

INTRODUCTION TO THE CTRIO & CTRIO2 MODULES



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CTRIO and CTRIO2 Module Overview

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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.



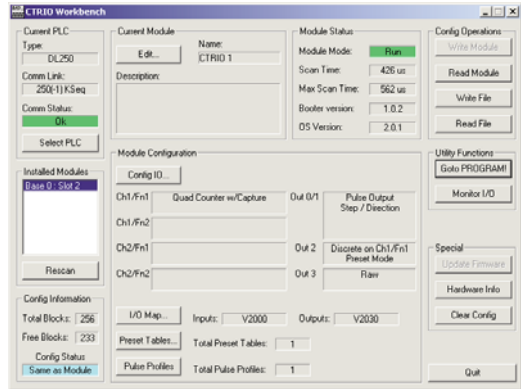
NOTE: For ease of documentation purposes, CTRIO will be used to designate all four CTRIO modules (H0-CTRIO(2), H2-CTRIO(2), H4-CTRIO and T1H-CTRIO) when the functionality and/or description applies to all four modules.

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:

Inputs:

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

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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	≤ 0.3V (H0, H2, H4, T1H-CTRIO) ≤ 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	T _{junction} = 150°C
Overtemperature reset	T _{junction} = 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

1 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.

1 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

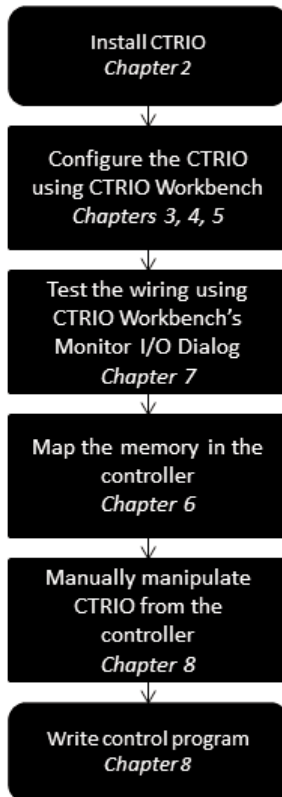
T1H-CTRIO LED Diagnostic Definitions		
OK	ER	Description
ON	OFF	RUN Mode
ON	ON	Hardware Failure
Blinking	Blinking	Boot Mode - Used for Field OS Upgrades
Blinking	OFF	Program Mode
OFF	Blinking	Module Self-diagnostic Failure
OFF	ON	Module Error Due to Watchdog Timeout
OFF	OFF	No Power to Module

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

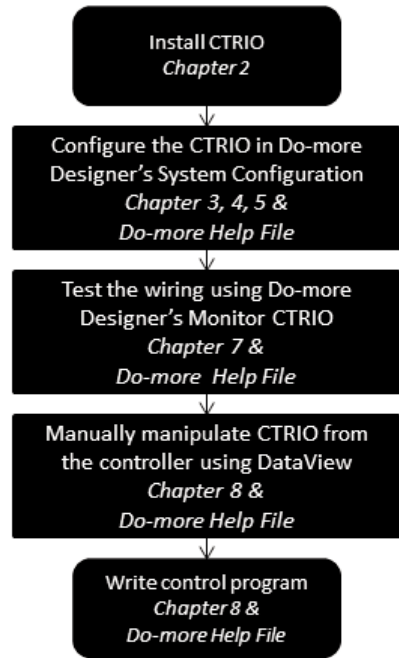
CTRIO Module Workflow Diagram

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: