APPLICATION NOTE

Product Family: 05, 06, 105, 205, 405, WinPLC, Terminator IO

Number: AN-MISC-021

Subject: High speed input/output device selection

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Revision: Original

PURPOSE

This application note is intended to give the potential buyer a clearer understanding of when to choose a particular component for use in a High Speed IO (HSIO) application. This will include both input functions and output functions.

So what kinds of applications can we use HSIO devices for?

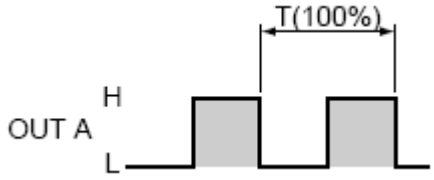
INPUTS:
-counters
-rate calculators
-event timing
-pulse catch
-interrupt inputs

OUTPUTS:
-stepper motor output
-preset driven output control

Let's go through each of these features in a little more detail:

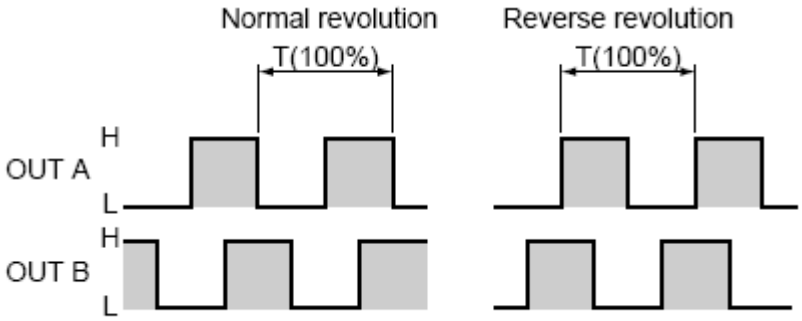
Counters

Counters are used to incrementally add up the number of pulses that have occurred on a given input. There are two kinds of counters in our products, single-ended and quadrature. A single-ended counter just counts up and is fed from a single pulse train.



Single-ended

A quadrature counter counts up or down based on two separate inputs which are being fed to the device from a quadrature device, usually an encoder. The two signals are 'phased' so that the order the leading edges occur in determines direction of counting. By this token, quadrature counting is more noise resistant than single-ended counting.



Quadrature

Rate Calculators
Rate calculators can be either extra code that the programmer has to enter in order to calculate a rate value, or they may be built into the HSIO device itself. In either case the basic concept is that the number of pulses coming into the HSIO device are counted for a specific period of time, then math is performed to generate a scaled rate calculation such as gallons per minute or revolutions per minute. Normally there is a trade off between speed of update and accuracy when calculating a rate, the longer the period the slower the update, but the more accurate the rate calculation.

Event Timing
Event timing is when the time between two events needs to be determined. This could be a single timing event that happens periodically, or a running sample which is tested each event. This method is also sometimes used for rate calculations for very slow signals (interval).

Pulse Catch
Pulse catch is very simply just having the HSIO device mark a flag in the control logic when a very short duration pulse occurs on a field device. It allows the code to see an event which happens much faster than the scan cycle allows.

Interrupt inputs
Interrupt inputs allow external signals to immediately cause the program scan to halt and send the program scan to an interrupt routine where the PLC can perform some immediate action. Uses include cut to length applications, material application, and conveyor control.

Stepper Motor Output
This feature is used to output either a step and direction signal, or a CW/CCW signal to a stepper motor control board. Typical uses include predefined trapezoidal moves, straight velocity outputs, and home search applications.

Preset Driven Output Control
This mode allows the programmer to specify to the HSIO device to turn on/off a physical output at a precise count value. Uses include cut to length applications, material application, and conveyor control.

Because the different PLC families/products handle HSIO differently, we will be discussing the individual features of each as they pertain to the above categories. Let's start with something simple, the DL05 line of PLCs.

D0-05 PLCs HSIO Features:

First of all, to use the HSIO features of the 05 PLCs, the PLC must be equipped with DC inputs or DC outputs depending on whether we are going to use an input feature or an output feature. So if we want to do some high speed counting, we need an 05 that has DC inputs, like a D0-05DR. If we wanted to run a stepper motor output, we would need an 05 with DC outputs, like a D0-05AD. Note that there are 05 PLCs with both DC inputs and DC outputs, these PLCs can perform EITHER input features OR output features but NOT BOTH at the same time. Programming examples for the 05 HSIO circuit can be found in chapter 3 of the D0-USER-M user manual.
http://web2.automationdirect.com/static/manuals/d0user/ch3.pdf

05 Input features

05 Counters

The 05 PLCs have only one counter available in two different modes. Mode 10 is a single-ended counter which uses a single pulse train to count in one direction only. Mode 20 is a quadrature counter which requires a quadrature signal on two inputs to count up or down based on rotation. An additional feature of Mode 10 is that it allows for the use of up to 24 presets. Mode 20 does not support presets in the 05. The program can be made to interrupt the program scan when any of these presets are reached and go to an interrupt routine in the PLC immediately. This is necessary for applications where outputs must be accurately controlled based on the input count value. The 05 can count pulse trains up to 5kHz.

05 Rate calculators

There are no prewritten or selectable rate calculators for the 05. It is best to write logic in the PLC to periodically load the value from the counter and perform math to determine the rate. The logic can then simply reset the counter and proceed to accumulate counts for the next sample period. This can be done in either mode 10 or mode 20. Normally there is a trade off between sample time and signal accuracy. The longer the sample, the more accurate the rate, but the slower the update will be.

05 Event timing

There are no provisions for event timing with the 05 HSIO circuit.

05 Pulse catch

The pulse catch mode for the 05 is called mode 50. This mode allows the PLC to monitor a particular input X0 and latch a particular bit (SP100) for an entire scan each time one or more pulses appear on the X0 input since the last scan cycle. This mode should NOT be used for counting as multiple pulses in will not cause multiple pulses of the SP100 bit. The minimum pulse width for the pulse catch mode is 0.1 milliseconds.

05 Interrupt inputs

The interrupt mode of the 05 is called Mode 40. This mode allows pulses occurring on X0 to immediately halt the program scan and send the program solution to the interrupt routine. This allows for immediate control of other output functions. This mode should NOT be used for applications where the X0 input can

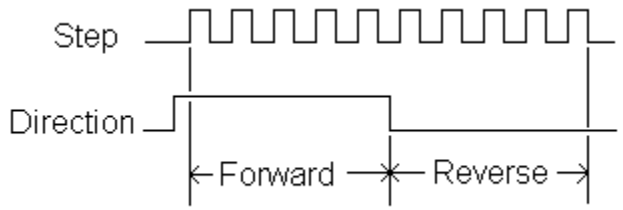
occur multiple times per scan as this will adversely affect the overall scan time of the PLC, which might cause a watchdog error to shut the PLC down. The minimum pulse width for the interrupt mode is 0.5 milliseconds.

05 Output features

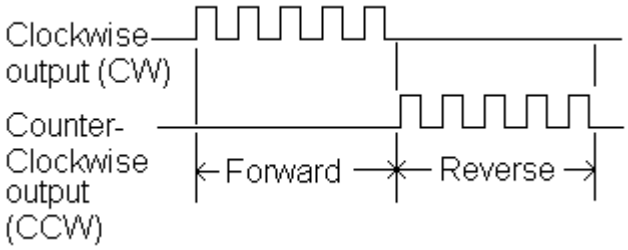
05 Stepper motor output

The 05 stepper motor output mode is called Mode 30. The range of frequency output is from 40Hz to 7kHz. Mode 30 allows the PLC to send various types of pulse output signals to the Y0 and Y1 outputs. These signals are intended for use with stepper motor control boards. Two output types are available,

Step and direction



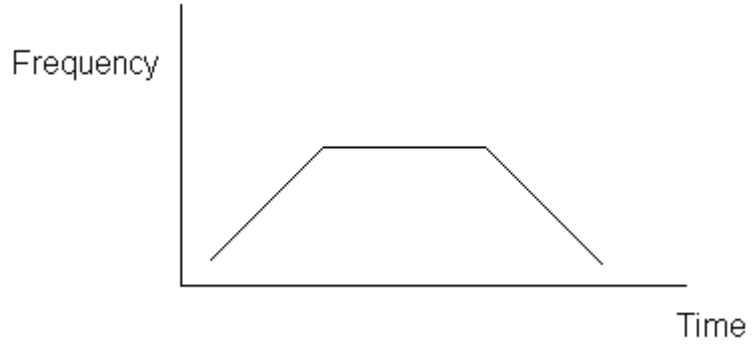
and CW/CCW.



Mode 30 also allows several types of waveforms to be sent to the outputs. Let's go over the available options:

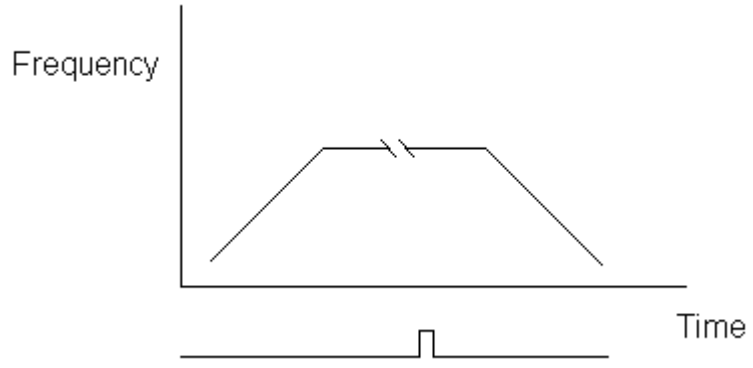
Trapezoidal

The trapezoidal profile allows for the output pulse train to start at a specified frequency, ramp up to a target frequency, then ramp down and stop at a particular pulse count. This profile type is popular for applications where devices cannot simply be run at a single speed due to inertial or other restrictions. It is by far the most popular profile type.



Registration

The registration profile is similar to the trapezoidal profile. The major difference is that the registration profile will continue to run at the target frequency until a separate pulse input indicates the profile should stop. The profile then decelerates and stops at a particular number of pulses BEYOND the point where the registration input occurred.



Velocity

The velocity profile just sends pulses to the output at a fixed frequency. Changes can be made in the program to the speed. Changes made will occur as a step response with no ramp between previous frequency and the new frequency.

05 Conclusions
Pretty neat, huh? Not bad for a $115 PLC. So, 05 PLCs are good for single counter or single stepper output applications. Don't forget, 05 PLCs can be networked to provide HSIO features at multiple locations. OK, let's see what the 05s big brother, the 06 adds to the mix.

D0-06 PLCs HSIO Features:

Just like the 05 PLCs, to use the HSIO features of the 06 PLCs, the PLC must be equipped with DC inputs or DC outputs depending on whether we are going to use an input feature or an output feature. So if we want to do some high speed counting, we need an 06 that has DC inputs, like a D0-06DR. If we wanted to run a stepper motor output, we would need an 06 with DC outputs, like a D0-06DD1. Note that there are 06 PLCs with both DC inputs and DC outputs, these PLCs can perform EITHER input features OR output features but NOT BOTH at the same time. Programming examples for the 06 HSIO circuit can be found in chapter 3 of the D0-06USER-M user manual.
http://web2.automationdirect.com/static/manuals/d006userm/ch3.pdf

06 Input features

06 Counters
The 06 PLCs have one or two counters available in two different modes. Mode 10 allows for up to two single-ended counters which use a single pulse train to count in one direction only. Mode 20 allows for a single quadrature counter which requires a quadrature signal on two inputs to count up or down based on rotation. An additional feature of Mode 10 is that it allows for the use of up to 24 presets per counter. Unlike the 05, presets are available in Mode 20 for the 06. The program can be made to interrupt the program scan when any of these presets are reached and go to an interrupt routine in the PLC immediately. This is necessary for

applications where outputs must be accurately controlled based on the input count value. The 06 can count pulse trains up to 7kHz.

06 Rate calculators

There are no prewritten or selectable rate calculators for the 06. It is best to write logic in the PLC to periodically load the value from the counter and perform math to determine the rate. The logic can then simply reset the counter and proceed to accumulate counts for the next sample period. This can be done in either mode 10 or mode 20. Normally there is a trade off between sample time and signal accuracy. The longer the sample, the more accurate the rate, but the slower the update is.

06 Event timing

There are no provisions for event timing with the 06 HSIO circuit.

06 Pulse catch

The pulse catch mode for the 06 is called mode 50. This mode allows the PLC to monitor one or more inputs X0-X3 and latch a particular bit (SP100-SP103) for an entire scan each time one or more pulses appear on the inputs since the last scan cycle. This mode should NOT be used for counting as multiple pulses in will not cause multiple pulses of the SP100-SP103 bits. The minimum pulse width for the pulse catch mode is 0.1 milliseconds.

06 Interrupt inputs

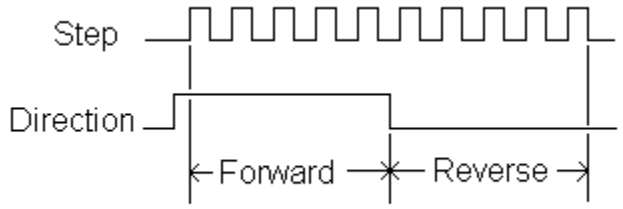
The interrupt mode of the 06 is called Mode 40. This mode allows pulses occurring on one or more of the inputs X0-X3 to immediately halt the program scan and send the program solution to one of four interrupt routines. This allows for immediate control of other output functions. This mode should NOT be used for applications where any of the inputs can occur multiple times per scan as this will adversely affect the overall scan time of the PLC, which might cause a watchdog error to shut the PLC down. The minimum pulse width for the interrupt mode is 0.5 milliseconds.

06 Output features

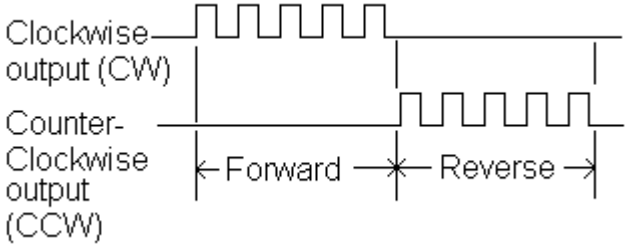
06 Stepper motor output

The 06 stepper motor output mode is called Mode 30. The range of frequency output is from 40Hz to 10kHz. Mode 30 allows the PLC to send various types of pulse output signals to the Y0 and Y1 outputs. These signals are intended for use with stepper motor control boards. Two output types are available,

Step and direction



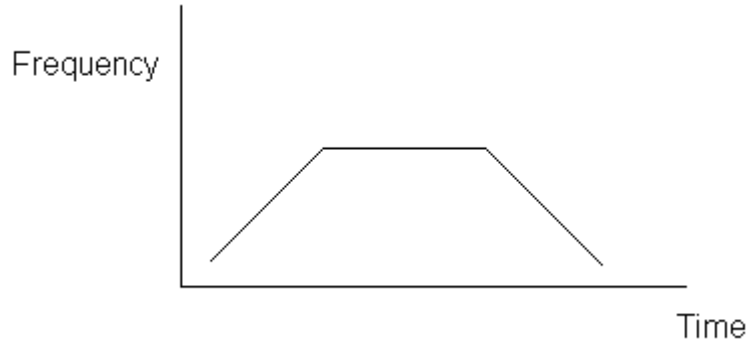
and CW/CCW.



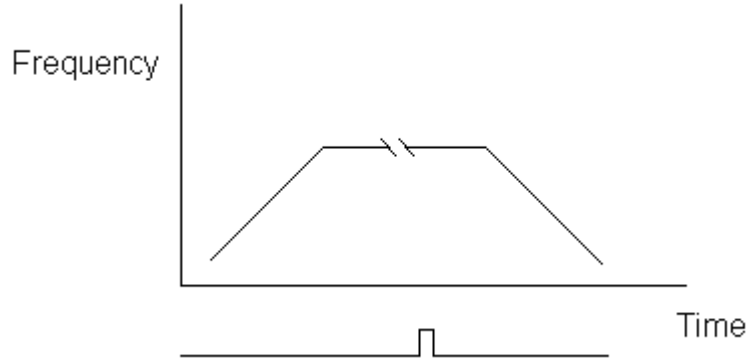
Mode 30 also allows several types of waveforms to be sent to the outputs. Let's go over the available options:

Trapezoidal

The trapezoidal profile allows for the output pulse train to start at a specified frequency, ramp up to a target frequency, then ramp down and stop at a particular pulse count. This profile type is popular for applications where devices cannot simply be run at a single speed due to inertial or other restrictions. It is by far the most popular profile type.

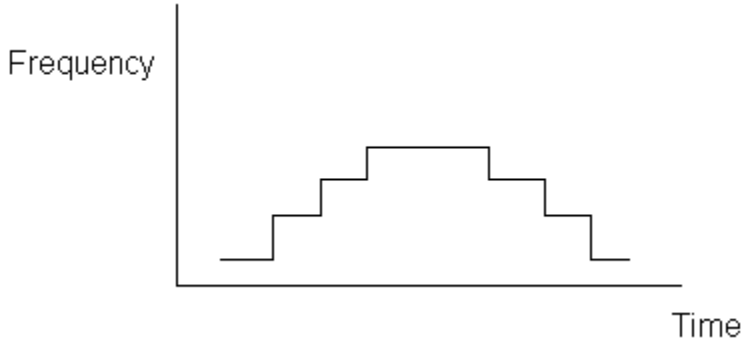


The 06 also includes a registration profile as part of the trapezoidal profile. The major difference is that the registration profile will continue to run at the target frequency until a separate pulse input indicates the profile should stop. The profile then decelerates and stops at a particular number of pulses BEYOND the point where the registration input occurred.



Step Trapezoidal

The step trapezoidal mode allows the programmer to define individual steps for acceleration and deceleration. This mode can also be used in a registration mode.



Velocity

The velocity profile just sends pulses to the output at a fixed frequency. Changes can be made in the program to the speed. Changes made will occur as a step response with no ramp between previous frequency and the new frequency.

06 Conclusions
So the 06 is a lot like the 05, but adds more features. 06 PLCs are good for single or multiple counter applications or applications requiring a single stepper output. They provide similar, but expanded, features to the 05 and have additional IO capabilities. 06 PLCs can also be networked via built in 422/485 or even ethernet via the H0-ECOM. So where does the 105 fit into this mix? Let's take a look.

D0-105 PLCs HSIO Features:

First of all, to use the HSIO features of the 105 PLCs, the PLC must be equipped with DC inputs or DC outputs depending on whether we are going to use an input feature or an output feature. So if we want to do some high speed counting, we need a 105 that has DC inputs, like a F1-130DR. If we wanted to run a stepper motor output, we would need a 105 with DC outputs, like a F1-130AD. Note that there are 105 PLCs with both DC inputs and DC outputs, these PLCs can perform EITHER input features OR output features but NOT BOTH at the same time. Programming examples for the 105 HSIO circuit can be found in chapter 3 of the D1-USER-M user manual.
http://web2.automationdirect.com/static/manuals/d1user/ch3.pdf

105 Input features

105 Counters

The 105 PLCs have only one counter available in two different modes. Mode 10 is a single-ended counter which uses a single pulse train to count in one direction only. Mode 20 is a quadrature counter which requires a quadrature signal on two inputs to count up or down based on rotation. An additional feature of Mode 10 is that it allows for the use of up to 24 presets. Mode 20 does not support presets in the 105. The program can be made to interrupt the program scan when any of these presets are reached and go to an interrupt routine in the PLC immediately. This is necessary for applications where outputs must be accurately controlled based on the input count value. The 105 can count pulse trains up to 5kHz.

105 Rate calculators

There are no prewritten or selectable rate calculators for the 105. It is best to write logic in the PLC to periodically load the value from the counter and perform math to determine the rate. The logic can then simply reset the counter and proceed to accumulate counts for the next sample period. This can be done in either mode 10 or mode 20. Normally there is a trade off between sample time and signal accuracy. The longer the sample, the more accurate the rate, but the slower the update is.

105 Event timing

There are no provisions for event timing with the 105 HSIO circuit.

105 Pulse catch

The pulse catch mode for the 105 is called mode 50. This mode allows the PLC to monitor a particular input X0 and latch a particular bit (SP100) for an entire scan each time one or more pulses appear on the X0 input since the last scan cycle. This mode should NOT be used for counting as multiple pulses in will not cause multiple pulses of the SP100 bit. The minimum pulse width for the pulse catch mode is 0.1 milliseconds.

105 Interrupt inputs

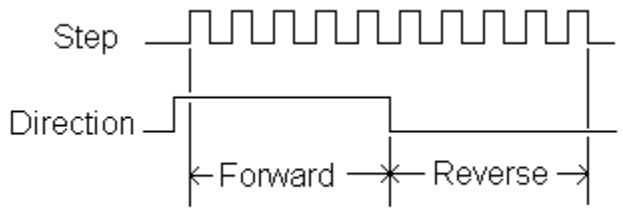
The interrupt mode of the 105 is called Mode 40. This mode allows pulses occurring on X0 to immediately halt the program scan and send the program solution to the interrupt routine. This allows for immediate control of other output functions. This mode should NOT be used for applications where the X0 input can occur multiple times per scan as this will adversely affect the overall scan time of the PLC, which might cause a watchdog error to shut the PLC down. The minimum pulse width for the interrupt mode is 0.5 milliseconds.

105 Output features

105 Stepper motor output

The 105 stepper motor output mode is called Mode 30. The range of frequency output is from 40Hz to 7kHz. Mode 30 allows the PLC to send various types of pulse output signals to the Y0 and Y1 outputs. These signals are intended for use with stepper motor control boards. Two output types are available,

Step and direction



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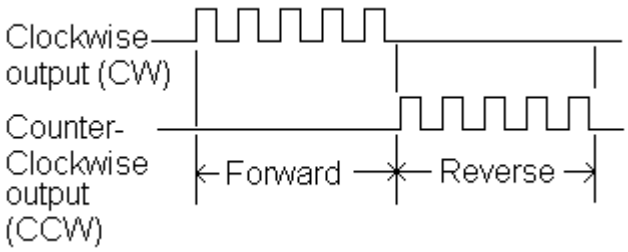

Mode 30 also allows several types of waveforms to be sent to the outputs. Let's go over the available options:

Trapezoidal

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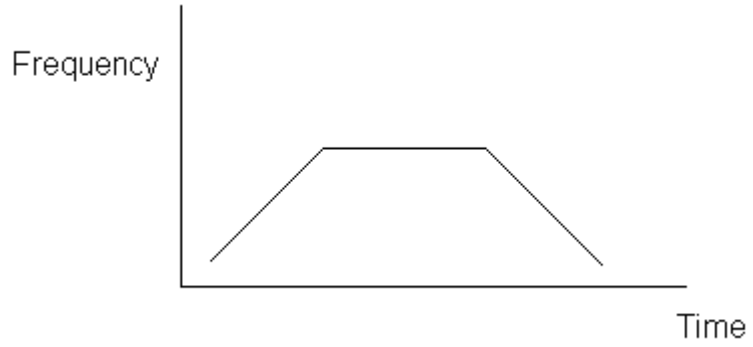

Registration

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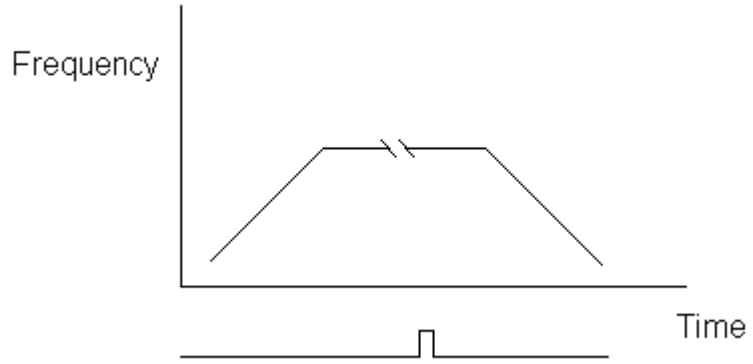


Velocity

The velocity profile just sends pulses to the output at a fixed frequency. Changes can be made in the program to the speed. Changes made will occur as a step response with no ramp between previous frequency and the new frequency.

So, the 105 PLCs are fairly limited in their HSIO, but are good for single counter or single stepper out applications. Don't forget! Unlike the 05 and 06 PLCs, the 105s do not have a secondary comm port. This means they cannot be networked. If you need multiple PLCs with HSIO features, be sure to use 05/06/205 PLCs.

Well, that's it for the built-in HSIO features of the 'brick' PLCs we sell. Let's take a look at our new H0-CTRIO card now. This card can be added to any 05 or 06 PLC which has a spare expansion slot available. The card can be used in conjunction with the built-in features of the 05/06 or it can be used to allow the inputs associated with the built-in HSIO to be used as regular inputs. The card adds a few features the 05/06 built-in HSIO does not have and has increased response time and output capabilities also. One of the more important features of the H0-CTRIO is that it can perform both input and output features at the same time. Programming examples for the H0-CTRIO HSIO circuit can be found in the HX-CTRIO-M manual.
http://web2.automationdirect.com/static/manuals/hxctriom/hxctriom.html

H0-CTRIO

H0-CTRIO Input features

H0-CTRIO Counters
The H0-CTRIOs can have one or two counters available depending on the type of counter. Two single-ended counters can be connected or a single quadrature counter can be configured. The H0-CTRIO can also have presets defined in the card which can turn outputs on the H0-CTRIO on or off independent of the PLC program scan. The H0-CTRIO publishes data to user defined V locations in the PLC, so no code is required to get count information from the H0-CTRIO. The H0-CTRIO can count pulse trains up to 100kHz.

H0-CTRIO Rate calculators
The H0-CTRIO has the ability to scale the value being published from the card to the PLCs V memory location. This scaling can also include rate calculations. Again, no extra PLC code is required to perform this function.

H0-CTRIO Event timing
The H0-CTRIO provides several event timing abilities. An edge timer configuration allows the H0-CTRIO to measure the time from a pulse to the next pulse on that input on the H0-CTRIO. The card can also be configured to use two separate inputs to measure the time from an event on one of the inputs to an event on a different input. This mode can also be scaled in the edge timer mode to allow for interval rate calculations. This can be useful for very slow pulse trains.

H0-CTRIO Pulse catch
The H0-CTRIO can monitor an input point on the card for pulses and either provide an extended pulse output on one of its own outputs or provide a software bit pulse of an extended length upon receiving an external pulse. Note that this mode should not be used for counting as multiple input pulses may not result in multiple extended pulse outputs.

H0-CTRIO Interrupt inputs
The H0-CTRIO does not support any inputs executing an interrupt routine in the PLC code. The H0-CTRIO can turn on/off local outputs on the H0-CTRIO based on presets defined in the card. These will happen at interrupt speeds. These

presets can be changed from the ladder code, but these changes require the interruption of the process due to backplane communication.

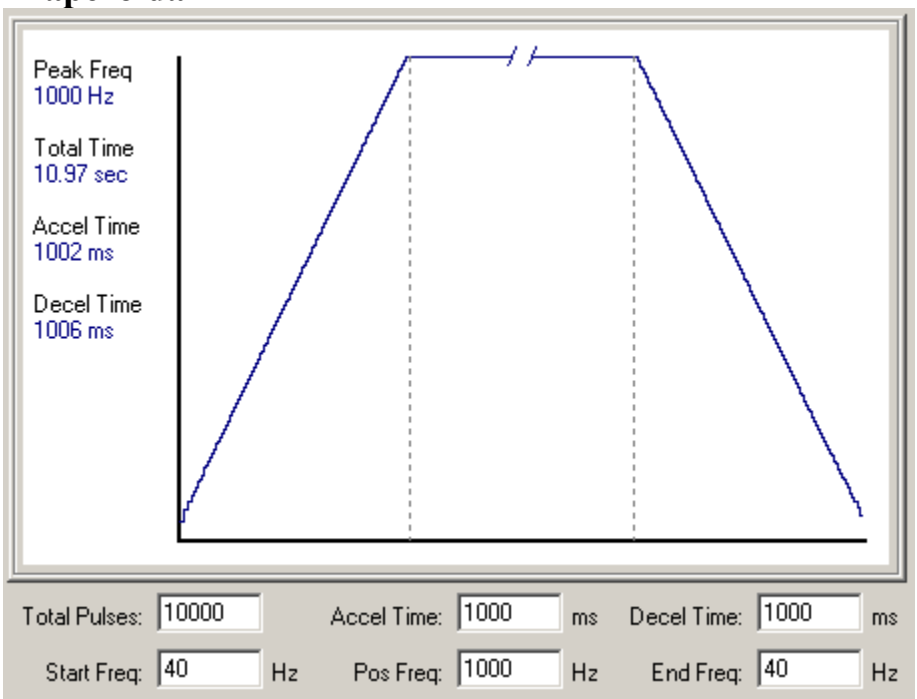
H0-CTRIO Output features

H0-CTRIO Stepper motor output

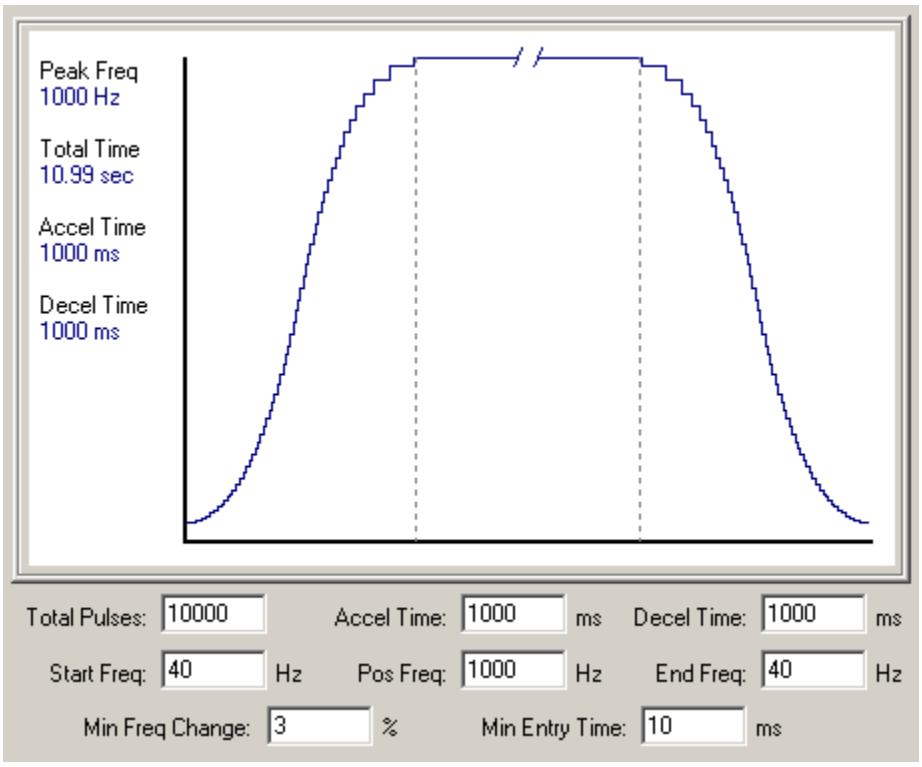
The H0-CTRIO stepper motor output can send one channel of either Step/Direction or CW/CCW pulse trains. The range of frequency output is from 20Hz to 25kHz. The CTRIO allows the programmer to either set up predefined trapezoidal or S-curve profiles, or to use several dynamic profile types to run their process.

The H0-CTRIO has the following predefined profiles:

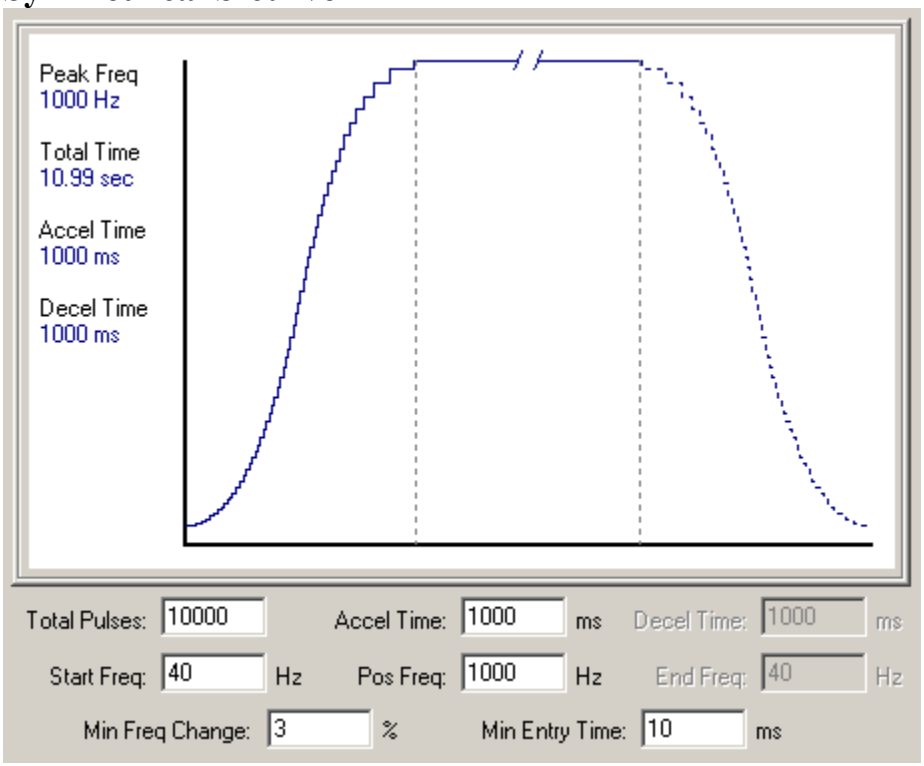
Trapezoidal



S-Curve



Symmetrical S-curve



The H0-CTRIO also has some profiles that are partially defined in the setup utility, but which have some parameters which can be changed from ladder logic. These include:

Dynamic positioning
Dynamic positioning is much like trapezoidal. The minimum frequency, maximum frequency, and acceleration rate are fixed per profile. When initiated, the output ramps up to a predefined speed at a predefined rate and then ramps down and stops at the given target number of pulses. The target position can be specified from the ladder code. This mode also allows for relative moves from previous targets. This is probably the most popular H0-CTRIO output mode.

Dynamic velocity
Dynamic velocity mode is similar to the velocity mode in the 05/105/06 except it does allow for ramping from one speed to another instead of simply changing immediately from the previous speed to the new speed. The rate of change is predefined for this profile and the velocity may be changed on the fly.

Home search
The home search profiles allow for several different profiles for finding a home point:
-Run to limit 1 at frequency 1.
-Run to limit 1 at frequency 1, then continue to limit 2 at frequency 2
-Run to limit 1 at frequency 1, then reverse to limit 2 at frequency 2
-Run to limit 1 at frequency 1, then continue to count at frequency 2
-Run to limit 1 at frequency 1, then reverse to count at frequency 2

Of course, you have to define some of the inputs on the H0-CTRIO as input limits to use this mode…so some of the input modes may not be available at the same time.

Free form
This profile allows the programmer to predefine any group of step responses they want into a profile.

There are also 3 output profiles that do not require a profile file be created in the H0-CTRIO.

Velocity mode
This mode is very similar to the 05/105/06 velocity mode. It sends a velocity signal for as long as the output enable is on. The frequency can be changed as a step response from the ladder code. The duty cycle can also be changed. This mode also allows you to define a specific number of pulses to run at the given frequency.

Run to limit
This mode allows the H0-CTRIO to output pulses at a given frequency until an input limit switch is encountered. The duty cycle can also be changed for this profile. This profile is less popular since the introduction of the home search profiles.

Run to position
This mode allows the H0-CTRIO to output pulses at a given frequency until an input count value on one of the input counters reaches a defined count value. The duty cycle can also be changed for this profile. This mode is useful for applications with stepper motors where slip is possible.

So, the H0-CTRIO adds many features the 05/06 do not normally support as well as simply adding more counters and stepper motor outputs. Multiple H0-CTRIOs can be added to a single 06 base to greatly increase the processors HSIO abilities.

OK, that's it for the 05/06/105 processors. Let's take a look at the 205 series HSIO options.

There are two different HSIO cards available for the 205 series, the D2-CTRINT and the H2-CTRIO. The D2-CTRINT has been around for many years and provides basic input and output features, it also has the advantage of being designed to interface on an interrupt level to the CPU. The H2-CTRIO is a relatively new card that has higher frequency capabilities and more HSIO features than the D2-CTRINT. Let's go over the cards functions independently.

D2-CTRINT HSIO features

First of all you can only put a D2-CTRINT in the slot adjacent to the CPU. This is because the D2-CTRINT shares some electrical connections directly with the CPU. Obviously this means you can only have one D2-CTRINT per PLC base. Also, if you use the D2-230 PLC with the D2-CTRINT the following features are disabled; Mode 10 presets, Quadrature or Up/Down counting, and mode 30. The inputs for the D2-CTRINT require 12-24VDC and the outputs require a separate 5VDC supply. Programming examples for the D2-CTRINT HSIO card can be found in the D2-CTRIF-M manual.
http://web2.automationdirect.com/static/manuals/d2ctrif/d2ctrif.html

OK, so what can this card do? Well it is very similar to the built-in HSIO of the 05/06/105, though there are enough differences that programs cannot simply be transferred between these PLCs. Let's go through the input features first.

D2-CTRINT Input features

D2-CTRINT Counters
The D2-CTRINT PLCs have one or two counters available in two different modes. Mode 10 allows for up to two (one with D2-230) single-ended counters which use a single pulse train to count in one direction only. Mode 20 (not available in D2-230) allows for a single quadrature counter which requires a quadrature signal on two inputs to count up or down based on rotation. Mode 10 allows for the use of up to 24 presets per counter. Mode 20 also allows for up to 24 presets. The program can be made to interrupt the program scan when any of these presets are reached and go to an interrupt routine in the PLC immediately. This is necessary for applications where outputs must be accurately controlled based on the input count value. The D2-CTRINT can count pulse trains up to 5kHz.

D2-CTRINT Rate calculators

There are no prewritten or selectable rate calculators for the D2-CTRINT. It is best to write logic in the PLC to periodically load the value from the counter and perform math to determine the rate. The logic can then simply reset the counter and proceed to accumulate counts for the next sample period. This can be done in either mode 10 or mode 20. Normally there is a trade off between sample time and

signal accuracy. The longer the sample, the more accurate the rate, but the slower the update is.

D2-CTRINT Event timing
There are no provisions for event timing with the D2-CTRINT HSIO circuit.

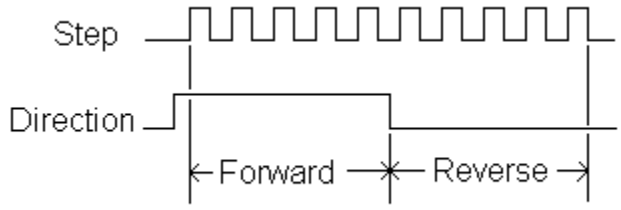
D2-CTRINT Pulse catch
The pulse catch mode for the D2-CTRINT is called mode 50. This mode allows the PLC to monitor one or more inputs X0-X3 and latch a particular bit (SP100-SP103) for an entire scan each time one or more pulses appear on the inputs since the last scan cycle. This mode should NOT be used for counting as multiple pulses in will not cause multiple pulses of the SP100-SP103 bits. The minimum pulse width for the pulse catch mode is 0.1 milliseconds.

D2-CTRINT Interrupt inputs
The interrupt mode of the D2-CTRINT is called Mode 40. This mode allows pulses occurring on one or more of the inputs X0-X3 to immediately halt the program scan and send the program solution to one of four interrupt routines. This allows for immediate control of other output functions. This mode should NOT be used for applications where any of the inputs can occur multiple times per scan as this will adversely affect the overall scan time of the PLC, which might cause a watchdog error to shut the PLC down. The minimum pulse width for the interrupt mode is 0.1 milliseconds.

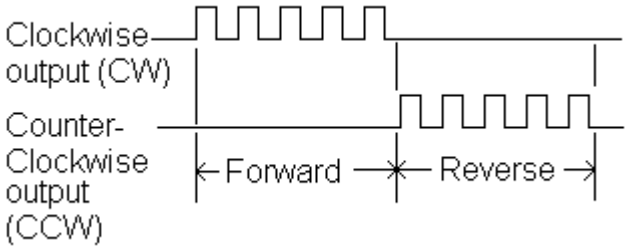
D2-CTRINT Output features

D2-CTRINT Stepper motor output
The D2-CTRINT stepper motor output mode is called Mode 30. This mode is not available in the D2-230. The range of frequency output is from 40Hz to 5kHz. Mode 30 allows the PLC to send various types of pulse output signals to the Y0 and Y1 outputs. These signals are intended for use with stepper motor control boards. Two output types are available,

Step and direction



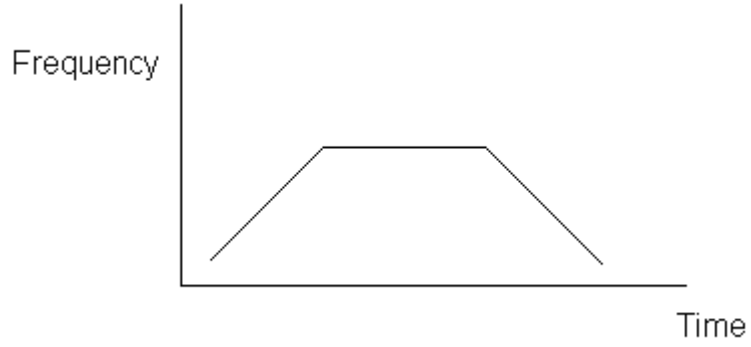
and CW/CCW.



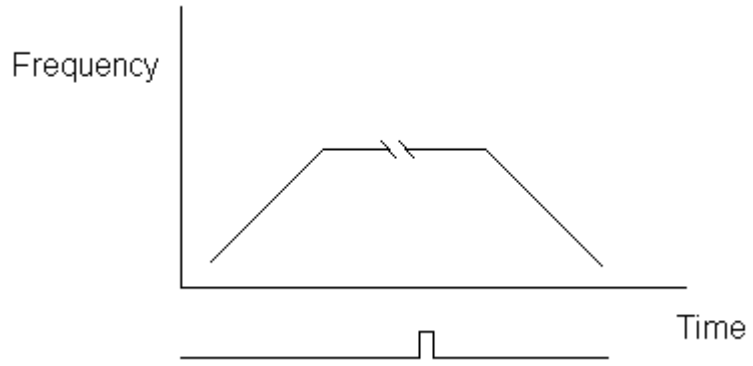
Mode 30 also allows several types of waveforms to be sent to the outputs. Let's go over the available options:

Trapezoidal

The trapezoidal profile allows for the output pulse train to start at a specified frequency, ramp up to a target frequency, then ramp down and stop at a particular pulse count. This profile type is popular for applications where devices cannot simply be run at a single speed due to inertial or other restrictions. It is by far the most popular profile type.

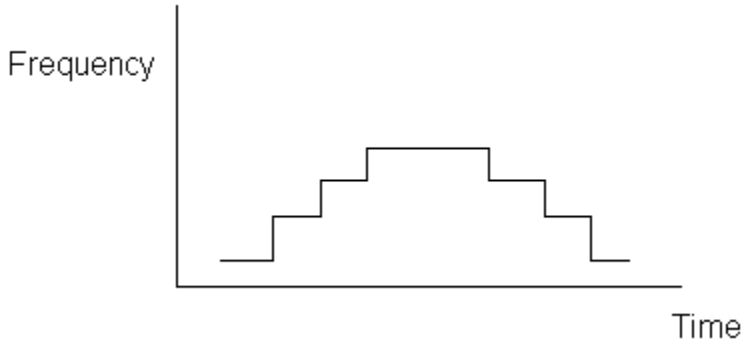


The D2-CTRINT also includes a registration profile as part of the trapezoidal profile. The major difference is that the registration profile will continue to run at the target frequency until a separate pulse input indicates the profile should stop. The profile then decelerates and stops at a particular number of pulses BEYOND the point where the registration input occurred.



Step Trapezoidal

The step trapezoidal mode allows the programmer to define individual steps for acceleration and deceleration. This mode can also be used in a registration mode.



Velocity

The velocity profile just sends pulses to the output at a fixed frequency. Changes can be made in the program to the speed. Changes made will occur as a step response with no ramp between previous frequency and the new frequency.

D2-CTRINT conclusions

So, very similar to the 05/06/105 features. Adding a D2-CTRINT to a 205 PLC base adds the same basic functionality as the 06 HSIO. Now the H2-CTRIO, its features are the same as those for the H0-CTRIO we have already discussed, but now there are twice as many inputs and outputs. Programming examples for the H2-CTRIO HSIO circuit can be found in the HX-CTRIO-M manual.
http://web2.automationdirect.com/static/manuals/hxctriom/hxctriom.html

H2-CTRIO Input features

H2-CTRIO Counters

The H2-CTRIOs can have one to four counters available depending on the type of counter. Four single-ended counters can be connected or two quadrature counters can be configured. The H2-CTRIO can also have presets defined in the card which can turn outputs on the H2-CTRIO on or off independent of the PLC program scan. The H2-CTRIO publishes data to user defined V locations in the PLC, so no code is required to get count information from the H2-CTRIO. The H2-CTRIO can count pulse trains up to 100kHz.

H2-CTRIO Rate calculators

The H2-CTRIO has the ability to scale the value being published from the card to the PLCs V memory location. This scaling can also include rate calculations. Again, no extra PLC code is required to perform this function.

H2-CTRIO Event timing

The H2-CTRIO provides several event timing abilities. An edge timer configuration allows the H2-CTRIO to measure the time from a pulse to the next pulse on that input on the H2-CTRIO. The card can also be configured to use two separate inputs to measure the time from an event on one of the inputs to an event on a different input. This mode can also be scaled in the edge timer mode to allow for interval rate calculations. This can be useful for very slow pulse trains.

H2-CTRIO Pulse catch

The H2-CTRIO can monitor an input point on the card for pulses and either provide an extended pulse output on one of its own outputs or provide a software bit pulse of an extended length upon receiving an external pulse. Note that this

mode should not be used for counting as multiple input pulses may not result in multiple extended pulse outputs.

H2-CTRIO Interrupt inputs

The H2-CTRIO does not support any inputs executing an interrupt routine in the PLC code. The H2-CTRIO can turn on/off local outputs on the H2-CTRIO based on presets defined in the card. These will happen at interrupt speeds. These presets can be changed from the ladder code, but these changes require the interruption of the process due to backplane communication.

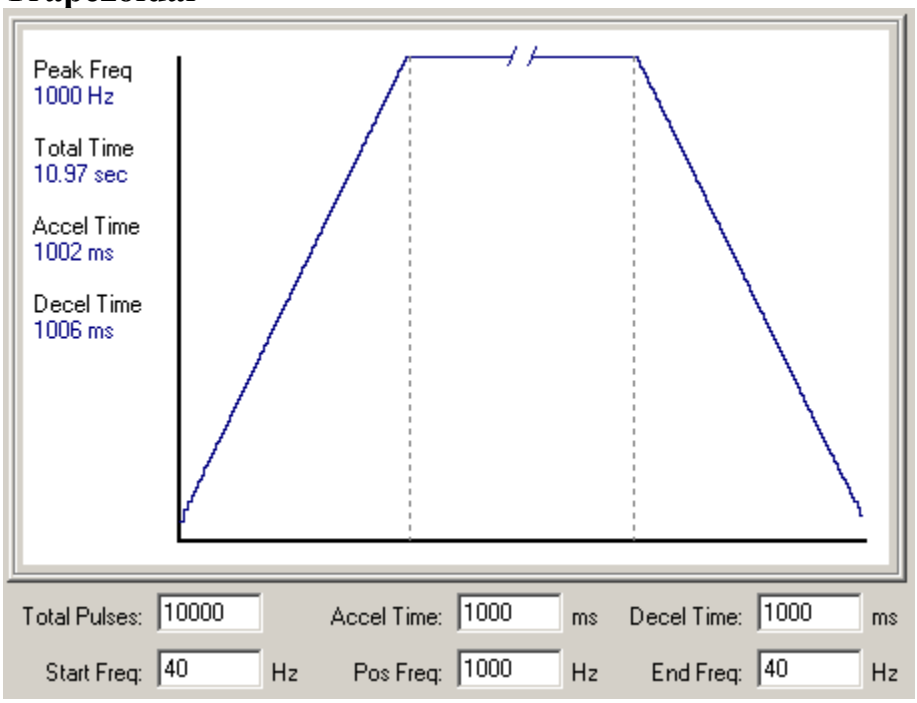
H2-CTRIO Output features

H2-CTRIO Stepper motor output

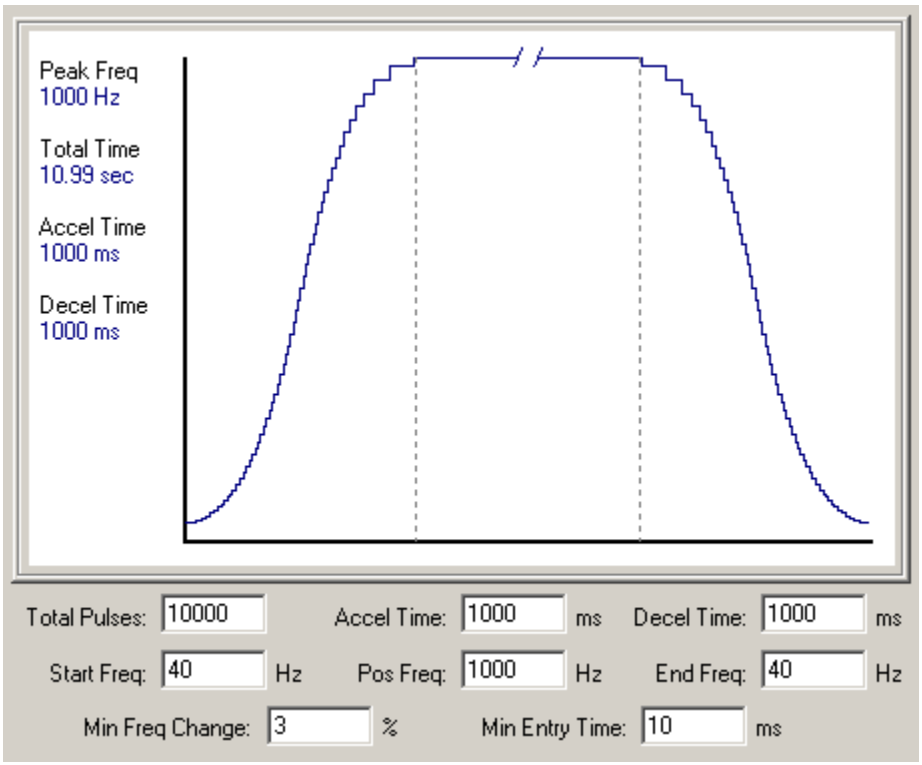
The H2-CTRIO stepper motor output can send two channels of either Step/Direction or CW/CCW pulse trains. The range of frequency output is from 20Hz to 25kHz. The CTRIO allows the programmer to either set up predefined trapezoidal or S-curve profiles, or to use several dynamic profile types to run their process.

The H2-CTRIO has the following predefined profiles:

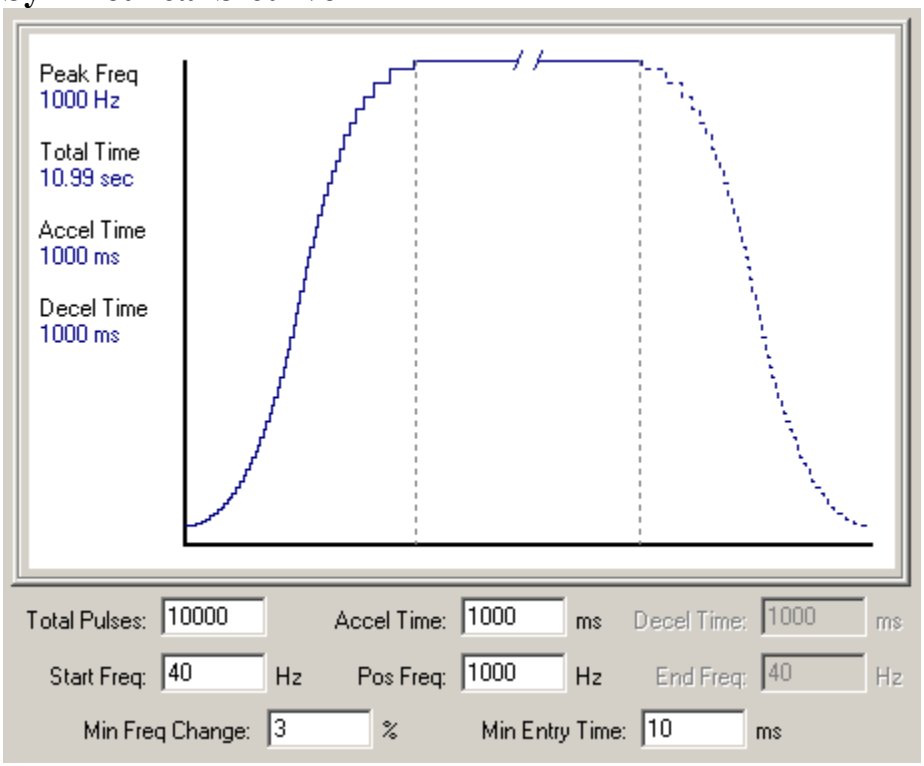
Trapezoidal



S-Curve



Symmetrical S-curve



The H2-CTRIO also has some profiles that are partially defined in the setup utility, but which have some parameters which can be changed from ladder logic. These include:

Dynamic positioning
Dynamic positioning is much like trapezoidal. The minimum frequency, maximum frequency, and acceleration rate are fixed per profile. When initiated, the output ramps up to a predefined speed at a predefined rate and then ramps down and stops at the given target number of pulses. The target position can be specified from the ladder code. This mode also allows for relative moves from previous targets. This is probably the most popular H2-CTRIO output mode.

Dynamic velocity
Dynamic velocity mode is similar to the velocity mode in the 05/105/06 except it does allow for ramping from one speed to another instead of simply changing immediately from the previous speed to the new speed. The rate of change is predefined for this profile and the velocity may be changed on the fly.

Home search
The home search profiles allow for several different profiles for finding a home point:
-Run to limit 1 at frequency 1.
-Run to limit 1 at frequency 1, then continue to limit 2 at frequency 2
-Run to limit 1 at frequency 1, then reverse to limit 2 at frequency 2
-Run to limit 1 at frequency 1, then continue to count at frequency 2
-Run to limit 1 at frequency 1, then reverse to count at frequency 2

Of course, you have to define some of the inputs on the H2-CTRIO as input limits to use this mode…so some of the input modes may not be available at the same time.

Free form
This profile allows the programmer to predefine any group of step responses they want into a profile.

There are also 3 output profiles that do not require a profile file be created in the H2-CTRIO.

Velocity mode
This mode is very similar to the 05/105/06 velocity mode. It sends a velocity signal for as long as the output enable is on. The frequency can be changed as a step response from the ladder code. The duty cycle can also be changed. This mode also allows you to define a specific number of pulses to run at the given frequency.

Run to limit
This mode allows the H2-CTRIO to output pulses at a given frequency until an input limit switch is encountered. The duty cycle can also be changed for this profile. This profile is less popular since the introduction of the home search profiles.

Run to position
This mode allows the H2-CTRIO to output pulses at a given frequency until an input count value on one of the input counters reaches a defined count value. The duty cycle can also be changed for this profile. This mode is useful for applications with stepper motors where slip is possible.

There are also CTRIO modules for the Terminator line (T1H-CTRIO) and the 405 series of PLCs (H4-CTRIO), both of these are identical in function to the H2-CTRIO. H2 and H4 CTRIOs can be used in local and ERM/EBC expansion bases, as well as used with WinPLCs and EBCs in Think and do Live and Studio systems.

Hx-CTRIO conclusions
The CTRIO modules add many features over the basic HSIO features of the 05/06/105 or even CTRINT modules. Event timing and both input and output at the same time are now possible. Be aware that there are certain applications where a CTRINT or 05/06/105 might be a better choice, like simple change-on-the-fly cut to length applications.

305 Counters

There is also a counter card for the 305 equipment, but it does not work with the 350 CPU. This card is difficult to work with and very limited, ADC strongly recommends using a newer PLC family like a 205 or 405 for any new counting applications.

405 Counters

The only other counting cards are the D4-HSC and F4-8MPI. Let's talk briefly about these two cards.

The F4-8MPI is specific for magnetic pulses and so requires a differential voltage signal from Hall effect type sensors. It can give any of the following choices for each channel; indicated or gross volume, flow rate, and pulse rate.

The D4-HSC counter is really only good for single or quadrature input counting. The card does have some ability to manipulate outputs for speed regulation via two brake outputs, but the functionality is limited compared to an H4-CTRIO.

Finally, here is a chart summarizing the features of each of the HSIO equipped PLCs/cards:

	Counters	Rate Calculators	Event Timing	Pulse Catch	Interrupt Inputs	Stepper Outputs	Preset Driven Output Control
05	1 quad or 1 single	Via code	None	1	1	1	Yes
06	1 quad or 2 single	Via code	None	4	4	1	Yes
105	1 quad or 1 single	Via code	None	1	1	1	Yes
H0-CTRIO	1 quad or 2 single	Built-in	2	2	None	1	On card only
D2-CTRINT	1 quad* or 2 single*	Via code	None	4	4	1*	Yes
H2-CTRIO	2 quad or 4 single	Built-in	4	4	4	2	On card only

305	1 single	Via code	None	None	None	None	None
F4-8MPI	8 single	Built-in	None	None	None	None	None
D4-HSC	1 quad or 1 single	Built-in	None	None	None	None	1 only on card
T1H-CTRIO	2 quad or 4 single	Built-in	4	4	4	2	On card only

* - not available if using D2-230.

So to review:

* 05/06/105 built-in HSIO is good for counting up through 5kHz and applications which need to have modifiable presets which control regular outputs at high speed. They have some pulse output capabilities up to 5-7kHz.

* CTRIO modules are good for counting up to 100kHz and allow for multiple modules as well as allowing both input and output features to be available at the same time. They also have built in rate calculators and event timing features.

* D2-CTRINT modules are inexpensive and provide similar features to the 05/06/105 built-in HSIO. You can only have one though, and it has to go in slot 0. The interrupt level access to the CPU does sometimes make these modules better for some applications, like cut to length applications, than the CTRIO.

* Never use 305 gear for new HSIO applications.

* The H4-CTRIO is simpler and more capable than the other 405 HSIO modules, use it.

Technical Assistance: If you have questions regarding this Application Note, please contact us at 770-844-4200 for further assistance.