report are a combination of the Input Functions, Output Functions and Systems Functions addresses shown in the I/O Map dialog. It is very convenient to have a printed list of the CPU/controller I/O memory used by the CTRIO module when attempting to write the control program.

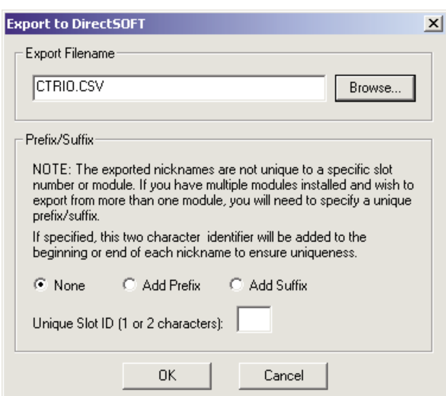
6

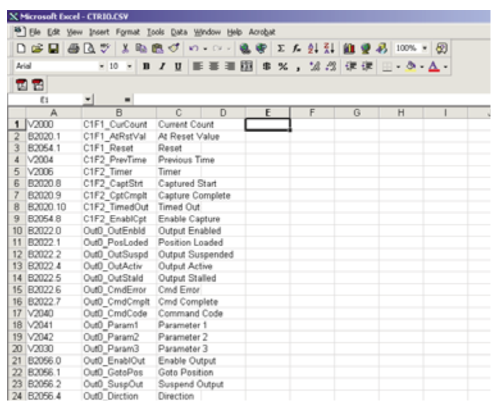
Exporting to *Direct*SOFT

You can export a (.csv) file containing addressing and nicknames used in the I/O Map dialog. Click on the Export button located near the bottom of the I/O Map dialog to display the Export to ***Direct***SOFT dialog shown below on the left.

The (.csv) file (shown below on right) contains a combination of the Input Functions, Output Functions and Systems Functions addressing and nicknames shown in the I/O Map dialog. This file can imported into your ***Direct***SOFT ladder logic program (***Direct***SOFT>File>Import>Element Documentation).

If you have more than one CTRIO module in a system and intend to create a (.csv) file for more than one module, use the Add Prefix or Add Suffix option to distinguish one module's nicknames from the others. For example, add add prefix or suffix "S1" to identify the CTRIO module's nicknames in slot 1.





Addressing Conventions (with V-memory Examples for *Direct*LOGIC PLCs)

Example for Bit-accessed Data in PLC CPUs

In this example, the V-memory location V2524 contains a value equal to 514 in decimal.

514 decimal = 0202 Hex = 0000 0010 0000 0010 binary

The bit V2524.1 refers to the 2nd to the least significant bit (set to 1 in this example). Likewise, V2524.9 refers to bit number 9, the 10th from the least significant bit (also set to 1 in this example).

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
V2524	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0

V2524.9 = 1

V2524.1 = 1

Addressing High and Low Byte of Word Parameters

In the following example, the V-memory location V2510 contains a value equal to 3 (decimal) in the high byte and 10 (decimal) in the low byte.

3 decimal = 03 Hex = 0000 0011 binary in the high byte, and

10 decimal = 0A Hex = 0000 1010 binary in the low byte.

This example could represent the Command Code "Edit Table Entry." The value 03 (Hex) would represent the File number in the high byte, and the 0A (Hex) would represent the remainder of the Command Code in the low byte.

	High Byte								Low Byte							
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
V2510	0	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0
	High Nibble				Low Nibble				High Nibble				Low Nibble			

Addressing High and Low Word of DWord Parameters

Double Word parameters are addressed in a similar fashion to the high and low bytes of a Word Parameter. For example, a DWord that begins in V2300 consumes both V2300 and V2301. The Low Word is V2300, and the High Word is V2301.

Input Function Status/Control Bits and Parameters

Input Function Status Bit Definitions

Input function offsets are listed in the order of Ch1/Fn1, Ch1/Fn2, Ch2/Fn1, Ch2/Fn2

Ch(x)/Fn(x) Status Bits (transfers from CTRIO to CPU)	Bit Offsets: WinPLC, EBC, PBC, DEVNETS, MODBUS	V-memory Offsets DirectLOGIC PLCs
Count Capture Complete Bit	0, 8, 16, 24	20.0, 20.8, 21.0, 21.8
Timer Capture Start	0, 8, 16, 24	20.0, 20.8, 21.0, 21.8
Timer Capture Complete (Timing) OR At Reset Value (Counting)	1, 9, 17, 25	20.1, 20.9, 21.1, 21.9
Timer “Timed Out” Bit	2, 10, 18, 29	20.2, 20.10, 21.2, 21.10
Pulse Catch Output Pulse State	0, 8, 16, 24	20.0, 20.8, 21.0, 21.8
Pulse Catch Start	1, 9, 17, 25	20.1, 20.9, 21.1, 21.9

Input Function Control Bit Definitions

Input function offsets are listed in the order of Ch1/Fn1, Ch1/Fn2, Ch2/Fn1, Ch2/Fn2

Ch(n)/Fn(n) Control Bits (transfers from CPU to CTRIO)	Bit Offsets: WinPLC, EBC, PBC, DEVNETS, MODBUS	V-memory Offsets DirectLOGIC PLCs
Enable Count Capture	0, 8, 16, 24	24.0, 24.8, 25.0, 25.8
Enable Timer Capture	0, 8, 16, 24	24.0, 24.8, 25.0, 25.8
Enable Pulse Catch	0, 8, 16, 24	24.0, 24.8, 25.0, 25.8
Reset	1, 9, 17, 25	24.1, 24.9, 25.1, 25.9

Input Function Status DWord Parameters

Input function offsets are listed in the order of Ch1/Fn1, Ch1/Fn2, Ch2/Fn1, Ch2/Fn2 and are in decimal format.

DWord Status CTRIO to CPU	DWord Offsets: WinPLC, EBC, PBC, DEVNETS, MODBUS	V-memory Offsets from Output Start (octal)
DWord Parameter 1	0, 2, 4, 6	0, 4, 10, 14
DWord Parameter 2	1, 3, 5, 7	2, 6, 12, 16

Configured Function from CTRIO Workbench	Parameter 1 Contents DWORD	Parameter 2 Contents DWORD
Non-scaled Counter	Raw Input Value	Not Used
Scaled Counter	Scaled Value (pos. or rate)	Raw Value
Non-scaled Counter with Capture	Raw Value	Captured Value
Scaled Counter with Capture	Scaled Value (pos. or rate)	Captured Value
Non-scaled Timer	Previous Time (us)	In Progress Time (us)
Scaled Timer	Scaled Interval (rate)	In Progress Time (us)
Pulse Catch	Not Used	Not Used

***NOTE:**: If you select the 'discrete on chx/fnx' option for an input channel using pulse catch mode, you will get a message when you exit the I/O config screen noting 'pulse follower mode' or 'Pulse extension mode' for this output channel. This means only that the output will pulse for the specified duration when the input receives a sufficiently long pulse input.*

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Example Input Control/Status Bits and Parameter Register Addresses

The following tables provide example addresses based on V2000 selected for the base input address and V2030 selected for the base output address. The Input Functions discussed on the following pages use these example addresses.

Status Registers: Example using V2000 as base input address for Input Channel 1 (Status bits and DWords received from CTRIO to CPU)

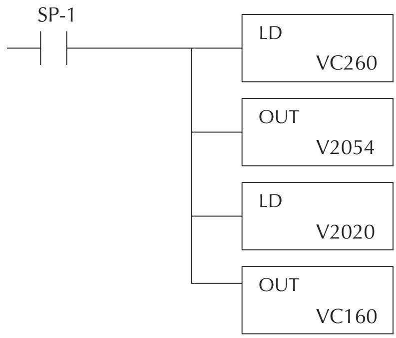
Name	PLC Example 1: Bit-of-Word (see note 2) D2-250-1/260, D4-450	PLC Example 2: Control Relay (see note 1) D2-240	Value
Counter Capture Complete Bit	V2020.0	C160	ON when Capture is complete
Timer Capture Starting	V2020.0	C160	On when Timer Capture begins
Timer Capture Complete (Timing) OR At Reset Value (Counting)	V2020.1	C161	ON when Timer Capture complete
Timer “Timed Out” Bit	V2020.2	C162	On when specified Timer “Time Out” period is exceeded
Pulse Catch Output Pulse State	V2020.0	C160	ON for the specified pulse time if input pulse qualifies as a valid pulse
Pulse Catch Starting	V2020.1	C161	ON when pulse edge occurs
Parameter 1	V2001-V2000	V2001-V2000	Decimal
Parameter 2	V2003-V2002	V2003-V2002	Decimal

Control Registers: Example using V2030 as base output address for Input Channel 1 (Control bits sent from CPU to CTRIO)

Name	PLC Example 1: Bit-of-Word (see note 2), D2-250-1/260, D4-450	PLC Example 2: Control Relay (see note 1), D2-240 CPU	# Format
Enable Counter Capture	V2054.0	C260	Bit
Enable Timer Capture	V2054.0	C260	Bit
Enable Pulse Catch	V2054.0	C260	Bit
Reset	V2054.1	C261	Bit

Memory Mapping Example for D2-240 CPU

***NOTE 1:** The D2-240 CPU does not support bit-of-word addressing. The status and control bits must be mapped to control relay words. An example of mapping code is shown below.*



***NOTE 2:** For example, **Direct**SOFT uses B2020.1 in the ladder code to indicate that you are addressing the second bit of V-memory register 2020. The "B" prefix indicates bit-of-word addressing.*

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Input Functions

Counter & Quadrature Counter

Parameters 1 and 2 are explained on page 6-16 and will be mapped to V2000 - V2003 in this example. If input D is configured for count Capture, the Enable Count Capture bit must be ON in order for input D to be able to snapshot the current count. The Count Capture Complete bit is used to indicate the acquisition has occurred. The program will need to turn OFF the Enable Capture and confirm the Capture Complete bit resets before attempting the next count capture. The Reset bit will reset raw and scaled values to the specified reset value. The last captured value, if applicable, will remain.

Name	PLC Control Outputs Base Addr = V2030 (Bit-of-Word)	PLC Status Inputs Base Addr = V2000 (Bit-of-Word)	PLC Control Outputs Base Addr = V2030 (Control Relay) D2-240	PLC Status Inputs Base Addr = V2000 (Control Relay) D2-240	Description
Parameter 1		V2001-V2000		V2001-V2000	refer to table on page 6-16
Parameter 2		V2003-V2002		V2003-V2002	refer to table on page 6-16
Counter Capture Complete		V2020.0		C160	On when Count Capture is complete (Available only when input D is configured for Capture input)
Enable Count Capture	V2054.0		C260		Turn ON to Capture Count (Available only when input D is configured for Capture input)
Reset	V2054.1		C261		Turn ON to Reset Counter Value to Reset Value
At Reset Value		V2020.1		C161	On when Counter is at Reset Value

Edge Timer and Dual Edge Timer

Parameters 1 and 2 are explained on page 6-16 and will be mapped to V2000 - V2003 in this example.

Standard Timers:
When the Enable Timer Capture bit is ON and the configured input edge occurs, the CTRIO will begin timing. The Timer Capture Starting bit will be ON while the timing is in progress and will turn OFF when the next configured input edge occurs and the Timer Capture Complete bit turns ON. The program will need to turn off the Enable Timer Capture bit, and confirm the Timer Capture Starting and Timer Capture Complete bits reset before attempting the next time capture cycle. Turning OFF the Enable Timer Capture bit resets the timers register values to zero.

Free Run Timers:
If the Free Run Timer option was configured, the Enable Timer Capture bit is not available. When the configured input edge occurs, the CTRIO will begin timing. The Timer Capture Starting bit will be ON while the timing is in progress and will turn OFF when the next configured input edge occurs. When this edge occurs, the Timer "in progress time" register resets to zero. The "previous time" register will always retain the most recent captured time value.

Name	PLC Control Outputs Base Addr = V2030 (Bit-of-Word)	PLC Status Inputs Base Addr = V2000 (Bit-of-Word)	PLC Control Outputs Base Addr = V2030 (Control Relay) D2-240	PLCStatus Inputs Base Addr = V2000 (Control Relay) D2-240	Description
Parameter 1		V2001-V2000		V2001-V2000	Previous Time
Parameter 2		V2003-V2002		V2003-V2002	In Progress Time
Timer Capture Starting		V2020.0		C160	On when Time Capture is in progress
Enable Timer Capture	V2054.0		C260		Turn ON to Enable Timer Capture Function (Not available when Free Run Timer option is selected)
Timer Capture Complete		V2020.1		C161	On when Timing is complete
Timer Timeout Bit		V2020.2		C162	

Edge and Dual Edge Timer Timeout Function

The Timer Timeout Function is available for use with standard and Free Run Timers. It is primarily used in Free Run timing of recurring events (rate, velocity calculations, etc.). The specified Timeout Period is in effect once the timer is enabled until receiving the first configured input edge. Then it is in effect until receiving the next edge of the timing input to complete the timing cycle.

Standard Timers:
Once the timer is enabled, the Timeout Bit is set if the time that it takes the CTRIO to see the configured input edge exceeds the specified Timeout Period. The program will need to turn off the Enable Timer Capture bit, and confirm the Timer Capture Complete bit and Timeout bit resets before attempting the next time capture cycle.

Once timing has been initiated, if the time before the CTRIO sees the next configured edge exceeds the specified Timeout Period, the Timeout bit is set. The Timer register values are reset to zero. The program will need to turn off the Enable Timer Capture bit, and confirm the Timer Capture Starting bit, Timer Capture Complete bit and the Timeout bit reset before attempting the next time capture cycle.

Free Run Timers:
The Timeout Bit is set if the time that it takes the CTRIO to see the configured input edge exceeds the specified Timeout Period. The Timeout bit resets when the next timing cycle begins. The “Previous Time” register value is reset to zero.

Once timing has been initiated, if the time before the CTRIO sees the next configured edge exceeds the specified Timeout Period, the Timeout bit is set. The Timer register values are reset to zero. The Timeout bit resets when the next timing cycle begins.

Pulse Catch Input Function

When the Enable Pulse Catch bit is ON and the configured input edge occurs, the CTRIO will begin timing and the Pulse Catch Starting bit will turn ON. If the input signal remains active for the specified qualification period, the Pulse Catch Output Pulse State bit will turn ON for the configured duration. If a discrete output is assigned to follow the pulse state, it will also turn ON for the configured duration. Unlike the Count or Time capture, the Pulse Catch function is automatically reset as long as the Enable Pulse Catch bit remains ON.

Name	PLC Control Outputs Base Addr = V2030 (Bit-of-Word)	PLC Status Inputs Base Addr = V2000 (Bit-of-Word)	PLC Control Outputs Base Addr = V2030 (Control Relay) D2-240	PLCStatus Inputs Base Addr = V2000 (Control Relay) D2-240	Description
Pulse Catch Starting		V2020.0		C160	On when Pulse Catch is in progress
Enable Pulse Catch	V2054.0		C260		Turn ON to Enable Pulse Catch Function
Pulse Catch Output Pulse State		V2020.1		C161	ON for the Pulse Output Width duration specified in Configure I/O

NOTE: *The CTRIO will not recognize any input pulses while the Output Pulse is active. Take this into consideration when configuraing the Pulse Output Width time.*

Runtime Changes to CTRIO Configured Preset Tables (DL PLCs)

Presets and preset tables can be set up entirely within CTRIO Workbench so that no program control is necessary to assign discrete Preset Tables to CTRIO Input Fuctions.

You can make runtime edits to presets / preset tables from your control program. To make a runtime change, a series of commands must be executed which will pass new values to a preset table or call a different preconfigured table.

Command Codes are passed to the CTRIO module to effect the required edit. Each Command Code has its own syntax, and all Command Codes must be presented in a particular sequence:

The command code and associated parameters must be loaded into the appropriate memory locations.

A Process Command instruction must be passed to the CTRIO module.

A Command Complete signal must be received and the Command Error bit must stay at zero.

Finally, the Enable Output instruction must be passed to the CTRIO module.

Some changes require a combination of Command Codes so those changes must follow the steps above for each Command Code processed.

(Output Control and Status Offsets are listed in order of Output 0 - Output 3)

Control Bit (transfers from CPU to CTRIO)	Bit Offsets: WinPLC, EBC, PBC, DEVNETS, MODBUS	V-memory Offsets DirectLOGIC PLCs
Enable Output	32, 40, 48, 56	26.0, 26.8, 27.0, 27.8
Process Command	39, 47, 55, 63	26.7, 26.15, 27.7, 27.15

Status Bit (transfers from CTRIO to CPU)	Bit Offsets: WinPLC, EBC, PBC, DEVNETS, MODBUS	V-memory Offsets DirectLOGIC PLCs
Command Error	38, 46, 54, 62	22.6, 22.14, 23.6, 23.14
Command Complete	39, 47, 55, 63	22.7, 22.15, 23.7, 23.15

In order to process a command, first the program must load the Command and Required Word and DWord Parameters. Then the program should drive the Process Command bit to a 1 and look for the CTRIO to acknowledge the command with the Command Complete bit. Finally the program should remove the Process Command bit and set the Enable Output bit when appropriate. If the Command Error bit is received, the CTRIO was unable to process the command due to an illegal value in either the Command Code or Parameter fields.

Word Control CPU to CTRIO	Word Offsets: WinPLC, EBC, PBC, DEVNETS, MODBUS	V-memory Offsets from Output Start (octal)
Command Code	0, 6	10, 16
Word Parameter 1	1, 7	11, 17
Word Parameter 2	2, 8	12, 20

DWord Control CPU to CTRIO	DWord Offsets: WinPLC, EBC, PBC, DEVNETS, MODBUS	V-memory Offsets from Output Start (octal)
DWord Parameter 3	0, 2	0, 4

Command DirectLOGIC n+10	Code Hex/BCD	Parameter 1 (Word) DirectLOGIC n+11	Parameter 2 (Word) DirectLOGIC n+12 (decimal)	Parameter 3 (DWord) DirectLOGIC n+0/n+1 (decimal)
Load Table from RAM	10	File Number (decimal)	-	-
Clear RAM Table[6]	11	-	-	-
Initialize RAM Table	12	Entry Type (decimal)	Pulse Time[1]	Preset Count/Time[4]
Add Table Entry[6]	13	Entry Type (decimal)	Pulse Time[1]	Preset Count/Time[4]
Edit Table Entry[6]	File &[2] 14	Entry Num. &[2] Entry Type[3] (Hex/BCD)	Pulse Time[1]	Preset Count/Time[4]
Write RAM to ROM[6]	99[5]	-	-	-
Edit and Reload[6]	File &[2] 15	Entry Num. &[2] Entry Type[3] (Hex/BCD)	Pulse Time[1]	Preset Count/Time[4]
Initialize Table on Reset[6]	16	Entry Type (decimal)	Pulse Time[1]	Preset Count/Time[4]
Run to Position[6]	22	-	-	Target Position
Edit Level Response[6]	30	Level Behavior (decimal)	Deadband	Level Rate Setting

[1] If appropriate for Entry Type (in ms).

[2] Field entries separated by an “&” are to be loaded in the high byte and low byte of that word. See example on page 6-7.

[3] Entry types are defined below.

[4] Follows format of Input DWord Parameter 1.

[5] Flash ROM is rated for 100,000 writes.

[5] Counter/Quad Counter Reset must be ON to perform the Edit.

Entry Number for Edit Table Entry Commands

The Entry Number refers to the position of the preset in the table sequence. The first preset is Entry Number “0,” the second preset is “1,” and so forth.

Entry Type for Edit Table Entry Commands

The Entry Type is defined according to the table below.

Entry Type	Code	Notes
Write Output ON (Set)	0	-
Write Output OFF (Reset)	1	-
Pulse Output ON	2	-
Pulse Output OFF	3	-
Toggle Output	4	-
Reset Function	5	Edits preset that resets count

Discrete Outputs Driven from a Scaled level (Edit Level Response: Command Code 30)

If a Counter or Timer function is scaled to produce a rate, alarm level settings can be used to trigger discrete outputs at values predetermined by the user. The alarm levels can be set within CTRIO Workbench or from the user's control program.

Additionally, a deadband percentage (in tenths of a percent) can be set to prevent the output from changing too frequently near the Rate Level threshold.

"ON when greater" condition example:
Consider a Discrete Output set to turn ON when a level gets to 100 with a 10% deadband. The output will turn ON when the level gets to 100. If the level drops, the output will stay on until the level drops below 90, where it will turn OFF.

"OFF when less" condition example:
Consider a Discrete Output set to turn "OFF when less"at 100. When the level gets to 100, the output turns OFF. If the level rises again, the output will stay OFF until the level gets to 110, where it will turn ON.

Edit the behavior of a Discrete Output triggered by a Rate Level by using the "Edit Level Response Command" (Command Code 30Hex).

The Level Behavior setting for Parameter 1 is given in the table below:

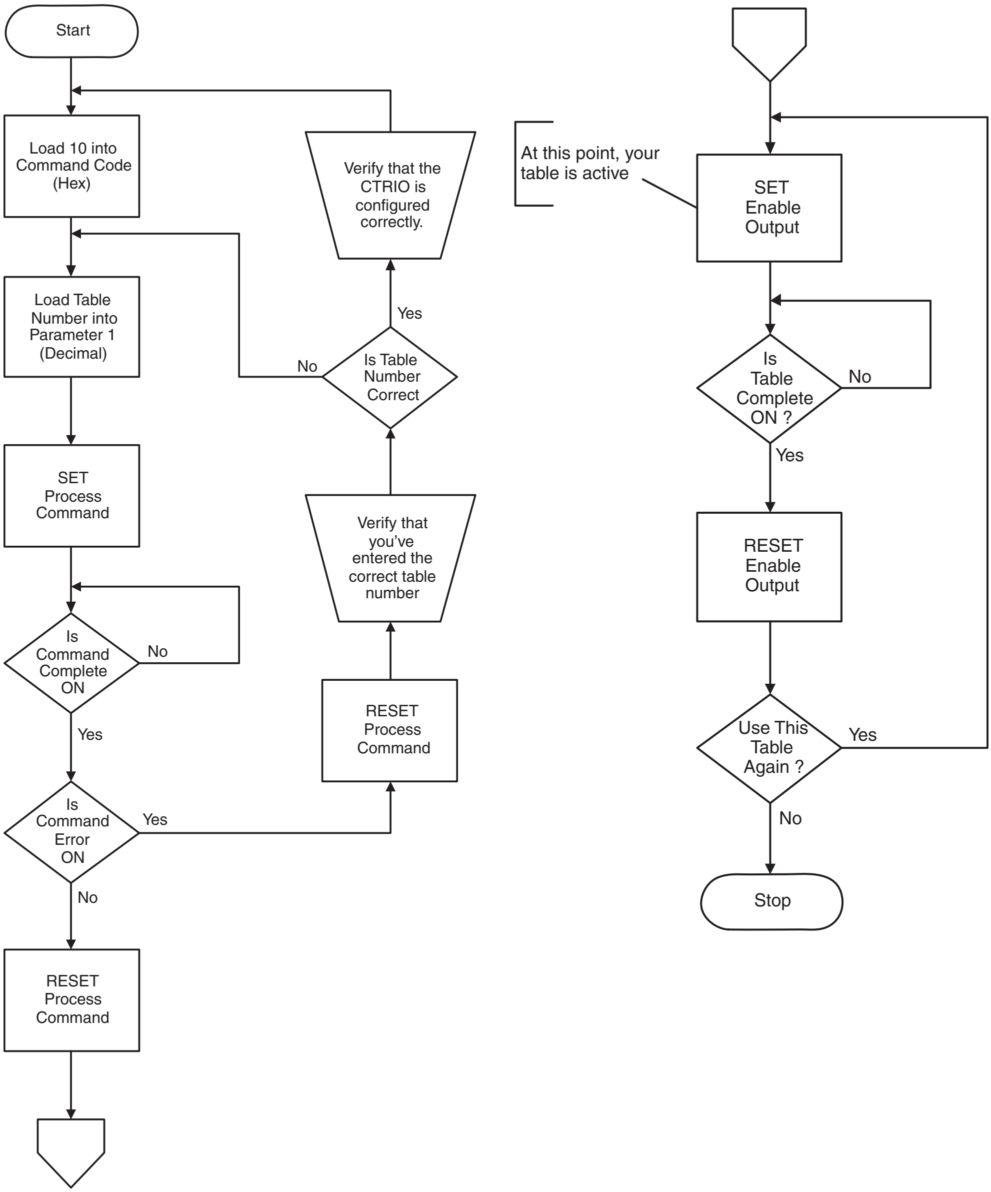
Level Behavior for Discrete Output	Parameter 1 Contents
ON when greater than Level Rate setting	0000 Hex
ON when less than Level Rate setting	0080 Hex
OFF when greater than Level Rate setting	0001 Hex
OFF when less than Level Rate setting	0081 Hex

The Deadband is written to Parameter 2 as a x10 integer (one implied decimal position). To achieve a 10.0% deadband, the control program needs to write 100 decimal (64 Hex) to Parameter 2.

The Level Rate setting is written to Parameter 3 in the same format as Input Parameter 1 of the CTRIO Function to which this Discrete Output has been assigned.

Load Preset Table Flowchart

The flowchart below provides the logical sequence necessary to load and execute a discrete output preset table.



Pulse Output Status/Control Bits and Command Codes (DL PLCs)

Output Status Bit Definitions (Pulse Output)

Pulse output control Offsets are listed in the order of Outputs 0/1, 2/3.

Status Bit CTRIO to CPU	Bit Offsets: WinPLC, EBC, PBC, DEVNETS, MODBUS	V memory Offsets from Input Start (octal)
Output Enabled	32, 48	22.0, 23.0
Position Loaded	33, 49	22.1, 23.1
Output Suspended	34, 50	22.2, 23.2
Output Active	36, 52	22.4, 23.4
Output Stalled	37, 53	22.5, 23.5
Command Error	38, 54	22.6, 23.6
Command Complete	39, 55	22.7, 23.7

Output Control Bit Definitions (Pulse Output)

Pulse output control Offsets are listed in the order of Outputs 0/1, 2/3.

Control Bit CPU to CTRIO	Bit Offsets: WinPLC, EBC, PBC, DEVNETS, MODBUS	V memory Offsets from Output Start (octal)	Read as:
Enable Output	32, 48	26.0, 27.0	Level
Go to Position	33, 49	26.1, 27.1	Rising Edge
Suspend Output	34, 50	26.2, 27.2	Level
Direction	36, 52	26.4, 27.4	Level
Process Command	39, 55	26.7, 27.7	Rising Edge

Output Control (D)Words (Pulse Output)

Pulse output control Offsets are listed in the order of Outputs 0/1, 2/3.

Word Control CPU to CTRIO	Word Offsets: WinPLC, EBC, PBC, DEVNETS, MODBUS	V-memory Offsets from Output Start (octal)
Command Code	0, 6	10, 16
Word Parameter 1	1, 7	11, 17
Word Parameter 2	2, 8	12, 20

DWord Control CPU to CTRIO	Word Offsets: WinPLC, EBC, PBC, DEVNETS, MODBUS	V-memory Offsets from Output Start (octal)
DWord Parameter 3	0, 2	0, 4

Command Code and Parameter Definitions

Command	Code (Hex/BCD)	Word Parameter 1 (decimal)	Word Parameter 2	DWord Parameter 3
Load Table from ROM	10	Trapezoid or S-curve Symmetrical S-Curve Home Search File Number	-	-
Load Table from ROM	10	Dynamic Positioning File Number	-	Target Position (decimal)
Load Table from ROM	10	Dynamic Velocity File Number	-	Target Velocity (decimal)
Velocity Mode	20	Run Frequency (20Hz - 25KHz)	Duty Cycle (0 to 99)* (decimal)	Number of Pulses (BCD/Hex)
Run to Limit Mode	21	Run Frequency (20Hz - 25KHz)	Edge & Duty Cycle (0 to 99)* (Hex/BCD)	-
Run to Position Mode	22	Run Frequency (20Hz - 25KHz)	Compare Function & Duty Cycle (0 to 99)* (Hex/BCD)	Desired Input Function Value (decimal)

* A value of 0 will generate a duty cycle of 50%

Fields above separated by an “&” indicate a code with different definitions for each byte (high byte and low byte). For example, to enter the Pulse Output to Limit command, set the high byte of the Word Parameter 2 to the edge you wish to terminate the output pulses (see definition following), and set the low byte to the desired duty cycle.

In order to process a command, first the program must load the Command Code and required DWord, Word, and bit parameters. Then the program should drive the Process Command bit to a 1 and look for the CTRIO to acknowledge the command with the Command Complete bit. Finally, the program should remove the Process Command bit and set the Enable Output bit when appropriate. If the Command Error bit is received, the CTRIO was unable to process the command due to an illegal value in either the Command Code or parameter files.

DWord and Word values for pulse outputs are unsigned integers.

Status Bits: Example using V2000 as base input address For Output Channel 1 (Status bits received from CTRIO to CPU)

Name	PLC Example 1: Bit-of-Word (see note 2) D2-250-1/260, D4-450	PLC Example 2: Control Relay (see note 1) D2-240	Value
Output Enabled	V2022.0	C120	ON when Enable Output is ON
Position Loaded	V2022.1	C121	Used for Dynamic Positioning
Output Suspended	V2022.2	C122	ON when Output pulse is suspended
Output Active	V2022.4	C124	ON when Output is Pulsing
Output Stalled	V2022.5	C125	CTRIO Output Fault (should never be ON)
Command Error	V2022.6	C126	ON if Command or Parameters are invalid
Command Complete	V2022.7	C127	ON if Module Receives Process Command

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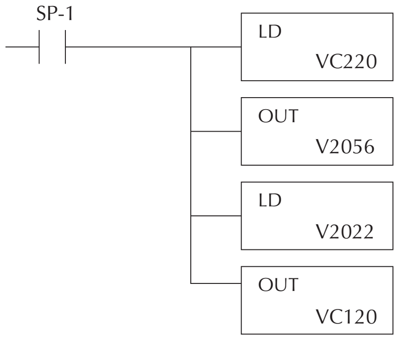
Control Bits/Registers: Example using V2030 as base output address for Output Channel 1 (Control DWords, Words, and bits sent from CPU to CTRIO)

Name	PLC Example 1: Bit-of-Word (see note 2), D2-250-1/260, D4-450	PLC Example 2: Control Relay (see note 1), D2-240 CPU
Command Code	V2040	V2040
Parameter 1	V2041	V2041
Parameter 2	V2042	V2042
Parameter 3	V2031 - V2030	V2031 - V2030
Enable Output	V2056.0	C220
Go to Position	V2056.1	C221
Suspend Output	V2056.2	C222
Direction	V2056.4	C224
Process Command	V2056.7	C227

Memory Mapping Example for D2-240 CPU

NOTE 1: *The D2-240 CPU does not support bit-of-word addressing. The status and control bits must be mapped to control relay words. An example of mapping code is shown below.*



NOTE 2: *For example,* ***Direct****SOFT uses B2022.2 in the ladder code to indicate that you are addressing the third bit of V-memory register 2022. The "B" prefix indicates bit-of-word addressing.*

Pulse Output Profiles (DL PLCs)

Loading a pre-defined Pulse Profile is the easiest method for pulse output motion control (Command Code = 0010 Hex/BCD). For the Trapezoid, S-Curve, Symmetrical S-Curve, Home Search and Free Form profiles, all of the required characteristics of acceleration, run frequency, and total pulse count, etc. are entered in the CTRIO Workbench Pulse Profile entry window. For Dynamic Positioning, Dynamic Positioning Plus, Trapezoid Plus, Trapezoid with Limits and Dynamic Velocity profiles, the target position and target velocity are stored in a memory location in the controller. All other profile characteristics are entered in the CTRIO Workbench Pulse Profile entry window.

For Velocity Mode (Command Code = 0020 Hex/BCD), Run to Limit Mode (Command Code = 21 Hex/BCD) and Run to Position Mode (Command Code = 22 Hex/BCD) all profile parameters are stored in the controller's memory registers. No CTRIO Workbench Pulse Profile is required.

In order to process a command, first the program must load the Command Code and required DWord, Word, and bit parameters. Then the program should drive the Process Command bit to a 1 and look for the CTRIO to acknowledge the command with the Command Complete bit. Finally, the program should remove the Process Command bit and set the Enable Output bit when appropriate. If the Command Error bit is received, the CTRIO was unable to process the command due to an illegal value in either the Command Code or parameter files.

On the pages that follow, Pulse Profile and System Functions flowcharts are provided to give an overview of the steps needed to execute a pulse output profile or a SystemFunctions command. ***Direct***LOGIC PLC addressing tables are also provided with CTRIO I/O data mapped in the word and CR bit areas of CPU memory shown on page 6-29.

Trapezoid, S-Curve, Symmetrical S-Curve, Home Search, Free Form Profiles

For predefined Trapezoid, S-Curve, Symmetrical S-Curve, Home Search and Free Form profiles, the program needs to prepare the Load Table command by selecting Command Code = 0010 Hex/BCD and setting Word Parameter 1 to the File number of the profile (example: File 1 Trapezoid 1). Then the program can set the Process Command bit and watch for the Command Complete bit. Then the program should clear the Process Command bit and set the Direction bit (if necessary) and finally the Enable Output bit to start the output pulses. Clearing the Enable Output bit will always suspend pulsing and reset any profile in progress to it's beginning . Once complete, the profile remains loaded and can be restarted by clearing the Enable Output, changing the direction bit (if desired), and again setting the Enable Output. The flowchart on the next page provides the logical sequence necessary to execute a Trapezoidal, S-Curve, Symmetrical S-Curve, Home Search or Free Form pulse profile.

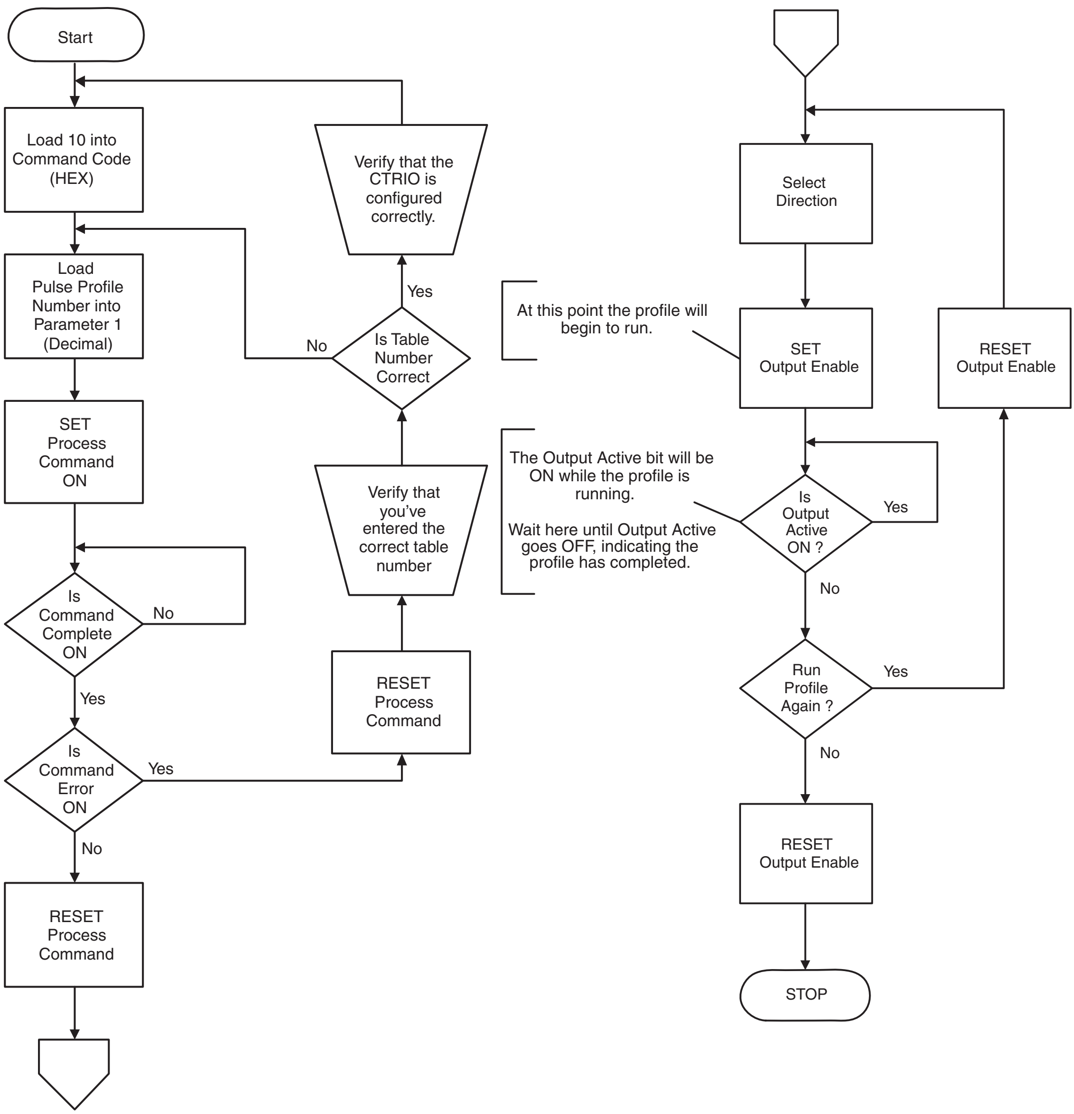
For the Home Search routine, a CTRIO input must be assigned to Limit by the CTRIO Workbench Configure I/O dialog.

See Chapter 8 for a ***Direct***LOGIC programming example that loads and runs a pulse profile using the bit/(D)word addressing in the table on the page 6-34.

NOTE: *For a Home Search Profile: if you are at the home position and the Home Search profile is initiated, there will not be any pulse outputs.*

Trapezoid, S-Curve, Symmetrical S-Curve, Home Search, Free Form Flowchart

The flowchart below provides the logical sequence necessary to execute a Trapezoid, S-Curve, Symmetrical S-Curve, Home Search or Free Form pulse profile.



Running a Trapezoid, S-Curve, Symmetrical S-Curve Profile, Home Search or Free Form Profile on CTRIO Y0 & Y1

Steps	Name	PLC Control Outputs Base Addr = V2030 (Bit-of-Word)	PLC Status Inputs Base Addr = V2000 (Bit-of-Word)	PLC Control Outputs Base Addr = V2030 (Control Relay) D2-240	PLC Status Inputs Base Addr = V2000 (Control Relay) D2-240	Action
1	Command Code	V2040		V2040		Set to 10 (Load Stored Profile)
2	Parameter 1	V2041		V2041		File # of stored profile, determined by user
3	Process Command	V2056.7		C227		Turn ON until Command Complete status bit is returned (see step 4)
4	Command Complete Status		V2022.7		C127	When ON, Profile is now loaded, clear Process Command bit (step 3)
5	Command Error		V2022.6		C126	ON if Command or Parameters are invalid
6	Set Direction	V2056.4		C224		Set ON or OFF for Direction of Rotation
7	Enable Output	V2056.0		C220		Turn ON to start pulses
8	Output Enable Status		V2022.0		C120	When ON, module is confirming Enable Output
9	Output Active Status		V2022.4		C124	When ON, module is pulsing, OFF with Enable Status ON = profile has completed
10	Disable Output	V2056.0		C220		Turn OFF when pulse status is OFF and Enable Status is ON
11	Suspend Output	V2056.2		C222		Turn ON to “pause” output pulses without resetting pulse count
12	Output Suspended		V2022.2		C122	ON when out pulse train has been suspended

Dynamic Positioning and Dynamic Positioning Plus

For Dynamic Positioning/Positioning Plus, only the motion limits of Min Frequency, Max Frequency, and Acceleration rate come from the CTRIO Workbench Profile. After loading a Dynamic Positioning/Positioning Plus Profile, setting the Enable Output causes the CTRIO module to assume a position of 0 pulses. The program should write the next target position in DWord Parameter 3, and set the Go to Position bit. This will cause the CTRIO to set both the Pulses Active and the New Position Loaded bit and begin to output pulses. The number of pulses and direction are determined by the CTRIO based on the difference between the current location and the specified target location. The flowchart on the following page provides the logical sequence necessary to execute this type of pulse profile.

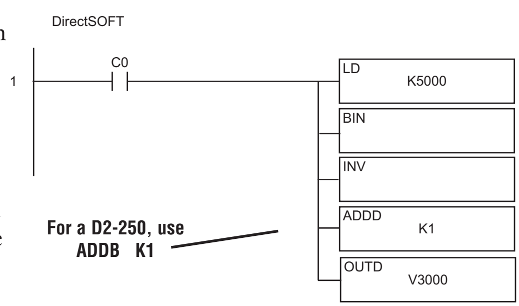
The program can monitor the state of the Pulses Active bit and the New Position Loaded bit to determine when the new position has been attained. The New Position Loaded status bit will always follow the state of the Load/Seek New Position control bit. This status bit should be used to signal the program that the CTRIO has received the new state of the control bit.

Position Loaded Status Bit V40622.1 or C441	Pulses Active Status Bit V40622.0 or c440	CTRIO Pulse Output State
0	0	Idle
1	1	Go To Position Acknowledged, Pulsing
0	1	Still Pulsing, Go To Position Control Bit is OFF
1	0	Go To Position Acknowledged, Position Attained

You do not have to wait on the CTRIO to complete a move that is in progress before loading the next target location. After the GoTo Position is acknowledged, the program can load the next position into the DWord Parameter 3. When Pulses Active Status goes to 0, then setting the GoTo Position control bit will again start the output toward the new position. The CTRIO moves to the new position relative to its previous position as long as the Enable Output control bit remains set. Clearing the Enable Output bit will disable output pulsing and reset the current position to 0.

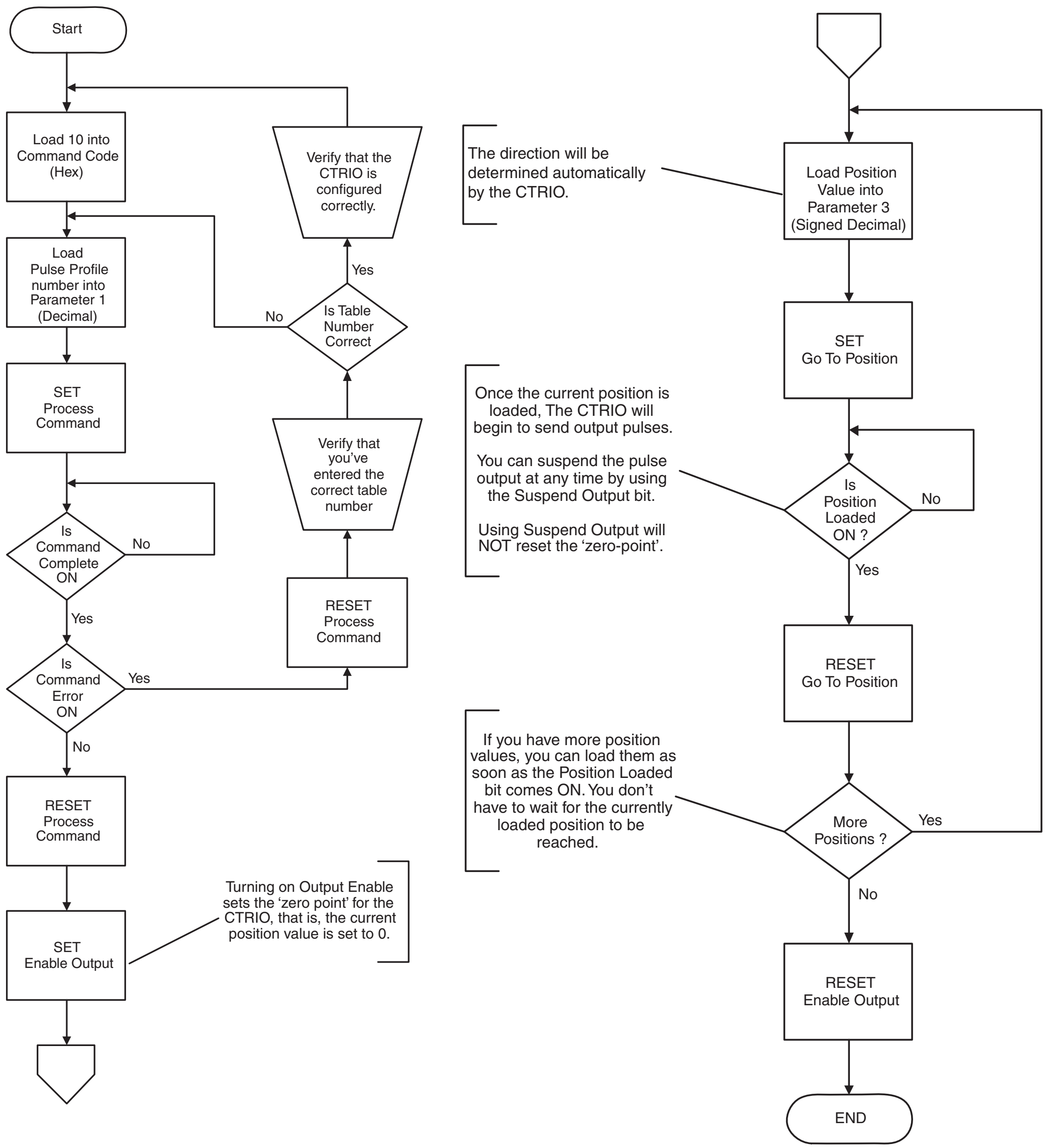
See Chapter 8 for a ***Direct***LOGIC programming example that executes a Dynamic Positioning/Positioning Plus pulse profile using the bit/(D)word addressing in the table on page 6-37.

The sign of the value in the Target Position register (Parameter 3) determines the direction of the pulse train output. In the ***Direct***LOGIC programming example to the right, BCD 5000 is converted to decimal -5000 when C0 is turned ON. You could load (LD) a V memory location instead of using a constant as shown in the example.



Dynamic Positioning or Dynamic Positioning Plus Flowchart

The flowchart below provides the logical sequence necessary to execute a Dynamic Positioning/Positioning Plus pulse profile.



Dynamic Positioning or Dynamic Positioning Plus using the CTRIO Y0 and Y1

Steps	Name	PLC Control Outputs Base Addr = V2030 (Bit-of-Word)	PLC Status Inputs Base Addr = V2000 (Bit-of-Word)	PLC Control Outputs Base Addr = V2030 (Control Relay) D2-240	PLC Status Inputs ase Addr = V2000 (Control Relay) D2-240	Action
1	Command Code	V2040		V2040		Set to 10 (Load Stored Profile)
2	Parameter 1	V2041		V2041		File # of desired Dynamic Positioning Profile
3	Process Command	V2056.7		C227		Turn ON until Command Complete status bit is returned (see step 4)
4	Command Complete Status		V2022.7		C127	When ON, Profile is now loaded, clear Process Command bit (step 3)
5	Command Error		V2022.6		C126	ON if Command or Parameters are invalid
6	Enable Output	V2056.0		C220		Turn ON to assume 0 position, Turn OFF to disable pulses and zero position
7	Output Enable Status		V2022.0		C127	When ON, pulses are now enabled and last position is retained
8	Parameter 3	V2031 / V2030		V2031 / V2030		Target position: User defined (DWord)
9	Go To Position	V2056.1		C221		Starts pulses with direction to obtain the new position relative to previous position.
10	Position Loaded Status		V2022.1		C121	When ON, Go To position is acknowledged
11	Output Active Status		V2022.4		C124	When ON, module is pulsing, OFF with Position Loaded status ON = new position move has completed
12	Go To Position	V2056.1		C221		Turn OFF to be ready to load a new position
13	Suspend Output	V2056.2		C222		Turn ON to “pause” output pulses without resetting pulse count
14	Output Suspend		V2022.2		C122	ON when out pulse train has been suspended

To seek the next position, repeat steps 7-10.

Dynamic Velocity

For Dynamic Velocity, the motion limits of clockwise acceleration and deceleration, and counter clockwise acceleration and deceleration come from the CTRIO Workbench Profile. The target velocity is stored in a register in the CPU/controller.

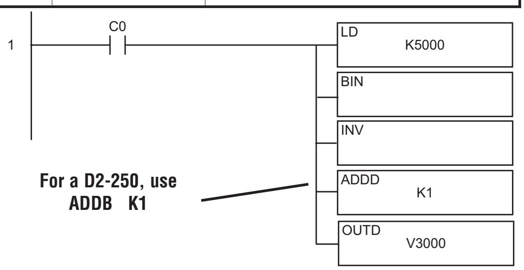
The program needs to prepare the Load Table command by selecting Command Code = 0010 Hex/BCD, set Word Parameter 1 to the File number of the profile (example: File 3 Dynamic Velocity 1) and set Word Parameter 3 to the desired target velocity. Then the program can set the Process Command bit and watch for the Command Complete bit. Then the program should clear the Process Command bit. Set the Enable Output bit to start the output pulses. The velocity can be changed "on the fly" by entering a different value into the target velocity register. The velocity will ramp up/down to the new target velocity at the specified accel/decel rates. Clearing the Enable Output bit will always suspend pulsing.

See Chapter 8 for a ***Direct***LOGIC programming example that executes a Dynamic Velocity pulse profile using the bit/(D)word addressing in the table below.

Dynamic Velocity using the CTRIO Y0 and Y1

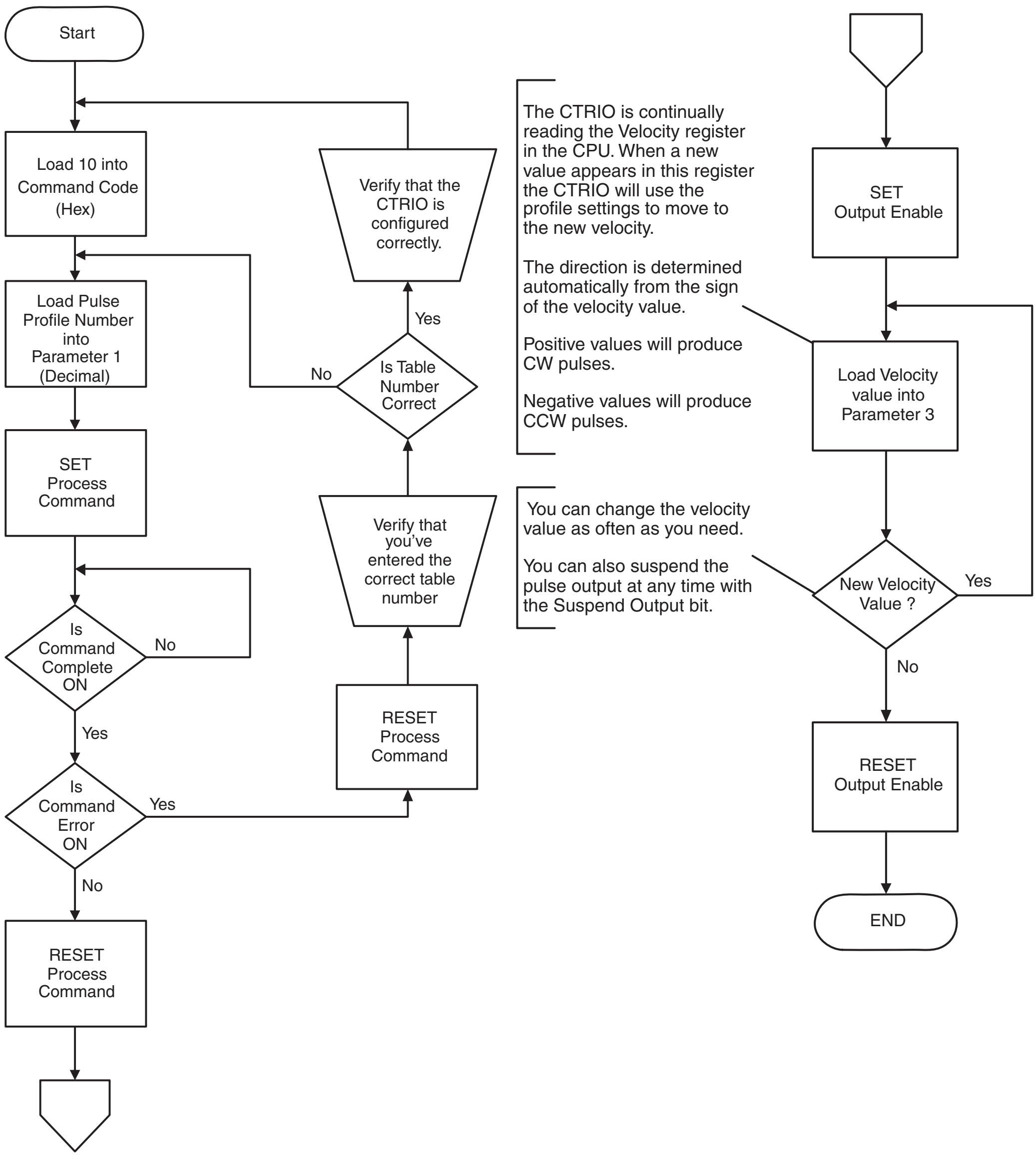
Steps	Name	PLC Control Outputs Base Addr = V2030 (Bit-of-Word)	PLC Status Inputs Base Addr = V2000 (Bit-of-Word)	PLC Control Outputs Base Addr = V2030 (Control Relay) D2-240	PLC Status Inputs Base Addr = V2000 (Control Relay) D2-240	Action
1	Command Code	V2040		V2040		Set to 10 (Load Stored Profile)
2	Parameter 1	V2041		V2041		File # containing cw accel/decel and ccw acccel/decel
3	Process Command	V2056.7		C227		Turn ON until Command Complete status bit is returned
4	Command Complete Status		V2022.7		C127	When ON, Profile is now loaded, clear Process Command bit
5	Command Error		V2022.6		C126	ON if Command or Parameters are invalid
6	Enable Output	V2056.0		C220		Turn ON to ramp to target velocity, Turn OFF to disable pulses.
7	Parameter 3	V2031 / V2030		V2031 / V2030		Target velocity: User defined (DWord)
8	Output Active Status		V2022.4		C124	When ON, module is pulsing
9	Suspend Output	V2056.2		C222		Turn ON to "pause" output pulses without resetting pulse count
10	Output Suspended		V2022.2		C122	ON when out pulse train has been suspended

The sign of the value in the Target Velocity register (Parameter 3) determines the direction of the pulse train output. In the DirectLOGIC programming example to the right, BCD 5000 is converted to decimal -5000 when C0 is turned ON. You could load (LD) a V memory location instead of using a constant as shown in the example.



Dynamic Velocity Mode Flowchart

The flowchart below provides the logical sequence necessary to execute a Dynamic Velocity pulse profile.



Velocity Mode

***NOTE:** Velocity Mode controls the pulse outputs directly from the CPU/controller program. No CTRIO Workbench Pulse Profile is required for this mode.*

Velocity Mode command (Command = 0020 Hex/BCD) allows a specified number of pulse output counts or the number of Pulses can be set to “FFFFFFFF” in Hex for unlimited pulse counts. Leaving the Duty Cycle set to 0 achieves the default (50%), otherwise it can be set in 1% increments by writing this value from 1 to 99 decimal. After this command is processed, the Run Frequency and Duty Cycle fields can be adjusted by direct access. In order to change directions from Pulse Output in “Velocity” mode, the Enable Output bit must first be cleared (which stops the Pulse Outputs). Then after the new direction bit is written, the Enable Output bit can be set to resume pulsing. The flowchart on the following page provides the logical sequence necessary to execute a Velocity Mode pulse profile.

See Chapter 8 for a *Direct*LOGIC programming example that executes a Velocity Mode pulse profile using the bit/(D)word addressing in the table below.

Velocity Mode control on CTRIO Y0 & Y1

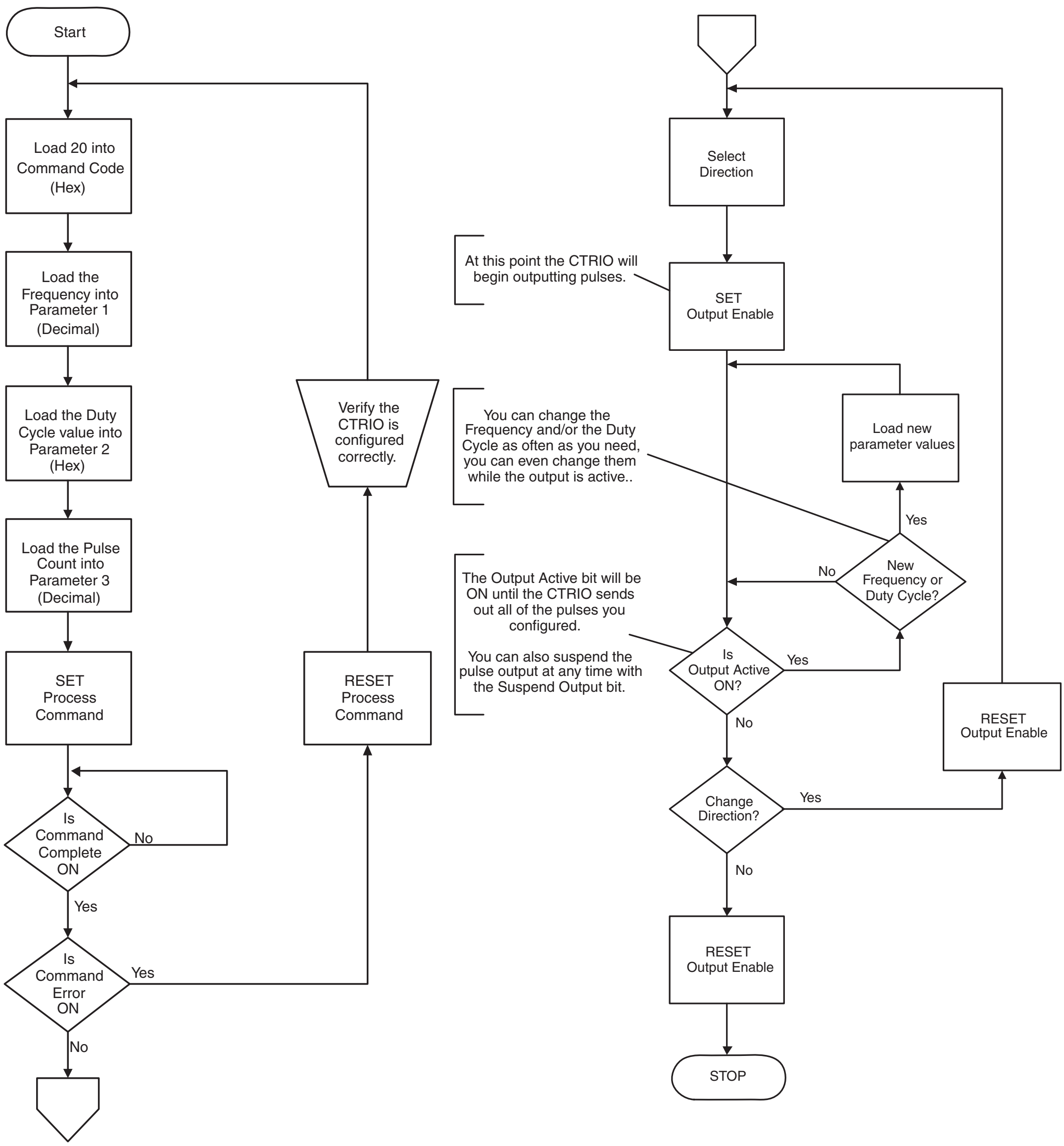
Steps	Name	PLC Control Outputs Base Addr = V2030 (Bit-of-Word)	PLC Status Inputs Base Addr = V2000 (Bit-of-Word)	PLC Control Outputs Base Addr = V2030 (Control Relay) D2-240	PLC Status Inputs Base Addr = V2000 (Control Relay) D2-240	Action
1	Command Code	V2040		V2040		**Set to 20 Hex** (Pulse at Velocity)
2	Parameter 1	V2041		V2041		Set initial run frequency (20Hz-25000Hz) decimal
3	Parameter 2	V2042		V2042		Duty cycle (1-99) (can leave 0 for 50%) decimal
4	Parameter 3	V2031 / V2030		V2031 / V2030		Number of pulses (DWord); set to FFFF FFFF for no limit, Hex
5	Set Direction	V2056.4		C224		Set ON or OFF for Direction of Rotation
6	Process Command	V2056.7		C227		Turn ON Command Complete status bit is returned (see step 4)
7	Command Status		V2022.7		C127	When ON, command has been accepted, clear Process Command bit (step 3)
8	Command Error		V2022.6		C126	ON if Command or Parameters are invalid
9	Enable Output	V2056.0		C220		Turn ON to start pulses
10	Disable Output	V2056.0		C220		Turn OFF to start pulses
11	Suspend Output	V2056.2		C222		Turn ON to “pause” output pulses without resetting pulse count
12	Output Suspended		V2022.2		C122	ON when out pulse train has been suspended

While Velocity Mode Control is running, Run Frequency (step 2) and Duty Cycle (step 3) may be actively changed simply by writing a new Parameter value. Since no accel/decel parameters are specified in this profile, the output change is a step response.

6

Velocity Mode Flowchart

The flowchart below provides the logical sequence necessary to execute a Velocity Mode pulse profile.



Run to Limit Mode

NOTE: *Run to Limit Mode controls the pulse outputs directly from the CPU/controller program. No CTRIO Workbench Pulse Profile is required for this mode.*

The Run to Limit (Command = 0021Hex/BCD) can be used to seek limit positions or for Home Search routines. You may want to consider using the Trapezoid with Limits Profile or the Home Search Pulse Profile created using Workbench unless you need the CPU/controller to control the entire profile and parameters, etc. The CTRIO input must be assigned for Limit by the CTRIO Workbench utility.

Set Word Parameter 1 to the desired Frequency. Set Word Parameter 2 Low Byte to the Duty Cycle and the High Byte to the Edge to Seek as defined below. Leaving the Duty Cycle set to 0 achieves the default (50%), otherwise it can be set in 1% increments by writing this value from 1 to 99 Hex/BCD.

The flowchart on the following page provides the logical sequence necessary to execute a Run to Limit pulse profile.

See Chapter 8 for a ***Direct***LOGIC programming example that executes a Run to Limit Mode pulse profile using the bit/(D)word addressing in the table on page 6-44.

Parameter 2

Word Parameter 2 defines three elements of the Run to Limit routine. Bits 13 and 12 determine which edge(s) to terminate Output Pulses and Bits 9 and 8 determine which CTRIO Input terminal to use for the limit. The low byte specifies the duty cycle.

Edge to Seek	Parameter 2 Bits 13 & 12	Parameter 2 Bits 9 & 8	Parameter 2 (Hex) (Duty cycle at 50%)
Rising Edge Ch1 C	00	00	0000
Falling Edge Ch1 C	01	00	1000
Both Edge Ch1 C	10	00	2000
Rising Edge Ch1 D	00	01	0100
Falling Edge Ch1 D	01	01	1100
Both Edge Ch1 D	10	01	2100
Rising Edge Ch2 C	00	10	0200
Falling Edge Ch2 C	01	10	1200
Both Edge Ch2 C	10	10	2200
Rising Edge Ch2 D	00	11	0300
Falling Edge Ch2 D	01	11	1300
Both Edge Ch2 D	10	11	2300

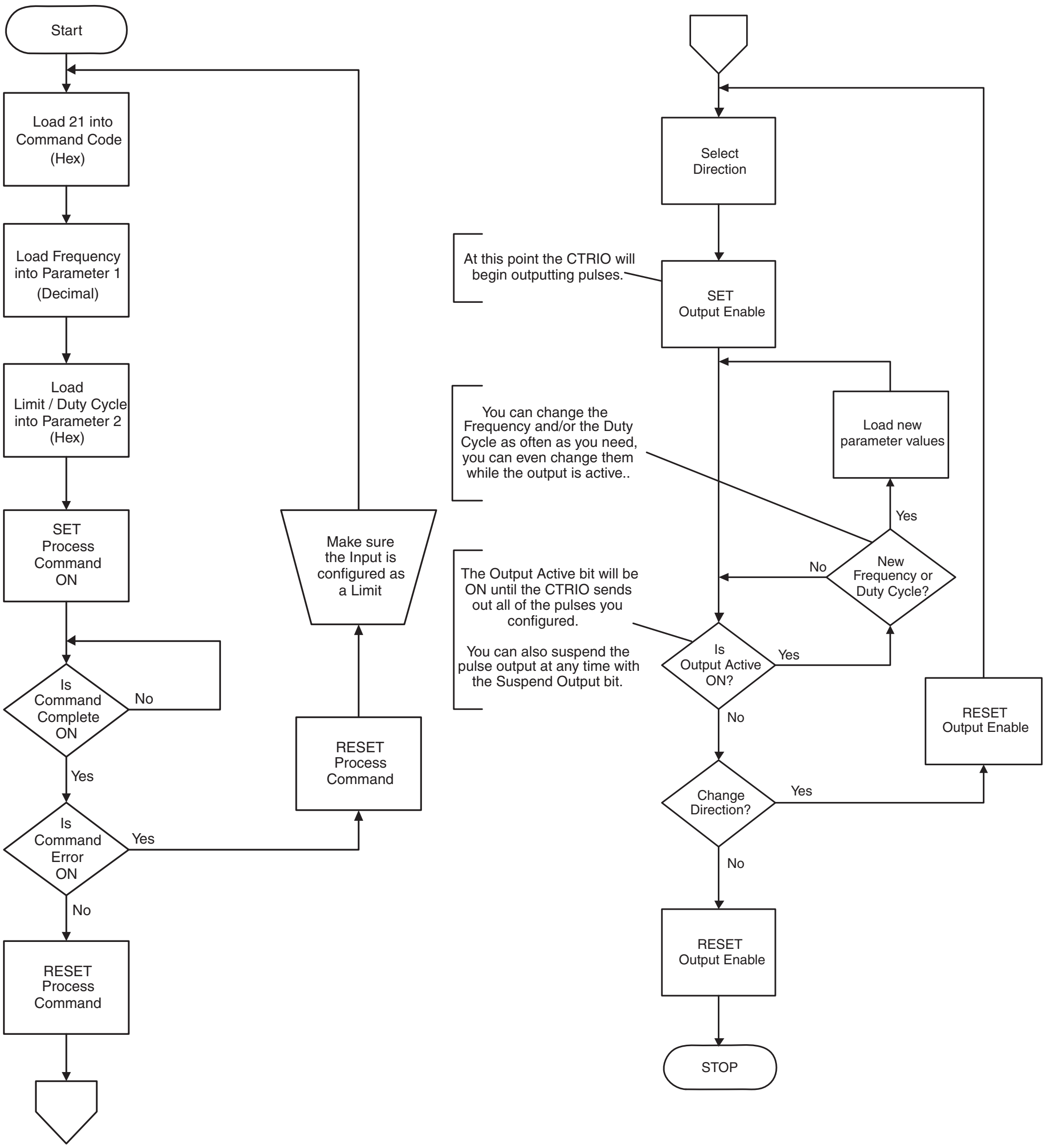
Edge(s)	Bits 15..12
Rising	0000, 0Hex
Falling	0001, 1Hex
Both	0010, 2Hex

CTRIO Input	Bits 11..8
Ch 1 C	0000, 0Hex
Ch 1 D	0001, 1Hex
Ch 2 C	0010, 2Hex
Ch 2 D	0011, 3Hex

6

Run to Limit Mode Flowchart

The flowchart below provides the logical sequence necessary to execute a Run to Limit Mode pulse profile.



Run at Velocity on CTRIO Y0 & Y1 until Discrete Input Limit

Steps	Name	PLC Control Outputs Base Addr = V2030 (Bit-of-Word)	PLC Status Inputs Base Addr = V2000 (Bit-of-Word)	PLC Control Outputs Base Addr = V2030 (Control Relay) D2-240	PLC Status Inputs Base Addr = V2000 (Control Relay) D2-240	Action
1	Command Code	V2040		V2040		**Set to 21 Hex** (Run to Limit Mode)
2	Parameter 1	V2041		V2041		Set initial run frequency (20Hz-25000Hz) decimal
3	Parameter 2	V2042		V2042		Select discrete input edge in high byte, low byte = duty cycle (1-99) Example: rising input 1D at Duty = 45%, set this parameter to 212D Hex
4	Set Direction	V2056.4		C224		Set ON or OFF for Direction of Rotation
5	Process Command	V2056.7		C227		Turn ON Command Complete status bit is returned (see step 4)
6	Command Status		V2022.7		C127	When ON, command has been accepted, clear Process Command bit (step 3)
7	Command Error		V2022.6		C126	ON if Command or Parameters are invalid
8	Enable Output	V2056.0		C220		Turn ON to start pulses
9	Output Active Status		V2022.4		C124	ON while pulsing, OFF when limit has stopped pulsing
10	Suspend Output	V2056.2		C222		Turn ON to “pause” output pulses without resetting pulse count
11	Output Suspended		V2022.2		C122	ON when out pulse train has been suspended

Run to Position Mode

NOTE: *Run to Position Mode controls the pulse outputs directly from the CPU/controller program. No CTRIO Workbench Pulse Profile is required for this mode.*

The Run to Position Mode command (Command = 0022Hex/BCD) allows Pulse Outputs that terminate when the specified Input Function Value position count is reached. Set Word Parameter 1 to the desired Frequency. Set Word Parameter 2 Low Byte to the Duty Cycle and the High Byte to the Compare Functions as defined below. Leaving the Duty Cycle set to 0 achieves the default (50%), otherwise it can be set in 1% increments by writing this value from 1 to 99 Hex/BCD.

Word Parameter 3 specifies the value that Input Function will compare against.

The flowchart on the following page provides the logical sequence necessary to execute a Run to Position pulse profile.

See Chapter 8 for a ***Direct***LOGIC programming example that executes a Run to Position pulse profile using the bit/(D)word addressing in the table on page 6-47.

Parameter 2

Word Parameter 2 defines three elements of the Run to Position routine. Bit 12 determines if the specified position is “greater than or equal” or “less than” the current Input Function position value. Bits 9 and 8 determine which Input Function to use for the comparison. The low byte specifies the duty cycle.

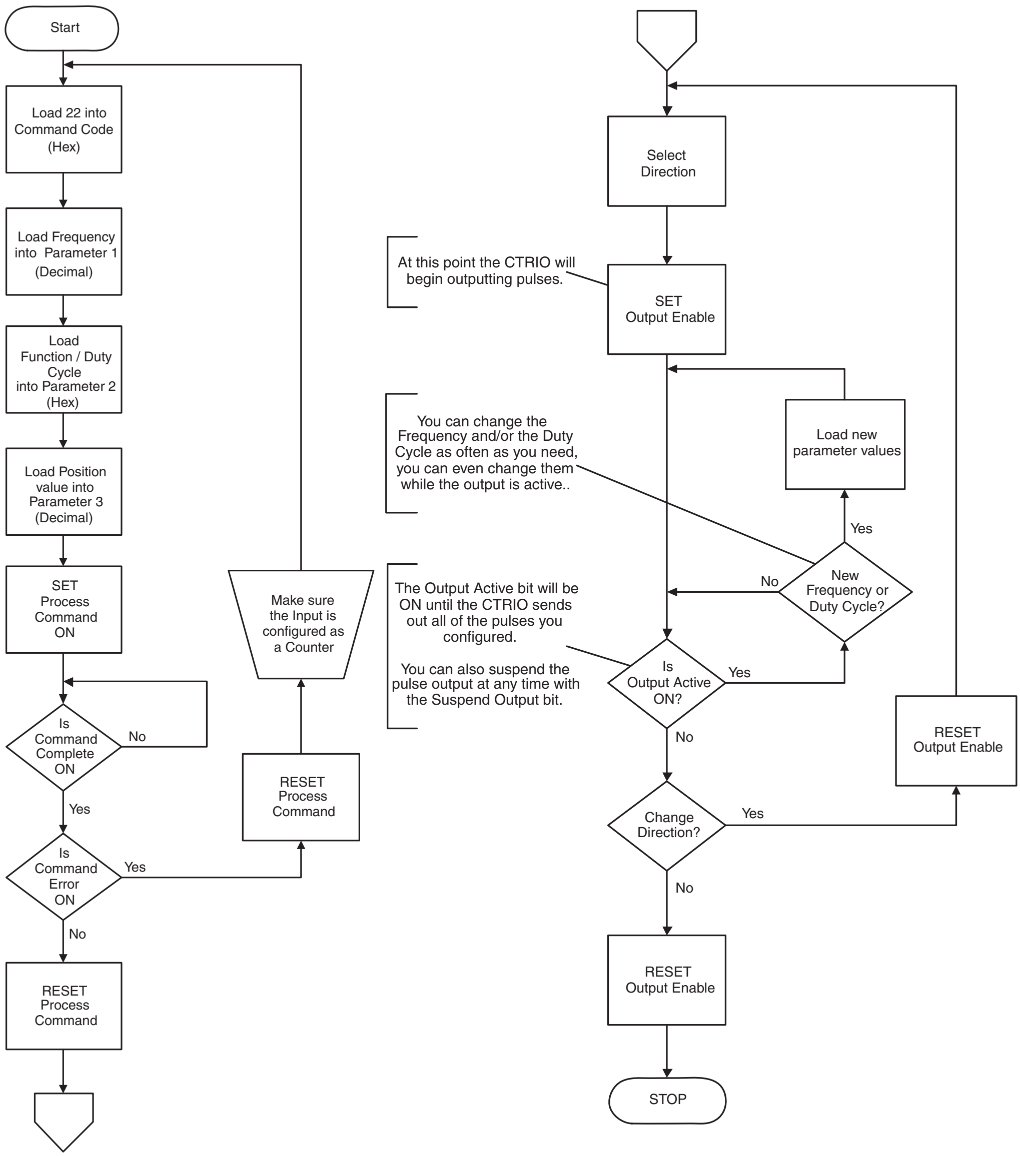
Specified Position (Parameter 3) is:	Parameter 2 Bit 12	Parameter 2 Bits 9 & 8	Parameter 2 (Hex) (Duty cycle at 50%)
less than Ch1/Fn1	0	00	0000
greater than Ch1/Fn1	1	00	1000
less than Ch1/Fn2	0	01	0100
greater than Ch1/Fn2	1	01	1100
less than Ch2/Fn1	0	10	0200
greater than Ch2/Fn1	1	10	1200
less than Ch2/Fn2	0	11	0300
greater than Ch2/Fn2	1	11	1300

Comparison	Bits 15..12
Greater Than or Equal	0001, 1Hex
Less Than	0000, 0Hex

Input Function	Bits 11..8
Ch 1 Fn 1	0000, 0Hex
Ch 1 Fn 2	0001, 1Hex
Ch 2 Fn 1	0010, 2Hex
Ch 2 Fn 2	0011, 3Hex

Run to Position Mode Flowchart

The flowchart below provides the logical sequence necessary to execute a Run to Position Mode pulse profile.



Run at Velocity on CTRIO until Input Function Value Position

Steps	Name	PLC Control Outputs Base Addr = V2030 (Bit-of-Word)	PLC Status Inputs Base Addr = V2000 (Bit-of-Word)	PLC Control Outputs Base Addr = V2030 (Control Relay) D2-240	PLC Status Inputs Base Addr = V2000 (Control Relay) D2-240	Action
1	Command Code	V2040		V2040		**Set to 22 Hex** (Pulse at velocity until Function Input Limit)
2	Parameter 1	V2041		V2041		Set initial run frequency (20Hz-25000Hz) decimal
3	Parameter 2	V2042		V2042		Bits 15-12: Comparison Bits 11-8: Input Function to use Low Byte:Duty cycle (1-99) (can leave 0 for 50%) Hex
4	Parameter 3	V2031 / V2030		V2031 / V2030		Specified position for Input Function DWord to compare against, decimal
5	Set Direction	V2056.4		C224		Set ON or OFF for Direction of Rotation
6	Process Command	V2056.7		C227		Turn ON Command Complete status bit is returned (see step 4)
7	Command Status		V2022.7		C127	When ON, command has been accepted, clear Process Command bit (step 3)
8	Command Error		V2022.6		C126	ON if Command or Parameters are invalid
9	Enable Output	V2056.0		C220		Turn ON to start pulses
10	Output Active Status		V2022.4		C124	ON while pulsing, OFF when position is reached
11	Suspend Output	V2056.2		C222		Turn ON to “pause” output pulses without resetting pulse count
12	Output Suspended		V2022.2		C122	ON when out pulse train has been suspended

System Functions

System Functions Commands are primarily used to read from and write to the CTRIO's internal registers. The flowcharts on the following pages provide ***Direct***LOGIC and ThinknDo users the logical sequence necessary to read from and write to the CTRIO's internal registers.

The CTRIO's internal current count register can be read from or written to to if the input is configured for a Counter or Quadrature Counter. Timer values are not accessable.

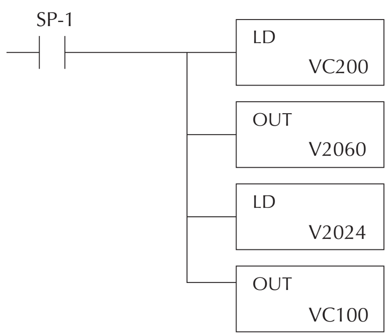
The CTRIO's internal current output pulse count can be read from or written to only if the pulse output is running Dynamic Velocity or Dynamic Positioning profiles.

See Chapter 8 for ***Direct***LOGIC programming examples that use the RD and WT instructions to execute system function commands.

See Chapter 9 for Do-more programming examples using read and write instructions to execute system function commands.

Steps	Name	PLC Control Outputs Base Addr = V2030 (Bit-of-Word)	PLC Status Inputs Base Addr = V2000 (Bit-of-Word)	PLC Control Outputs Base Addr = V2030 (Control Relay) D2-240	PLC Status Inputs Base Addr = V2000 (Control Relay) D2-240	Action
1	Command Code	User Specifed to use with RD/WT Instruction		User Specifed to use with RD/WT Instruction		1 Hex: Read All Registers 2 Hex: Write All Registers 4 Hex: Write One Register 5 Hex: Write Reset Value
2	System Command Error		V2024.6		C106	ON if Command or Parameters are invalid
3	System Command Complete		V2024.7		C107	When ON, command has been accepted, clear Process Command bit
6	Process Command	V2060.7		C207		Turn ON Command Complete status bit is returned

NOTE 1:*The D2-240 CPU does not support bit-of-word addressing. The status and control bits must be mapped to control relay words. An example of mapping code is shown below.*

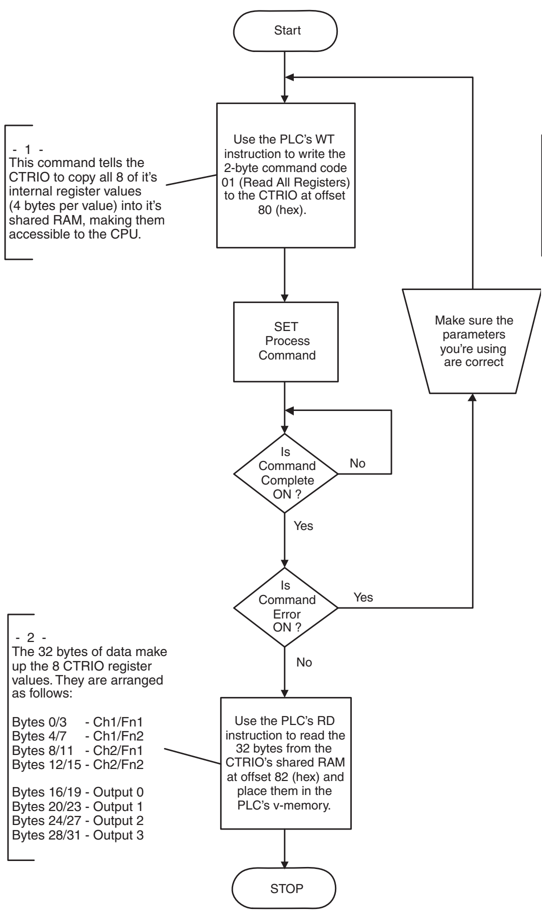


NOTE 2: *For example, **Direct**SOFT uses B2020.1 in the ladder code to indicate that you are addressing the second bit of V-memory register 2020. The "B" prefix indicates bit-of-word addressing.*

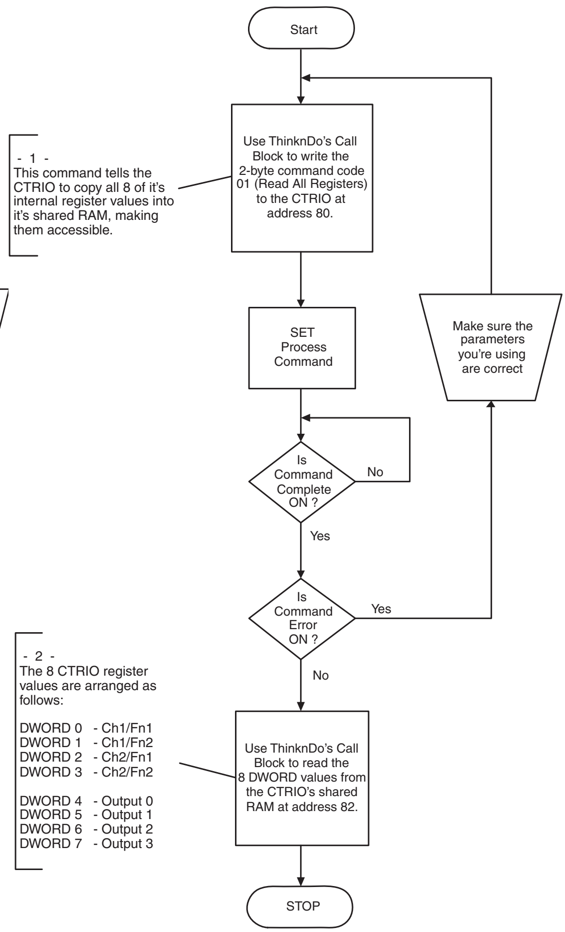
Reading All CTRIO's Internal Registers Flowcharts

The flowcharts below provide the logical sequence necessary to Read the CTRIO's internal registers. Reading the CTRIO's internal registers is a two-step process.
1) Ask the CTRIO to transfer the internal register values to its shared RAM.
2) Transfer the values from the CTRIO's shared RAM to the controller's memory.

*Direct*LOGIC Read from CTRIO



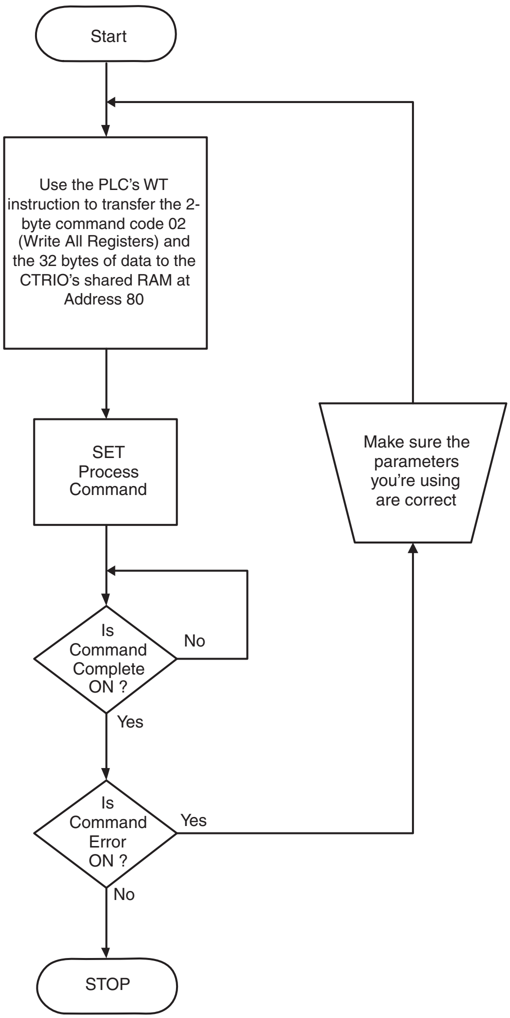
ThinknDo Read from CTRIO



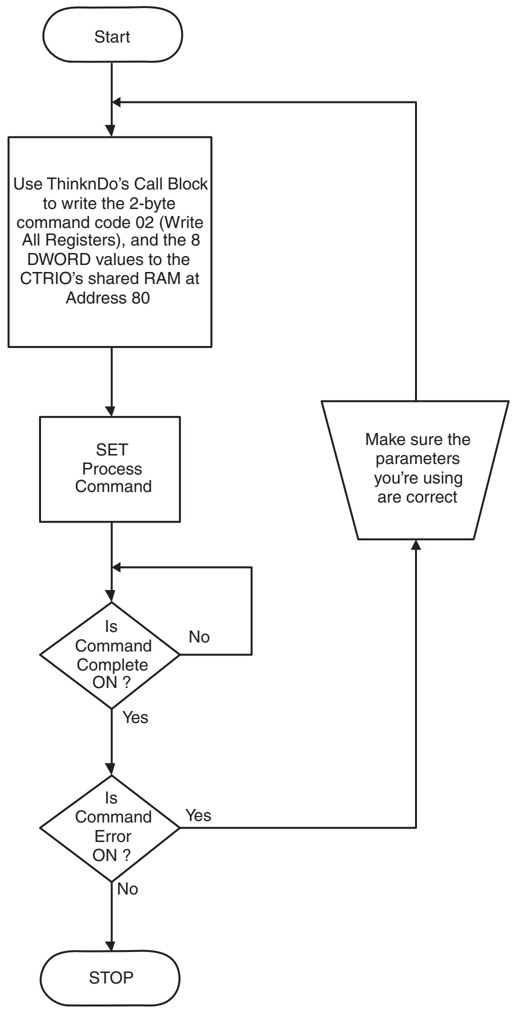
Writing to All CTRIO's Internal Registers Flowcharts

The flowcharts below provide the logical sequence necessary to Write to all of the CTRIO's internal registers. Writing to the CTRIO's internal registers is a two-step process.
1) Transfer the data values from the controller's memory to the CTRIO's shared RAM.
2) Ask the CTRIO to transfer these values from its shared RAM to it's internal registers.

***Direct*LOGIC Write to CTRIO**



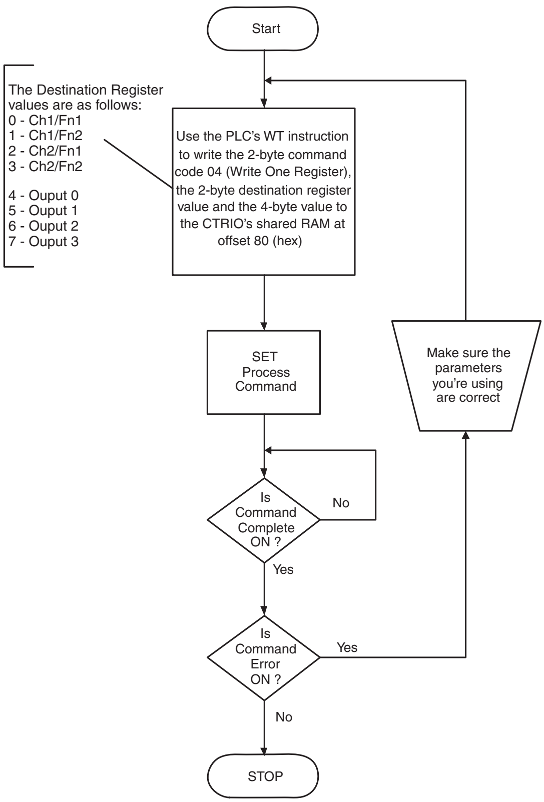
ThinknDo Write to CTRIO



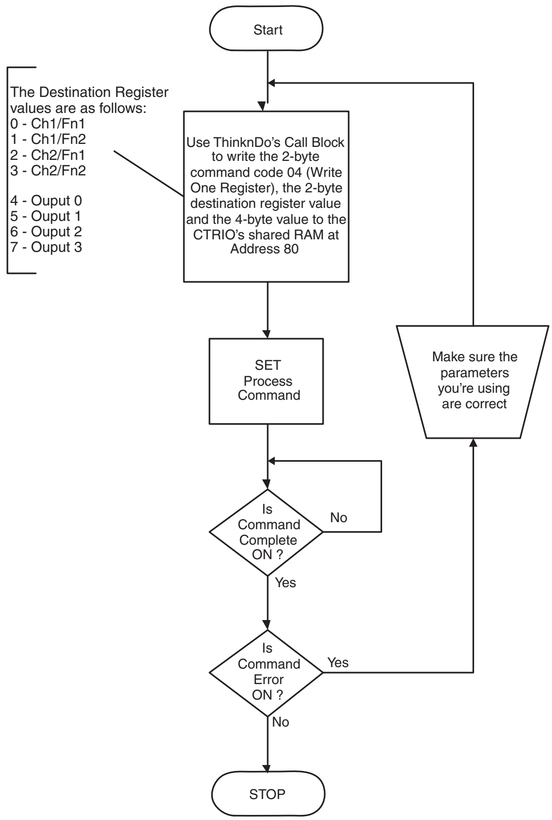
Writing to One CTRIO Internal Register Flowcharts

The flowcharts below provide the logical sequence necessary to Write to one of the CTRIO's internal registers. Writing to a CTRIO internal register is a two-step process.
1) Transfer the data value from the controller's memory to the CTRIO's shared RAM.
2) Ask the CTRIO to transfer this value from its shared RAM to it's internal registers.

*Direct*LOGIC Write to CTRIO



ThinknDo Write to CTRIO



CHAPTER 7

USING MONITOR I/O

In This Chapter...

Do-more and Monitor CTRIO

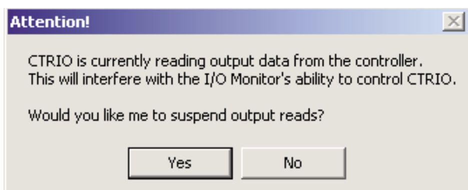
In Do-more, Monitor CTRIO is part of the Do-more Designer programming software. To access Monitor CTRIO in Do-more Designer, look under the PLC menu and select Monitor CTRIO Module. For detailed information on using Monitor CTRIO Module in Do-more Designer, see help file topic DMD0308: Monitor CTRIO Module. You can also access this help file topic by opening Monitor CTRIO and pressing F1.

Using the Monitor I/O Dialog

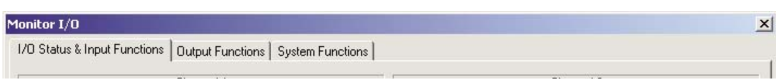
NOTE: *It is highly recommended to simulate your CTRIO Counter, Timer or Pulse Output Profile, etc. application using Monitor I/O before attempting to control the module from your controller program. Monitor I/O is extremely useful for debugging and the commissioning of a new system. Monitor I/O allows you to confirm proper configuration of the module, as well as field wiring and external device operation.*

The Monitor I/O dialog is accessible from the main Workbench dialog when the module is in Run Mode.
On the main Workbench dialog, click the button labeled Monitor I/O.

After clicking on the Monitor I/O button, the dialog below will appear if you have mapped the I/O in the CTRIO to the controller. Here you have the ability to suspend CTRIO reads from the CPU/controller. Doing so will allow Monitor I/O to control the CTRIO without any control program intervention. With the output reads suspended, the Monitor I/O dialog allows you to simulate program control; for example, enabling a timer, resetting a counter, running a pulse profile or turning on an output configured for Raw mode, etc. When exiting Monitor I/O, you will be prompted to re-enable the controller output reads.



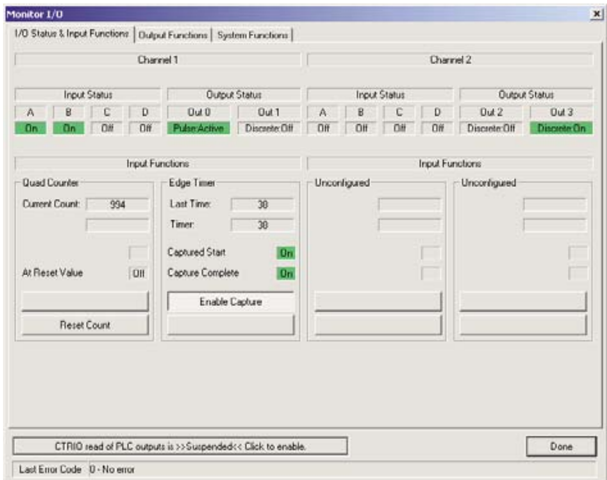
The Monitor I/O dialog is divided into three functional areas: I/O Status & Input Functions, Output Functions and System Functions. Just below the Windows title bar, you will see tabs to switch between the three Functions. The functions are described on the pages that follow.



I/O Status & Input Functions

I/O Status & Input Functions dialog includes all Input Function DWord Parameters (raw count/time, scaled count/time, etc.) and status bits passed from the CTRIO module to the CPU (Capture Starting, Complete bits, etc.). The control bits that would be passed from the CPU to the CTRIO are also included (Function enable bits, etc.).

The current status of each configured input and output is shown just below the Input Status and Output Status columns.



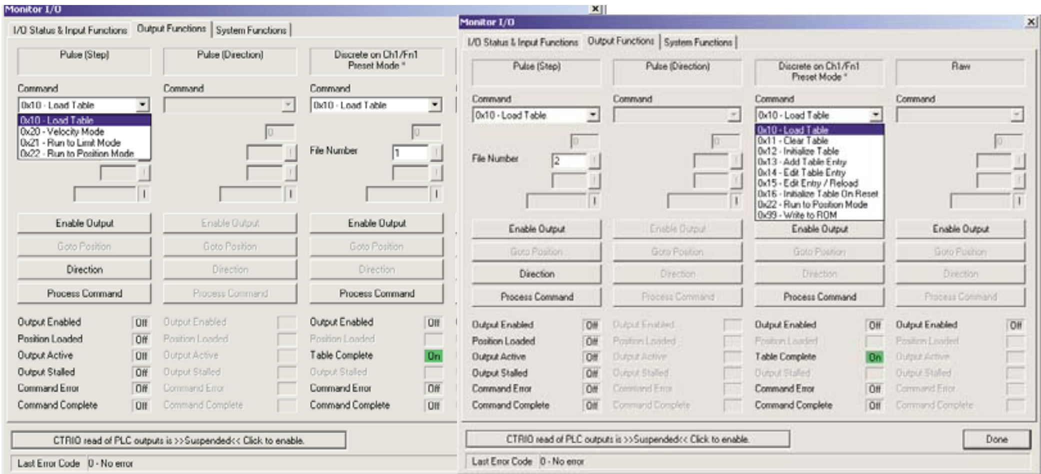
In the example above, the Current Count for Ch1/Fn1 Quad counter is 994. The Reset Count button can be used to reset the count to the configured Reset Value.

For Ch1/Fn2, the Edge Timer is captured at 38us. The Enable Capture bit must be on prior to when the configured edge input occurs.

Note that Output Status Out 0 and Out 3 are ON. Out 0 is configured for pulse output and Out 3 is configured for a Raw discrete output. These outputs can be controlled from the Output Functions window.

Output Functions

The Output Functions dialog includes all Output Function Word and DWord Parameters (file number, duty cycle, target position, etc.) and status bits passed from the CTRIO module to the CPU (Output Enabled, Command Complete, etc.). The control bits that would be passed from the CPU to the CTRIO are also included (Enable Output, Go to Position, Direction, etc).



In the example above, Outputs 0 and 1 are configured for Pulse step and direction, Output 2 is configured to Preset mode assigned to Ch1/Fn1 (quad counter) and Output 3 is configured as Raw mode.

In the screen capture on the left, notice the pull down menu. The menus are context sensitive. They will change to display values that are appropriate to the CTRIO's configuration. Here you have acccess to all pulse profile commands. Command 0x10 will allow you to load any configured Pulse Profiles (Trapezoidal, S-Curve, Dynamic Positioning, etc.). In the screen capture on the right, you'll see we have selected Pulse Profile number 2 for this example.

To run a configured Pulse Profile, follow these steps:
1) select Command Code 10 (0x10)
2) enter the desired Pulse Profile Number in the File Number field
3) click the Process Command button and confirm the Command Complete bit is ON. If the Command Error is ON, an explanation of the error will appear on the dialog status line. Then turn the Process Command button OFF.
4) select the Direction; leaving the Direction button OFF selects forward, clicking the button ON selects the reverse direction.
5) click on Enable Output to run the Pulse Profile. The Output Enabled and Output Active indicators will turn ON. When the profile is complete, the Output Active indicator will turn OFF.

Turning OFF the Enable Output during the profile run will terminate the pulse output. To run the profile again, turn OFF the Enable Output and then re-enable it.

In the screen capture on the right on the previous page, notice the drop down menu. Here you have access to all of the Preset Table Commands. The Load Table Command (0x10) will allow you to load any configured Preset Tables. In the screen capture on the left, you'll see we have selected Preset Table number 1 for this example. Remember that Output 2 is assigned to Input Function Ch1/Fn1, which is configured as a Quad Counter Input.

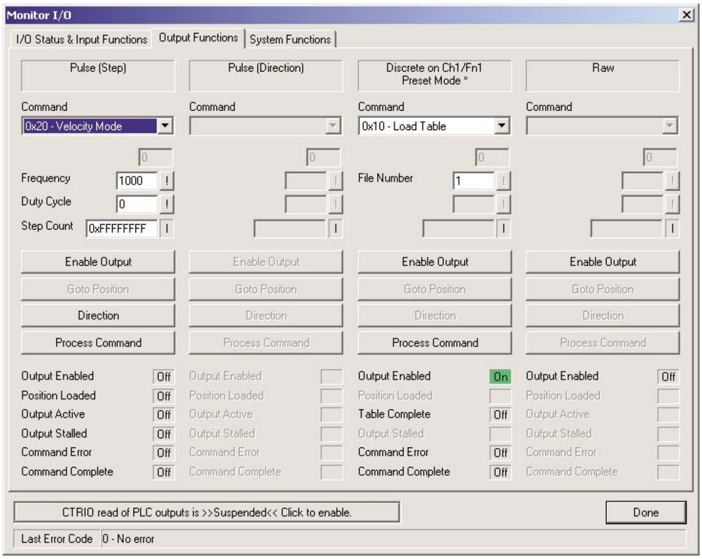
To load a configured Preset Table for Output 2 to use based on Ch1/Fn1's count, follow the steps below:

1) select Command Code 10 (0x10)
2) enter the desired Preset Table Number in the File Number field

3) click the Process Command button and confirm the Command Complete bit is ON. If the Command Error is ON, an explanation of the error will appear on the dialog status line. Then turn the Process Command button OFF.
4) click on the Enable Output to allow the output to operate based on the Preset Table and current status of Ch1/Fn1 quad counter input.

As the encoder's count on Ch1/Fn1 changes, the output 2 turns ON and OFF based on the entries in Preset Table number 1. Turning the Enable Output OFF while the Preset Table is being executed will disable the output.

7



Pulse Output Command Codes 0x20, 0x21 and 0x22

Velocity mode (0x20) is shown in the example above. Depending upon which command is selected, different parameter fields, status bits and control bits will apply. No matter which one is selected, be sure to fill in the parameter fields with valid entries (refer to chapter6), and then Process the Command.

System Functions

The Systems Functions dialog allows you read from or write to the current input count and the current output pulse count under the following conditions:

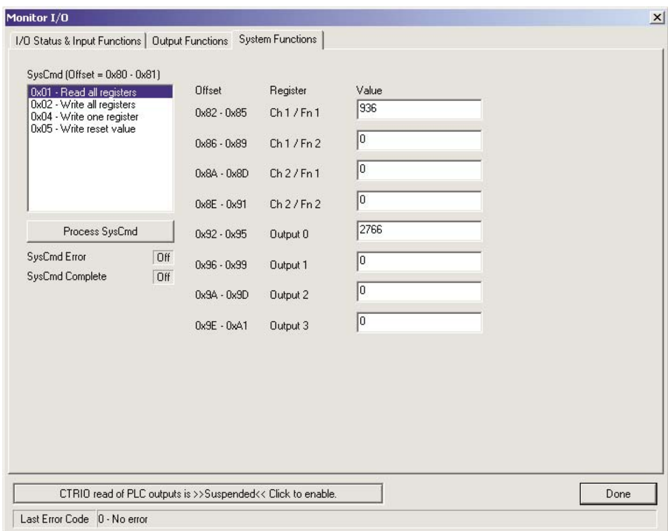
- The current input count can be read from or written to if the input is configured for a Counter or Quad Counter. Timer values are not accessable.
- The current output pulse count can be read from or written to only if the pulse output is running Dynamic Velocity or Dynamic Positioning profiles.

*Direct*Logic Users

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. See chapter 8 for Systems Functions ladder logic examples.

EBC, WinPLC, PBC, DEVNETS, MODBUS Users

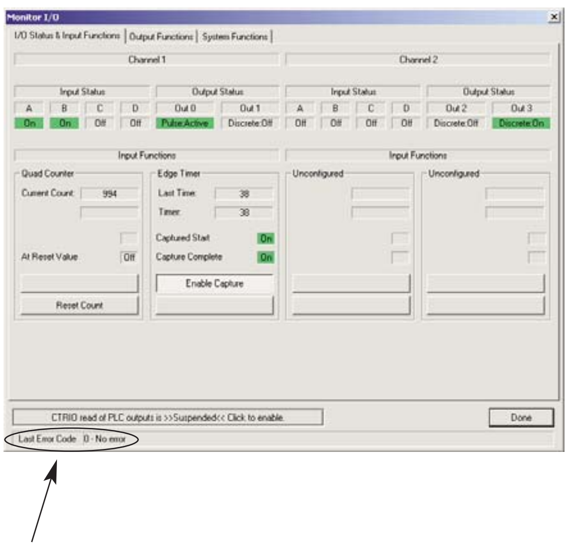
The Systems Functions dialog is available for use when connected to these interface devices, however, there is currently no way for the user control program to read from or write to the CTRIO's internal registers.



Monitor I/O Error Codes

The appropriate error code listed below will be displayed on the Monitor I/O Status Bar when an error occurs.

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



Status bar

Notes

DIRECTLOGIC PROGRAMMING EXAMPLES

CHAPTER 8

In This Chapter...

DirectLOGIC Programming Examples Overview

NOTE: *The programming examples on the following pages are provided "as is" without a guarantee of any kind. This Chapter is provided by our technical support group to assist others. We do not guarantee the examples are suitable for a particular application, nor do we assume any responsibility for them in your application. Chapter 6 "Program Control" contains flowcharts that provide detailed steps needed to execute a pulse profile or System Functions command.*

The *Direct*SOFT programming examples provided on the following pages are simple examples that are intended to assist you in the basics of loading and running various output pulse profiles. The examples are complete enough to load a profile, process the command and load the Parameter registers necessary to execute the profile. Two System Functions examples are also provided.

Load and Run a Pulse Profile example:
You will need to have a Trapezoid, S-Curve, Symmetrical S-Curve, Home Search or Free Form profile configured using the Configure I/O dialog. You will also need to have the appropriate Pulse Profile Table File Number (decimal) stored in V3000 for this example. You must turn C0 on to load and run the pulse profile. C2 controls the pulse output direction.

Dynamic Positioning/Positioning Plus Profile example:
You will need to have a Dynamic Positioning/Positioning Plus profile configured as Table File Number 1 using the Configure I/O dialog. You will also need to have the appropriate Target Pulse Count Position (signed decimal) stored in V3000 for this example. You must turn C0 on to initialize the settings. Then turn C2 on to Go to Position.

Dynamic Velocity Profile example:
You will need to have a Dynamic Velocity profile configured as Table File Number 1 using the Configure I/O dialog. You will also need to have the appropriate Target Velocity (signed decimal) stored in V3000 for this example. You must turn C0 on to initialize the settings and enable the output.

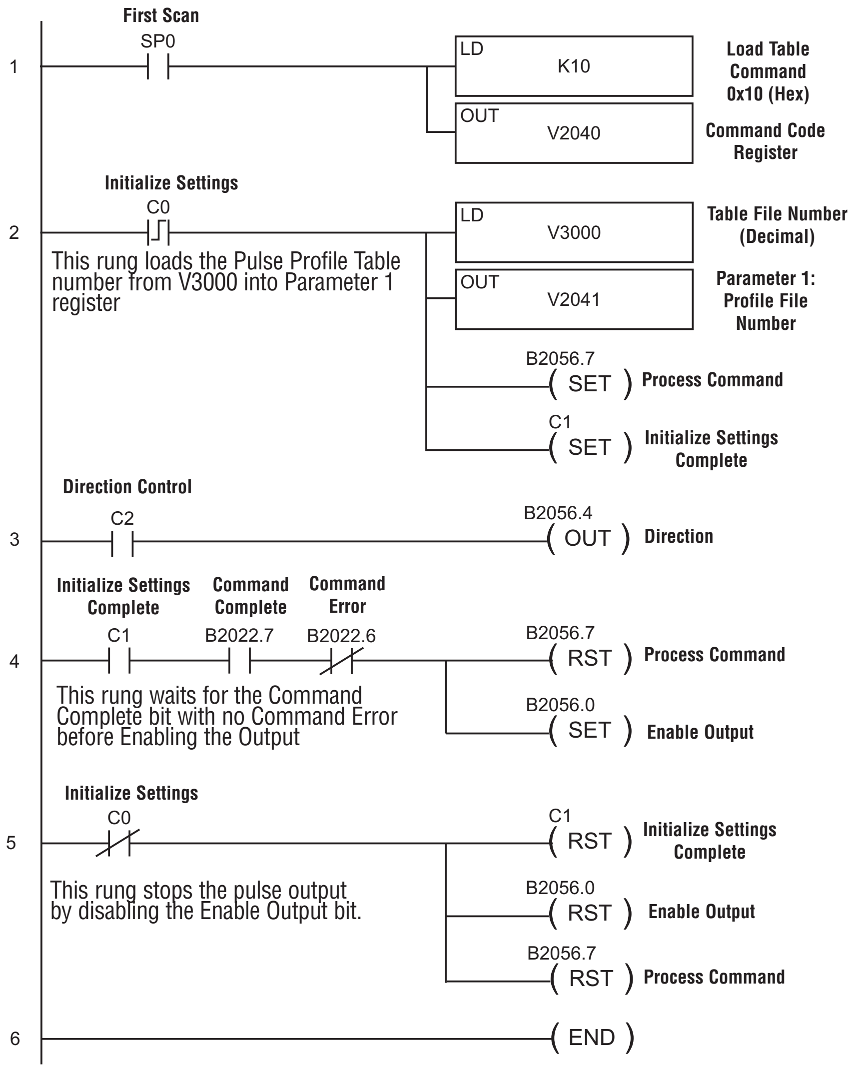
Velocity Mode, Run to Limit Mode and Run to Position Mode examples:
No CTRIO Pulse Profile Tables are necessary to execute these profiles, but the Outputs need to be configured for Step/Direction or CW/CCW using the Configure I/O dialog. All parameters are stored in memory as shown in the examples. You must turn C0 on to initialize the settings and to run the pulse profile. C2 controls the pulse output direction. For Run to Position Mode, Ch1 Inputs A & B must be configured for Quad Counter in CTRIO Workbench. The position from that encoder is used to stop the move.

Simulating Retentive Counter example:
This Systems Functions example uses the Write to Intelligent (WT) instruction to write the current count stored in the PLC's retentive memory to the CTRIO's current count register on a power cycle or a RUN-STOP-RUN PLC mode change. No permissive bits are required to be turned on in this example.

Reading CTRIO Internal Registers example:
This Systems Functions example uses the Write to Intelligent Module (WT) and Read from Intelligent Module (RD) instructions to read all of the CTRIO's internal registers every 900ms. You must turn C0 on to initialize the settings to perform the Read routine.

Load and Run a Pulse Profile

The following example program loads and executes a Pulse Profile that was created using CTRIO Workbench Pulse Profiles dialog . This example can be used for Trapezoid, S-Curve, Symmetrical S-Curve, Home Search and Free Form profiles (Home Search requires that CTRIO inputs C and/or D are configured for Limit Out 0 and/or Limit Out 2). The Pulse Profile number is stored in V3000 for this example. Turning on C0 will load and run the pulse profile.

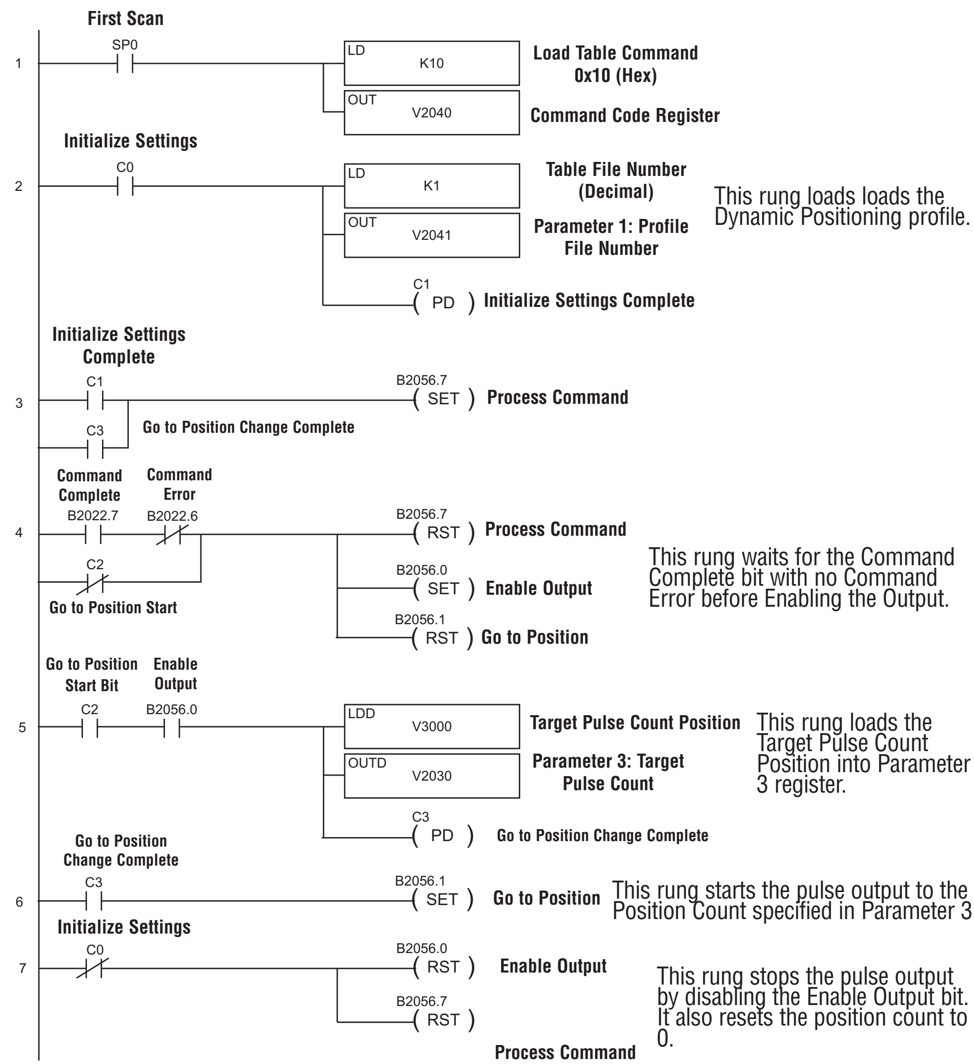


8

Dynamic Positioning/Positioning Plus

The following example program runs a Dynamic Positioning/Positioning Plus pulse profile. Turn on C0 to load the profile number and process the command. The first move starts at position count = 0. Turning on C2 will start the pulse output to position specified in Parameter 3.

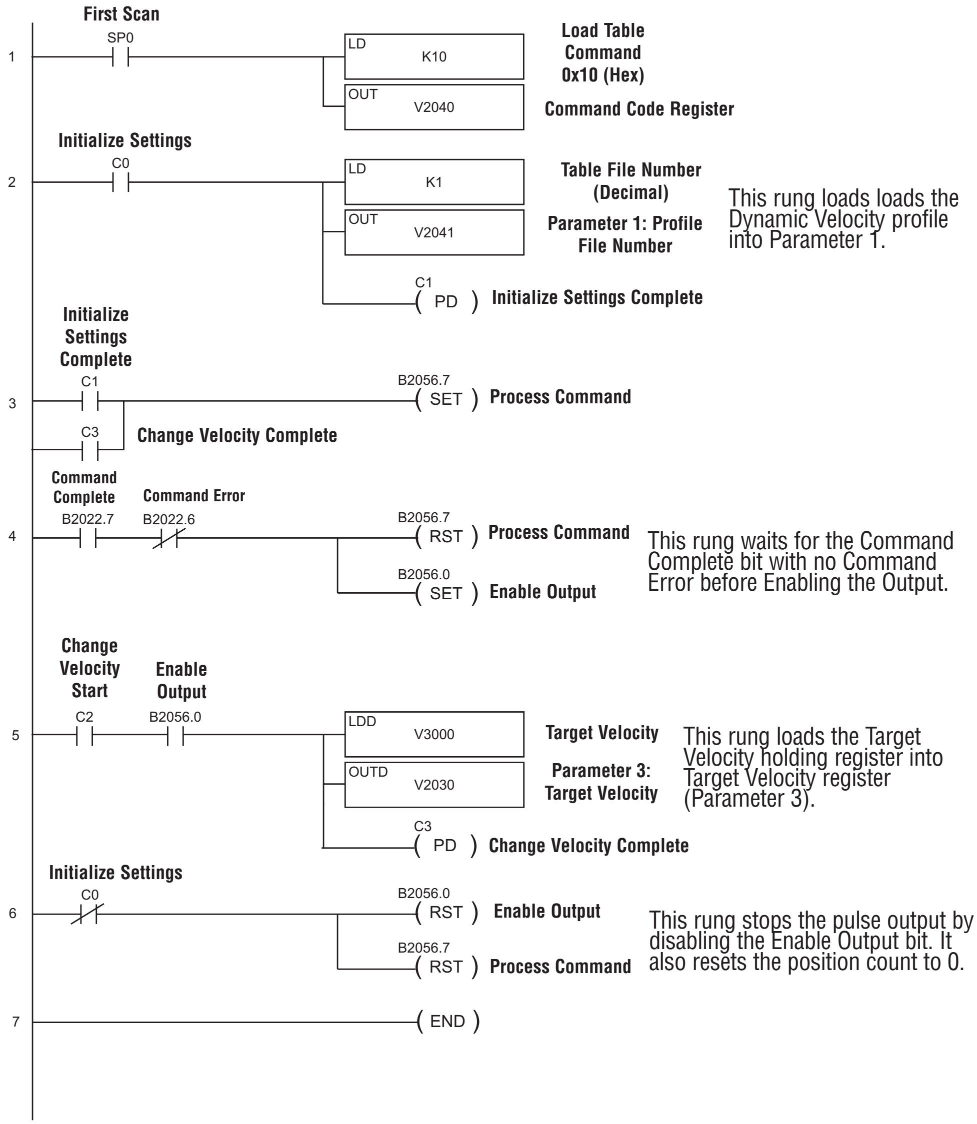
The output will move in whichever direction is appropriate to reach the position specified in Parameter 3. To make additional moves, wait for the current move to complete, load a new value into the Target Pulse Count register and set the Go to Position bit. Subsequent moves are still referenced to the same 0 location as the first move. Clearing the Enable Output bit will disable output pulsing and reset the current position to 0.



8

Dynamic Velocity

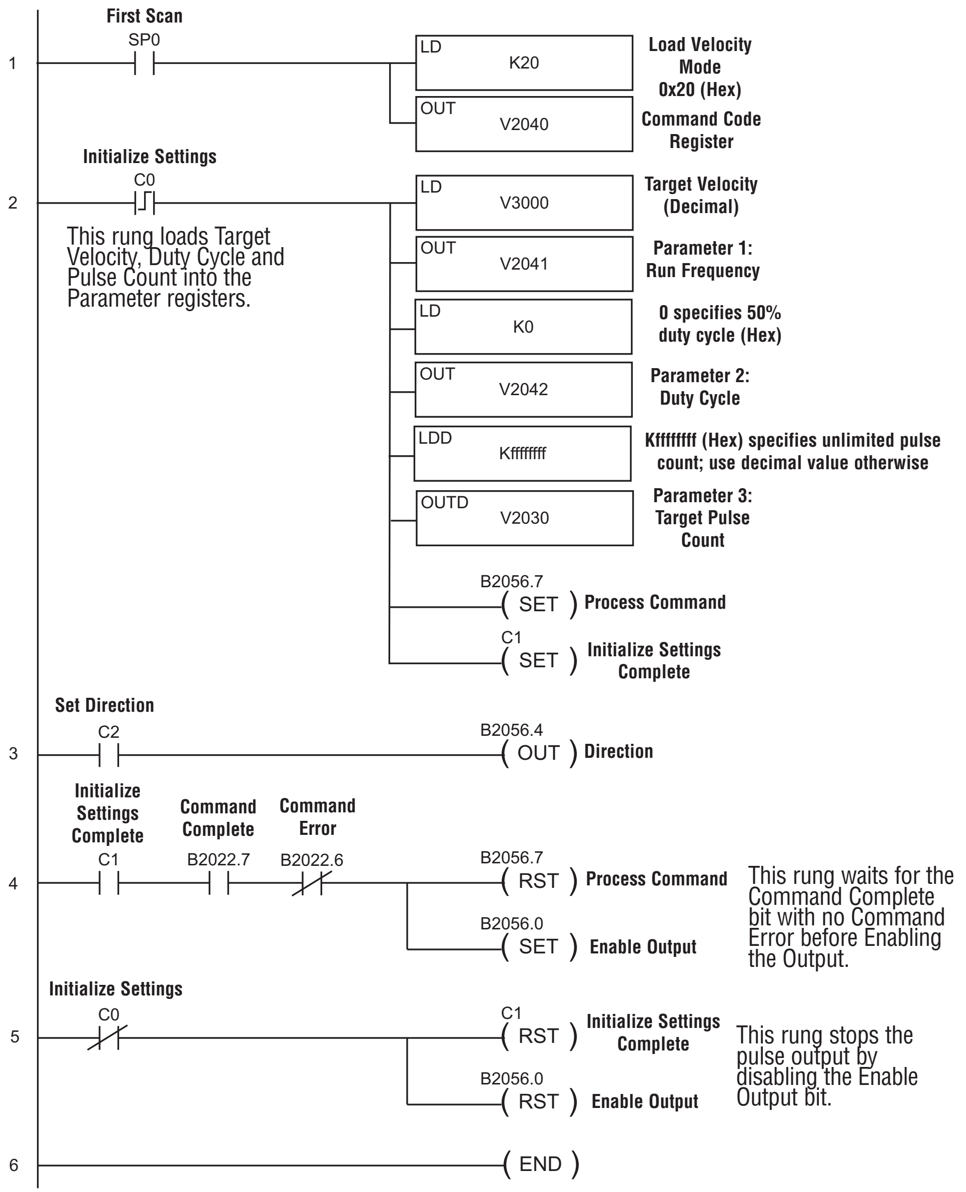
The following example program executes a Dynamic Velocity pulse profile. Turn C0 on to load the profile number, process the command and enable the output. The Target Velocity needs to be specified inV3000. The velocity can be changed “on the fly” by entering a different value into V3000. The sign of the value in the target velocity register controls the pulse output direction. Clearing the Output Enable bit will always suspend pulsing.



8

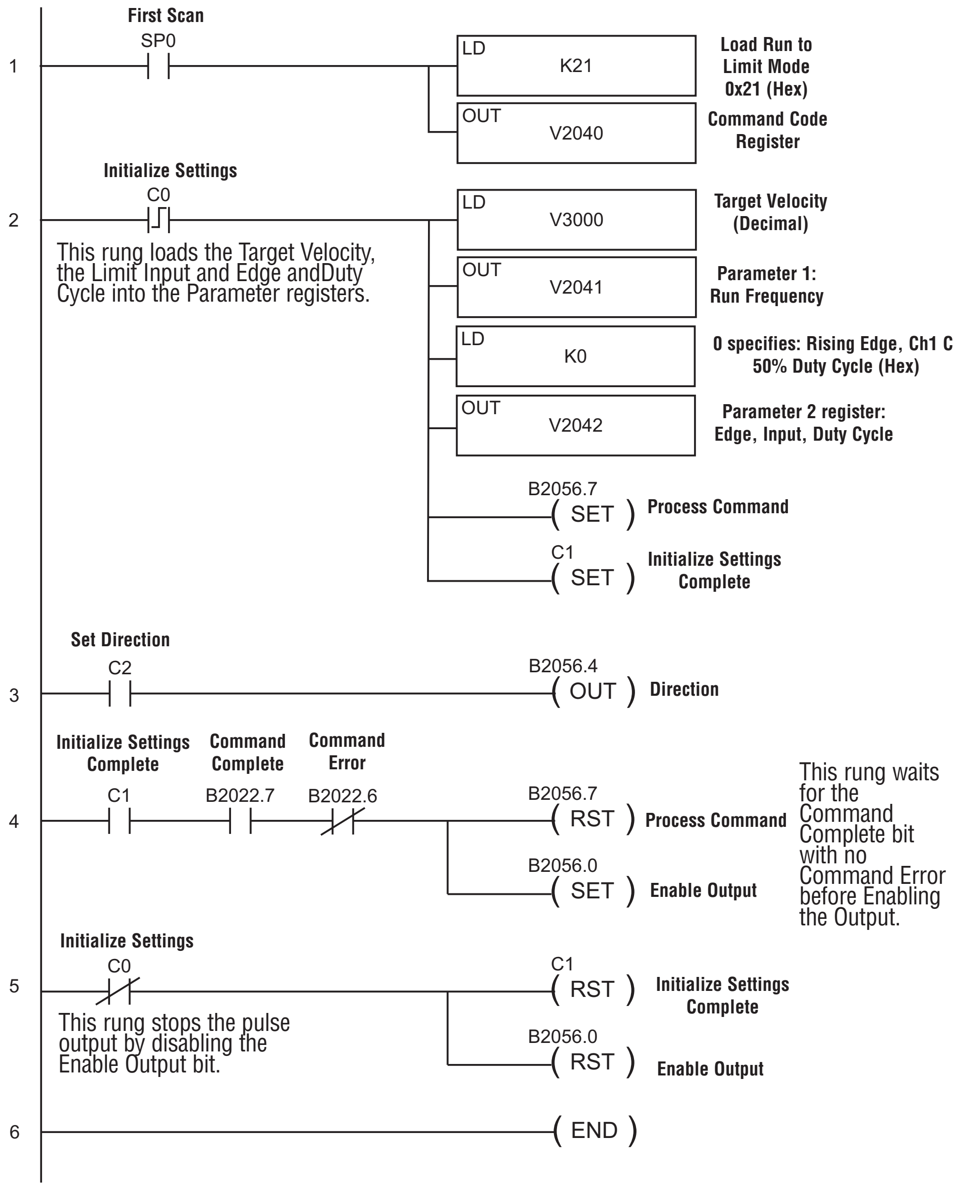
Velocity Mode

The following example program loads and executes a Velocity Mode pulse profile. For Parameter 3, a specific number of pulse output counts can be specified or if set to “ffffffff” Hex, the pulse output will remain ON at the specified Target Velocity until the output is disabled.



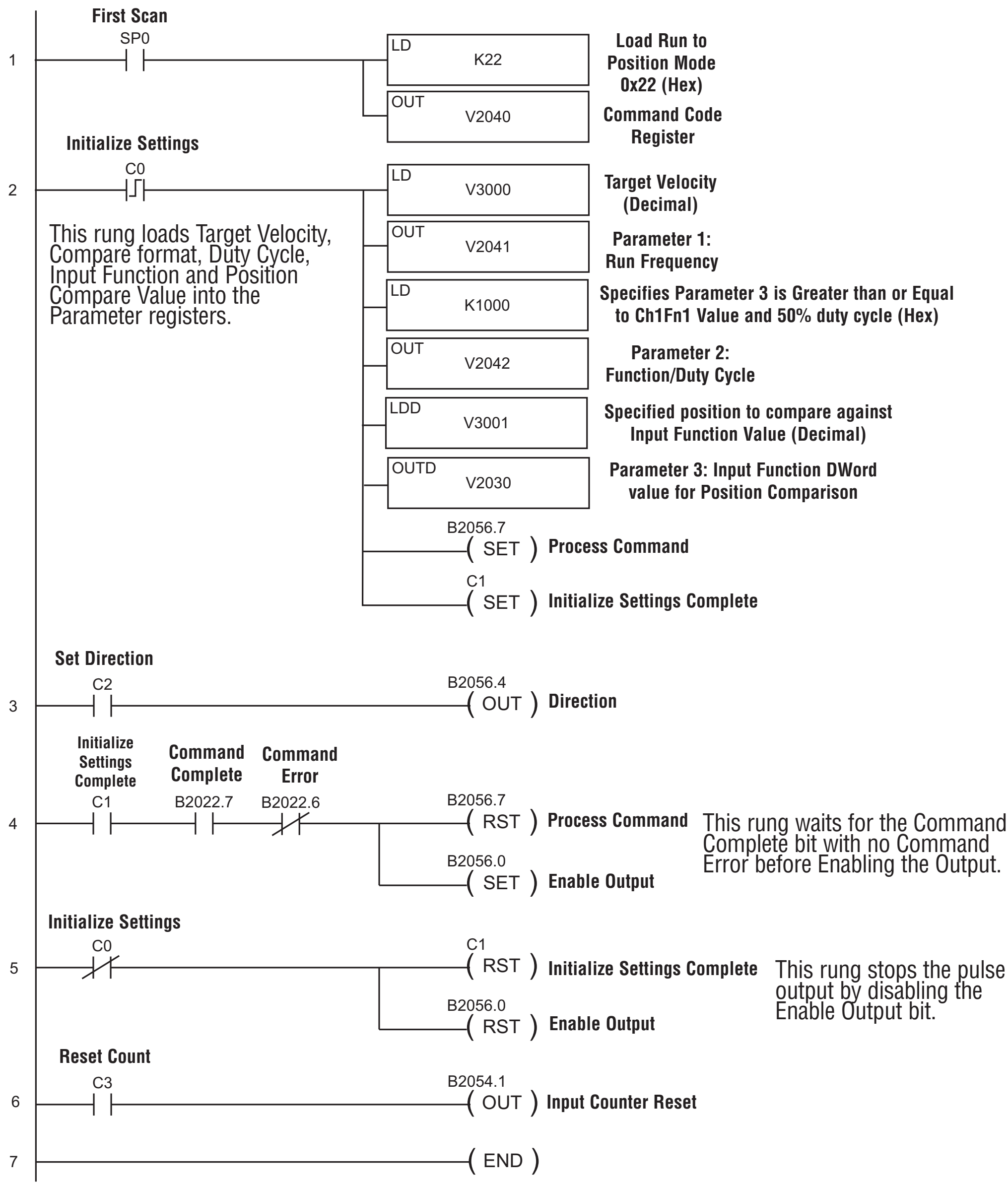
Run to Limit Mode

The following example program loads and executes a Run to Limit Mode pulse profile. Turn on C0 to run the profile. CTRIO input C or D must be assigned to Limit for this profile.



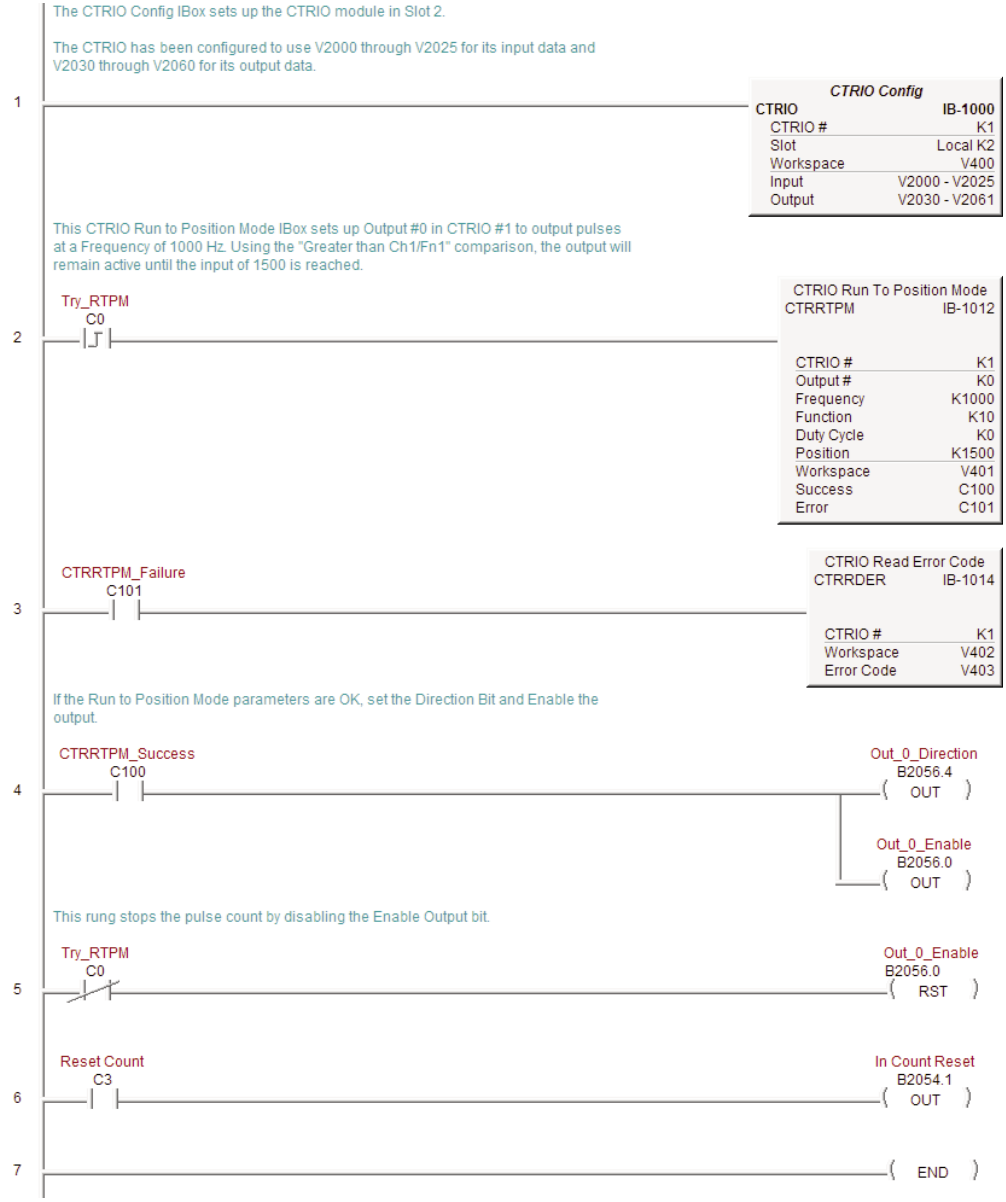
Run to Position Mode

The following example program loads and executes a Run to Position Mode pulse profile. Turn on C0 to run the pulse profile.



Run to Position Mode with DirectSOFT IBox Instructions

This is the equivalent ladder using IBox instructions in DirectSOFT to the ladder shown on the previous page.



System Functions Examples Overview

***NOTE:** System Functions are supported only when the CTRIO module is installed in the same base as the **Direct**tLOGIC CPU.*

The Systems Functions examples on the following pages use the *Direct*LOGIC Write to Intelligent Module (WT) and/or Read from Intelligent Module (RD) instructions to write to or read from the CTRIO's internal registers.

Reading From CTRIO Internal Memory

Reading the CTRIO's internal memory consists of several steps. Step one is using the WT instruction to send a Systems Function's command to the CTRIO telling it to put its internal register values into the CTRIO's "shared RAM". Step two is processing the request for the internal register values using the Process Command bit. Step three is using the RD instruction to read the values from the CTRIO's "shared RAM" memory into PLC V-memory.

Steps 1 and 2: WT instruction and Process Command
PLC V-memory ==> CTRIO's Shared RAM
CTRIO's Shared RAM ==> Process Command to internal processor
CTRIO's Shared RAM <== Internal data values

Step3: RD instruction
PLC V-memory <== CTRIO's Shared RAM

Writing to CTRIO Internal Memory

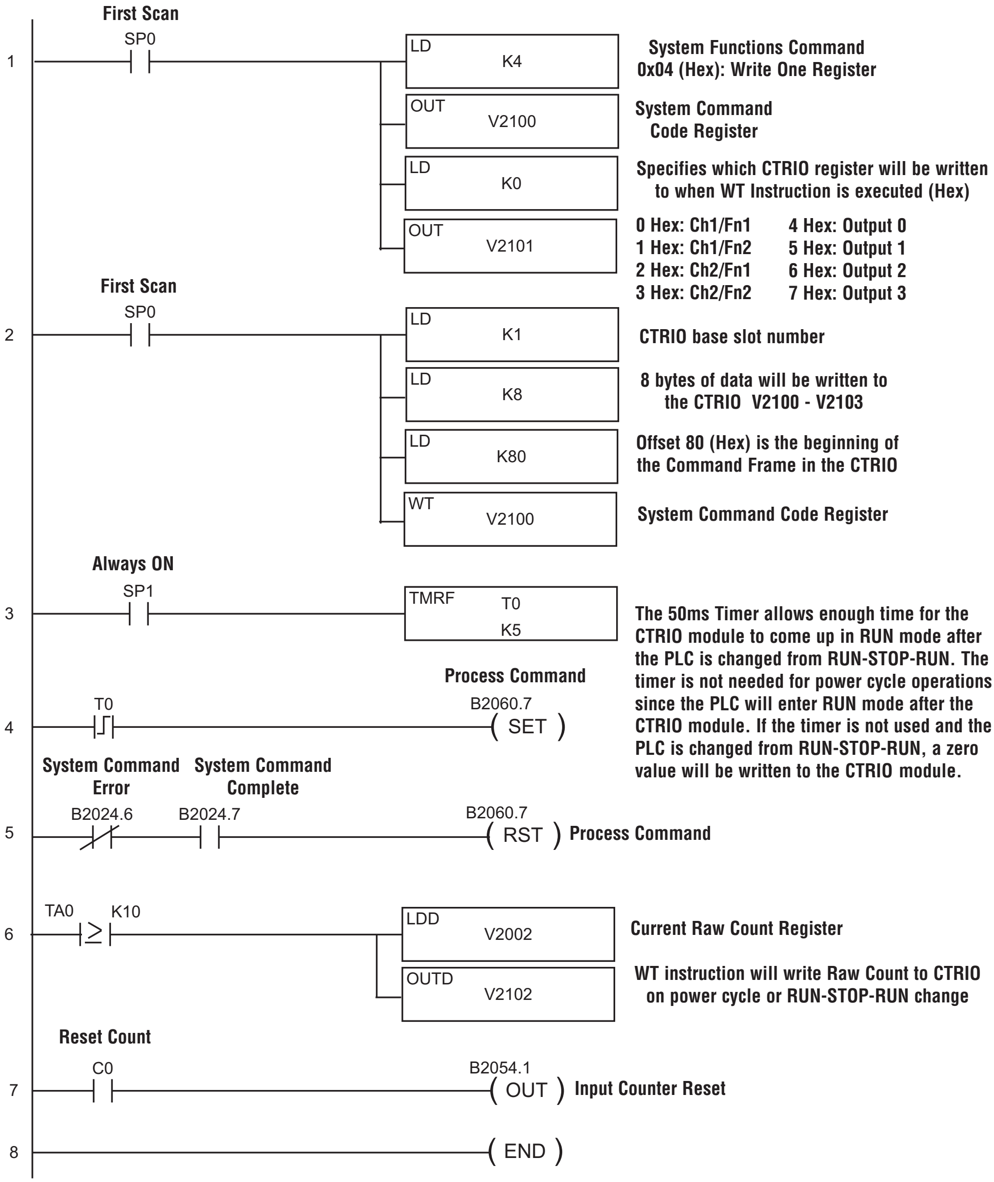
Writing to the CTRIO's internal registers is basically a two step process. Step one is using the WT instruction to send a System Function's command and the desired data values to the CTRIO's "Shared RAM". Step two is using the Process Command bit to tell the CTRIO to process the command and data values that are in the CTRIO's Shared RAM. This moves the data values from the Shared RAM into the CTRIO's internal registers.

Steps 1 and 2: WT instruction (command and data) and Process Command Bit:
PLC V-memory ==> CTRIO Shared RAM
CTRIO Shared RAM ==> Process Command to internal processor
CTRIO Shared RAM ==> internal data registers

***NOTE:** This function is not available when the CTRIO module is installed in a EBC expansion base.*

Simulating Retentive Counter

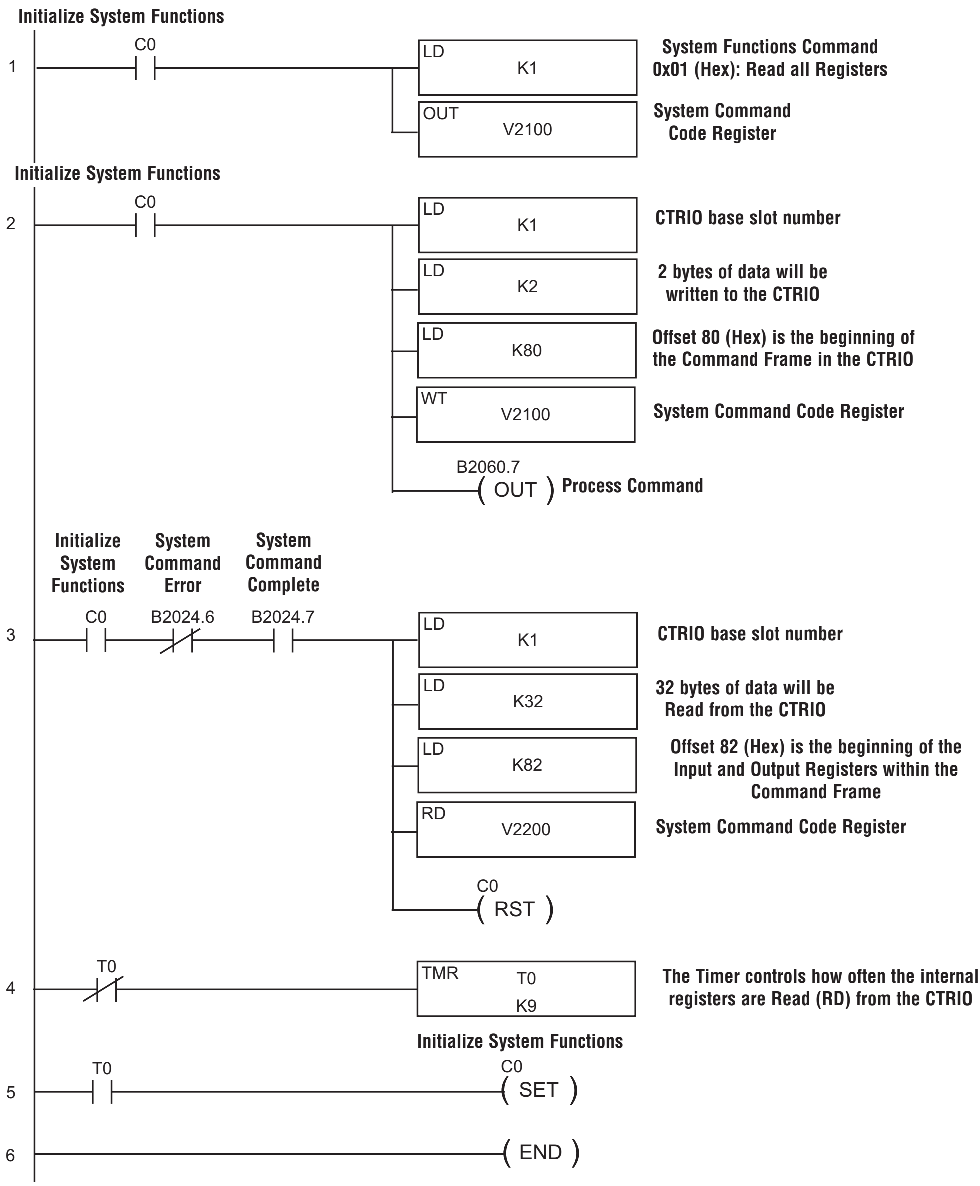
The following Systems Functions example uses the Write to Intelligent (WT) instruction to write the current count stored in the PLC's retentive memory to the CTRIO's current count register on a power cycle or a RUN-STOP-RUN PLC mode change.



8

Reading CTRIO Internal Registers

The following Systems Functions example uses the Write to Intelligent Module (WT) and Read from Intelligent Module (RD) instructions to read all of the CTRIO's internal registers every 900ms and place the data starting at V2200.



Do-more Programming Examples

Chapter 9

In This Chapter...

Do-more Programming Examples Overview

***NOTE:** The programming examples on the following pages are provided "as is" without a guarantee of any kind. This Chapter is provided by our technical support group to assist others. We do not guarantee the examples are suitable for a particular application, nor do we assume any responsibility for them in your application.*

The Do-more Designer programming examples provided on the following pages are simple examples that are intended to assist you in the basics of loading and running various output pulse profiles. The examples are complete enough to load a profile, process the command and load the Parameter registers necessary to execute the profile. Two System Functions examples are also provided.

Load and Run a Pulse Profile example:
You will need to have a Trapezoid, S-Curve, Symmetrical S-Curve, Home Search or Free Form profile configured using the Configure I/O dialog.

Dynamic Positioning/Positioning Plus Profile example:
You will need to have a Dynamic Positioning/Positioning Plus profile configured as Table File Number 1 using the Configure I/O dialog.

Dynamic Velocity Profile example:
You will need to have a Dynamic Velocity profile configured as Table File Number 1 using the Configure I/O dialog.

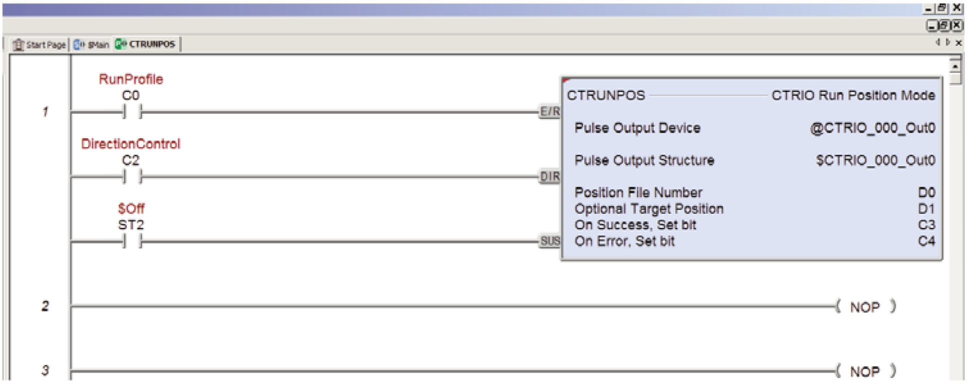
Velocity Mode, Run to Limit Mode and Run to Position Mode examples:
No CTRIO Pulse Profile Tables are necessary to execute these profiles, but the Outputs need to be configured for Step/Direction or CW/CCW using the Configure I/O dialog. All parameters are stored in memory as shown in the examples. For Run to Position Mode, Ch1 Inputs A & B must be configured for Quad Counter in the Configure I/O dialog. The position from that encoder is used to stop the move.

Simulating Retentive Counter example:
This Systems Functions example uses the Write to Intelligent (WT) instruction to write the current count stored in the PLC's retentive memory to the CTRIO's current count register on a power cycle or a RUN-STOP-RUN PLC mode change. No permissive bits are required to be turned on in this example.

Reading CTRIO Internal Registers example:
This Systems Functions example uses the Write to Intelligent Module (WT) and Read from Intelligent Module (RD) instructions to read all of the CTRIO's internal registers every 900ms. You must turn C0 on to initialize the settings to perform the Read routine.

Load and Run a Pulse Profile

Make sure D0 of the instruction (Position File Number) has the correct file number, choose the direction with C2 and turn on C0 to begin the move. (Optional Target Position is ignored by the instruction when used with a fixed profile. This field is the equivalent of Parameter 3 for other profiles in DirectLOGIC).



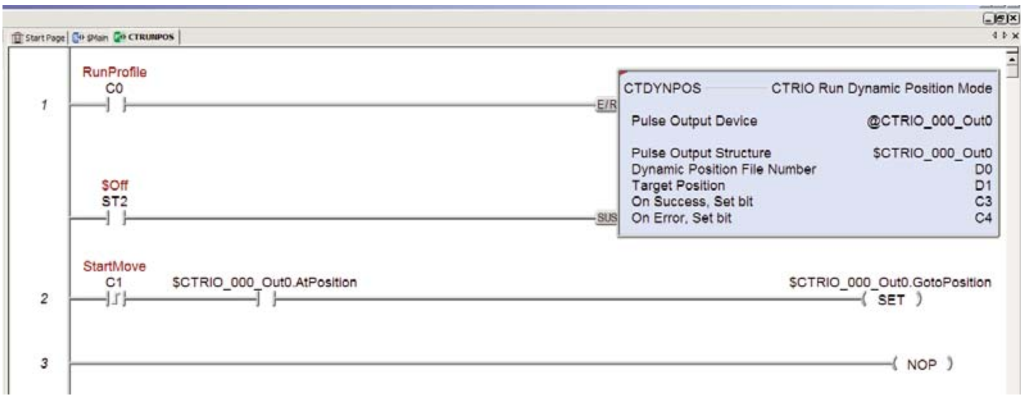
For detailed information on the CTRUNPOS – CTRIO Run Position Mode instruction, see Do-more Designer help file topic DMD0529.

9

Dynamic Positioning/Positioning Plus

Make sure D0 of the instruction (Dynamic Position File Number) has the correct file number. Set the target position in D1 and turn on C0 to load the profile and zero out the position register, $CTRIO_000_Out0.OutputPosition. Turn on C1 to start the move. Pulses are generated to move toward the position specified in D1. The structure member, .AtPosition, turns on when the move completes.

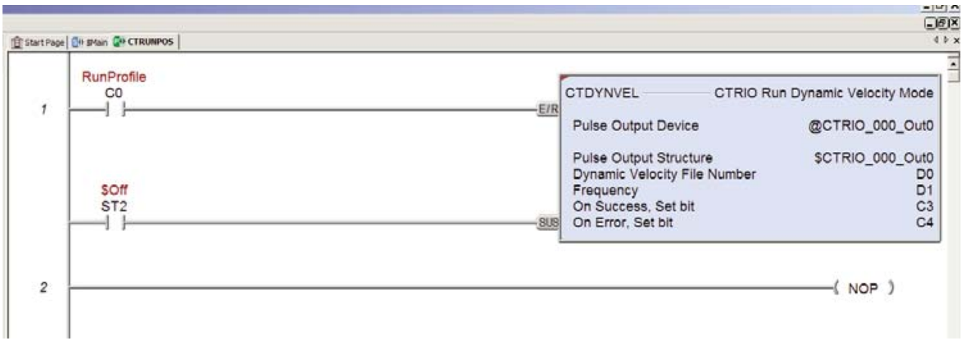
After a move completes, load the next position into D1 and turn on C1 to start another move.



For detailed information on the CTDYNPOS – CTRIO Run Dynamic Position Mode instruction, see Do-more Designer help file topic DMD0516.

Dynamic Velocity

Make sure D0 of the instruction (Dynamic Velocity File Number) has the correct file number. Set the target velocity in D1 and turn on C0 to load the profile. The sign of the value in D1 determines the pulse output direction. The velocity can be changed ‘on the fly’ by placing a new value in D1.

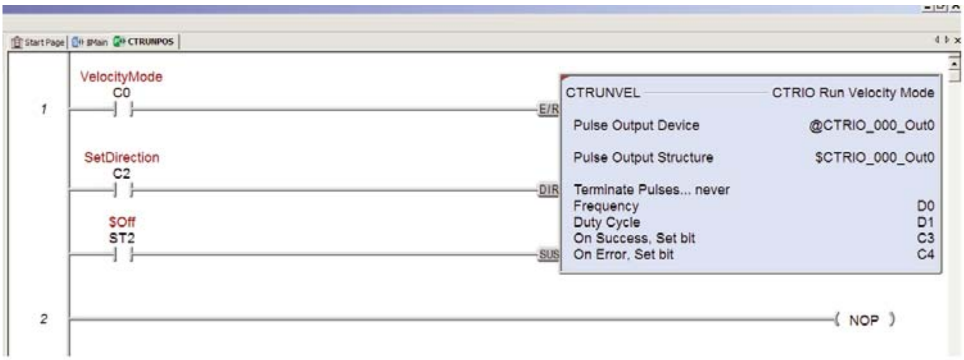


For detailed information on the CTDYNVEL – CTRIO Run Dynamic Velocity Mode instruction, see Do-more Designer help file topic DMD0517.

9

Velocity Mode

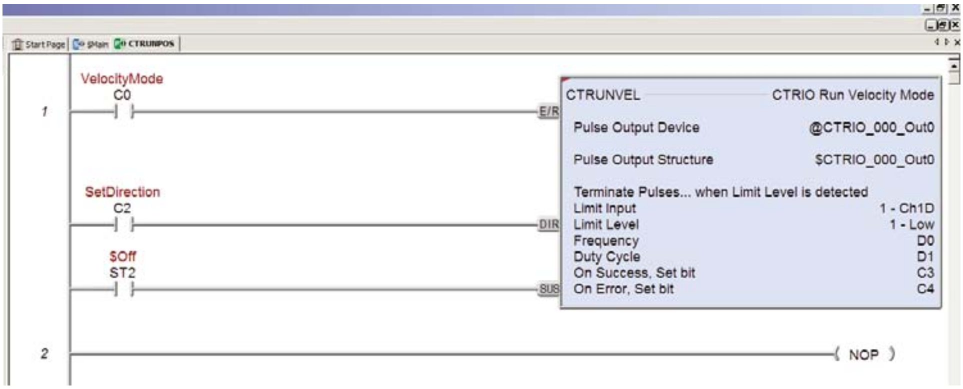
Load the desired frequency into D0 and select the desired direction using C2. Turn on C0 to start the output. The velocity can be changed 'on the fly' by placing a new value in D1. The direction is latched in when the instruction is enabled. To change direction, the instruction must first be disabled (C0 OFF).



For detailed information on the CTRUNVEL – CTRIO Run Velocity Mode instruction, see Do-more Designer help file topic DMD0530.

Run to Limit Mode

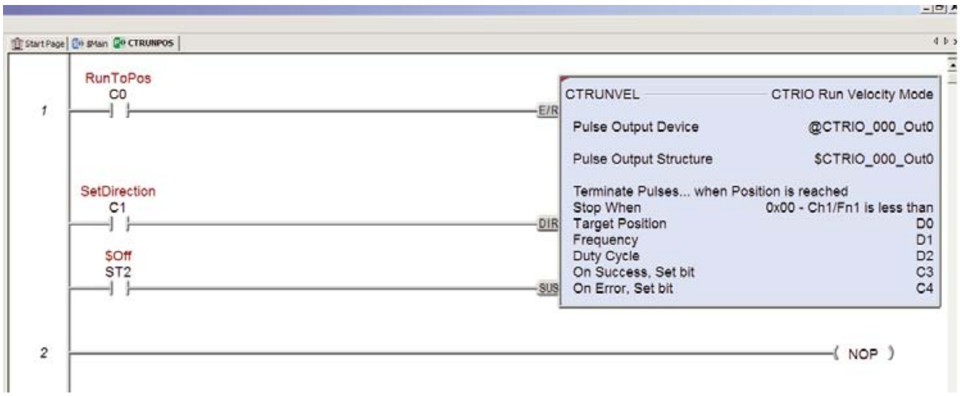
Choose the “Terminate Pulses when Limit Level is detected” option when selecting the CTRUNVEL instruction shown below. Load the desired frequency into D0 and select the desired direction using C2. Turn on C0 to start the output. When Ch1D meets the limit condition, (‘Low’ in this example) the move stops.



For detailed information on the CTRUNVEL – CTRIO Run Velocity Mode instruction, see Do-more Designer help file topic DMD0530.

Run to Position Mode

This is the equivalent ladder in Do-more Designer to the ladder shown on the previous two pages. Choose the “Terminate Pulses when Position is reached” option and select the desired stop conditions when programming the CTRUNVEL instruction shown below. As configured by default, the move completes when the counts on an encoder connected to Ch1 are less than the value in D0. Load the desired position into D0, the desired frequency into D1 and select the direction using C2. Turn on C0 to start the move.



For detailed information on the CTRUNVEL – CTRIO Run Velocity Mode instruction, see Do-more Designer help file topic DMD0530.

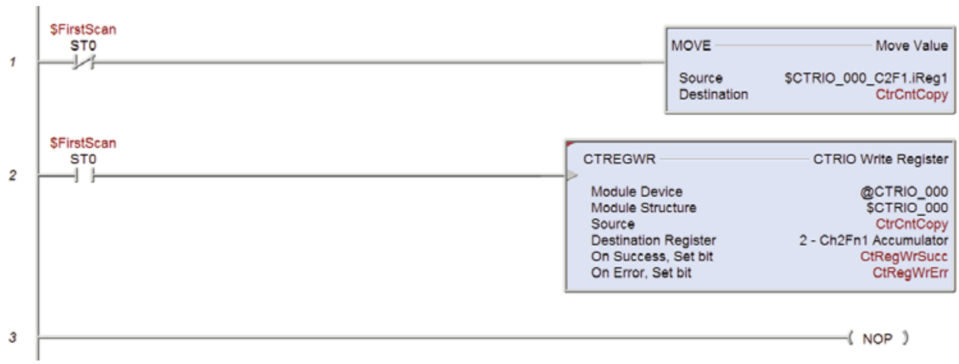
System Functions Examples Overview

NOTE: *System Functions are supported only when the CTRIO module is installed in the same base as the CPU.*

The Systems Functions examples on the following pages use the Do-more Designer's CTREGWR – CTRIO Write Register and CTREGRD - CTRIO Read Register instructions to write to or read from the CTRIO's internal registers.

Simulating Retentive Counter

The following example uses the CTREGWR – CTRIO Write Register instruction to write the current count stored in the PLC's retentive memory to the CTRIO's current count register after a power cycle or a RUN-STOP-RUN PLC mode change.



Rung 1 copies the CTRIO's counts value from channel 2 into a retentive memory location on every scan, except the First Scan.

NOTE: *This example uses the .iReg1 member, which contains integer raw counts when no scaling is applied in the CTRIO module configuration. If scaling WERE applied for this CTRIO function, .iReg1 would contain the scaled value and .iReg2 would contain the raw counts. CTREGWR only writes to the raw counts accumulator, so use .iReg2 if this CTRIO function is scaled in your configuration.*

Rung 2 uses the CTREGWR instruction to write the retained value back into the CTRIO's internal register on the First Scan.

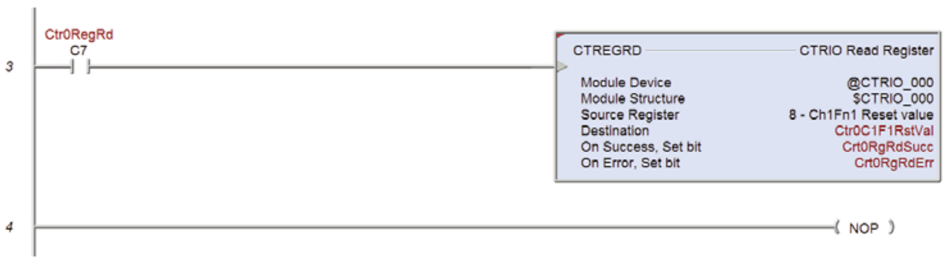
NOTE: *Since CTREGWR is an asynchronous instruction (note the red triangle), execution of any other ladder that references the current count of this CTRIO needs to be held off until this CTREGWR instruction returns its On Success bit, or its On Success JMP to Stage.*

For detailed information on the CTREGWR – CTRIO Write Register instruction, see Do-more Designer help file topic DMD0527.

Reading CTRIO Internal Registers

For most applications, reading CTRIO Internal Registers using ladder is not necessary. All the data needed from the module is already made available in the Do-more CPU through the CTRIO module structure. For a list of CTRIO module structures, see Help File topic: DMD0313 High Speed I/O Applications.

There are some registers in the CTRIO whose values are not available in structures. Examples are the Reset Value for a resettable counter and Filter Time for inputs. To read these values into ladder, use the CTREGRD - CTRIO Read Register instruction as shown below.



NOTE:: *The CTREGRD instruction can also be used to read the accumulator for a counter channel. However, this value is already available in structure elements .iReg1, .iReg2, .fReg1, or .fReg2. The only time CTREGRD would need to be used to read the accumulator is if scaling and capture are enabled and the raw accumulator value is needed in ladder.*

In the sample ladder above, turn on C7 to read in the Channel1 Function1 Reset Value of the CTRIO module in slot 0. The value will be written into address nicknamed Ctr0C1F1RstVal.

For detailed information on the CTREGRD – CTRIO Read Register instruction, see Do-more Designer help file topic DMD0526.