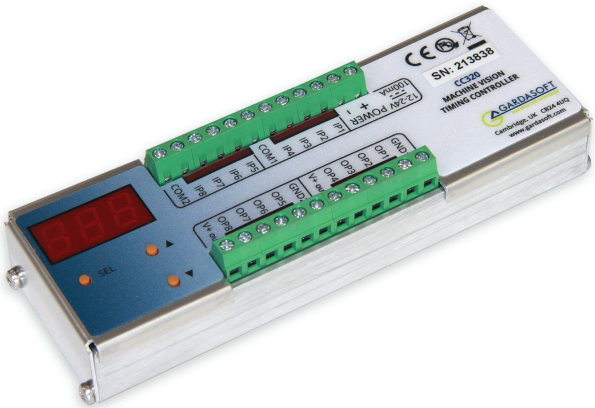
GARDASOFT
Machine Vision Control

CC320 Trigger Timing Controller

User Manual



Version 015

Copyright and disclaimer notice

Except as prohibited by law:

All hardware, software and documentation is provided on an 'as is' basis. This information is for guidance only. Installers must perform their own risk assessment specific to each installation.

It is essential that the user ensures that the operation of the product is suitable for their application.

The user must ensure that incorrect functioning of this equipment cannot cause any dangerous situation or significant financial loss to occur.

Deliberate acts of endangerment and vandalism are not covered by this document and must be considered by the installer.

While care has been taken in the preparation of this document Gardasoft Vision Ltd will not accept any liability for consequential loss of any kind except those required by law.

EC conformity declaration

The EC Certificate of Conformity is available from Gardasoft Vision Ltd on request

Issue status of this document: Issue 015 (April 2023)

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1 Getting started

Read Section 2 , “Safety” (or Abschnitt 3 , “Sicherheit”, or Section 4 , “Sécurité”) and Section 7, “Operation” and check the CC320 fulfils your requirements.

Mount the CC320 as described in Section 5, “Mounting” using either the DIN rail or the mounting holes.

Connect the CC320 as described in Section 6, “Connections”. When the CC320 powers up it should show two alternating lines on the display to indicate that it is operating properly. Three indicator LEDs on the outputs should be pulsing in sequence every second.

Connect Ethernet to the CC320 and set it up according to Section 8, “Ethernet setup”.

Use a web browser or the GardasoftMaint program (available from www.gardasoft.com) to configure the unit.

To configure the CC320 without an Ethernet connection, you can use the keypad on the front panel. Visit www.gardasoft.com to view Application Note APP987 explaining the use of the keypad.

Visit www.gardasoft.com for further Application Notes giving additional information on the use of the CC320.

2 Safety

Read this before using the CC320. Always observe the following safety precautions. If in doubt, contact your distributor or Gardasoft Vision. The following symbols mean:

Warning: Read instructions to understand possible hazards.

Warning: Possible hazardous voltage.

Where these symbols appear in the manual, refer to the text for precautions to be taken.

2.1 Electrical

The user must ensure that the potential difference between any combination of applied signals does not exceed the supply voltage.

The CC320 does not have complete tracking isolation of inputs and outputs.

Transients caused by inductive loads must be suppressed externally to the CC320.

2.2 General

The CC320 must not be used in an application where its failure could cause a danger to personal health or damage to other equipment.

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

3 Sicherheit

Bitte lesen Sie dieses Dokument, bevor Sie die CC320 verwenden. Beachten Sie immer die folgenden Sicherheitshinweise. Bei Fragen wenden Sie sich an Ihren Händler oder an Gardasoft Vision. Die folgenden Symbole bedeuten:

Warnung: Lesen Sie die Anleitung, um die mögliche Gefährenquelle zu verstehen.

Warnung: Mögliche gefährliche Spannung.

Wenn diese Symbole in der Anleitung erscheinen, finden Sie im beistehenden Text die zu ergreifenden Vorsichtsmaßnahmen.

3.1 Elektrik

Der Benutzer muss sicherstellen, dass der Potenzialunterschied zwischen jeder beliebigen Kombination an angelegten Signalen die Versorgungsspannung nicht überschreitet.

Die CC320 verfügt über keine vollständige Nachlauf-Isolierung der Ein- und Ausgänge.

Spannungsspitzen am CC320 aufgrund von induktiven Ladungen müssen extern unterdrückt werden.

3.2 Allgemeines

Die CC320 darf nicht in Bereichen verwendet werden, in denen bei Ausfall eine Gefahr von Personen - oder Sachschäden besteht.

Wenn das Gerät nicht entsprechend den Herstellerangaben eingesetzt wird, kann der durch das Gerät bereitgestellte Schutz beeinträchtigt werden.

4 Sécurité

Veuillez lire la notice avant d'utiliser le CC320. Respectez toujours les mesures de sécurité qui suivent. En cas de doute, contactez votre distributeur ou Gardasoft Vision. Les symboles suivants signifient:

Attention: Lisez les consignes afin de bien comprendre les dangers encourus.

Attention: Risque d'électrocution.

Veuillez vous référer aux consignes du manuel pour connaître les précautions à suivre au regard de ces symboles.

4.1 Électricité

L'utilisateur doit s'assurer que la différence de potentiel entre toute combinaison des signaux appliqués ne dépasse pas la tension de fourniture.

Le CC320 ne dispose pas de système complet d'isolation des entrées et sorties.

Les transitoires causés par les charges inductives doivent être supprimés à l'extérieur du CC320.

4.2 Général

Le CC320 ne doit pas être utilisé dans une situation où toute panne de celui-ci mettrait en danger la santé des personnes ou risquerait d'endommager d'autres équipements.

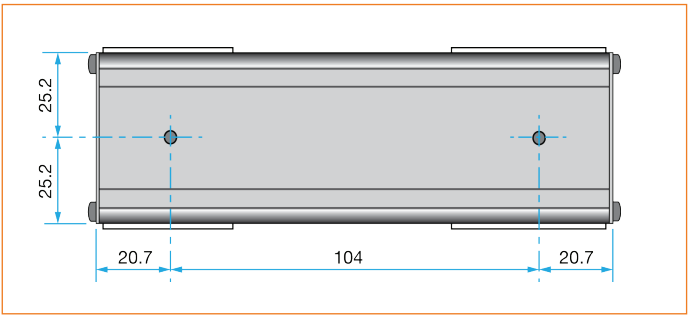
Si l'appareil est utilisé d'une manière différente de celle recommandée par le fabricant, la protection offerte par l'appareil pourra en être altérée.

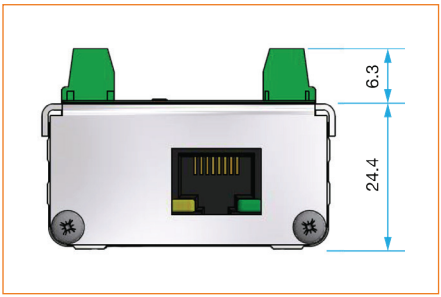
5 Mounting

The CC320 can be mounted onto a panel using the M3 threaded holes in the base, shown in the diagram below.

Note: Ensure the mounting screws protrude no further than 6mm from the surface to which the CC320 is to be attached.

The PP703 kit is available for mounting the CC320 on a DIN rail. The dimensions in the diagrams below are all in millimetres.





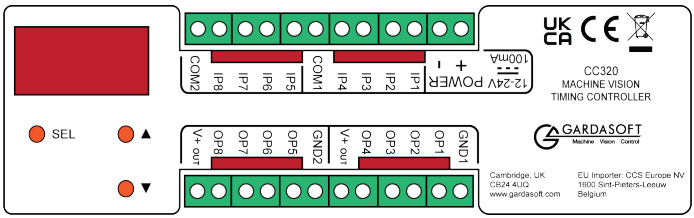
The CC320 does not have an IP rating and should be mounted such that moisture and dirt cannot enter the unit.

The CC320 is a fire enclosure as long as the following conditions are met:

- The Ethernet connector must not be facing downwards and,
- The mounting holes on the base must be covered or have a screw fitted

6 Connections

All connections except Ethernet are available on screw terminals. The CC320 top panel connections are shown below:



6.1 Power supply

The power supply must be 12VDC to 24VDC regulated. The maximum current required is 100mA. The maximum heat dissipation is 2.4W.

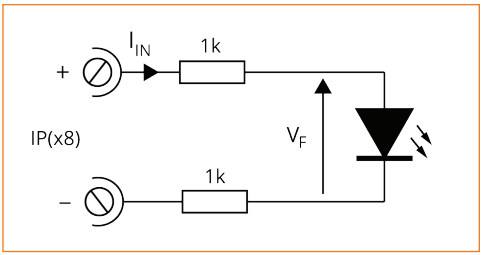
Caution: Do not connect a power supply to the V+out connections. This is a low power reference voltage.

6.2 Digital inputs

The state of each input is shown on an LED next to the connector. The inputs are arranged in two groups of 4, each group having a common negative connection. This is summarised below:

Connector	Function
POWER +	Power supply, 12V to 24V
POWER –	Power supply 0V
IP1	Input 1 positive
IP2	Input 2 positive
IP3	Input 3 positive
IP4	Input 4 positive
COM1	Common negative for inputs 1, 2, 3, 4
IP5	Input 5 positive
IP6	Input 6 positive
IP7	Input 7 positive
IP8	Input 8 positive
COM2	Common negative for inputs 5, 6, 7, 8

The CC320 inputs are optically coupled and the equivalent circuit is shown below:



An input voltage between 5V and 24V is recognised by the CC320 as a logic level '1'. An input voltage of 2V or less is recognised as a logic level '0'.

Referring to the diagram above, the forward voltage V_F is typically 1.5V.

The input current I_{IN} is 1.8mA at 5V and 11.3mA at 24V.

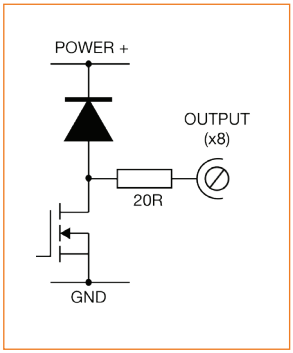
6.3 Digital outputs

The state of each output is shown on an LED next to the connector. The connection details are shown in the table below:

Connector	Function
GND1	Common 0V for outputs 1, 2, 3, 4
OP1	Output 1 open drain
OP2	Output 2 open drain
OP3	Output 3 open drain
OP4	Output 4 open drain
V+out	Low power regulated output. Maximum source current 50mA. ***Caution! Do not connect a PSU to V+out***

Connector	Function
GND2	Common 0V for outputs 5, 6, 7, 8
OP5	Output 5 open drain
OP6	Output 6 open drain
OP7	Output 7 open drain
OP8	Output 8 open drain
V+out	Low power regulated output. Maximum source current 50mA. ***Caution! Do not connect a PSU to V+out***

The CC320 equivalent circuit for the output is shown below:



The voltage between the output and ground must not be greater than 24V and the output can only sink up to 50mA.

If the output is shorted to a voltage higher than 5V then the output may be damaged.

Do not draw more than 50mA from the V+out connections as this can affect the internal operation of the controller. These outputs are just to be used for low current, for example pull-up resistors.

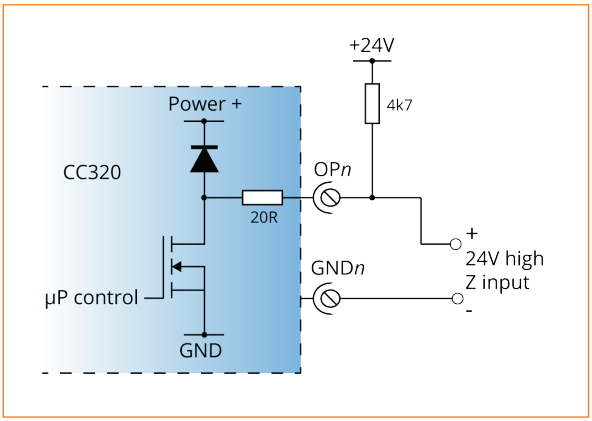
6.4 Ethernet connector

The RJ45 Ethernet connector requires a straight through cable to connect into a network switch, hub or router. It runs at 10Mbits per second.

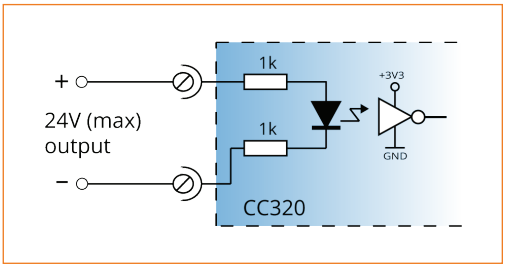
6.5 Connecting a CC320 to other devices

Use the following examples to help you connect your CC320 to other devices in your system:

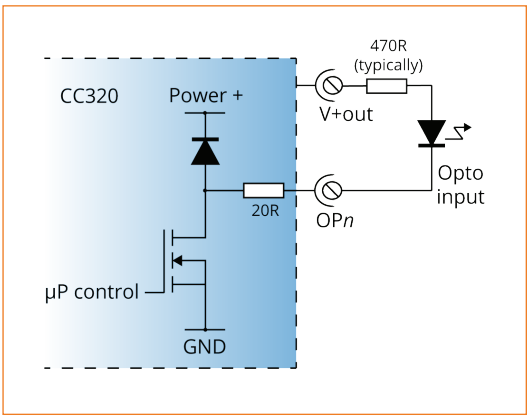
6.5.1 Connecting the output to a 24V input



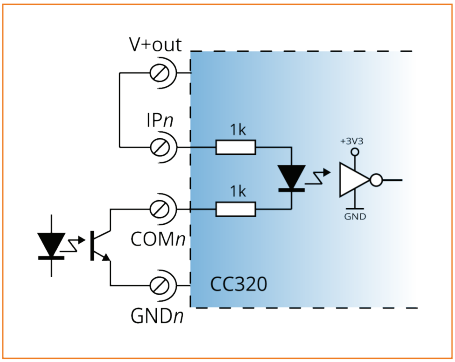
6.5.2 Connecting the input to a 24V output



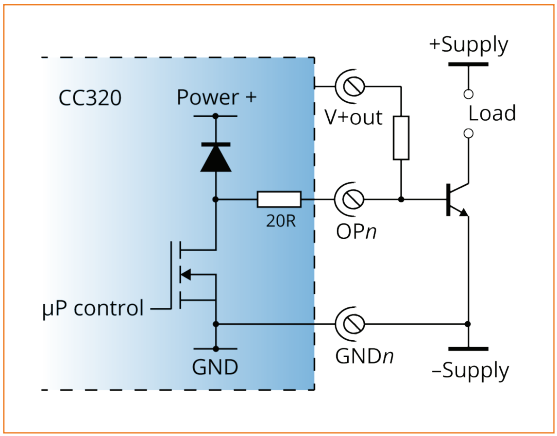
6.5.3 Connecting the output to an opto-coupled input



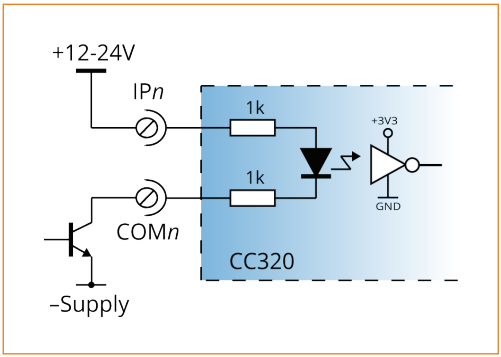
6.5.4 Connecting the input to an opto-coupled output



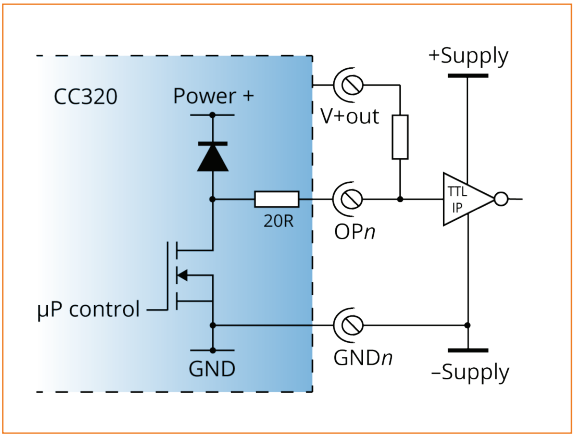
6.5.5 Connecting the output to an open-collector input



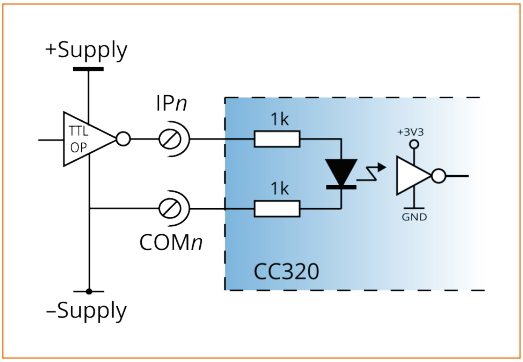
6.5.6 Connecting the input to an open-collector output



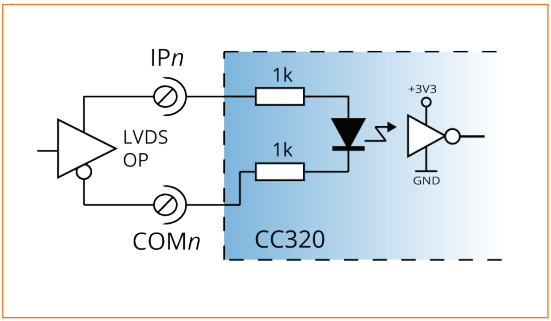
6.5.7 Connecting the output to a TTL input



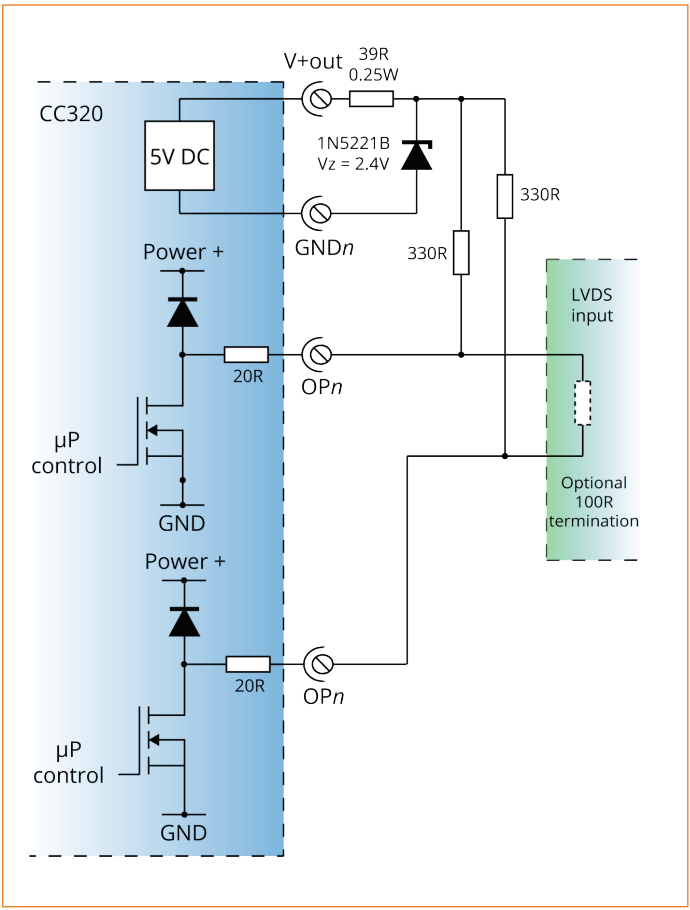
6.5.8 Connecting the input to a TTL output



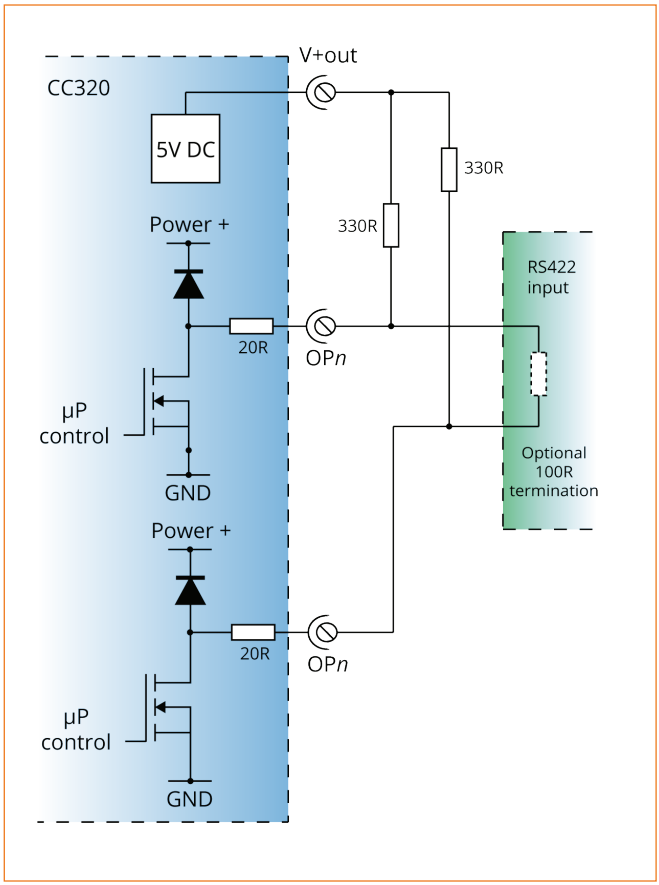
6.5.9 Connecting the input to an LVDS output



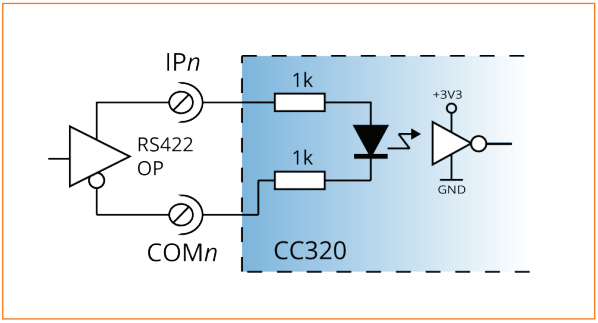
6.5.10 Connecting the output to an LVDS input



6.5.11 Connecting the output to an RS422 input



6.5.12 Connecting the input to an RS422 output



7 Operation

The CC320 Trigger Timing Controller has eight digital inputs, eight physical outputs, and eight virtual outputs (see Section 7.5, “Virtual channels”). All outputs operate independently and are configured separately. Their configuration is very flexible to provide solutions for a wide variety of timing problems.

There is also an internal input (IP0) which may be used as a periodic trigger.

The number of active triggers is limited to 50 at any one time. A triggers is considered active until the end of its re-trigger time. This also applies to the number of delayed buffer edges pending when using the *buF* and *buE* modes (see Section 7.2, “Output Modes”).

The configuration can be saved in non-volatile memory so that the CC320 resumes operation after a power cycle.

The state of each input and output is shown on an LED next to the connector. Pulses are displayed for a longer period than they actually are – a 10µs pulse is shown as a 100ms pulse on the LED, so that it is visible to the user.

7.1 Input modes

All input connections are general purpose inputs except for IP1 and IP2, which can be used for an encoder as well as for general inputs.

7.1.1 Encoder operation

The CC320 supports two types of encoder; one wire and two wire. The table below summarises this.

Mode	Connections	Operation	Maximum frequency
n1 one wire encoder	IP1 is QEA	Simple encoder provides position information. All movement is assumed to be forward.	100kHz*
n2 two wire encoder	IP1 is QEA IP2 is QEB	Quadrature encoder provides position and direction information.	100kHz*

***Note:** In some applications a higher maximum frequency may be achievable. For further advice, contact Gardasoft on vision@gardasoft.com.

For 2 wire encoders, the CC320 correctly handles timing when the belt is reversing. When the belt is travelling in reverse:

- the letter ***b*** is displayed on the front panel.
- triggers received in Pulse ET, Pulse EE, and Divide Enc, modes (see Section 7.2, “Output Modes”) are ignored.
- output pulses in Pulse TE, Pulse ET, Pulse EE, and Divide Enc modes are not duplicated.

7.1.2 Free running trigger

The internal input (IP0) can be used as a periodic trigger. The parameter shown below can be set by using the CC320 web pages or by using the **RB1,p** command (see Section 10.3, "Commands"):

Parameter	Use
Period	The period (inverse of frequency) of the simulated trigger. 0 disables the free-running timer.

For example a period of 20ms could be set, which would result in a 50Hz trigger. This can be used to trigger pulses on any of the outputs.

7.2 Output Modes

There are sixteen output channels available:

OP1 to OP8 Physical output connections

OP9 to OP16 Virtual output connections

Physical outputs represent the output connections of the controller. Virtual output channels are locations within the controller.

Each channel operates independently from all the other output channels. By configuring each channel to take its input and gate connection from an input connection (or from another channel's output) it is possible to build complex sequencing operations.

Multiple output channels can be triggered by one input to give synchronous operation, or from separate inputs to give asynchronous operation of different functions.

The output modes and their parameters are listed below:

Mode 0 - Set Low (*OFF*)

The output is set to off or logic 0. The output is inverted if flag O is set.

Mode 1 - Set High (*On*)

The output is set to on or logic 1. The output is inverted if flag O is set.

Mode 2 - Pulse TT (*Ptt*)

Pulsed output triggered by a digital input. The delay and pulse width are set as time periods.

Parameter	Use
Trigger input	The channel can take any input, or the output of any other channel as it's trigger. This can be configured using the CC320 web pages and selecting a trigger source using the pull-down menus. Alternatively the trigger and input source can be set using the **i** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands"). 0 for the free-running timer, if IP0 is enabled 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 to CH8) 17 to 24 for virtual outputs (channels CH9 to CH16).
Gate input	The channel can take any input, or the output of any other channel as it's gate. The gate enables/disables the output of the channel. This can be selected using the CC320 web pages and using the pull-down menu. Alternatively the gate input source can be set using the **g** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands"). 0 for None 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16).

Parameter	Use
Pulse delay	Specifies the delay time from trigger to pulse output using the web interface Pulse Delay field or the **p** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, “Commands”).
Pulse width	Specifies the width of the pulse output as a time period using the web interface Pulse Width field or the **d** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, “Commands”).
Re-trigger delay	The re-trigger delay is the minimum time from a channel being triggered to the next time it can be triggered. This can be used to de-bounce noisy inputs or when a product sensor fires more than once for one product. The re-trigger delay can be set in the web pages or by using the **r** parameter of the ‘Re-trigger delay’ command **RRc,r** (see Section 10.3, “Commands”).
Flags	All flags available. See Section 7.3, “Flags”.

Mode 3 - Pulse TE (*PtE*)

Pulsed output triggered by a digital input. The delay and the pulse width are set as time periods.

Parameter	Use
Trigger input	The channel can take any input, or the output of any other channel as its trigger. This can be configured using the CC320 web pages and selecting a trigger source using the pull down menu. Alternatively the trigger input source can be set using the **i** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands"). 0 for the free-running timer, if IP0 is enabled 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16).
Gate input	The channel can take any input, or the output of any other channel as it's gate. The gate enables/disables the output of the channel. This can be selected using the CC320 web pages and using the pull-down menu. Alternatively the gate input source can be set using the **g** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands"). 0 for None 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16).
Pulse delay	Specifies the delay time from trigger to pulse output using the web interface Pulse Delay field or the **p** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, "Commands").

Parameter	Use
Pulse width	Specifies the width of the pulse output as a number of encoder pulses using the web interface Pulse Width field or the **d** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, “Commands”).
Re-trigger delay	The re-trigger delay is the minimum time from a channel being triggered to the next time it can be triggered. This can be used to de-bounce noisy inputs or when a product sensor fires more than once for one product. The re-trigger delay can be set in the web pages or by using the **r** parameter of the ‘Re-trigger delay’ command **RRc,r** (see Section 10.3, “Commands”).
Flags	All flags available. See Section 7.3, “Flags”.

Mode 4 - Pulse ET (*PEt*)

Pulsed output triggered by a digital input. The delay is set as a number of encoder pulses and the pulse width is set as a time period.

Parameter	Use
Trigger input	The channel can take any input, or the output of any other channel as its trigger. This can be configured using the CC320 web pages and selecting a trigger source using the pull down menu. Alternatively the trigger input source can be set using the **i** parameter of the ‘Set the output’ command **RSc,m,i,g,f** (see Section 10.3, “Commands”). 0 for the free-running timer, if IP0 is enabled 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16).

Parameter	Use
Gate input	The channel can take any input, or the output of any other channel as it's gate. The gate enables/disables the output of the channel. This can be selected using the CC320 web pages and using the pull-down menu. Alternatively the gate input source can be set using the **g** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands"). 0 for None 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16).
Pulse delay	Specifies the number of encoder pulses from trigger to pulse output using the web interface Pulse Delay field or the **p** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, "Commands").
Pulse width	Specifies the width of the pulse output as a time period using the web interface Pulse Width field or the **d** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, "Commands").
Re-trigger delay	The re-trigger delay is the minimum number of encoder pulses from a channel being triggered to the next time it can be triggered. This can be used to de-bounce noisy inputs or when a product sensor fires more than once for one product. The re-trigger delay can be set in the web pages or by using the **r** parameter of the 'Re-trigger delay' command **RRc,r** (see Section 10.3, "Commands").
Flags	All flags available. See Section 7.3, "Flags".

Mode 5 - Pulse EE (*PEE*)

Pulsed output triggered by a digital input. The delay and pulse width are set as a number of encoder pulses.

Parameter	Use
Trigger input	The channel can take any input, or the output of any other channel as its trigger. This can be configured using the CC320 web pages and selecting a trigger source using the pull down menu. Alternatively the trigger input source can be set using the **i** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands"). 0 for the free-running timer, if IP0 is enabled 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16).
Gate input	The channel can take any input, or the output of any other channel as it's gate. The gate enables/disables the output of the channel. This can be selected using the CC320 web pages and using the pull-down menu. Alternatively the gate input source can be set using the **g** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands"). 0 for None 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16).
Pulse delay	Specifies the number of encoder pulses from trigger to pulse output using the web interface Pulse Delay field or the **p** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, "Commands").

Parameter	Use
Pulse width	Specifies the width of the pulse output as a number of encoder pulses using the web interface Pulse Width field or the **d** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, “Commands”).
Re-trigger delay	The re-trigger delay is the minimum number of encoder pulses from a channel being triggered to the next time it can be triggered. This can be used to de-bounce noisy inputs or when a product sensor fires more than once for one product. The re-trigger delay can be set in the web pages or by using the **r** parameter of the ‘Re-trigger delay’ command **RRc,r** (see Section 10.3, “Commands”).
Flags	All flags available. See Section 7.3, “Flags”.

Mode 6 - Divide Trig (*Pd*)

Pulse divider. Every [*Pulse delay*] trigger pulses, the output is pulsed for the time set in [*Pulse width*].

Parameter	Use
Trigger input	The channel can take any input, or the output of any other channel as its trigger. This can be configured using the CC320 web pages and selecting a trigger source using the pull down menu. Alternatively the trigger input source can be set using the **i** parameter of the ‘Set the output’ command **RSc,m,i,g,f** (see Section 10.3, “Commands”). 0 for the free-running timer, if IP0 is enabled 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16). ***Note:*** 0 may be selected but Divide Trig mode will not trigger from the free running timer.

Parameter	Use
Gate input	The gate input is ignored in this mode.
Pulse delay	Specifies the number used to divide the trigger pulse by. Set by using the web interface Pulse Delay field or the **p** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, “Commands”).
Pulse width	Specifies the width of the pulse output as a time period using the web interface Pulse Width field or the **d** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, “Commands”).
Re-trigger delay	Not used in this mode.
Flags	I and O flags available. See Section 7.3, “Flags”.

Mode 7 - Divide Enc (*Enc*)

Pulse divider. Every [*Pulse delay*] encoder pulses, the output is pulsed for the period of time defined by the number of encoder pulses in [*Pulse width*].

Parameter	Use
Trigger input	The trigger input is ignored in this mode.
Gate input	The gate input is ignored in this mode.
Pulse delay	Specifies the number used to divide the encoder pulses by. Set by using the web interface Pulse Delay field or the **p** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, “Commands”).

Parameter	Use
Pulse width	Specifies the width of the pulse output as a number of encoder pulses using the web interface Pulse Width field or the **d** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, “Commands”).
Re-trigger delay	Not used in this mode.
Flags	Only the I flag is available in this mode. See Section 7.3, “Flags”.

Mode 8 - Burst T (*bur*)

Burst output. When triggered by the selected trigger input, a number of pulses set by [*Gate input*] are produced. The maximum number of pulses that can be output is 250.

Parameter	Use
Trigger input	The burst can be triggered by any input, or the output of any other channel. This can be configured using the CC320 web pages and selecting a trigger source using the pull down menu. Alternatively the trigger input source can be set using the **i** parameter of the ‘Set the output’ command **RSc,m,i,g,f** (see Section 10.3, “Commands”). 0 for the free-running timer (unlikely to be used) 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16).

Parameter	Use
Gate input	The gate input sets the number of pulses in a burst of pulses. 1 to 24 can be selected using the CC320 web pages' pull-down menu. Input IP1 to IP8 for 1 to 8 pulses Output 1 to Output 8 for 9 to 16 pulses Output 9 to Output 19 for 17 to 24 pulses. Alternatively, the number of pulses can be set using the **g** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands") up to a limit of 250 pulses.
Pulse delay	Specifies the **pulse width** as a period of time in this mode. Set by using the web interface Pulse Delay field or the **p** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, "Commands").
Pulse width	Specifies the **gap** between pulses in the burst as a period of time. It can be set using the web interface Pulse Width field or the **d** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, "Commands").
Re-trigger delay	Not used in this mode. In modes that produce bursts of pulses, the channel cannot be re-triggered during the sequence of pulses.
Flags	Only the I, O, and E are available in this mode. See Section 7.3, "Flags".

Mode 9 - Frequency (*FrE*)

Mode 9 is not supported.

Mode 10 - Buffer T (*buF*)

When enabled by the gate input, the output will follow the trigger input signal, but it will be delayed by a period of time.

Note: The number of pending delayed buffer edges is limited to 50.

Parameter	Use
Trigger input	The channel can take any input, or the output of any other channel as its trigger. This can be configured using the CC320 web pages and selecting a trigger source using the pull down menu. Alternatively the trigger input source can be set using the **i** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands"). 0 for the free-running timer, if IP0 is enabled 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16).
Gate input	The channel can take any input, or the output of any other channel as it's gate. The gate enables/disables the output of the channel. This can be selected using the CC320 web pages and using the pull-down menu. Alternatively the gate input source can be set using the **g** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands"). 0 for None 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16).
Pulse delay	Specifies the delay time from trigger to pulse output using the web interface Pulse Delay field or the **p** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, "Commands").
Pulse width	Not used in this mode.
Re-trigger delay	Not used in this mode.
Flags	Only flags I, O, G, and E are available in this mode. See Section 7.3, "Flags".

Mode 11 - Buffer E (*buE*)

When enabled by the gate input, the output will follow the trigger input signal, but it will be delayed by a number of encoder pulses.

Note: The number of pending delayed buffer edges is limited to 50.

Parameter	Use
Trigger input	The channel can take any input, or the output of any other channel as its trigger. This can be configured using the CC320 web pages and selecting a trigger source using the pull down menu. Alternatively the trigger input source can be set using the **i** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands"). 0 for the free-running timer, if IP0 is enabled 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16)
Gate input	The channel can take any input, or the output of any other channel as it's gate. The gate enables/disables the output of the channel. This can be selected using the CC320 web pages and using the pull-down menu. Alternatively the gate input source can be set using the **g** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands"). 0 for None 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16).
Pulse delay	Specifies the number of encoder pulses from trigger to pulse output using the web interface Pulse Delay field or the **p** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, "Commands").

Parameter	Use
Pulse width	Not used in this mode.
Re-trigger delay	Not used in this mode.
Flags	Only flags I, O, G, and E are available in this mode. See Section 7.3, “Flags”.

Mode 12 - Burst E (*brE*)

When triggered by the selected trigger input, a number of pulses set by [*Gate input*] are produced. The maximum number of pulses that can be output is 250. The pulse delay and gap between pulses is set as a number of encoder pulses.

Parameter	Use
Trigger input	The burst can be triggered by any input or any other channel. This can be configured using the CC320 web pages and selecting a trigger source using the pull down menu. Alternatively the trigger input source can be set using the **i** parameter of the ‘Set the output’ command **RSc,m,i,g,f** (see Section 10.3, “Commands”). 0 for the free-running timer (this is unlikely) 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16) ***Note:*** Input 1 and possibly input 2 will not be available as they are encoder inputs.

Parameter	Use
Gate input	The gate input sets the **number** of pulses in a burst of pulses. 1 to 24 can be selected using the CC320 web page' pull down menu. Input IP1 to IP8 for 1 to 8 pulses Output 1 to Output 8 for 9 to 16 pulses Output 9 to Output 19 for 17 to 24 pulses. Alternatively, the number of pulses can be set using the **g** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands") up to a limit of 250 pulses.
Pulse delay	Specifies the **pulse width** as a number of encoder pulses in this mode. Set using the web interface Pulse Delay field or the **p** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, "Commands").
Pulse width	Specifies the width of the **gap** between pulses as a number of encoder pulses using the web interface Pulse Width field or the **d** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, "Commands").
Re-trigger delay	Not used in this mode. In modes that produce bursts of pulses, the channel cannot be re-triggered during the sequence of pulses.
Flags	Only flags I, O, and E are available in this mode. See Section 7.3, "Flags".

Mode 13 - Counter (*CoU*)

The channel counts the number of trigger inputs. It starts counting when it receives a start signal from the gate input. The channel's output goes high for [*Pulse width*] time when the counter reaches the number set by [*Pulse delay*].

Parameter	Use
Trigger input	This field defines what is to be counted. The channel can take any input, or the output of any other channel. This can be configured using the CC320 web pages and selecting a trigger source using the pull down menu. Alternatively the trigger input source can be set using the **i** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands"). 0 for the free-running timer, if IP0 is enabled 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16)
Gate input	In this mode, the gate input is used as a start count signal. It can take any input, or the output of any other channel. This can be selected using the CC320 web pages and using the pull-down menu. Alternatively the gate input or source of the start signal can be set using the **g** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands"). 0 for None 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16).
Pulse delay	In this mode the pulse delay represents the number to count up to. The maximum count is 2×10^9. This number can be set using the web interface Pulse Delay field or the **p** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, "Commands").
Pulse width	Specifies the width of the pulse output as a time period. Set using the web interface Pulse Width field or the **d** parameter of the Output Pulse Timing command **RTc,p,d** (see Section 10.3, "Commands")..

Parameter	Use
Re-trigger delay	Not used in this mode.
Flags	Only flags I, O, G, and E are available in this mode. See Section 7.3, “Flags”.

Mode 14 - Min Pulse Trig (*iPF*)

The output will pulse only if the trigger input signal stays valid for a period less than the time set in [*Pulse delay*].

Parameter	Use
Trigger input	Specifies which input is used for triggering. The channel can take any input, or the output of any other channel. This can be configured using the CC320 web pages and selecting a trigger source using the pull down menu. Alternatively the trigger input source can be set using the **i** parameter of the ‘Set the output’ command **RSc,m,i,g,f** (see Section 10.3, “Commands”). 0 for the free-running timer, if IP0 is enabled 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16).

Parameter	Use
Gate input	The gate input is used to enable the function. The channel can take any input, or the output of any other channel as it's gate input. This can be selected using the CC320 web pages and using the pull-down menu. Alternatively the gate input or source of the start signal can be set using the **g** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands"). 0 for None 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16).
Pulse delay	Sets the minimum input trigger pulse time.
Pulse width	Not used in this mode.
Re-trigger delay	Not used in this mode.
Flags	Only flags I, O, G, and E are available in this mode. See Section 7.3, "Flags".

Mode 15 - Max Pulse Trig (*APF*)

The output will pulse only if the trigger signal stays valid for a period of [*Pulse delay*]. The output pulse starts when the [*Pulse delay*] time has completed, which can be before the end of the trigger pulse.

Parameter	Use
Trigger input	Specifies which input is used for triggering. The channel can take any input, or the output of any other channel as its trigger input. This can be configured using the CC320 web pages and selecting a trigger source using the pull down menu. Alternatively the trigger input source can be set using the **i** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands"). 0 for the free-running timer, if IP0 is enabled 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16)
Gate input	The gate input is used to enable the function. The channel can take any input, or the output of any other channel as it's gate input. This can be selected using the CC320 web pages and using the pull-down menu. Alternatively the gate input or source of the start signal can be set using the **g** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands"). 0 for None 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16).
Pulse delay	Sets the maximum input trigger pulse time.
Pulse width	Sets the output pulse width.
Re-trigger delay	Not used in this mode.
Flags	Only flags I, O, and E are available in this mode. See Section 7.3, "Flags".

Mode 16 - D-Type Latch (*dLA*)

The logic level on the trigger input is latched by a rising edge on the gate input.

Parameter	Use
Trigger input	The channel can take any input, or the output of any other channel as its trigger input. This can be configured using the CC320 web pages and selecting a trigger source using the pull down menu. Alternatively the trigger input source can be set using the **i** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands"). 0 for the free-running timer, if IP0 is enabled 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16).
Gate input	The gate input is used to latch the logic level on the trigger input. The channel can take any input, or the output of any other channel as it's gate input. This can be selected using the CC320 web pages and using the pull-down menu. Alternatively the gate input or source of the start signal can be set using the **g** parameter of the 'Set the output' command **RSc,m,i,g,f** (see Section 10.3, "Commands"). 0 for None 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16).
Pulse delay	Not used in this mode.
Pulse width	Not used in this mode.
Re-trigger delay	Not used in this mode.

Parameter	Use
Flags	Only flags I, O, G, and E are available in this mode. See Section 7.3, “Flags”.

Mode 17 - RS Latch (*rLA*)

The output is set when a leading edge is received on the gate input and is cleared when a leading edge is received on the trigger input.

Parameter	Use
Trigger input	The trigger input has the function of resetting the RS latch. The channel can take any input, or the output of any other channel as its trigger input. This can be configured using the CC320 web pages and selecting a trigger source using the pull down menu. Alternatively the trigger input source can be set using the **i** parameter of the ‘Set the output’ command **RSc,m,i,g,f** (see Section 10.3, “Commands”). 0 for the free-running timer, if IP0 is enabled 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16).
Gate input	The gate input is used to set the latch. The channel can take any input, or the output of any other channel as it’s gate input. This can be selected using the CC320 web pages and using the pull-down menu. Alternatively the gate input or source of the start signal can be set using the **g** parameter of the ‘Set the output’ command **RSc,m,i,g,f** (see Section 10.3, “Commands”). 0 for None 1 to 8 for IP1 to IP8 9 to 16 for OP1 to OP8 (channels CH1 toCH8) 17 to 24 for virtual outputs (channels CH9 to CH16).”.
Pulse delay	Not used in this mode.

Parameter	Use
Pulse width	Not used in this mode.
Re-trigger delay	Not used in this mode.
Flags	Only flags I, O, G, and E are available in this mode. See Section 7.3, “Flags”.

7.3 Flags

Each output also has the following flags which specify other options. For Ethernet commands, multiple flags can be set by adding the flag values together. Note that because the outputs are open collector, ‘high’ means the output floats as against being clamped to zero when the output is ‘low’.

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. See Section 7.3.1, “Ethernet message flag (E)”.

Flag value	Flag name	Operation when flag = 0	Operation when flag = 1
16	F	Triggers are ignored until output pulse is complete.	FIFO output mode. Multiple triggers are queued up. See Section 7.3.2, “FIFO flag (F)”.
32	R	Resync mode disabled.	Resync mode enabled. See Section 7.3.3, “Resync flag (R)”.
64	P	Default to pulse in resync mode.	Default to no pulse in resync mode. See Section 7.3.4, “Pulse flag (P)”.

7.3.1 Ethernet message flag (E)

When the CC320 is used to trigger a camera, the image processing can either be triggered by the acquisition of an image or by an Ethernet message sent from the CC320.

When a trigger is received it is assigned a unique tag number (an incrementing number from 0 to 255). Using the **GT** Ethernet command and the Ethernet message flag, the CC320 sends the tag number in a message to the host computer to say that a trigger has occurred.

The message has the form:

```
Evt<channel>,<tag>
```

Where `<channel>` is the channel number from 1 to 8 and `<tag>` is a number from 0 to 255. Multiple tag messages may be sent in one packet, separated by a semi-colon (**;**)

7.3.2 FIFO flag (F)

The FIFO flag is used for systems where there can be more than one product between the trigger point and reject gate. This is usually used with the Resync flag, so that each product has its own pass/fail result.

If the FIFO flag is not set, then an output cannot be re-triggered until the previous pulse has completed. Others triggers in this time are ignored

If the FIFO flag is set, then multiple triggers are stored in the CC320 and a pulse is generated for each trigger at the correct time.

The number of active triggers is limited to 50 at any one time. A trigger is considered active until the end of its re-trigger time.

7.3.3 Resync flag (R)

Reject gate operation usually needs to be synchronised to the original product trigger. However image processing can take a variable length of time to complete, so rejects based on when the processing result is available cannot be accurately timed. The Resync flag allows pass/fail results to be re-synchronised to the original trigger.

There are two types of reject gate:

- A pulse is required to reject a product (set the P flag)
- A pulse is required to stop a product being rejected (don't set the P flag)

The Resync Flag should be used with the Ethernet Message flag. The host computer receives a tag number message, processes the image and sends a pass/fail result (as an **SN** command) back to the CC320. The CC320 matches the message to the original trigger and time the pass/fail output pulse accurately.

If an **SN** command is not received in time, then the product is rejected, and an error code output.

7.3.4 Pulse flag (P)

The Pulse flag is used to select whether a pulse is needed to reject or to accept a product when the Resync flag is set. When not set, a pulse

is required to reject product. If a pass/fail message is not received in Resync mode, the CC320 defaults to rejecting the product.

7.4 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 mode must be set to Mode 10 - Buffer T mode (*buF*), which makes the output the same signal as the input.

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

7.4.1 NOT

Use the configuration below to set up a NOT operation such that:

If IP1=0, then OP1=1

If IP1=1, then OP1=0

Output	Mode	Trigger Input	Gate input	Pulse delay	Pulse width	Re-trigger time	Flags
1	10	1	0	0	0	0	O (2)

7.4.2 AND

Use the configuration below to set up an AND operation such that:

If IP1=0, and IP2=0, then OP1=0

If IP1=0, and IP2=1, then OP1=0

If IP1=1, and IP2=0, then OP1=0

If IP1=1, and IP2=1, then OP1=1

Output	Mode	Trigger Input	Gate input	Pulse delay	Pulse width	Re-trigger time	Flags
1	10	1	2	0	0	0	(0)

7.4.3 NAND

Use the configuration below to set up a NAND operation such that:

If IP1=0, and IP2=0, then OP1=1

If IP1=0, and IP2=1, then OP1=1

If IP1=1, and IP2=0, then OP1=1

If IP1=1, and IP2=1, then OP1=0

Output	Mode	Trigger Input	Gate input	Pulse delay	Pulse width	Re-trigger time	Flags
1	10	1	2	0	0	0	O (2)

7.4.4 OR

Use the configuration below to set up a NAND operation such that:

If IP1=0, and IP2=0, then OP1=0

If IP1=0, and IP2=1, then OP1=1

If IP1=1, and IP2=0, then OP1=1

If IP1=1, and IP2=1, then OP1=1

Output	Mode	Trigger Input	Gate input	Pulse delay	Pulse width	Re-trigger time	Flags
1	10	1	2	0	0	0	I, O, G (7)

7.4.5 NOR

Use the configuration below to set up a NAND operation such that:

If IP1=0, and IP2=0, then OP1=1

If IP1=0, and IP2=1, then OP1=0

If IP1=1, and IP2=0, then OP1=0

If IP1=1, and IP2=1, then OP1=0

Output	Mode	Trigger Input	Gate input	Pulse delay	Pulse width	Re-trigger time	Flags
1	10	1	2	0	0	0	I, O, (3)

7.5 Virtual channels

In addition to its eight physical channels, the CC320 has a further eight virtual channels. These are numbered from 9 to 16.

Where physical channels are connected to an output of the device, virtual channels have no physical output, but are otherwise identical to the physical channels. They allow inputs to be propagated though the system, setting parameters such as pulse width and delay. Virtual channels can then be connected to the physical channels to give a physical output.

You can set up the virtual channels using the CC320's web pages and command line interface. However you cannot set up the virtual channels from the front panel.

When using the output from a channel as the input to another channel, the input channel number is calculated as 8 + the input channel number. For example, to use the output from channel number 4 you would use the input channel number 12.

7.6 Cold boot

A cold boot function is available to reset the CC320 to a known state. The unit can be cold booted as follows:

Press and hold the **SEL** and ▼ buttons when powering up the unit

- Sending an Ethernet command
- Pressing a button on an internal web page

When the unit is cold booted it is set to the following state:

IP0 (free running trigger) is set up as a 1Hz internal trigger

The unit is set up for no encoder input.

- OP1 triggers from IP1, delay for 100ms then pulse for 100ms
- OP2 triggers from IP2, delay for 100ms then pulse for 100ms
- OP3 triggers from IP3, delay for 100ms then pulse for 100ms
- OP4 triggers from IP4, delay for 100ms then pulse for 100ms
- OP5 triggers from IP5, delay for 100ms then pulse for 100ms
- OP6 triggers from IP0, delay for 100ms then pulse for 100ms

- OP7 triggers from IP0, delay for 200ms then pulse for 100ms
- OP8 triggers from IP0, delay for 300ms then pulse for 100ms
- OP9 to OP16 (virtual outputs) are also set to test conditions. These should be 'Set Low', Mode 0 if not required.

8 Ethernet setup

You may need to ask your network administrator for advice about setting up the Ethernet connection.

Ethernet set up is not affected by cold booting the CC320.

See Application note APP923 (available from www.gardasoft.com) for troubleshooting Ethernet problems.

8.1 Connection

The Ethernet link uses a 10Base-T connection on an RJ45 connector. The CC320 is usually connected to a network switch, hub or router, but you can connect it directly into the network port on a PC .

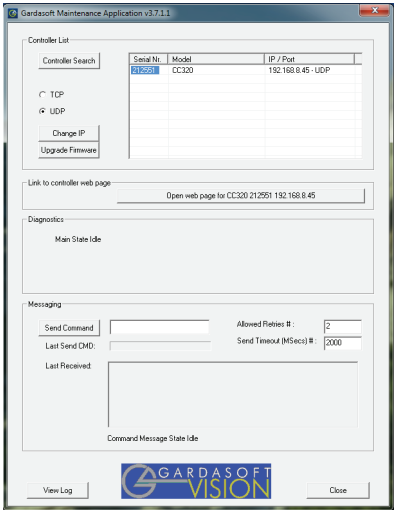
8.2 IP Address

The CC320 needs an IP address to communicate over Ethernet. There are two ways to get an IP address; either programmed into the unit or using DHCP.

For DHCP mode, the CC320 acquires its IP address, subnet mask and gateway address from a DHCP server. Otherwise the CC320 has a fixed IP address, subnet mask and gateway address.

DHCP mode or the IP address can be set and read using the GardasoftMaint program available at www.gardasoft.com.

The GardasoftMaint window is shown overleaf:



GardasoftMaint allows you to view the controllers on your network, change their IP addresses and Gardasoft can upgrade their firmware if it becomes necessary. In the messaging section of GardasoftMaint, you can communicate with your controller using the commands explained in Section 10, Command configuration. You can also open the selected controller's web pages at the click of a button. For more information about the CC320's web pages, see Section 9, "Web page configuration".

8.2.1 DHCP

Most networks use a DHCP server. If there is a PC on the network, you may be able to find out whether a PC on the same network uses DCHP as follows:

i. Right-click on the Windows 11™ Start icon in your PC's task bar.

ii. Select **Network Connections**.

iii. Click on the **Ethernet** tab.

iv. The IP assignment will be shown as *Automatic (DHCP)*.

You can find out what IP address is being used by a PC at any time by following the steps below:

i. Right-click on the Windows 11™ Start icon in your PC's task bar.

ii. Select **Network Connections**.

iii. Click the **Ethernet** tab.

iv. Under **Properties**, your IP address will be given as the 'IPV4 address'.

8.2.2 Fixed IP address

When using a fixed IP address, you must ensure that you use an IP address that is not being used by any other device on the network. It is usual to keep the first three numbers of the IP address the same as other devices and to change only the last number. For example, if you have a network consisting of a PC (IP address 192.168.1.35) and two CC320s could be allocated addresses 192.168.1.201 and 192.168.1.202.

8.3 Controller Search

There is a search mechanism which allows any device to find all Gardasoft controllers on a local network. The replies will tell any host the following about each controller:

» Model

» Serial number

» MAC address

» IP address

8.4 Enquiry Packets

Enquiry packets can be sent by a PC or other device. Gardasoft controllers send an enquiry packet every 60 seconds.

An enquiry packet is a UDP packet from source port 30310, destination port 30311 with the message body 'Gardasoft Search' (8-bit ASCII, 13 characters).

The CC320 sends a broadcast message on three events:

i. On power up

ii. When an IP address is received or renewed by DHCP

iii. When an enquiry message is received.

An enquiry message is a UDP packet from source port 30310, destination port 30311 with the message body 'Gardasoft Search' (8-bit ASCII,13 characters).

The message output by the CC320 is a UDP packet from source port 30311, destination port 30310. It is formatted as:

Gardasoft,CC320,000000,111111111111,22222222

(8-bit ASCII, 44 characters) where,

000000 The serial number of the unit

111111111111 The MAC address in 6 HEX bytes

22222222 The IP address in 4 HEX bytes

For example; for CC320, serial number 012345, IP address 192.168.1.103, MAC address 0.0B.75.01.80.99 the packet is formatted:

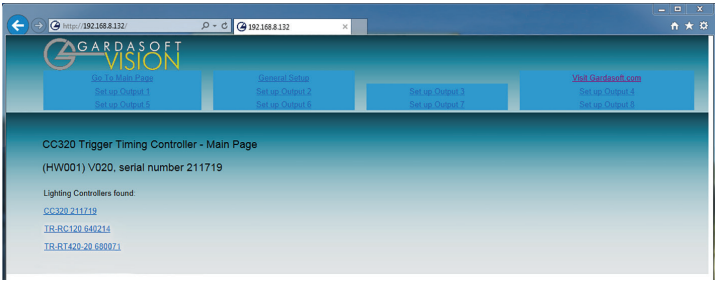
Gardasoft,CC320,012345,000B75018099,C0A8016

9 Web page configuration

You can set up the CC320 through its own internal web pages. Click the **Open webpage...** button in GardasoftMaint to take you directly to the CC320's web pages. You can also type the controller's IP address (displayed in GardasoftMaint) into your web browser, which will display the Main page. GardasoftMaint software is available from www.gardasoft.com/Downloads.

9.1 Main page

The Main Page (shown below) is the first to open when you access the CC320's web pages. This gives the controller's hardware and firmware revision levels and its serial number. It also contains links to the CC320's other web pages.



9.2 Channel configuration page

There is one configuration page for each channel as shown below:

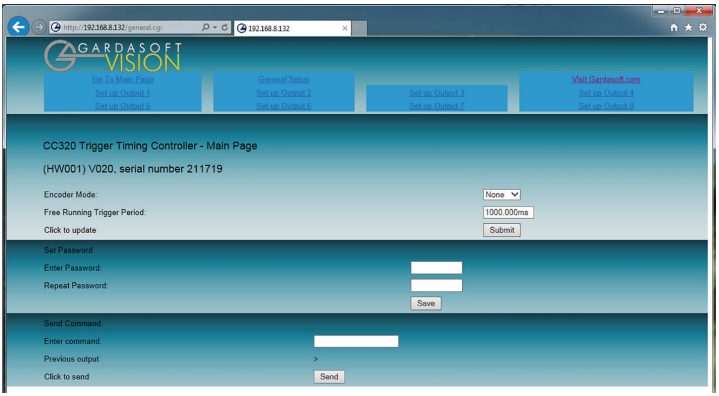
You can set up all the parameters for each output channel. Pressing the Submit button updates the CC320 configuration and saves the changes to non-volatile memory. On this page you can:

- Select the channel's mode
- Select the trigger input
- Set up the gate input
- Define the pulse characteristics
- Set the flags

Refer to "Appendix A - Timing" for timing limitations.

9.3 General setup page

The General Setup page (shown below) allows you to set up or clear the web page's password, set up the free-running trigger, and set the encoder mode. You can also enter any Ethernet command from Section 10, "Command configuration".



10 Command configuration

The CC320 can be configured via the Ethernet connection using UDP or TCP/IP.

10.1 Communication

Communication consists of commands sent by the host - the controlling PC. All output generated by the command is returned in reply UDP or TCP/IP packets. The last character sent is **>** ('greater than' symbol). Once this is received, the host knows that the command has been completed. We recommended that the host waits for the **>** symbol before sending the next command. UDP communications are not guaranteed to arrive, so the host software must be able to cope with lost messages.

Using the **GT** command, a host can request that a message is sent to it whenever an error occurs.

Commands from a host should be sent to destination port 30313. Any port number can be used for the source port. Replies from the C320 are sent to the source port.

A TCP/IP connection times out and closes if it is idle for more than 10 seconds. The host must send regular 'heartbeat' commands (for example **VR**) to keep the link open.

10.2 Command structure

Several commands can be put into one command line by separating them by a semi-colon (**;**). A carriage return character should be sent to terminate the command line. The CC320 send any replies to the commands and then send a **>** character to indicate that the command line has been completed.

Commands comprise a code of two letters followed by the parameters (if any) needed for the command.

Numeric parameters are separated by a comma (**,**). For a parameter which is a time period the default units are milliseconds. **s**, **ms**, or **us** can be added to the end of the number to indicate seconds, milliseconds or microseconds. **K** can be used for 1 000 encoder pulses and **M** for 1 000 000 encoder pulses. For example:

Parameter	Meaning
0.1	0.1 milliseconds
200us	200 microseconds
0.1s	0.1 seconds
100	100 encoder pulses
15.5K	15 500 encoder pulses
14.5M	14 500 000 encoder pulses

Encoder values can be up to 1 000 000 000. Time periods can be from 0.1ms to 100 seconds in steps of 0.1ms.

Note: Parameters are in 'USA/UK' format so that one half is written '0.5' not '0,5'.

The command codes and their meanings are described in Section 10.3 "Commands" below. The single upper case letter codes for the parameters are also shown, followed by lower case letters denoting the numeric argument.

Note: Any changes made using Ethernet commands are not saved permanently until the **AW** command has been sent.

10.3 Commands

Show the firmware version

VR

Outputs the version number of the firmware, for example '001'.

Clear configuration

CL

Clears the configuration to the cold boot state.

Save configuration

AW

Saves the configuration to non-volatile memory. When the CC320 is turned off and on, this configuration is restored.

Show configuration

ST

The current configuration is shown. The first line gives the encoder mode and the internal trigger timing. Then the configuration of each of the outputs is given, one per line. The flags are shown as lower case letters if not set and upper case if set. An example of the output from this command is shown below:

```
No encoder, trigger period = 1.000s
OP1: MD=2, IP=1, GT=-, DL=100.00ms, PL=100.00ms,
RT=0.00ms, iogefrp
OP2: MD=2, IP=2, GT=-, DL=100.00ms, PL=100.00ms,RT=
0.00ms, iogefrp
www.gardasoft.com 51|
OP3: MD=2, IP=3, GT=-, DL=100.00ms, PL=100.00ms,RT=
0.00ms, iogefrp
OP4: MD=2, IP=4, GT=-, DL=100.00ms, PL=100.00ms,RT=
0.00ms, iogefrp
OP5: MD=2, IP=5, GT=-, DL=100.00ms, PL=100.00ms,RT=
0.00ms, iogefrp
OP6: MD=2, IP=0, GT=-, DL=100.00ms, PL=100.00ms,RT=
0.00ms, iogefrp
OP7: MD=2, IP=0, GT=-, DL=200.00ms, PL=100.00ms,RT=
0.00ms, iogefrp
```

```
OP8: MD=2, IP=0, GT=-, DL=300.00ms, PL=100.00ms,RT=
0.00ms, iogefrp
```

Virtual outputs are also displayed.

STc

This commands returns the channel specified in **c**.

Enable Ethernet messages

GTm

Where:

m = 0 to disable Ethernet messages

m = 1 to enable Ethernet messages

When Ethernet messages are enabled, any trigger tag messages and error reports are sent to the most recent UDP or TCP address from which a command has been received.

Read any error messages

GR

If Ethernet messages are not enabled, the last error number can be read by this command. The reply is of the form:

`Err 45`	Error 45 was the last error
`Err 0`	No error has occurred since the last **GR** command

Set/clear the web page password

EY

EY asc1, asc2, asc3, asc4, asc5, asc6

This command sets the password required to access the web pages. If **EY** is entered on its own, then the password is cleared. There are six optional parameters, which are ASCII values for a password from one to six letters. **A** value of 65 is A, 66 is **B**, and so on up to 90, which is **Z**.

Set pass/fail

SNc,t,p

Where:

- **c** is the output channel (1to8)
- **t** is the trigger tag number
- **p** is set to 1 for pass, and 0 for fail

In Resync mode, this command returns the pass/fail state of image processing for the given trigger tag. For example:

SN3,76,1 = Output 3, trigger tag 76 is a pass

Set the output mode

RSc,m,i,g,f

Where:

- **c** is the output channel (1to 8).
- **m** is the mode.
- **i** is the trigger input: 0 for the free running timer, 1 to 8 for IP1 to IP8, and 9 to 16 for OP1 to OP8.
- **g** is the gate input: 0 for none, 1 to 8 for IP1 to IP8, and 9 to 16 for OP1 to OP8.
- **f** is the flag parameter.

This command sets the configuration for an output channel. (See Output modes for a description of these parameters). For example:

RS4,2,5,0,2

Sets output channel 4 to pulse mode (Ptt), triggered by input 5, no gate input and flags = 2 (invert the output). The flag parameter must be entered as a decimal number.

Set the output pulse timing

RTc,p,d

Where:

- **c** is the output channel (1 to 8).
- **p** is the pulse width (as time or as encoder pulses).
- **d** is the pulse delay (as time or as encoder pulses).

The pulse delay and pulse width timings are either a time period or a number of encoder pulses, as previously set by the mode parameter of the **RS** command.

Note: The mode should be set with the **RS** command before the pulse timing is set. For example:

RT2,3ms,5K = Output 2, 3ms output pulse after 5000 encoder pulses.

Set retrigger time

RRc,r

Where:

- **c** is the output channel (1 to 8).
- **r** is the re-trigger time or encoder pulses

The re-trigger time is the minimum time from when an output is triggered to the next time. The mode should be set before the re-trigger time. For example:

RR4,10ms = Output 4 won't accept another trigger until 10ms after the previous one.

Set the internal free running trigger

RB1,p

Where:

p is the period of the timer

The internal timer is set to run at the specified time period. For example:

RB1,1ms Set period to 1ms (1000Hz).

RB1,3s Set period to 3s (once per 3 seconds).

RB1,40 Set period to 40ms (25Hz).

To turn the internal timer off, set the period to 0.

Set encoder mode

This command sets the type of encoder:

REe

Where:

e = 0 to turn the encoder off.
= 1 for a one-wire encoder.
= 2 for a two-wire encoder.

Set an output

This command sets an output to a given logic level. This is a temporary override which is cancelled the next time the output is pulsed or if its configuration is changed.

If the 'O' configuration flag is set for an output, then the output is inverted.

RVc,v

c is the output channel (1 to 8).

v = 0 to set the output to a logic '0'

(logic '1' if the O flag is set)

= 1 to set the output to a logic '1'

(logic '0' if the O flag is set)

Read/change the encoder count

EN to read the encoder count.

EN0,c to adjust the encoder count backwards.

EN1,c to adjust the encoder count forwards.

This command returns `VL` and the encoder count. For example, the reply is `VL200` if 200 encoder counts have been received since the CC320 was turned on. The count is a 32 bit unsigned number and wraps to 0 when it reaches 232.

EN0 adjusts the encoder count backwards. It has the same effect as if the encoder moved backwards by the specified distance. It works for 1-wire and 2-wire encoders.

EN1 adjusts the encoder count forwards. This has the same effect as the encoder moving forwards by the specified distance. This might have an effect on outputs which use the encoder for timing. For example, in PEE mode a pulse may become due to start or stop.

For example, the commands:

EN returns `VL0`.

EN1,25 moves the encoder forwards by a count of 25.

EN returns `VL25`.

EN0,10 moves the encoder backwards by a count of 10.

EN returns `VL15`

EN0,40 moves the encoder backwards by a count of 40.

EN returns `VL4294967271` because the count has wrapped to $2^{32} - 25$.

Show the state of an input

RIi

Where:

i is the input channel (1 to 8).

The command returns `VL0` if the input is logic 0 and `VL1` if the input is on.

Override the state of an input

This command can be used to override the state of an input. The override is cancelled as soon as an edge is detected on the input.

MIc,v

Where:

c the input channel (1 to 8)

v = 0 to set the input to 'off'

= 1 to set the input to 'on'.

Show the state of an output

ROc

Where:

c is the output channel (1 to 8).

The command returns `VL0` if the output is logic 0 and `VL1` if the output is on.

Simulate an input pulse

This command generates a simulated pulse on an input. The input can be a physical input or the free running timer (IP0).

MPi

Where:

i = the input channel (0 to 8).

Disable keyboard

In some applications it may be necessary to disable the keyboard so that operation can only be controlled from the Ethernet port. The setting of this command is restored after a power cycle.

KBd

Where:

d = 0 to enable the keyboard, and 1 to disable the keyboard.

10.4 Command summary

Command syntax	Function
VR	Show the firmware version.
CL	Clear all configuration.
ST	Show configuration.
AW	Make configuration non-volatile.
GR	Read any error messages
GTm	Enable Ethernet messages.
EYa1,a2	Set web page password to 'AB'.

Command syntax	Function
SNc,t,p	Set pass/fail.
RTc,d,p	Set pulse timing.
RRc,r	Set re-trigger time.
RSc,m,i,g,f	Set output mode.
RB1,p	Set internal trigger period.
REe	Set encoder mode.
EN	Read the encoder count.
RVc,v	Set an output.
RIi	Read the state of an input.
MI	Override the state of an input.
ROc	Read the state of an output.
MPi	Simulate an input pulse.
KBd	Disable the keyboard.

Appendix A - Timing

These timings assume that a single output channel is being used. Simultaneous events on multiple inputs can cause some variation. Typically this can vary the timing by up to 100µs for each input.

Pulse widths below 4ms are repeatable to within 1µs and are not subject to variation even with other simultaneous events. Pulse widths above 4ms are repeatable to within 100us and are subject to variation.

When the CC320 is in Mode 2 - Pulse TT (*Ptt*), pulses in the following conditions have higher priority and better timing:

» Delay = 0, pulse width <=4ms.

» Delay + pulse width <= 4ms and O flag not set

For example with OP1 to OP4 all meeting the first condition:

OP1 has a delay of 24µs +/-4µs

OP2 has a delay of 29µs +/-4µs

OP3 has a delay of 34µs +/-4µs

OP4 has a delay of 40µs +/-4µs

The reply time of a simple Ethernet command (for example the **GT** command) is around 1.8ms for UDP, and 2.8ms for TCP.

In buffer mode there is a minimum delay of 20µs between the input changing and the output changing.

Appendix B - Error codes

Error number	Reason
Err 1	Ethernet command: A parameter value is invalid.
Err 2	Ethernet command: Command not recognised.
Err 3	Ethernet command: Numeric value is in the wrong format.
Err 4	Ethernet command: Wrong number of parameters.
Err 5	Unable to read the EEPROM.
Err 6, Err 12, Err 16	EEPROM corrupt. The configuration has been cleared.
Err 8, Err 25	Unable to read settings from the EEPROM.
Err 9, Err 17	Unable ta save settings to the EEPROM.

Error number	Reason
Err 13	SN command: The resync event cannot be found. The channel/tag values may be incorrect or the delay period may have completed.
Err 49	Ethernet hardware not working.
Err 51	Unable to read Ethernet settings from EEPROM, so they may be incorrect.
Err 52	Unable to save Ethernet settings to EEPROM.
Err 81	Too many FIFO events have been used and the CC320 has run out of storage.

Appendix C - Examples

This section provides a range of examples of ways in which the CC320 trigger timing controller may be configured. You can use these examples as a basis from which to set up your CC320 for your own application. A blank configuration form is available for download from www.gardasoft.com (see Appendix D - Configuration sheet).

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 of the CC320. 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.

A problem arises because the cameras are at different positions and the results arrive at different times. The solve this, trigger OP3 from the result of camera 2, but enable the trigger with a delayed result from camera 1. You can delay the result by using pulse operation (which can extend the pulse width) or use Mode 10 - Buffer T (*buF*). The configuration details are shown below:

Output	Mode	Trigger Input	Gate input	Pulse delay	Pulse width	Re-trigger time	Flags
1	2	3	0	1s	1ms	0	(0)
2	2	3	0	2s	1ms	0	(0)
2	2	1	0	200ms	100µs	0	(0)

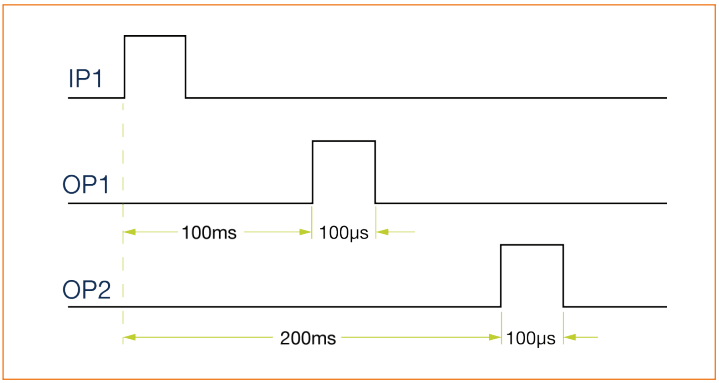
You could also use a variable speed conveyor with an encoder. However, this is more complex because there is a mixture of time and encoder delays.

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. The configuration details are shown below:

Output	Mode	Trigge Input	Gate input	Pulse delay	Pulse width	Re-trigger time	Flags
1	2	1	0	100ms	100µs	0	(0)
2	2	1	0	200ms	100µs	0	(0)

Both outputs are set to pulse mode. Two different delays give the timing difference between the two cameras (see overleaf).



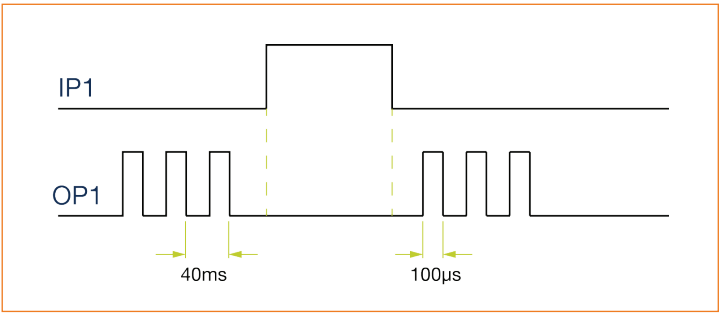
Gated pulses

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. The configuration details for this are shown below:

Output	Mode	Trigger Input	Gate input	Pulse delay	Pulse width	Re-trigger time	Flags
1	2	0	1	0ms	100µs	0	G (4)
Set free running triggers to 25 Hz							

OP1 triggers continuously at 25Hz only when IP1 is low. Note: Flags are

set to 4 to invert the sense of IP1. If Flags are set to 0, then OP1 only triggers when IP1 is high. The timing diagram is shown overleaf:



Delayed signal

A product sensor provides a signal when a product is present. This signal needs to be delayed so that an inspection light is only turned on when the product is present. The delay can be expressed as a time period 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 has 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 has the same signal as IP3, but delayed by 1000 encoder counts.

The two examples can be implemented using the following configuration:

Output	Mode	Trigger Input	Gate input	Pulse delay	Pulse width	Re-trigger time	Flags
1	10	3	0	500ms	0µs	0	(0)

Output	Mode	Trigger Input	Gate input	Pulse delay	Pulse width	Re-trigger time	Flags
2	11	3	0	1000 encoder counts	0µs	0	(0)

Belt position triggering

On a conveyor with an encoder, a sensor detects product presence. There are two cameras which are 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.

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. The configuration details for this are shown below:

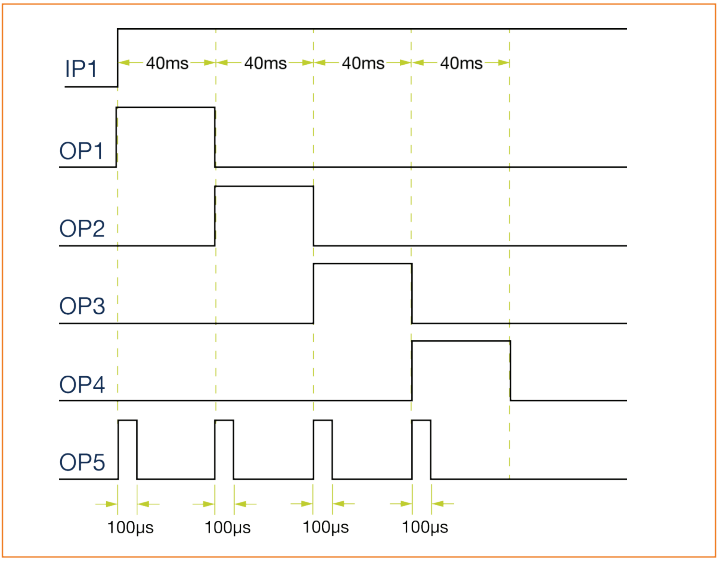
Output	Mode	Trigger Input	Gate input	Pulse delay	Pulse width	Re-trigger time	Flags
1	5	4	0	2000 encoder counts	100µs	0	I, O (3)
2	5	4	0	4000 encoder counts	100µs	0	I, O (3)

Pulse burst

A sensor on IP1 detects the presence of a product . Four images are 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. The configuration details for this are shown below:

Output	Mode	Trigger Input	Gate input	Pulse delay	Pulse width	Re-trigger time	Flags
1	2	1	0	0ms	40ms	0	(0)
2	2	1	0	40ms	4ms	0	(0)
3	2	1	0	80ms	40ms	0	(0)
4	2	1	0	120ms	40ms	0	(0)
5	8	1	4	40ms	100ms	0	(0)

OP1 to OP4 are pulsed for 40ms in sequence. As each output is pulsed, OP5 is also pulsed for a short time to trigger the camera (gate input set to 4 specifies four pulses). The timing diagram is shown overleaf:

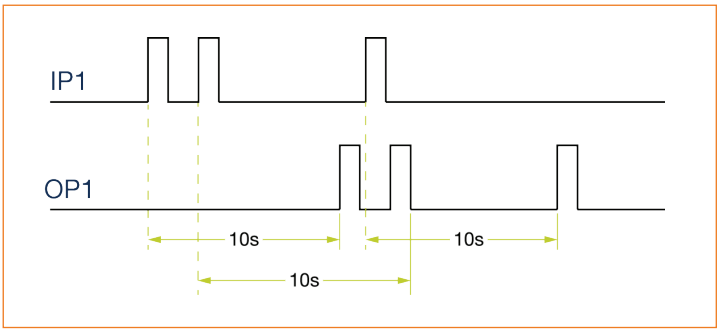


Simple FIFO mode

A sensor on IP1 detects the presence of a product . After a delay, OP1 triggers a camera. There may be several products between the sensor and the camera. The CC320 stores each of the triggers and then outputs a pulse after the correct delay. The configuration for this is shown below:

Output	Mode	Trigger Input	Gate input	Pulse delay	Pulse width	Re-trigger time	Flags
1	2	1	0	10s	100µs	0	F (16)

The timing diagram is shown below:



Resync mode

A sensor on IP1 detects the presence of a product . 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.

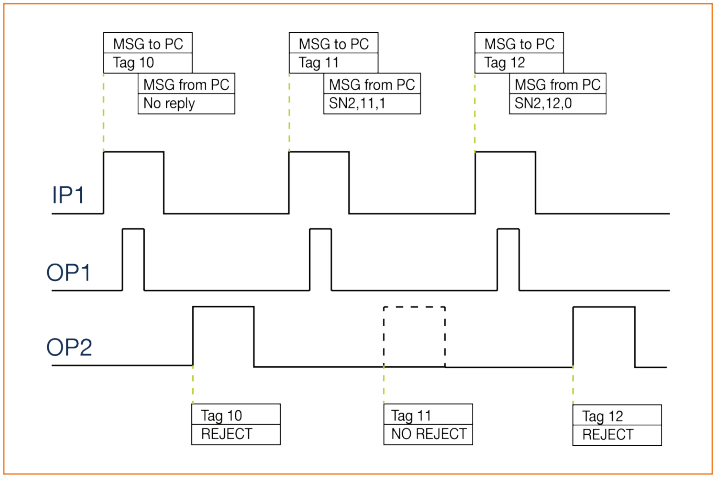
The reject gate is on OP2 and pulses high to reject the product. Products take 10 seconds to travel from the sensor to the reject gate, and take 1 second to move past the reject gate. The configuration details for this are shown below:

Output	Mode	Trigger Input	Gate input	Pulse delay	Pulse width	Re-trigger time	Flags
1	2	1	0	100ms	100µs	0	(0)
2	2	1	0	200ms	100µs	0	(0)

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 product is detected, 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. The timing diagram for this is shown below:



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

An Ethernet message with tag number 10 was sent to the host computer when the first trigger was received, but a reply was not received, so the product was rejected for fail-safe operation.

After the second trigger, a Tag 11 message 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.

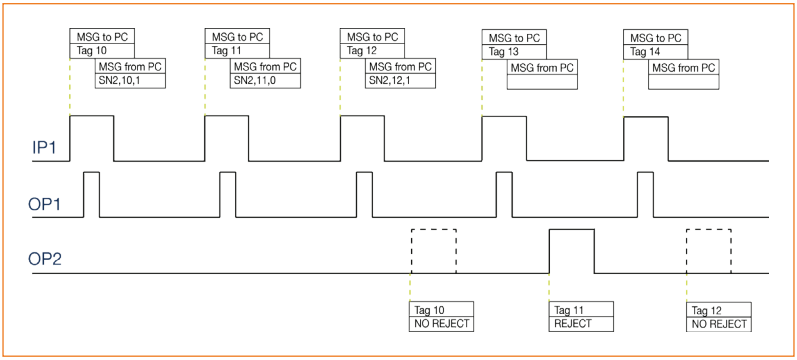
Resync and FIFO mode

This example uses the same situation as the previous example, but the 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. The configuration details for this are shown below:

Output	Mode	Trigger Input	Gate input	Pulse delay	Pulse width	Re-trigger time	Flags
1	2	1	0	200ms	100µs	0	
2	2	1	0	10s	1s	0	E, F, R, P, (104)

The timing diagram is shown below:



Appendix D - Configuration sheet

The CC320 configuration sheet is illustrated below. A full-size copy can be downloaded from www.gardasoft.com.

Output	Mode	Trigger input	Gate input	Pulse delay	Pulse width	Retrigger delay	Flags	Tick when complete
1								
2								
3								
4								
5								
6								
7								
8								
Free running timer period:								
Encoder mode:								

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Version 015 - April 2023

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