Application note

The CC320 has very flexible operation, allowing almost all machine vision timing problems to be solved. This application note highlights the available functions, offers some sample application data and also gives an insight into other features such as the flags and how the controller can be configured to achieve simple two input logic operators.

With 8 independent input triggers, each of the 8 output channels can be independently configured to provide an output function commonly required within machine vision system integration. The available output modes below illustrate the functions available.

Mode Name	Operation
OFF	The output is set to FALSE.
On	The output is set to TRUE.
Ptt, PtE, PEt, PEE (pulsing)	The output is pulsed from an internal or external trigger. The delay from the trigger and the pulse width can be either fixed times or encoder counts. A gate signal can be used to enable/disable the triggers.
Pd (pulse divider)	The trigger frequency is divided down. A pulse is output after a configured number of triggers.
Enc (encoder divider)	The encoder signal is divided down. A pulse is output after a configured number of triggers.
Bur (Pulse burst)	When triggered, a sequence of equally spaced pulses are output.
FrE	Outputs a constant square wave. The frequency is configurable.
buF (buffer)	The output is the same signal as the input, but possibly delayed by a fixed time. A gate signal can be used to enable/disable the output.
buE (buffer)	Same as buF mode, except the output signal can be delayed by a given number of encoder pulses.

See the manual for a precise description.

A number of sample problems and solutions are given on the following pages.

Integrating Smart Cameras

A constant speed conveyor belt has a product sensor, two smart cameras (at different positions) and a reject gate. The sensor is on IP3. Camera 1 is triggered by OP1 and pulses IP4 to show a pass. Camera 2 is triggered by OP2 and pulses IP5 to show a pass. The reject gate is pulse-to-accept on OP3.

The problem is that because the cameras are at different positions, the results arrive at different times. The solution is to trigger OP3 from the result of camera 2, but enable the trigger with a delayed result from camera 1. Delaying the result can be achieved using pulse operation (which can extend the pulse width) or buF buffer mode.

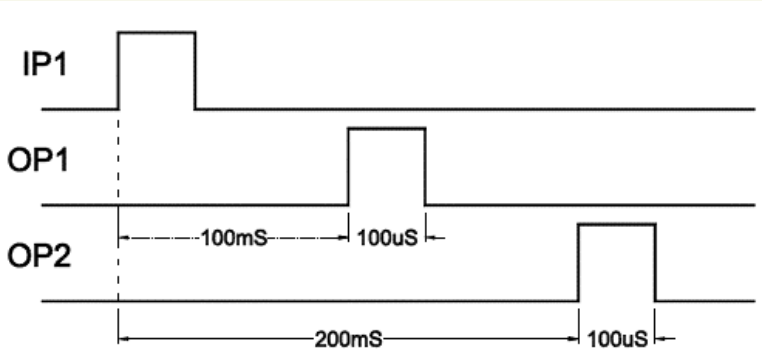
CC320 Configuration							
Output	Mode	Input	Gate Input	Pulse Delay	Pulse Width	Retrigger Time	Flags
1	2	IP3	0	1s	1ms	0	(0)
2	2	IP3	0	2s	1ms	0	(0)
2	2	1	0	200ms	100us	0	(0)

Sequenced Pulses

A sensor detects product presence. There are two cameras which need to take an image after different delays. The leading edge of IP1 is used as the trigger. OP1 triggers the first camera after 100ms. OP2 triggers the second camera after 200ms. Both camera triggers are positive pulses.

CC320 Configuration							
Output	Mode	Input	Gate Input	Pulse Delay	Pulse Width	Retrigger Time	Flags
1	2	1	0	100ms	100us	0	(0)
2	2	1	0	200ms	100us	0	(0)

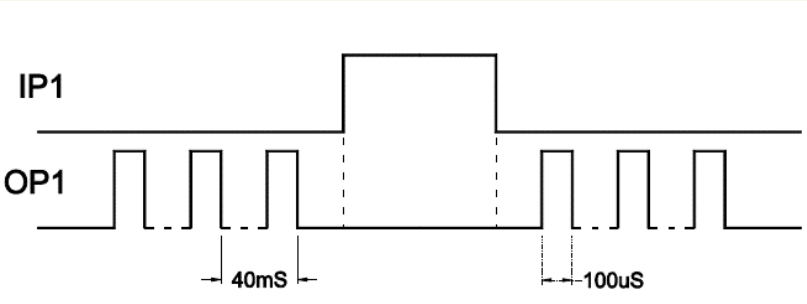
Both outputs are set into pulse mode. Two different delays give the timing difference between the two cameras.



Gated Pulses

A camera needs to be triggered at 25Hz continuously, except when IP1 is high to indicate that the machine has stopped. The camera is triggered on OP1.

CC320 Configuration							
Output	Mode	Input	Gate Input	Pulse Delay	Pulse Width	Retrigger Time	Flags
1	2	0	1	0ms	100us	0	G (4)
Set free running trigger to 25Hz.							



OP1 will trigger continuously at 25Hz only when IP1 is low. Note that Flags = G(4) to invert the sense of IP1. If there were no flag, then OP1 will only trigger when IP1 is high.

Delayed Signal

A product sensor provides a signal when a product is present. This signal needs delaying, so that an inspection light is only turned on when a product is present. The delay can be time or a number of encoder counts.

For example:

IP3 is the input from the sensor and OP1 is the signal to turn the light on and off. OP1 will have the same signal as IP3, but delayed by 500ms.

Or:

IP3 is the input from the sensor and OP2 is the signal to turn the light on and off. OP2 will have the same signal as IP3, but delayed by 1000 encoder counts.

These two examples can be implemented by:

CC320 Configuration							
Output	Mode	Input	Gate Input	Pulse Delay	Pulse Width	Retrigger Time	Flags
1	10	IP3	0	500ms	0us	0	(0)
2	11	IP3	0	1000 encoder counts	0us	0	(0)
Set free running trigger to 25Hz.							

Belt Position Triggering

On a conveyor with an encoder, a sensor detects product presence. There are two cameras which need to take an image at fixed distances along the belt. The camera trigger pulses must be fixed width for exposure control. The trailing edge of IP4 is used as the trigger. OP1 triggers the first camera after 2000 encoder counts. OP2 triggers the second camera after 4000 encoder counts. Both camera triggers are negative pulses.

CC320 Configuration							
Output	Mode	Input	Gate Input	Pulse Delay	Pulse Width	Retrigger Time	Flags
1	5	4	0	2000 encoder counts	100us	0	I, O (3)
1	5	4	0	4000 encoder counts	100us	0	I, O (3)
Set encoder mode.							

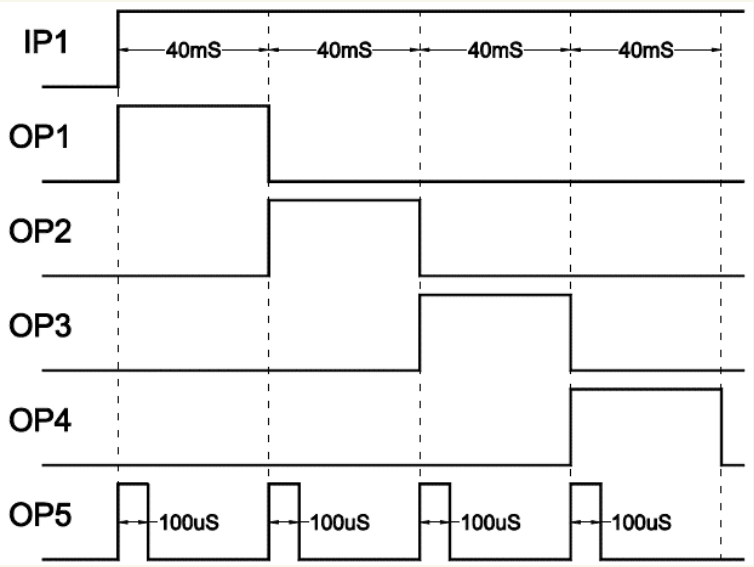
Both outputs are set into pulse mode. The pulse delay is a number of encoder pulses and the pulse width is a fixed time. The flags specify the trailing edge of the trigger signal and that the output pulse is active low.

Pulse Burst

A sensor on IP1 detects product presence. Four images need to be taken from one camera using four different lights at 40ms intervals. OP1, OP2, OP3, OP4 are used to output triggers to turn on the four lights in sequence. OP5 is used to trigger the camera four times.

CC320 Configuration							
Output	Mode	Input	Gate Input	Pulse Delay	Pulse Width	Retrigger Time	Flags
1	2	1	0	0ms	40ms	0	(0)
2	2	1	0	40ms	40ms	0	(0)
3	2	1	0	80ms	40ms	0	(0)
4	2	1	0	120ms	40ms	0	(0)
5	8	1	4	40ms	100us	0	(0)

OP1 to OP4 are pulsed for 40ms in sequence. As each one is pulsed, OP5 is also pulsed for a short time to trigger the camera (Gate Input = 4 specifies four pulses).

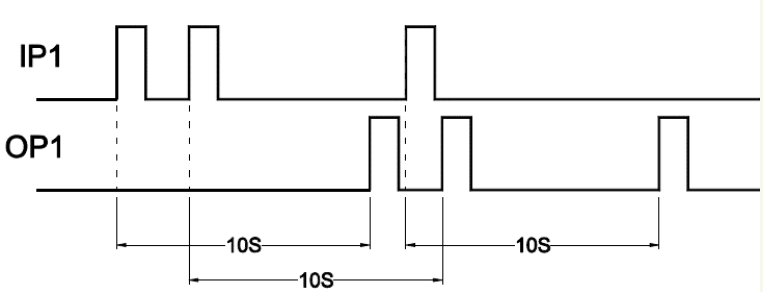


Simple FIFO Mode

A sensor on IP1 detects product presence. After a delay OP1 triggers a camera. There may be several products between the sensor and the camera.

The CC320 needs to store each of the triggers and then output a pulse after the correct delay.

CC320 Configuration							
Output	Mode	Input	Gate Input	Pulse Delay	Pulse Width	Retrigger Time	Flags
1	2	1	0	10 secs	100us	0	F (16)



Resync Mode

A sensor on IP1 detects product presence. After a delay OP1 triggers a camera. Image processing software processes the image (which can take a variable length of time) and then sends a pass/fail message to the CC320. The pass/fail is re-synchronised to the original product presence and the reject gate is opened if necessary.

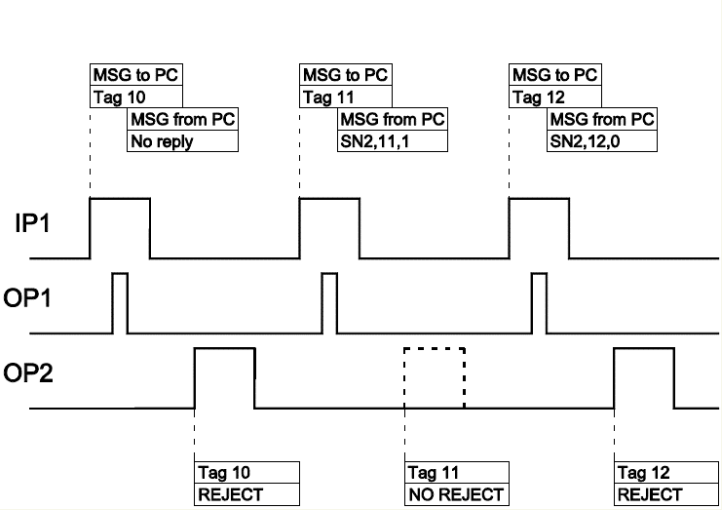
The reject gate is on OP2 and pulses high to reject the product. Products take 10 seconds to travel from the sensor to the reject gate and take 1 second to move past the reject gate.

CC320 Configuration							
Output	Mode	Input	Gate Input	Pulse Delay	Pulse Width	Retrigger Time	Flags
1	2	1	0	200ms	100us	0	
2	2	1	0	10 secs	1 sec	0	E, R, P (104)

10 seconds after a trigger, OP2 is set to pulse for 1 second to reject a product.

The camera trigger has the “Send trigger message” flag set. So that when the camera is triggered, a message is send to the image processing software. The image processing software must use the GT command to receive these messages.

The image processing has to send a pass/fail message before the reject gate is reached by the product. As well as “Resync mode” the “default to pulse” flag is set. This means that if the image processing software does not send a pass/fail message OP2 is pulsed anyway.



In this example, three product triggers were received. The camera was triggered using OP1.

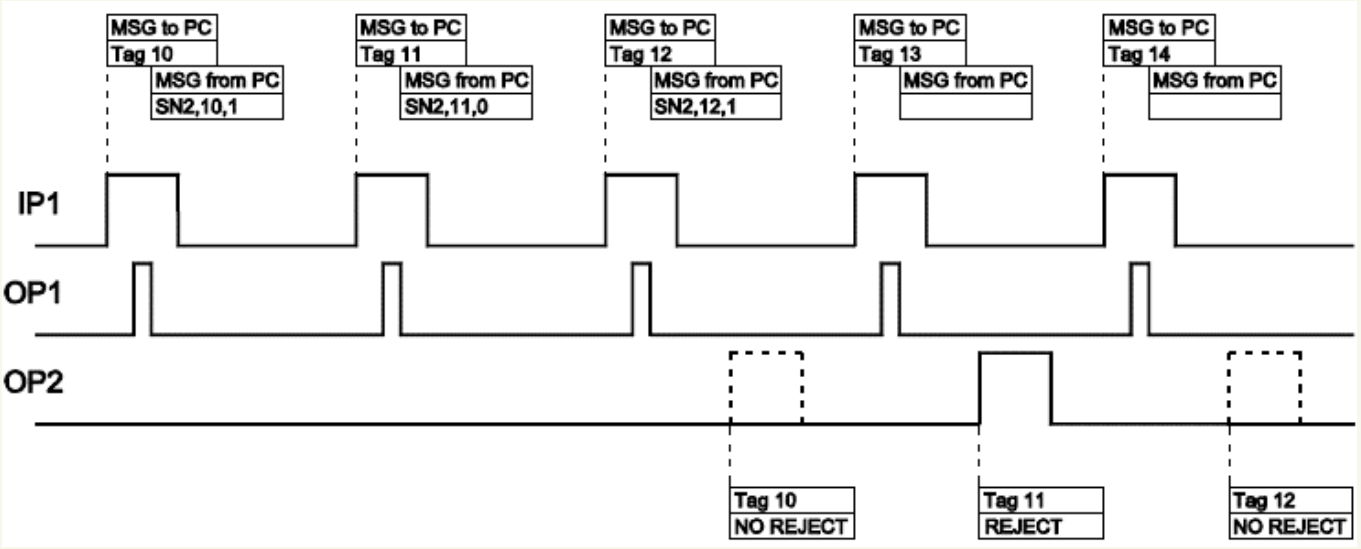
A Tag10 Ethernet message was sent to the host computer when the first trigger was received, but for some reason a reply was not received, so the product was rejected for fail-safe operation. After the second trigger a Tag 11 messages was sent, with the reply “SN2,11,1” (OP2, tag 11, pass) so the reject pulse on OP2 was cancelled. After the third trigger a Tag 12 messages was sent, with the reply “SN2,12,0” (OP2, tag 12, fail) so the reject pulse on OP2 was not cancelled.

Resync and FIFO Mode

This uses the same situation as the previous example, but products are 4 seconds apart, so that when a product is detected, there are already two others travelling towards the reject gate.

Image processing software processes the image (which can take a variable length of time) and then sends a pass/fail message to the CC320. The pass/fail is re-synchronised to the original product presence and the reject gate is opened if necessary.

CC320 Configuration							
Output	Mode	Input	Gate Input	Pulse Delay	Pulse Width	Retrigger Time	Flags
1	2	1	0	200ms	100us	0	
2	2	1	0	10 secs	1 sec	0	E, F, R, P (120)



Flags

Many of the examples given above make use of the flags to invert either the input, output or gate from their normal conditions, as well as other functions such as FIFO. Below is a summary of the operation flags available.

Flag Value	Flag Name	Operation when flag = 0	Operation when flag = 1
1	I	Trigger off leading edge of input.	Trigger off trailing edge of input.
2	O	Output is normally low, going high when pulsing.	Output is inverted. It is normally high, going low when pulsing.
4	G	If a gate input is specified, the input must be high to enable triggers.	If a gate input is specified, the input must be low to enable triggers.
8	E	No Ethernet message.	Send message on Ethernet when triggered.
16	F	Triggers are ignored until output pulse is complete.	FIFO output mode. Multiple triggers are queued up.
32	R	Resync mode disabled.	Resync Mode enabled.
64	P	Default to pulse in resync mode.	Default to no pulse in resync mode.

Logic Operations

It is possible to configure the CC320 trigger timing controller to conduct simple logic operations based on two inputs. The operators that can be achieved are NOT, AND, NAND, OR and NOR. The output must be set to buffer mode, which makes the output the same signal as the input.

The gate feature of the CC320 gives an AND operation. This operation can be used to provide the other functions, using the following configurations (these examples use IP1, IP2 and OP1):

CC320 Configurations								
Output	Mode	Input	Gate Input	Pulse Delay	Pulse Width	Retrigger Time	Flags	Operations
1	10	1	0	0	0	0	0 (2)	NOT If IP1=0 then OP1=1 If IP1=1 then OP1=0
1	10	1	2	0	0	0	(0)	AND If IP1=0, IP2=0 then OP1=0 If IP1=0, IP2=1 then OP1=0 If IP1=1, IP2=0 then OP1=0 If IP1=1, IP2=1 then OP1=1
1	10	1	2	0	0	0	0 (2)	NAND If IP1=0, IP2=0 then OP1= 1 If IP1=0, IP2=1 then OP1= 1 If IP1=1, IP2=0 then OP1= 1 If IP1=1, IP2=1 then OP1= 0
1	10	1	2	0	0	0	I, 0, G (7)	OR If IP1=0, IP2=0 then OP1=0 If IP1=0, IP2=1 then OP1=1 If IP1=1, IP2=0 then OP1=1 If IP1=1, IP2=1 then OP1=1
1	10	1	2	0	0	0	I, O (3)	NOR If IP1=0, IP2=0 then OP1=1 If IP1=0, IP2=1 then OP1=0 If IP1=1, IP2=0 then OP1=0 If IP1=1, IP2=1 then OP1=0

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Pyramid Imaging
945 East 11th Ave
Tampa, FL 33605
https://pyramidimaging.com