1

Getting Started

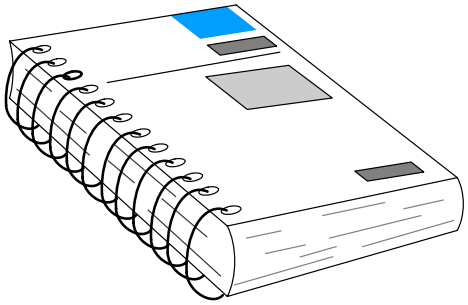
In This Chapter. . . .

- Introduction
- Physical Characteristics
- Specifications
- Modes of Operation
- Motion Control Made Easy – Four Simple Steps

Manual Introduction

The Purpose of this Manual

This manual describes the installation of the D2–CTRINT Counter Interface Module, and how to select the operating modes of the high–speed counting features. It also shows shows several ways to use the data in a PLC program.



Supplemental Manuals

The following manuals are essential for the proper use of your DL05 DeviceNet Slave Module.

- DL205 PLC User Manual part number **D2–USER–M**

  This manual contains detailed descriptions of the instructions used to setup and control the counter module. It also contains the complete I/O Memory Map which will be helpful.
- The ***Direct***SOFT32 Programmer Software Users Manual

Who Should Read This Manual

If you understand the DL205 instruction set and system setup requirements, this manual will provide the information you need to install and use the Counter Interface Module. This manual *is not* intended to be a tutorial on motion control theory, but rather a user reference manual for the D2-CTRINT Counter Interface Module.

Technical Support

We strive to make our manuals the best in the industry and rely on your feedback in reaching our goal. If you cannot find the solution to your particular application, or, if for any reason you need additional technical assistance, please call us at

770–844–4200.

Our technical support team is glad to work with you in answering your questions. They are available **weekdays from 9:00 a.m. to 6:00 p.m. Eastern Time**. We also encourage you to visit our website where you can find technical and nontechnical information about our products and our company.

www.automationdirect.com

Conventions Used

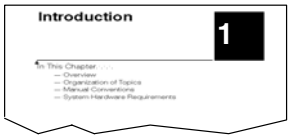
The “light bulb” icon in the left-hand margin indicates a **tip** or **shortcut**.

The “note pad” icon in the left–hand margin indicates a **special note**.

The “exclamation mark” icon in the left-hand margin indicates a **warning** or **caution**. These are very important because the information may help you prevent serious personal injury or equipment damage.

Key Topics for Each Chapter

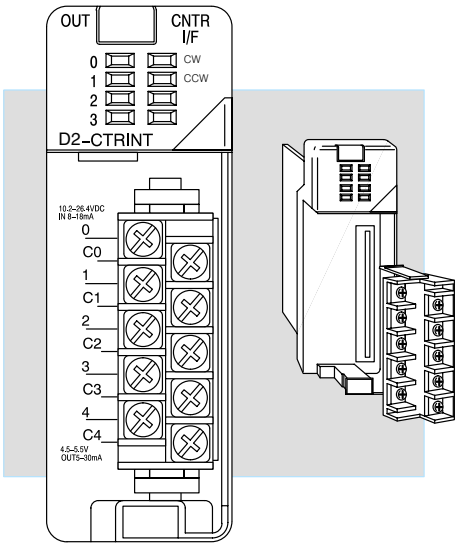
The beginning of each chapter will list the key topics that can be found in that chapter.



Module Overview

Low–Cost Motion Control Solution

Many machine control applications require various types of simple high-speed control. These applications usually involve some type of motion control, or high-speed interrupts for time-critical events. The DL205 product family solves this traditionally expensive problem with built-in CPU features which are accessed by the D2-CTRINT, Counter Interface Module.



Typical Applications

The Counter Interface Module is well suited for monitoring and controlling various types of high-speed input signals (pulses) which cannot be measured with standard discrete input modules. The Counter Interface Module works with a special part of the DL205 CPU which operates independently of the CPU program scan. This provides the accurate measurement and capturing of high-speed pulses, short duration discrete inputs, etc. The pulses can be provided from several different devices, such as, pulse encoders, sensors and limit switches.

A typical application is an encoder which is connected to a rotating device. The encoders produce a given number of pulses for each rotation of the shaft, so control decisions can be made based on the number of pulses counted.

Modes of Operation

The D2–CTRINT module operates at up to 5 KHz and allows you to access several different counting options. These counter features are built into the CPU, but the Counter Interface Module must be used to connect these features to a particular process. There are several options available:

- High Speed counter with up to 24 presets and built-in interrupt subroutines
- Quadrature encoder input to measure counts and clockwise or counter clockwise direction
- Programmable pulse output with external interrupts and separate acceleration and deceleration profiles for positioning and velocity control
- External interrupt inputs for immediate response to critical or time sensitive tasks
- Pulse catch feature to read up to 4 inputs, with each input having a pulse width as small as 0.1ms
- Programmable discrete filtering (both on and off delay up to 99ms) to ensure input signal integrity

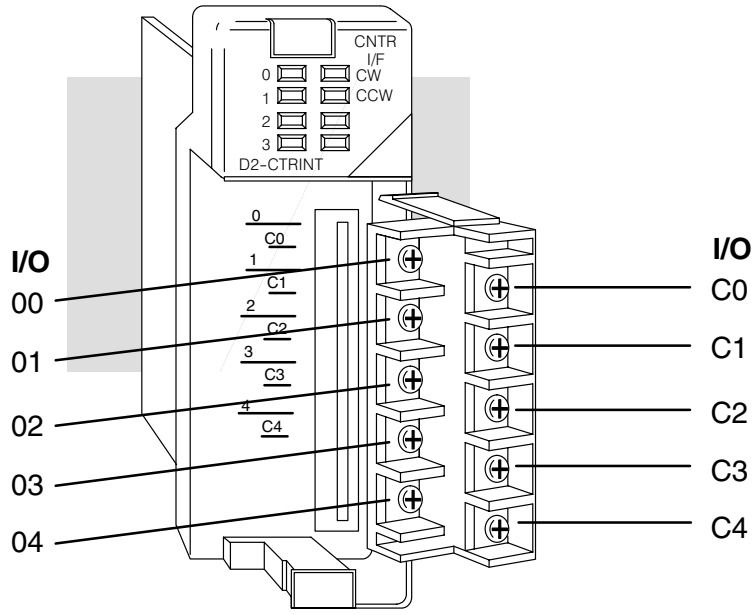
Physical Characteristics

Input and Output Terminals

The D2–CTRINT, Counter Interface Module, is an interface for several counting methods. It also provides a means to use embedded features of the CPU for interrupt, pulse catching, pulse output and discrete input. As a result, the module has both input and output terminals. Sometimes the same terminals are used as inputs in one mode and outputs in a different mode. The terminal block can be removed for ease of wiring.

There are pinch tabs on the top and bottom of the terminal block. To remove the terminal block, squeeze the pinch tabs and pull the terminal block from the module.

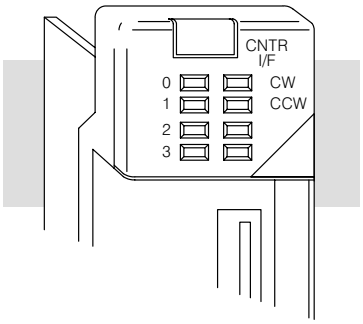
WARNING: Field device power may still be present on the terminal block even though the power has been disconnected from the PLC system. To minimize the risk of electrical shock, check all field device power before removing the connector.



Module Indicators

The Counter Interface Module also has LEDs to indicate the module operation.

The module has four indicators: one for each input, one for clockwise and one for counter clockwise operation (for those modes which use direction.)



Specifications

The following tables provide specifications for the Counter Interface Module.

General

Modules per System	1 only
Module Type	Discrete Input/Pulse Output
Installation Requirements	**Must install in slot 0, next to CPU**
Power Budget Requirement	200mA, 5 VDC (from base)
Digital I/O Consumed Input Points Output Points	 8 input points (X0–X7) 8 output points (Y0–Y7)
Field Wiring	Standard 8pt. removable terminal block
Operating Temperature	32 to 131° F (0 to 55° C)
Storage Temperature	–4 to 158° F (–20 to 70° C)
Relative Humidity	30 to 95% (non-condensing)
Environmental air	No corrosive gases permitted
Vibration	MIL STD 810C 514.2
Shock	MIL STD 810C 516.2
Noise Immunity	NEMA ICS3–304

Input Specifications

Input	4 points, current sink/source, 5KHz maximum
Minimum Pulse Width	100μs (0.1ms)
Input Voltage Range	12 or 24 VDC ±15%
Maximum Voltage	30 VDC
Rated Input Current	10mA typical, 13mA maximum
Minimum ON Voltage	8.0 VDC
Maximum OFF Voltage	1.0 VDC
Minimum ON Current	8.0mA
Maximum OFF Current	1.0mA
OFF to ON Response	Less than 30μs
ON to OFF Response	Less than 30μs

Output Specifications

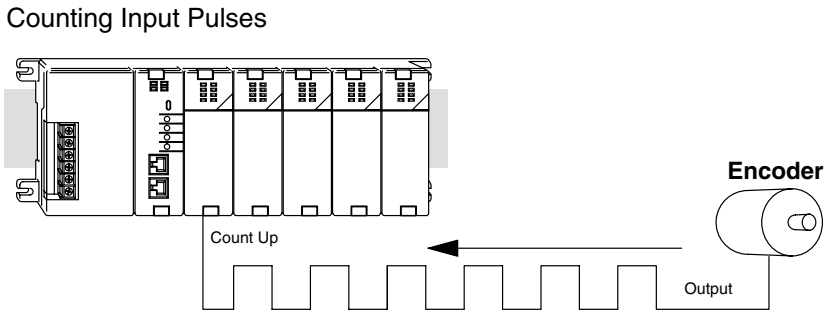
Output	2 points, current sinking, 5KHz maximum
External Power Supply Requirements	5.0 VDC±10%
Output Voltage Range	5.0 VDC ±15%
Maximum Voltage	5.5 VDC
Maximum Load Current	30mA
Minimum Load Voltage	4.5 VDC
Leakage Current	Less than 0.1mA at 5.5 VDC
Inrush Current	0.5A (for 10ms)
OFF to ON Response	Less than 30μs
ON to OFF Response	Less than 30μs

Modes of Operation

The D2–CTRINT module provides easy access to six modes of operation for the DL240/250–1/260 and four modes for the DL230.

Mode 10: Up Counter

There are two high-speed UP counters (5KHz) embedded internally in the DL240/250–1/260 CPUs and one in the DL230 CPU. These counters work independently of the CPU scan. When the counter reaches a preset value (up to 24 per counter), the CPU stops normal operations and executes an interrupt subroutine which is associated with the UP counter (one interrupt subroutine per UP counter).

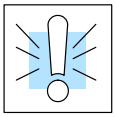


Each of the 24 presets has a special relay which is used to trigger events whenever the preset equals the current value. Absolute presets can be used to compare the preset directly to the current count, or incremental presets can be used to compare the current count to the current preset plus the accumulated value of the previous presets.

The subroutine can be programmed to perform whatever tasks are necessary. For example, Immediate I/O instructions can be used in the interrupt subroutine to provide a very fast response. Once the interrupt execution is complete, the CPU resumes normal program execution from the point where the interrupt occurred.

Turning the ENABLE of the counter ON and OFF will start and halt the counting.

There are three ways to reset the counters, (1) signal sent from an input module to the CPU where the input is read during the normal scan update, (2) signal sent directly into the module via point 02 and/or point 03, and (3) using an internal relay of the PLC to perform the reset via the program. The second choice is the quickest reset.



This module remains an OPEN LOOP counting solution for your application and depends on the system designer to close the loop properly.

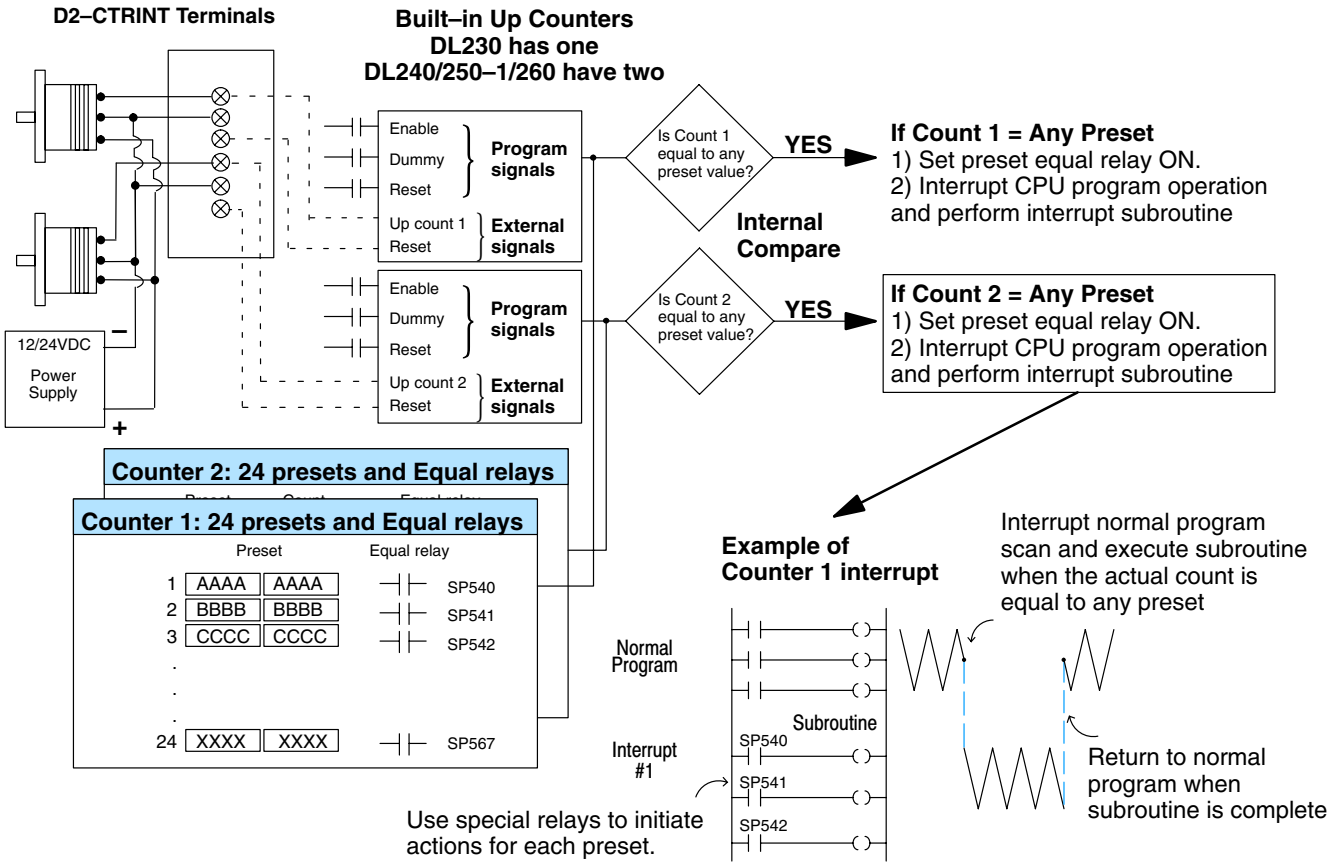
The following diagram provides a quick overview of the specifications and operations sequence for the Up Counters.

Specifications for the Up counters

Input voltage	12 or 24VDC
Frequency	5KHz maximum
Minimum pulse width	100 μSec
Maximum count	99,999,999
Preset types	Absolute or Incremental
Number of presets	24 per counter
Interrupt priority	Counter 1 over Counter 2

Hardware Connections (DL240/250–1/260)

Input 1:	Up count of UP counter 1 (pt. 00)
Input 2:	Up count of UP counter 2 (pt. 01)
Input 3:	External Counter 1 reset (pt. 02)
Input 4	External Counter 2 reset (pt. 03)



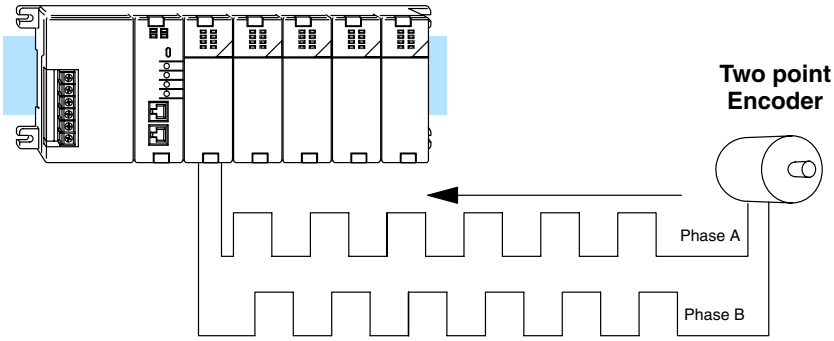
Note: Refer to page 2–4 for actual wiring diagram.

Mode 20: Up/Down Counter (DL240/250–1/260 Only)

The internal counters can be configured to operate either as a standard Up/Down Counter or as a single Quadrature Up/Down Counter with a DL240/250–1/260 CPU. As a standard Up/Down Counter, the input signal for up counting to a preset is wired to point 00 on the module. The signal that is to count down from a preset is connected to point 01. Typically, these signals are being processed from two separate *single point* encoders.

In the Quadrature mode, the signals are typically received from a two-point quadrature encoder interfaced to a motor. The two signals are 90 electrical degrees out of phase with each other. By counting the signals and comparing them, the CPU can determine both shaft velocity and direction of motor rotation.

Quadrature Signal Processing



The counter operates independently of the CPU scan. Ladder logic can be written so that when the counter reaches a preset value (up to 24 presets), the CPU stops normal operations and executes an interrupt subroutine which is associated with the counter .

There are 24 presets, each of them having a special relay that can be used to trigger events when the preset equals the actual value. Absolute presets can be used to compare the preset directly to the actual count. Incremental presets can be used to compare the actual count to the current preset plus the accumulated value of the previous presets.

A subroutine can be programmed to perform whatever tasks are necessary. For example, Immediate I/O instructions can be used in the interrupt subroutine to provide a very fast response. Once the interrupt execution is complete, the CPU resumes normal program execution from the point where the interrupt occurred.

Turning the enable of the counter ON and OFF will start and halt the counting. Counters can be reset either by an external signal (point 02) or by special internal relays which can be activated by the program.

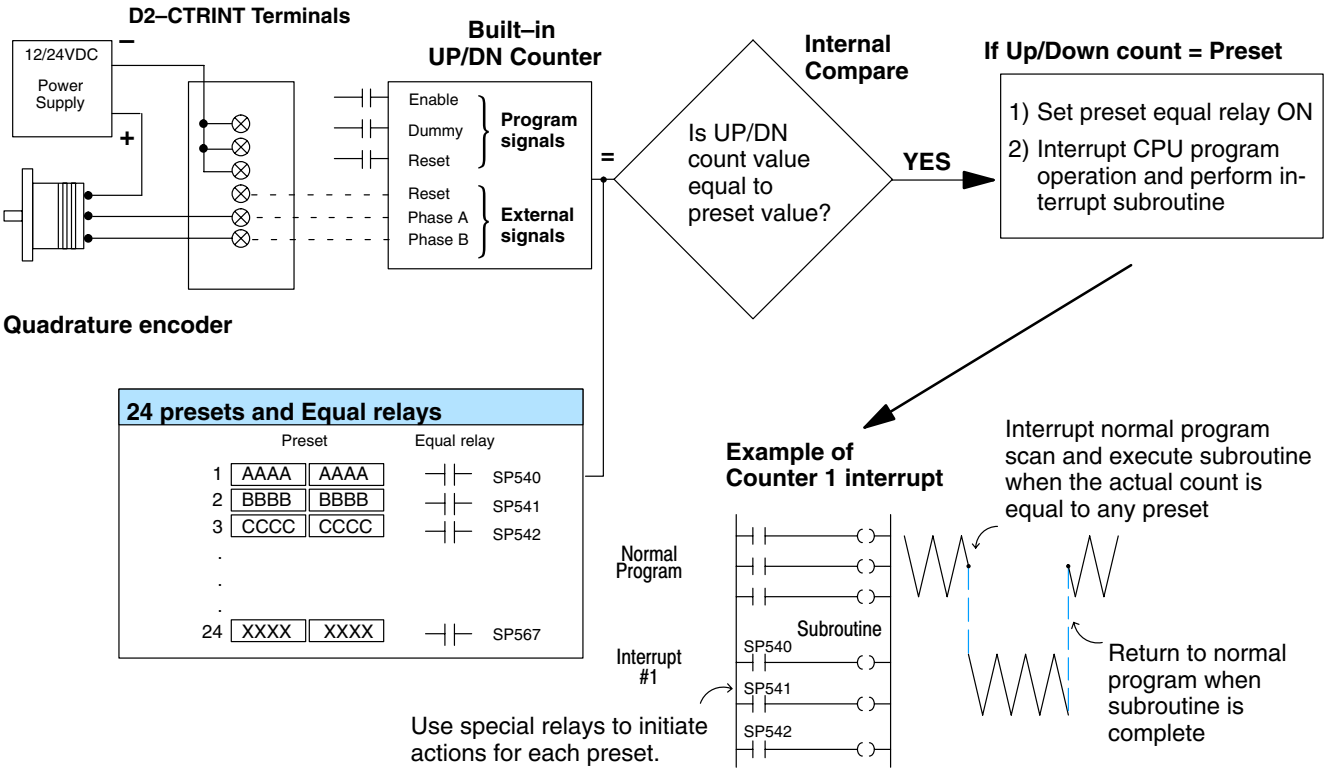
The following diagram provides a quick overview of the specifications and operations sequence for the Up/Down Counter.

Specifications for Up/Down Counter

Input voltage	12 or 24VDC
Frequency	5KHz maximum
Minimum pulse width	100μs
Count Range	–8,388,608 to 8,388,607
Preset types	Absolute or Incremental
Number of presets	24 (2 words per preset)

Hardware Connections

Input 1:	Phase A (pt. 00)
Input 2:	Phase B (pt. 01)
Input 3:	External counter reset (pt. 02)

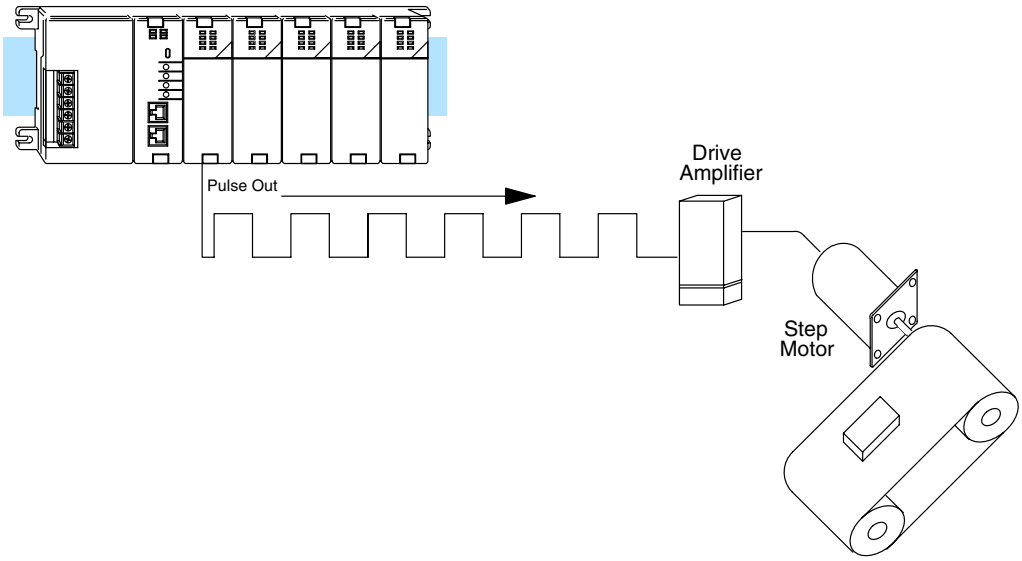


Note: Refer to page 2–4 for actual wiring diagram.

Mode 30: Pulse Output (DL240/250–1/260 Only)

This feature is only available for the DL240/250–1/260. The CPU has embedded pulse output circuitry which can be used to build simple motion and positioning control systems for transfer and indexing tables which are common applications. The pulse output is typically used with stepper motors which translate the pulses into an amount and direction of rotation.

Pulse Output

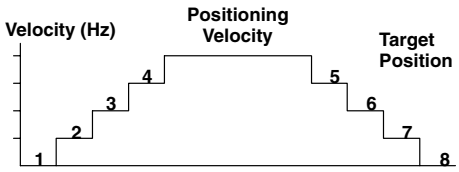


This mode of operation has two basic pulse output options; positioning control and velocity control.

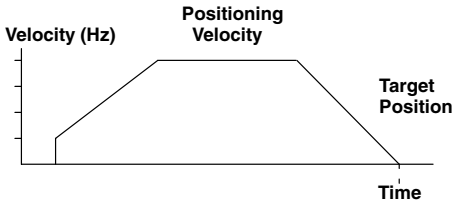
Positioning Control

This option uses a trapezoid profile to achieve a target position.

One approach provides preset acceleration control by defining four (4) acceleration steps to reach the positioning velocity and four deceleration steps as an approach to the target position.

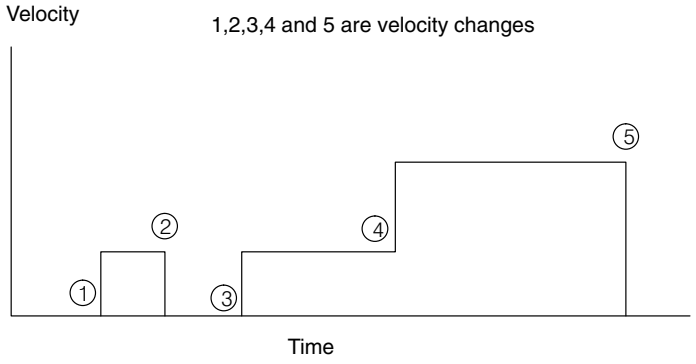


Another method provides automatic acceleration. With this method the starting velocity, the positioning velocity, and the amount of time required (100ms to 10 sec) are specified to accelerate from the start to positioning velocity. The CPU then automatically calculates the acceleration and deceleration.



Velocity Control

The velocity control option has clockwise (CW) and counter-clockwise (CCW) output capability, two separate outputs generating pulses. Unlike the other two pulse output functions mentioned on the previous page, velocity control does not seek a target pulse count for positioning. It only has two parameters, velocity and direction. During the velocity control operation, the direction and velocity can be set at anytime. By setting the upper bit in a reserved V-memory location the CPU will either send a CW or CCW signal to the motor drive. Another reserved V-memory location configuration will control the velocity in the same manner. Both of these V-memory locations are configured in ladder logic. The details of these V-memory locations are covered in the chapter that specifically discusses the pulse output mode in depth.

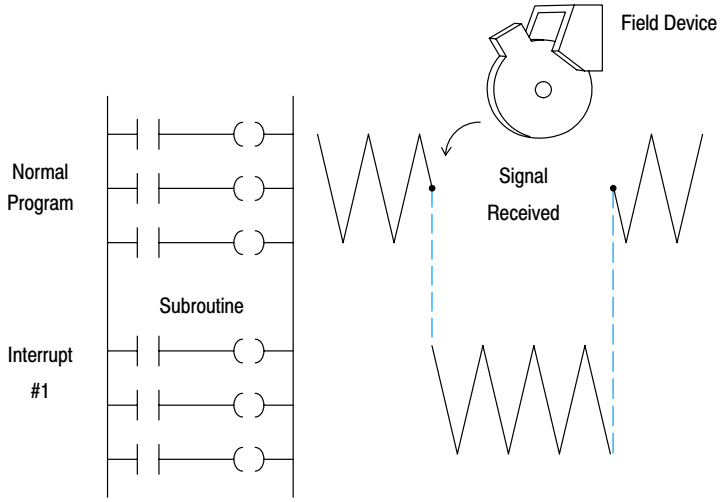


Mode 40: External Interrupts

Any one of the four points on the D2–CTRINT module can be used as external interrupts. One to four points can be configured to be external interrupt inputs. This is accomplished through the V-memory setup location in the DL230, DL240, DL250–1 and DL260 CPUs.

This mode is intended for applications that have a high-priority event which requires special operations to be performed. When this high-priority event occurs, the D2–CTRINT module senses an ON input signal. The module automatically informs the CPU to interrupt its present operation. The CPU immediately suspends the scan cycle and jumps to a subroutine identified with that particular interrupt input signal point. The CPU executes this interrupt subroutine (subroutines can use immediate I/O to immediately read and write I/O points). When the subroutine is complete, the CPU automatically resumes the normal scan cycle starting at the exact location from where it was interrupted. The CPU continues the normal scan until another interrupt signal is sensed.

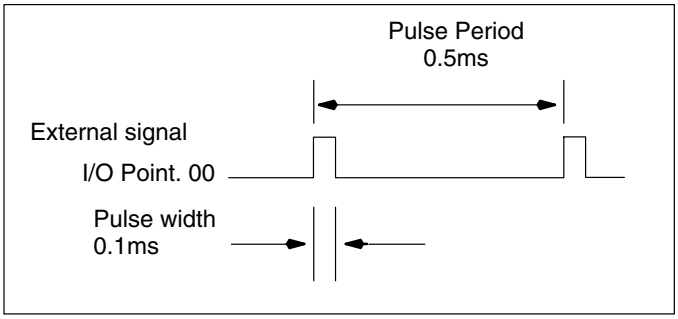
The interrupts can be pulses with a width as small as 100µs. The leading edge of the interrupt request pulse is what triggers the CPU. It takes 0.5ms to register an interrupt; if multiple pulses are sent to the same input point in a span of time less than 0.5ms, only the first signal will be acknowledged. If pulses are received simultaneously at two or more of the four input points, the priority of acknowledgement by the CPU will be point 00 first, point 01 second, point 02 third, and point 03 will be last.

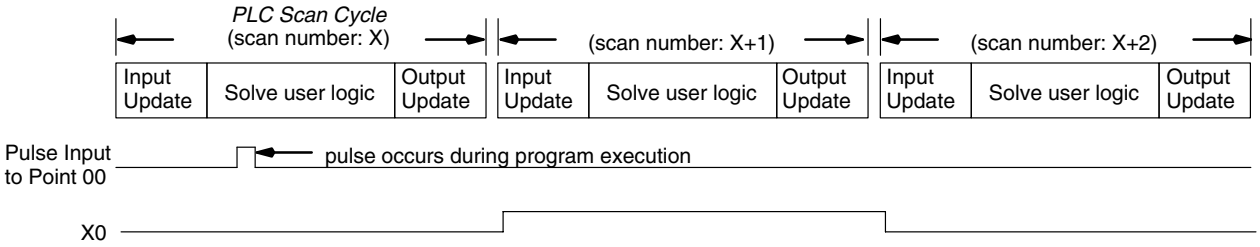


Mode 50: Pulse Catch Inputs

Using the D2–CTRINT module with the DL240/250–1/260, any one or all four points of the module can be used as “pulse catchers”. The DL230 offers this feature for channel one (point 00) only. A pulse catching point can sense and latch a pulse width from 0.1ms to 0.5ms. This type of feature is needed when processing signals of a very short duration. Typically, these pulses are of such short duration that they cannot be detected during the normal program execution.

Instead of increasing the pulse length so that it can be processed, the D2–CTRINT and CPU combination makes use of special internal relays embedded in the CPU firmware which “trap” the pulses. When an external pulse is encountered, a special internal status relay (SP) is set to ON. The special purpose relay remains in the ON state for the next scan of the CPU, then gets set automatically to the OFF state. A pulse can be trapped at anytime regardless of the CPU scan.





Mode 60: Discrete Inputs with Filter

This mode is selected when the primary need is to have four or less discrete inputs with very high integrity. Noise caused by switch bounce or other sources can be filtered so the inputs will be valid.

When an input signal is first detected at any one of the four points, a programmable filter is activated which begins a timed countdown. The ON status of the signal is temporarily prevented from being read by the input update of the CPU. The ON signal must stay present long enough for the filter to “time out”.

Once the signal has remained ON for the required time, it is latched and allowed to be accepted by the CPU during the normal input update of the PLC scan cycle. The signal is latched for the remaining duration of the ON signal plus an amount of time equal to the filter time. The filter time can be programmed for 0 to 99ms in 1ms increments.