DL05/06 High-Speed Counter I/O Module

High-Speed Counter I/O Module

H0-CTRIO2 $298.00

DirectLOGIC DL05 and DL06 PLCs

You can use the H0-CTRIO2 module with any of the DL05 and DL06 PLCs.

Typical applications

- High-speed cut-to-length operations using encoder input
- Pick-and-place or indexing functions controlling a stepper/servo drive
- Dynamic registration for web material control
- Accurate frequency counting for speed control with onboard scaling
- PLS (Programmable Limit Switch) functions for high-speed packaging, gluing, or labeling
- Sub 10µs pulse-catch capability for high-speed product detection
- Functions for level or flow

Supported systems

Multiple CTRIO2 modules can reside in the same PLC, provided the base power budget is adequate.

Overview

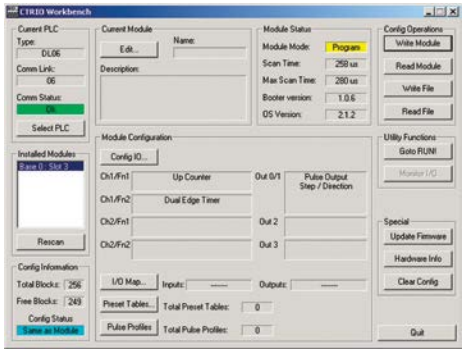
The High-Speed Counter I/O module is designed to accept high-speed pulse-type input signals for counting or timing applications and to provide high-speed pulse-type output signals for stepper/servo motor control, monitoring, alarm or other discrete control functions. The H0-CTRIO2 module offer great flexibility for applications that call for precise counting or timing, based on an input event or for high-speed control output applications.

The module has its own microprocessor and operate asynchronously from the PLC/controller. This means that the on-board outputs respond in real time to incoming signals so there is no delay waiting for the PLC/controller to scan I/O.

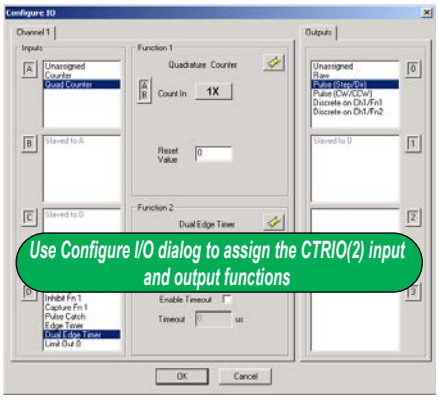
The module is designed to work with incremental encoders or other field devices that send pulse outputs.

Terminal block supplied. Replacement terminal block: Order part no. F0-IOCON.

CTRIO Workbench main configuration screen



Configure I/O screen



Note: CTRIO Workbench Version 2.2.0 is required to use H0-CTRIO2.

H0-CTRIO2 features

The H0-CTRIO2 module offers the following I/O features:

- 4 DC sink/source inputs, 9–30 VDC
- 2 isolated sink/source DC outputs, 5–36 VDC, 0.5 A per point

Inputs supported:

- 1 quadrature encoder counter up to 250kHz, or 2 single-channel counters also up to 250kHz using module terminals A and B
- High-speed edge timers, dual edge timers, pulse catch, count reset, count inhibit, count capture or home search limits using module terminals C or D

Outputs supported:

- 2 independently configurable high-speed discrete outputs or 1 channel pulse output control (20Hz–250kHz)
- Pulse and direction or cw/ccw pulses supported for pulse output control
- Raw control of discrete output directly from user control program

CPU	Firmware Required	DirectSOFT Required
DL05	Version 4.60 or later	Version 3.0c or later
DL06	Version 1.40 or later	Version 4.0, Build 16 or later

Software configuration

All scaling and configuration is done via CTRIO Workbench, a Windows software utility program. This eliminates the need for PLC ladder programming or other interface device programming to configure the module. CTRIO Workbench runs under Windows 98/2000/XP/7 and NT 4.0 SP5 or later.

DL05/06 High-Speed Counter I/O Module

I/O Specifications

General	
Module Type	Intelligent
Modules Per Base	Limited only by power consumption
I/O Points Used	None, I/O map directly in PLC V-memory or PC control access
Field Wiring Connector	Removable terminal block
Internal Power Consumption	250 mA Max at +5V from base power supply; (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	1500V I/0 to Logic (H0-CTRIO2), 1000V among input channels and all outputs

H0-CTRIO2 Output Specifications		
Module		H0-CTRIO2
Outputs		2 pts, independently isolated, current sourcing or sinking FET outputs: open drain and source with floating gate drive
Voltage Range		5 - 36 VDC
Maximum Voltage		36VDC
Output clamp Voltage		60VDC
Maximum Load Current		0.5 A at 23 °C, 0.33 A at 60 °C
Maximum Load Voltage		33 VDC
Maximum Leakage Current		100 µA
Inrush Current		1.0 A for 10 ms
OFF to ON Response		less than 3 µsec
ON to OFF Response		less than 3 µsec
ON State V Drop		0.3 V max.
External Power Supply		For loop power only, not required for internal module function. User supplied power source required for stepper drive configuration.
Overcurrent Protection		15A max Self resetting overcurrent protection
Thermal Shutdown		T-junction = 150°C
Overtemperature Reset		T-junction = 130°C
Duty Cycle Range		1% to 99% in 1% increments (default = 50%)
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
Maximum Output Frequency	Velocity Mode	65 kHz
	Run to Limit Mode	
	Run to Position Mode	
	Trapezoid	
	S-Curve	
	Symmetrical S-Curve	
	Dynamic Positioning	
	Home Search	
	Free Form	
	Dynamic Velocity	
	Dynamic Positioning Plus	250 kHz
	Trapezoid Plus	
	Trapezoid with Limits	

H0-CTRIO2 Input Specifications	
Module	H0-CTRIO2
Inputs	4 pts sink/source 250kHz Max
Minimum Pulse Width	0.5 µs
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 0.5 µs
ON to OFF Response	Less than 0.5 µs

H0-CTRIO2 Input Resources	
Counter/Timer	2
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); 1µs
Counter Range	±2.1 billion (32 bits or 31 bits + sign bit)

H0-CTRIO2 Output Resources	
Module	H0-CTRIO2
Pulse output / Discrete outputs	Pulse outputs: 1 channel (20Hz–250kHz); Discrete outputs: 2 pts.
Resource Options	Pulse outputs: pulse/direction or cw/ccw
	Output Profiles: Trapezoid S-Curve Symmetrical S-Curve Dynamic Positioning Dynamic Velocity Home Search Free Form Dynamic Positioning Plus Trapezoid Plus Trapezoid w/Limits 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/Counter input functions)
	Raw mode: Direct access to discrete output from user application program
Target Position Range	±2.1 billion (32 bits or 31 bits + sign bit)

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Status indicators

H0-CTRIO2 LED Descriptions	
OK	Module OK
ER	User Program Error
A	Channel 1 Fn1 Status
B	Channel 1 Fn2 Status
Y0 - Y1	Output Status

H0-CTRIO2 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-CTRIO2 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

Installation and wiring

The H0-CTRIO2 module has one input channel, consisting of four optically isolated input points (pts. A-D on common M). The inputs can be wired to either sink or source current. The module has two optically isolated output points (pts. Y0-Y1 on common YC).

The outputs must be wired so positive current flows into the YC terminal and then out of the Yn terminal. 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. Source operation is the factory default setting. See the schematic on the next page for sample jumper settings.

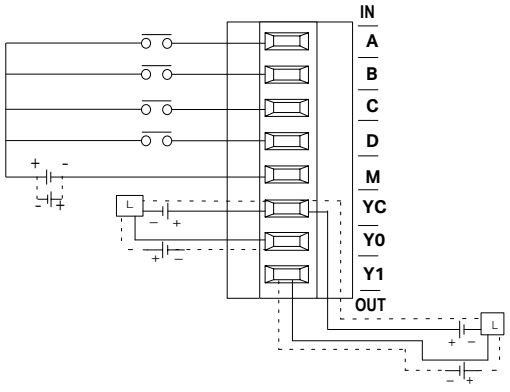
The module is configured, using CTRIO Workbench, to accommodate the user's application. The function of each input (counting, timing, reset, etc.) and output (pulse output, discrete output, etc.) is defined in the configuration of the module.

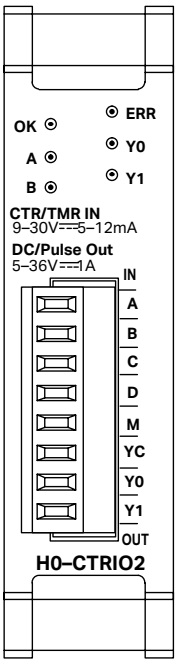
Terminal block supplied. Replacement terminal block: Order part no. F0-IOCON

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

Notes:

1. **Inputs (A, B, C, D) require user-provided 9-30 VDC power sources. Terminal M is the common for Channel 1 inputs. Maximum current consumption is 12 mA 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 5-36 VDC power sources. The maximum allowable current per output circuit is 0.5 A for the H0-CTRIO2.**
   Module output jumpers must be set to the High side or Low side common position for Source/Sink applications. Refer to the diagrams on the next page for sample jumper settings.





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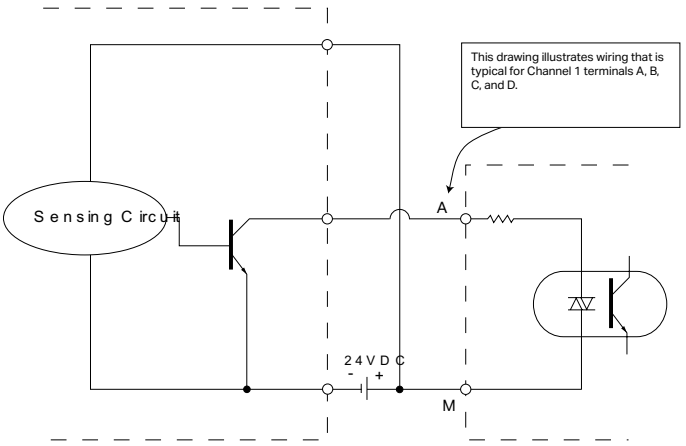
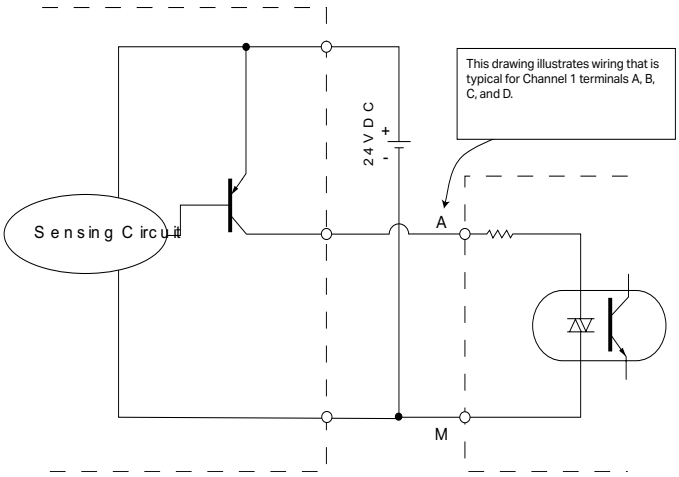
Solid state input wiring device

DC types of field devices are configured to either sink or source current. This affects the wiring of the device to the H0-CTRIO2 module. Refer to the sinking/sourcing section in the Appendix for a complete explanation of sinking and sourcing concepts.

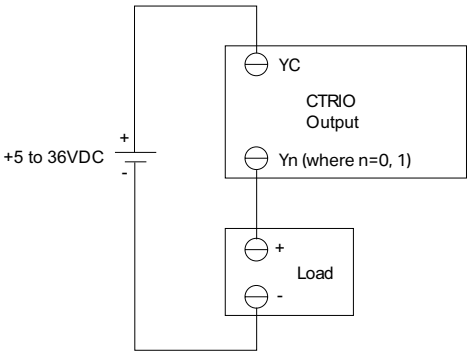
NPN Field Device (sink)



PNP Field Device (source)

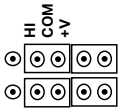


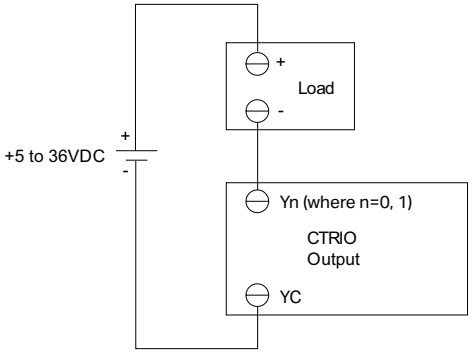
Pulse output schematic



Set the module jumpers to Hi Common position when switching the high side of a DC load.

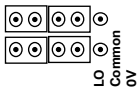
H0-CTRIO2



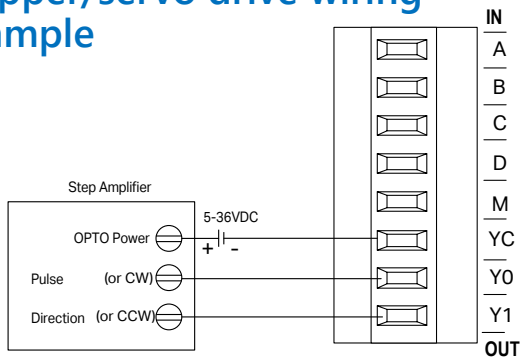


Set the module jumpers to LO Common position when switching the low side of a DC load.

H0-CTRIO2

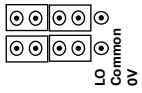


Stepper/servo drive wiring example

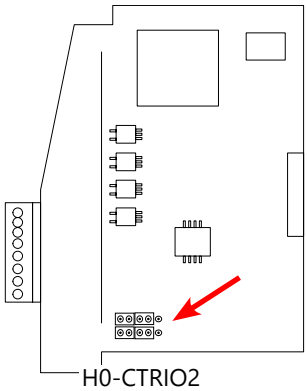


For this wiring example, the module jumpers should be set to the LO Common position.

H0-CTRIO2



H0-CTRIO2 Jumper Location



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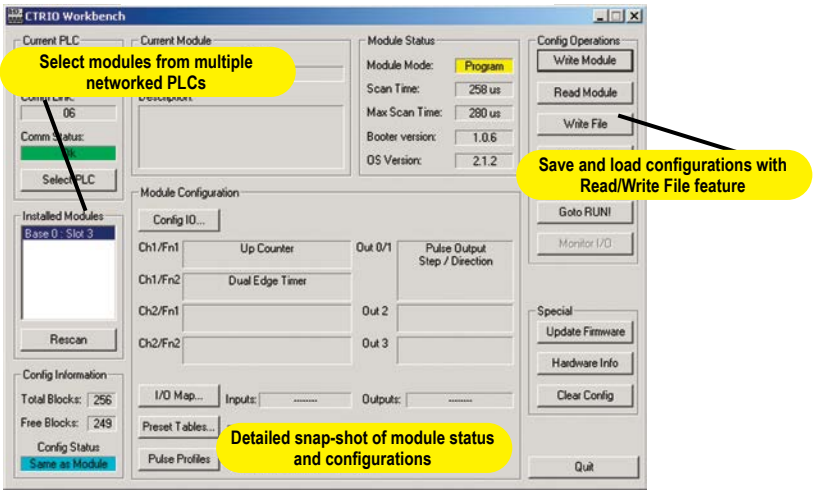
Fill-in-the-blank configuration software

The CTRIO Workbench is the software utility used to configure the CTRIO modules and to scale signals to desired engineering units. Workbench also allows you to perform various other functions, such as switching between the CTRIO's Program mode and Run mode, monitoring I/O status and functions, and diagnostic control of module functions. The latest version of the CTRIO Workbench utility can be downloaded for free at Host Engineering's Web site: www.hosteng.com.

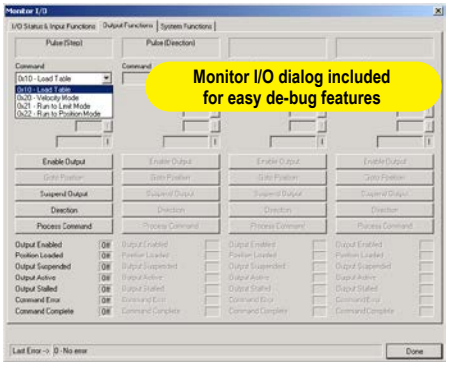
CTRIO Workbench main configuration screen



CTRIO Workbench diagnostics and monitoring

The Monitor I/O dialog is accessible from the main Workbench dialog when the module is in Run Mode. This allows for a convenient way to test and debug your configuration prior to installation. The Monitor I/O dialog is divided into three functional areas: Input Functions, Output Functions and System Functions. The data displayed under the Input Functions tab includes all input Dword parameters, status bits and the current status of each configured input and output function. The fields displayed under the Output Functions tab includes all output parameters and configuration information that can be altered during runtime and the bits that indicate successful transfers or errors. The System Functions can be used to read from or write to the CTRIO's internal registers.

Monitor I/O screen

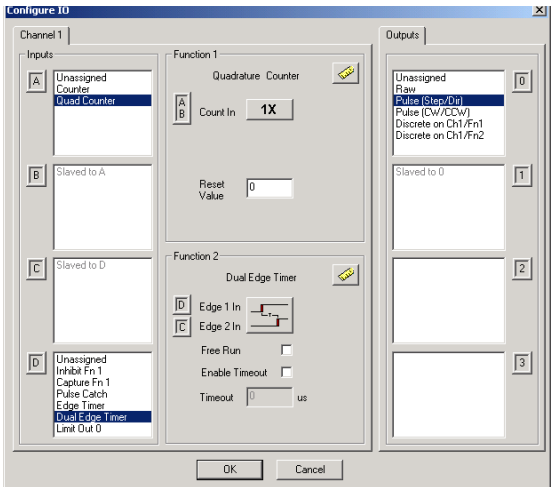


CTRIO Workbench configure I/O setup

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 function boxes prompt you with selections for supported functions. The Workbench software automatically disallows any unsupported configurations.

H0-CTRIO2

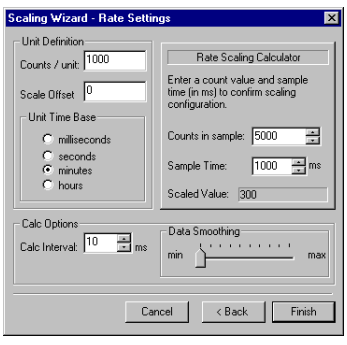
Configure I/O screen



CTRIO Workbench on-board scaling

Scaling raw signals to engineering units is accomplished using the Scaling Wizard. 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.

Scaling Wizard screen



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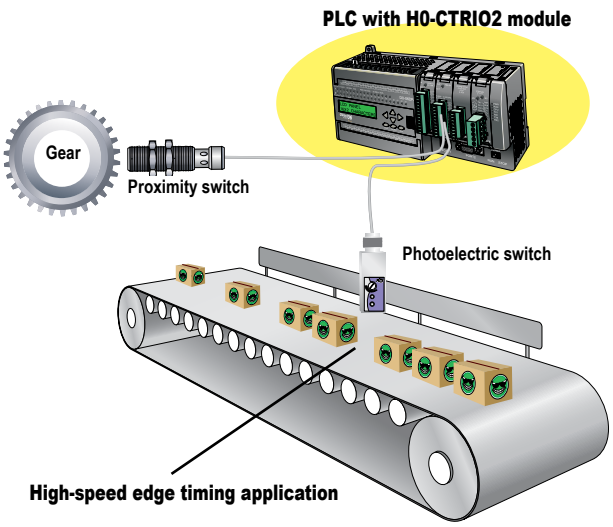
High-speed input operations

The CTRIO2 module is capable of a wide variety of high speed input and output operations all within one module. With single channel input and separate single channel output design, the H0-CTRIO2 module can satisfy both high-speed counting, timing, pulse catch operations, along with high speed discrete output or several profile choices of pulse output operations. Not all combinations of input functions and output functions are possible within the resources of the module, but the following examples are some of the most common applications for the H0-CTRIO2 module. Check out these examples and see how they relate to your high speed application needs.

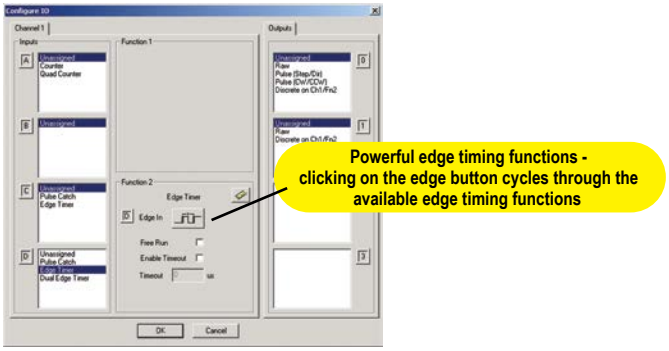
High-speed timing

The H0-CTRIO2 module can be configured for timing functions based on count or rate. Using a common configuration of a proximity switch sensing the teeth on a gear, the module is able to calculate the velocity of the gear based on the rate it receives counts. This value can be scaled within the module to the engineering units required for the application.

High-speed timing application



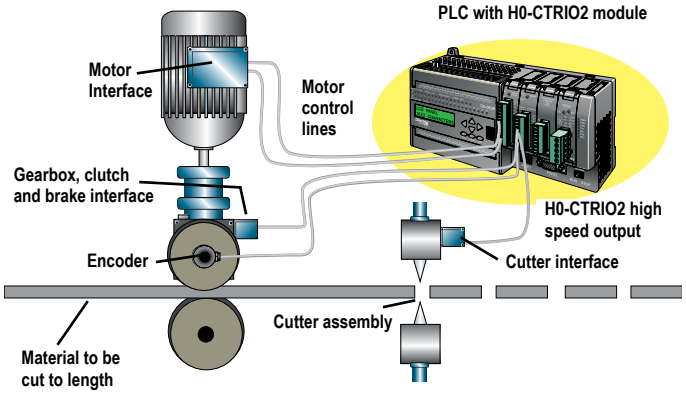
Using Configure I/O screen to configure H0-CTRIO2 module for high-speed timing



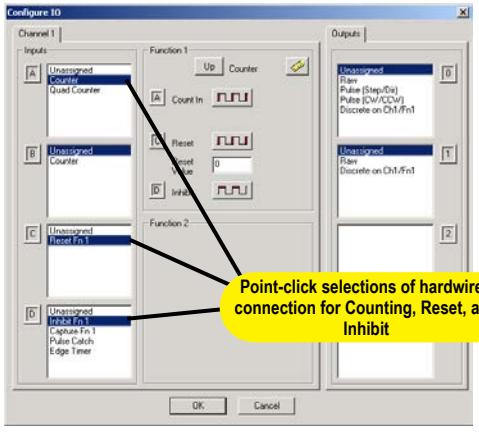
High-speed counting

The H0-CTRIO2 module can be configured for counting functions with an encoder input with available connections for external reset, capture and inhibit signals. In a simple cut-to-length application as shown, the encoder provides an input position reference for the material to the module. The module's high speed outputs are wired to the cutting device and to the clutch and/or braking device. When the count from the encoder is equal to a pre-programmed setpoint within the module, the high speed outputs are activated to stop and cut the material to a repeatable fixed length. Additionally, the clutch/brake signal can be used for an inhibit signal to not accumulate counts while the material is being cut.

High-speed cut-to-length application



Using Configure I/O screen to configure H0-CTRIO2 module for high-speed counting



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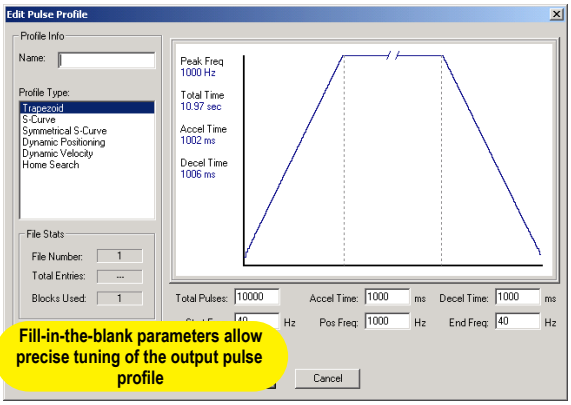
Pulse output operations

Using Edit Pulse Profile screen to select Trapezoid pulse output profile

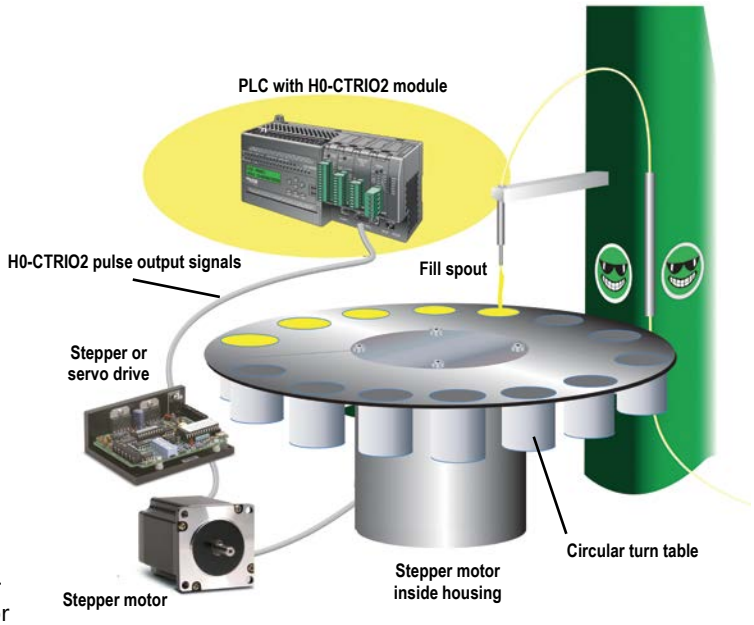


Pulse output for stepper/servo control

The H0-CTRIO2 module is capable of multiple configurations for pulse output control, most often when connected to a stepper or servo drive system. The module can deliver a pulse output signal up to a maximum of 250 kHz, along with support for pulse-and-direction or CW/CCW pulses. The available profile choices include Trapezoid, S-Curve, Symmetrical S-Curve, Dynamic Positioning, Dynamic Velocity, Home Search, Free Form, Dynamic Positioning Plus, Trapezoid Plus and Trapezoid w/Limits. All profiles can be easily configured using the CTRIO Workbench software with fill-in-the-blank parameter fields and a graphic representation of the selected profile. Three additional profiles are available that are completely controlled by the user program (no H0-CTRIO2 Workbench profile is configured). They are Velocity Mode, Run to Limit Mode and Run to Position Mode.

Example application

In a simple rotary indexing application, as shown above, a fixed Trapezoid profile is chosen. The H0-CTRIO2 module for this application is wired to a stepper drive for pulse-and-direction. The requirement for this application is to provide a smooth movement of the rotary table to allow product to be filled into individual containers an equal distance apart. The predetermined number of pulses required for each movement is entered into the CTRIO Workbench as "Total Pulses" along with the Starting Frequency, Ending Frequency, and Positioning Frequency (speed after acceleration). The Acceleration and Deceleration parameters are entered in units of time, so no ramp-distance calculations are required. After all parameters are entered, a graphical representation of the configured profile is shown automatically. Once the configuration has been downloaded to the module, all that is needed from the PLC CPU is the Enable Output signal to begin a movement.

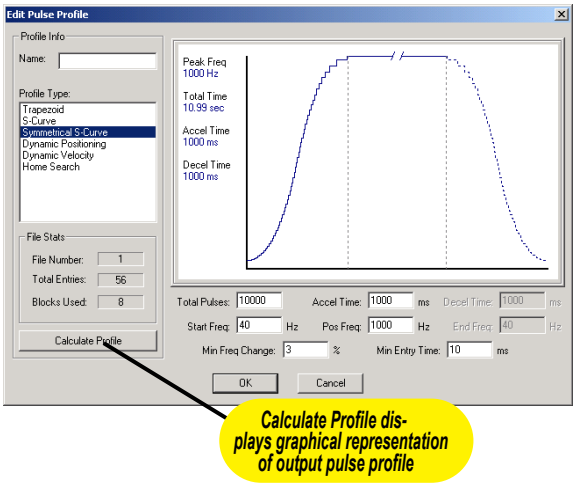


Rotary indexing liquid fill application

Other common pulse output applications:

- S-Curve accel/decel profile for signaling a stepper or servo drive that needs a curved acceleration and deceleration profile, i.e. for diminishing any initial "jerk" upon movement of static products, boxes on conveyors, liquids in containers on an indexer, printing registrations, etc.
- Dynamic Positioning for any run-to-a-specific-position requirement, either by a pre-programmed count of an external high speed discrete input wired to the module. This is popular in winding or webcontrol with any dynamic registration mark or variable speed requirement.
- Home search routines to seek a home position based on CTRIO module discrete input limit(s).

Example of S-Curve acceleration and deceleration pulse output profile



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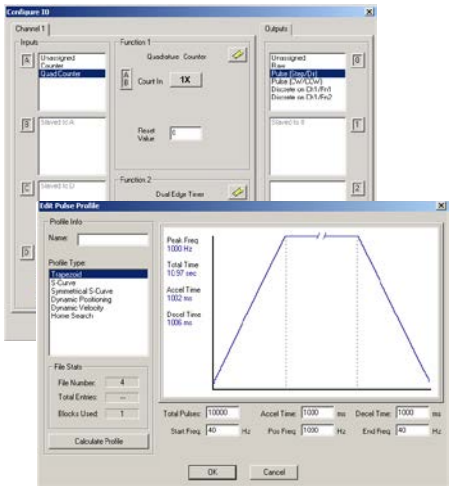
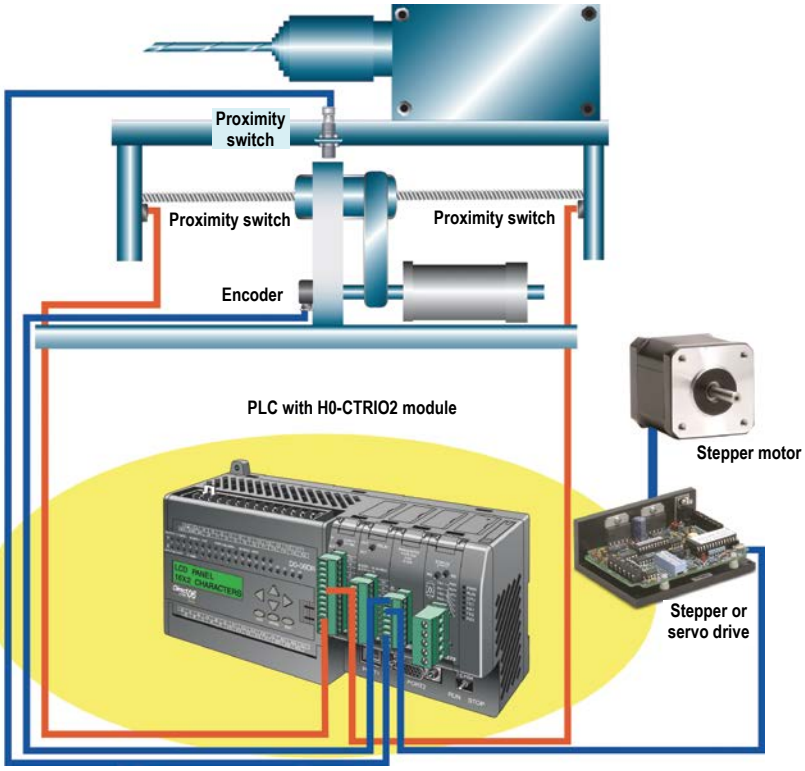
Combining high-speed input and pulse output operations

Using CTRIO Workbench to configure the module for simultaneous high-speed input and high-speed pulse output operation



Multi-head drill machine application

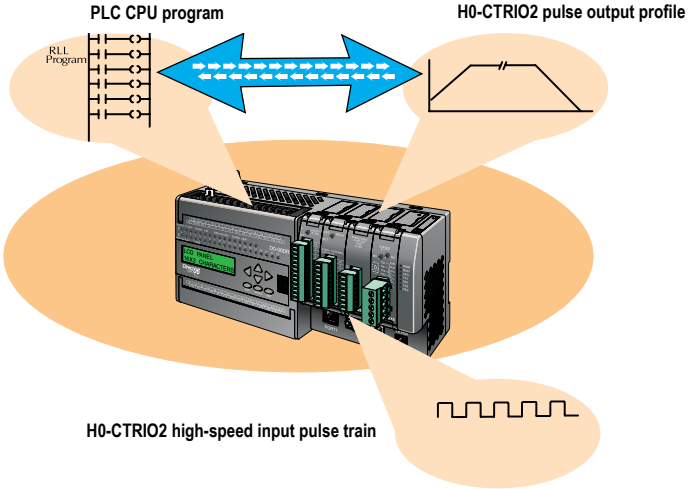


Use Encoder for Position

Three profiles offer the option to Use Encoder for Position. They are Dynamic Position Plus, Trapezoid Plus and Trapezoid w/ Limits. When Use Encoder for Position is enabled, the target positions are specified in units of the encoder and the move is complete when the encoder reaches that position, not when the output has finished generating a certain number of pulses. This functionality is useful for hitting a target position more accurately with a mechanical system that slips or has excessive lash.

In the simple drill head application shown above, the H0-CTRIO2 module pulse outputs are wired to a stepper or servo drive. The inputs are wired to an encoder attached to the lead screw on the movable portion of the drill head assembly. The H0-CTRIO2 module outputs a pulse train to the drive that allows the motor to spin the lead screw, making the drill move forward into the passing material. The encoder monitors the speed and position of the drill head. Proximity switches at each end act as limit switches ensuring the drill head will not over-travel. A home sensor is positioned in the middle of the assembly, which allows the PLC to reset the count.

Example application



As shown in diagram on left, using an encoder to calculate the appropriate position for a move using H0-CTRIO2 is done manually through ladder logic. The inherent lag of doing this slows the process considerably. The H0-CTRIO2 can handle this functionality natively on-the-fly when Use Encoder for Position is enabled, eliminating the scan time delay and the need for extra ladder code.

Power Budgeting for the DL06

The DL06 has four option module slots. To determine whether the combination of modules you select will have sufficient power, you will need to perform a power budget calculation.

Power supplied

Power is supplied from two sources: the internal base unit power supply and, if required, an external supply (customer furnished). The D0-06xx (AC powered) PLCs supply a limited amount of 24VDC power. The 24VDC output can be used to power external devices.

For power budgeting, start by considering the power supplied by the base unit. All DL06 PLCs supply the same amount of 5VDC power. Only the AC units offer 24VDC auxiliary power.

Be aware of the trade-off between 5VDC power and 24VDC power. The amount of 5 VDC power available depends on the amount of 24VDC power being used, and the amount of 24VDC power available depends on the amount of 5VDC power consumed. Determine the amount of internally supplied power from the table to the right.

Power required by base unit

Because of the different I/O configurations available in the DL06 family, the power consumed by the base unit itself varies from model to model. Subtract the amount of power required by the base unit from the amount of power supplied by the base unit. Be sure to subtract 5VDC and 24VDC amounts.

Power required by option modules

Next, subtract the amount of power required by the option modules you are planning to use. Again, remember to subtract both 5VDC and 24VDC.

If your power budget analysis shows surplus power available, you should have a workable configuration.

DL06 Power Supplied by Base Units

Part Number	5 VDC (mA)	24 VDC (mA)
D0-06xx	1500mA	300mA
	2000mA	200mA
D0-06xx-D	1500mA	none

DL06 Base Unit Power Required

Part Number	5 VDC (mA)	24 VDC (mA)
D0-06AA	800mA	none
D0-06AR	900mA	none
D0-06DA	800mA	none
D0-06DD1	600mA	280mA*
D0-06DD2	600mA	none
D0-06DR	950mA	none
D0-06DD1-D	600mA	none
D0-06DD2-D	600mA	none
D0-06DR-D	950mA	none

* Only if auxiliary 24VDC power is connected to V+ terminal.

DL06 Power Consumed by Other Devices

Part Number	5 VDC (mA)	24 VDC (mA)
D0-06LCD	50mA	none
D2-HPP	200mA	none
DV-1000	150mA	none
C-more Micro-Graphic	210mA	none

Power Budgeting Example

Power Source		5VDC power (mA)	24VDC power (mA)
D0-06DD1 (select row A or B)	A	1500mA	300mA
	B	2000mA	200mA
Current Required		5VDC power (mA)	24VDC power (mA)
D0-06DD1		600mA	280mA*
D0-16ND3		35mA	0
D0-10TD1		150mA	0
D0-08TR		280mA	0
F0-4AD2DA-1		100mA	0
D0-06LCD		50mA	0
Total Used		1215mA	280mA
Remaining	A	285mA	20mA
	B	785mA	note 1

* Auxiliary 24 VDC used to power V+ terminal of D0-06DD1 sinking outputs.

Note 1: If the PLC's auxiliary 24 VDC power source is used to power the sinking outputs, use power choice A, above.

DL05/06 Power Consumed by Option Modules

Part Number	5 VDC (mA)	24 VDC (mA)
D0-07CDR	130mA	none
D0-08CDD1	100mA	none
D0-08TR	280mA	none
D0-10ND3	35mA	none
D0-10ND3F	35mA	none
D0-10TD1	150mA	none
D0-10TD2	150mA	none
D0-16ND3	35mA	none
D0-16TD1	200mA	none
D0-16TD2	200mA	none
F0-04TRS	250mA	none
F0-08NA-1	5mA	none
F0-04AD-1	50mA	none
F0-04AD-2	75mA	none
F0-08ADH-1	25mA	25mA
F0-08ADH-2	25mA	25mA
F0-04DAH-1	25mA	150mA
F0-08DAH-1	25mA	220mA
F0-04DAH-2	25mA	30mA
F0-08DAH-2	25mA	30mA
F0-2AD2DA-2	50mA	30mA
F0-4AD2DA-1	100mA	40mA
F0-4AD2DA-2	100mA	none
F0-04RTD	70mA	none
F0-04THM	30mA	none
D0-DEVNETS	45mA	none
H0-CTRIO2	250mA	none
H0-ECOM100	300mA	none
F0-08SIM	1mA	none
D0-DCM	250 mA	none
F0-CP128	150 mA	none
F0-08SIM	1 mA	none