

TRAINING

3 ...Display, Control, Communicate



Tutorial

High Speed Counter



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Introduction

The purpose of this tutorial is to demonstrate the High Speed Counter input. The i^3 models have a 4 channel High Speed Counter. They can be set up to accept 2 quadrature inputs or act independently as Frequency, Totalise or Pulse counters.

In this tutorial we will use all 4 types of high counters available.

Configuration

To Configure the HSC options we need to configure the I/O. This is best done with the i^3 connected to your computer, although it can be done offline. Open the I/O Configure menu by clicking on the icon or selecting from the menu.

i^3 i	³ Config	gurator -	[untitled1	1]		
‡∳ F	ile Edit	Program	Controller	Debug	Tools	Scree
	91	🛛 🔳 💆	I/O Con	figure		
	 		I/O Filte	rs		
] 🖻 🖿	188	Set Targ	jet Netwo	ork ID	
	А	в	Set Netv	work Bau	d Rate	•
1 Ø-			Set Loca	al Networ	k ID	
1	%S0007		Data Wa	atch		
2			Status			
			Diagnos	tics		
_			View/Se	t Clock		
3			Clear Me	emory		
			Idle/Sto	p		
4			Run/Mor	nitor		





Dig	jital / H	HSC Input C	onfiguration							×	
	Digital in Posi Neg	puts active mo itive Logic gative Logic	de Note: This setting match that of the on the product	i must jumpers					Input assoc with l	s iated HSC	
	High Spe	eed Counters-									
		Туре:		Mode:				(0 = full 2	per Hev: 2ª counts)		
	#1	Disabled	•	%19			-	0			
	#2	Disabled	•	%110			~	0			
	#3	Disabled	•	%111			~	0			
	#4	Disabled	•	%112			-	0		Mo	odes vary
										dep	pending on
	Dis	abled	-	1						the	type
	Dis	abled		1		Ľ	OK		Cance	1	
	Fre	quency (H	z)								
	Tot	alize			0	f the fo	our o	ption	ns selec	ting	Ouadrature
	Pub	se adratura				ccupies	mor	tha	n one i	nput	channel
	<u>l u</u> ua	aurature		J		couples	moi	e ina		nput	Channel

The associated inputs I09-I12 have associated analogue input registers that contain operational data.

Input	Current Value	Status Register	Reset
%I09	%AI05	%AI06	%Q17
%I10	%AI07	%AI08	%Q18
%I11	%AI09	%AI10	%Q19
%I12	%AI11	%AI12	%Q20

Once the HSC inputs are configured and assigned to the inputs %I09-%I12, click OK and close the I/O configure window. These configurations now will be downloaded to the i^3 when you next download the program into the unit.

Configuring Frequency HSC Type

Select "Frequency (Hz)" from the drop down "Type" menu. We now have four options in the Mode menu to configure the resolution of the Frequency HSC.

Digital / HSC Input Configuration	
Digital inputs active mode Positive Logic Note: This setting must match that of the jumpers on the product	
High Speed Lounters Mode: #1 Frequency (Hz) Isec. resolution #2 Disabled 100 msec resolution #3 Disabled scan resolution #4 Disabled \$12	Counts per Rev: (0 = full 2 ^{re} counts) 0 0 0 0 0 0 0
	OK Cancel

The frequency input counts the frequency of the input pulses for the selected resolution.

Configuring Totalising HSC Type

Select "Totalising" from the drop down "Type" menu. We now have two options in the Mode window - to count the rising edge or falling edge, the Counts per rev option should also be set. This value defines the HSC reset value.

I) igital / H	ISC Input C	Configuration				×
	Digital in Posi Neg	puts active mo tive Logic ative Logic	de Note: This settin match that of the on the product	g must ; jumpers			
	– High Spe	eed Counters-				Counts per Rev:	
		Туре:		Mode:		(0 = full 2 ^{se} counts)	
	#1	Totalize	•	Rising edge	•	0	
	#2	Disabled	•	Rising edge Falling edge		0	
	#3	Disabled	•	8111	*	0	
	#4	Disabled	•	% 12	-	0	
						,	
						OK Cancel	

The Totalising input counts the total number of Rising or Falling edges of the input pulses and resets when it reaches either the Count number inserted or the maximum value $(2^{32} (4294967296 \text{ counts}))$.



Configuring Pulse HSC Type

Select "Pulse" from the drop down "Type" menu. We now have four options in the "Mode" window - these options relate to the pulse properties.

I	Digital / H	ISC Input (Configuration				
	Digital in Posi Neg	puts active mo tive Logic lative Logic	ode Note: This setting match that of the on the product) must jumpers			
	– High Spe	eed Counters-		Mada			Counts per Rev: (0 = full 2 ^{se} counts)
	#1	Pulse	_	Mode: Width high, 1	usec, counts	•	100
	#2	Disabled		Width high, 1 Width low, 1	usec, counts		
	#3	Disabled	•	Period rising Period falling	edges, 1 usec. counts edges, 1 usec. counts		0
	#4	Disabled	-	%112		-	0
						0	K Cancel

The Pulse input measures the Pulse width from either the width of a high or low pulse or the period between falling edges or rising edges.

Configuring Quadrature HSC Type

Select "Quadrature" from the drop down "Type" menu. We now have two options in "Mode" window relating to the direction of the encoder. We also have the "Counts per revolution" option to define how many pulses equal a full revolution of the encoder. If we set a value in here the HSC will reset once it reaches that value.

Digit	ial / I	ISC Input C	Configuration					3
C Di	gital in Posi Neg	puts active mo tive Logic ative Logic	de Note: This setting match that of the on the product	g must ijumpers				
⊢ Hi	gh Spe	eed Counters-					Counts per Rev:	
		Туре:		Mode:			(0 - run z counts)	
	#1	Quadrature	•	1 leads 2, co	ount down	-	360	
	#2	Disabled	Ŧ	1 leads 2, co 1 leads 2, co	ount down ount up		0	
	#3	Disabled	•	% 11		T	0	
	#4	Disabled	•	%12		Ŧ	0	
						0	K Cancel	

The Quadrature input counts the total number of input pulses and resets when it reaches either the Count number inserted or the maximum value (2^{32}) . The Quadrature input uses two channels to determine the position and rotation direction of the encoder.

With the Quadrature HSC input it is possible to have a third channel set up as a Marker (Z). The marker input is typically a separate channel from the encoder indicating a complete rotation.

Digital / HSC Input C	onfiguration			×
Digital inputs active mo Positive Logic Negative Logic	de Note: This setting mus match that of the jump on the product	88		
High Speed Counters Type: #1 Quadrature #2 Disabled #3 Marker #4 Disabled	Mod I le X X Low High Low High Low High Low	e: ids 2, count down io. Reset on rising edge , Reset on 1 rising , Reset on 1 falling , Reset on 2 rising , Reset on 2 rising , Reset on 2 falling , Reset on 2 falling Reset on 2 falling	Counts per Rev: (0 = full 2 ^{sc} counts)	



The count can also be reset using the associated output bit.

Programming the HSC

Once the I/O has been configured and the HSC set up as required (remembering that there is the possibility of four independently configured HSC inputs) the corresponding analogue input registers are used in the program.

Register	Frequency	Totalize	Pulse	Quad		
%AI5-6	HSC1	(function) Accum	ulator	Quad 1 Acc		
%AI7-8	HSC2	(function) Accum	ulator			
%AI9-10	HSC3	(function) Accum	ulator	Quad 2 Acc		
%AI11-12	HSC4	HSC4 (function) Accumulator				
%AQ1-2		HSC1 Preset				
%AQ1-4		HSC2 Preset				
%Q17		Clear HSC1		Clear Quad 1		
%Q18		Clear HSC2		Set Quad 1		
%Q19		Clear HSC3		Clear Quad 1		
%Q20		Clear HSC4		Set Quad 1		

Example 1. Multi-Channel HSC Input

Utilising three out of the four HSC counter functions in this example to show the varied and powerful combination of HSC facilities.

The first channel will be set to a Frequency count with I9 connected to a flow meter. If the frequency drops below the predetermined value then we will set an alarm lamp to indicate that there is a problem in the flow.

The second channel will be set to a Totalise counter to count the total number of pulses from a proximity sensor. After a preset number of products have been counted the production line will stop.

The third channel will be set as a Pulse counter to measure the period between rising pulse edges, connected to a cam switch. This will measure the time taken for one rotation.

I/O configuration

Configure the first three channels of the HSC as shown below;

Chanı	nel 1 -	- Frequenc	сy
Chanı	nel 2 -	- Totalise	
~			

Channel 3 – Pulse	
-------------------	--

Digital / HSC Input Configuration	
 Digital inputs active mode Positive Logic Note: This setting must match that of the jumpers on the product 	
High Speed Counters Type: Mode: #1 Frequency (Hz) 1 sec. resolution #2 Totalize Rising edge #3 Pulse Width high, 1 usec. counts #4 Disabled \$2112	Counts per Rev: (0 = full 2 ^{ec} counts) 0 0 0
	K Cancel

Once the high-speed counter has been configured we will use the corresponding registers in the ladder program.

Ladder Logic Programming

For the control aspect of this program we are going to use compare functions. For channel one we are going to use a greater than and a less than function to set and reset an output coil. With channel two we will use a greater than or equal to function operating a Normally Closed coil. In the last channel we will use a limit function block to control the output for when it is between two limits.

In the control logic for channel 1 we are going to compare the value in %AI5 to a constant value.

Insert a Less Than (LT) function by clicking on the icon into a rung with a N/O contact assigned to "always on". On the output to the LT function insert a N/O Set coil and assign to %Q01. Double click on the function and add the properties as shown.



ALV_ON		LT_INT	Flow_warning
%S0007	%A10005-	IN1	%Q0001
	200-	IN2	

Insert a Greater Than (GT) function by clicking on the icon into a rung with a N/O contact assigned to "always on". On the output to the GT function insert a N/O Reset coil and assign to %Q01. Double click on the function and add the properties as shown.

ALV_ON	GT_INT	Flow_warning
%S0007 %Al0005	-IN1	%Q0001
500	-IN2	

For channel 2 we are comparing % AI7 to a constant batch value. When the counted value is greater than or equal to batch value, the N/C output will open.

Enter the ladder functions as shown below.

ALW_ON		GE_INT	motor
%S0007	%AI0007-	IN1	%Q0002
	1000-	IN2	

Allocate the user key %K2 to reset the second HSC channel.

F2_KEY	Rst_ch2
	()_
%K0002	%Q0018

Finally for channel 3 we are going to use a limit function, select the icon IIM and insert it into a new rung. At the start of the rung insert a N/O contact and assign to "always on". On the output of the function insert a N/C coil and assign to %Q03. The HSC values in %AI9 will have the limits 5000 and 15000, if it is outside of those limits then the N/C coil will open.

ALV_ON	LIM int	()_)_())()()()()())()()()()())()()()())()())()())())())_())_())_())_())_())_())_())_())_())_())_()))_())))))
%S0007 2000-	Low	%Q0003
%AI0009-	IN	
15000-	High	

Once again, assign a user key to reset the HSC channel.

F3_KEY	0
	()
%K0003	%Q0019

Screen Editor Programming

We want to display the current value of all the counters and have the output lamps displayed on the screen. To do this one screen will be sufficient.

Insert three numeric data functions 123 onto the first screen and three lamps 23 by clicking on the icons.

Assign the lamps to the outputs %Q1, %Q2 and %Q3 by double clicking on the lamps. Now setup the numeric data functions for the three channels, %AI5, %AI7 and %AI9.

The screen should now look very similar to the one shown below.



Running to Program

After downloading the program to the i^{3} ensure you put the i^{3} into run mode. On receiving a High speed input to the HSC inputs you will see the values in the numeric functions on the screen. By pressing the appropriate keys on the front you will be able to reset the value.

Please use the program: multi-ch-hsc.csp



Example 2. Quadrature HSC Input

The quadrature setting on the high-speed counter can use up to three channels. We will set up an encoder feed back to do just this with an Up/Down input and a marker.

Configuring the I/O

Configure the first channel to be a quadrature input and you will notice that channel 2 selection is greyed out. Select the third channel to be a marker.

Digital / I	HSC Input (Configuration					×
Digital in Posi Neg	puts active mo itive Logic jative Logic	nde Note: This setting match that of the on the product	g must 9 jumpers				
- High Sp	eed Counters- Tune:		Mode:			Counts per Rev: (0 = full 2 ^{se} counts)	
#1	Quadrature	•	1 leads 2, cou	unt down	-	3600	
#2	Disabled	-	%110		-	0	
#3	Marker	•	Async, Reset	on rising edge	•	0	
#4	Disabled	•	%112		-	0	
					0	K Cance	;

Input %I9 will lead the count up and %I10 will count in the opposite direction (i.e. down). Set the counts per rev to match the encoder, for example 3600 counts per rev has a resolution of 0.1 degrees.

Ladder Logic Programming

In the ladder program we want to drive a motor until the tool is in the correct position, as fed back by the encoder feedback. The motor will only be able to turn in one direction, and as it gets to within ten percent of the target the speed will slow to a crawl.

On the first rung have a N/O contact setting a latching coil on, as shown below.

start	Running
<u> </u>	(s)
%M0001	%M0002

Below this rung have M2 operating a Not Equal to function (selected from the comparison operations menu), the output of which will operate %Q1 the motor run

signal. In the Not Equal to function we are comparing the encoder position to the set position.

Running	NE_INT	motor_run
%M0002	encoder_pds %AI0005- IN1	%Q0001
	set_pos %R0001- IN2	

When the encoder has reached the set position the Not Equal function \swarrow will go low. This will act as the reset for the running trigger for when we are in running mode.

Running	motor_run	Bunning (-)
	1/1	(6)
%M0002	%Q0001	%M0002

The key 1 will act as an overall reset, resetting both the Encoder and the running process.

F1_KEY	encoder_rst	Bunning
<u>F</u>	()	(n)
%K0001	%Q0017	%M0002

To control the speed of the drive we are going to use an equation function $\underbrace{(m)}$

(selected from the maths operations menu) and a Greater then or equal to function \geq (selected from the compare operations menu).

ALV_ON	Math Expres INT		GE_INT	speed_select
%S0007	- %r2=(%r17100)^90	encoder_po %AI0005-	s IN1	%M0003
		%R0002-	IN2	

The maths equation function allows the user to enter an equation that uses the basic maths operations into one function block. This has the advantage of reducing the amount of function blocks required and hence saves on memory registers. In the equation function block we are dividing the set point by 100 and multiplying by 90 to get a value 90% of the set point.

Running speed_select	Fast_speed
1 1 1/1	· · · ·
%M0002 %M0003	%Q0002
Running speed_select	slow_speed
	()
%M0002 %M0003	%Q0003



Lastly we need to insert the logic to select the correct speed. If the encoder is within 90% of the set point and the system is in run mode then the speed will be slow, otherwise it will be in fast speed mode. The logic will be as above.

Screen Editor Programming

We need to display on the screen a lamp indication for if the motor is running and what speed it is running at. We also need to have a set point data entry and a current value view of the encoder.

Firstly we are going to assign the top left soft key to start the running process and indicate that the motor is in running mode. Select a switch sum and insert it into the screen, moving it to the top left. Double click and assign it to %M01. Click on the indicator properties and enable indicator text, entering the text for the ON string to "RUN". Select the text to follow an indicator register and assign to %M02. Click OK when complete. Click on Legend and enter the text to "Start". Click ok when complete.

Switch Properties	×
Controller Register Keypress Source Address: 2M0001 Name: start Switch Type: Standard Action: Momentary V Legend Plate	vitch State Properties
☐ 3D Bezel IV Show Inside Line Detail	Text follows controller register (switch output) C Text follows indicator register C Color follows indicator register
Indicator Properties >> Display Properties Attributes >>> Background Color >>> Legend >>> Line Color >>>	Indicator Register Address: [2:M0002 Name: Running

Next insert two lamps 2 and assign to %Q2 and %Q3, with the legend text of "Fast" and "Slow" respectively.

Finally insert two numeric data functions ¹²³ assigning the first to %Ai5 to read the current position and the second to %R1 for the set position. Make the later editable with limits of 0 to 3600. Enter legend texts accordingly.

The screen should now resemble the screen below.

/ Start	Position
	####
Fast Slow	SET POS
0	####

Running the Program

To connect the encoder into the iSmart please follow the wiring diagram as shown in the hardware manual.

After downloading the program to the i^3 ensure you put the i^3 into run mode. On rotating the encoder in one direction you should see the value increase, turn n the opposite direction and the value will decrease.

0

Please use the program hsc_quadrature.csp supplied





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