USER MANUAL

RTCC4xx

LED Lighting Controller

with Trigger Timing

Revision 01

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Contents

1 Disclaimer

Except as prohibited by law:

- Hardware, software and documentation are provided on an “as is” basis.
- 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.
- Gardasoft Vision Ltd and Gardasoft Products Ltd do not accept any liability for consequential loss of any kind.

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2 Getting Started

Read the sections on Safety (Section 3) and Specifications (Appendix A) and check the RTCC fulfils your requirements. See the back cover for other Gardasoft Vision lighting products.

The RTCC series features SafePower™ low heat technology and so, for most applications, heatsinking is not required. SafePower™ automatically “steps-up” the output voltage, so from a 24V supply a higher voltage (e.g. 36V) can be output. SafePower™ operates automatically.

Mount the RTCC as described in Section 4.

Connect the RTCC up to a power supply as described in Connections (Section 5)..

Read section 7 on Lighting Setup, enter the current or voltage rating of the lights to be connected and then connect the lights. Set up the RTCC for the desired operation as described in the configuration section 8, 10 and 11.

Visit www.gardasoft.com for application notes on this product. There is also a Support page which has information on troubleshooting problems.

The RTCC may emit a slight noise when operating.

2.1 Summary of Features

Throughout this manual, references to the RTCC refer to all variants in the RTCC range unless otherwise stated. RTCC420 refers to all versions with Ethernet, RTCC460 refers to all versions with RS232.

The convention for the part number is:

RTCCcd0-vv

RTCCcd0F-vv

where:

RTCC	product range name
c	Number of channels: 4
d	Configuration option: 2 = Ethernet, 6 = RS232
F	Option for fast pulsing
vv	Maximum current rating in amps: 2, 20

The following table lists the features on each model.

	Number of channels	Max Current	Front panel configuration	Ethernet / webpage configuration	RS232 configuration	Fast pulsing
RTCC420-20	4	20	No	Yes	No	No
RTCC420F-20	4	20	No	Yes	No	Yes
RTCC460-20	4	20	No	No	Yes	No
RTCC460F-20	4	20	No	No	Yes	Yes
RTCC420-2	4	2	No	Yes	No	No
RTCC420F-2	4	2	No	Yes	No	Yes
RTCC460-2	4	2	No	No	Yes	No
RTCC460F-2	4	2	No	No	Yes	Yes

3 Safety

Read this before using the RTCC. 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 hazard

⚠ Warning: Possible hazardous voltage

⚠ Warning: Surface may get hot

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

⚠ 3.1 Heat

The RTCC can dissipate up to 10W and so can get hot and should be positioned where personnel cannot accidentally touch it and away from flammable materials.

Read the Mounting (Section 4). Do not exceed the power ratings given in the manual.

Note: At the maximum ratings the case temperature can reach 65°C.

Allow free flow of air around the unit.

⚠ 3.2 Electrical

- The lighting connections can exceed 46.7V but should not exceed 70V. Pulse peak voltages above 46.7V are considered hazardous. The lighting connections must be shielded from being touched along the whole length of the cable and in the light.
- The user must ensure that the potential difference between any combination of input signals does not exceed 46.7V. WARNING: Higher voltages may cause a danger to personal health.
- The RTCC does not have complete tracking isolation of inputs and outputs.
- Transients caused by inductive loads must be suppressed external to the RTCC.
- The RTCC outputs high energy pulses. Care must be taken to connect the outputs correctly and protect the output wiring and load from inadvertent short-circuits. When switched off, there is still energy stored in the RTCC for about 15 seconds.

⚠ 3.3 General

- The RTCC 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.

4 Mounting

In order to provide fixing points to mount the unit onto a flat surface or bracket M3 nuts must be inserted into one or more of the slots in the base, see illustration below. The quantity and position of these nuts depends on the user's requirements. One of the end covers features cut-outs to allow the M3 nuts to be easily slid into place without dismantling the controller. Ensure that the fixing screws used do not extend past the lower base surface by more than 5.5mm.

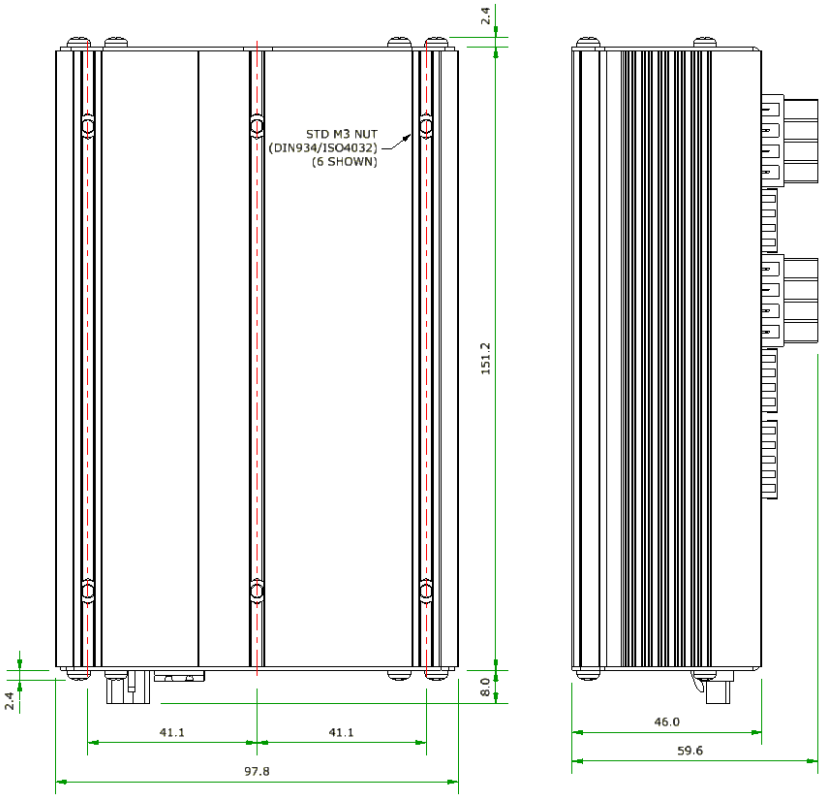
The PP704 kit is available for mounting the RTCC on a DIN rail.

4.1 Environmental considerations

The RTCC enclosure is a fire enclosure as long as it is mounted so that none of the connectors are facing downwards.

If a fire enclosure is used, the enclosure should be metal or plastic (with a flammability rating of UL94 V1 or better); with no holes below or to the sides of the RTCC when mounted. Cable entries below the RTCC should be via glands that have a flammability rating as before. The RTCC should be at least 10mm from any other part or side of the enclosure.

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


STD M3 NUT
(DIN934/ISO4032)
(6 SHOWN)
2.4
151.2
8.0
2.4
41.1
41.1
97.8
46.0
59.6

5 Connections

See the Specification (Appendix A) for information on connection ratings.

5.1 Power Supply

To avoid a fire hazard from the RTCC or the power supply consider the implications of overheating in the unlikely event of a fault in the RTCC. The maximum power dissipation in the RTCC in a fault condition can be:

<Power supply voltage> * <max current delivered by power supply>

Either limit the power supply output current so that not more than 30W can be dissipated in the RTCC, or mount the unit in a fire enclosure.

Choose a PSU that limits its output current by design, by setting the current limit on the supply (if this feature exists) or use fuses. The fuse should be de-rated if mounted in an enclosure, as the temperature can be higher than the ambient temperature. The external power supply must be capable of supplying at least the average output power for all active channels.

The use of a regulated power supply with 100% short circuit protection is recommended. If however a non-regulated power supply is used, then the maximum ripple voltage of this power supply must not exceed 10% of the actual DC value.

The low voltage and mains wiring should be separately routed. If they must be loomed together ensure that low voltage insulation rating is sufficient or that supplementary insulation is used.

Pin	Power Input Connector
1	+24V to +48V
2	GND

5.2 Lighting Output

The lighting connections can exceed 46.7V but should not exceed 70V DC. Pulse peak voltages above 46.7V are considered hazardous. The lighting connections must be shielded from being touched along the whole length of the cable and in the light.

Make sure you set the current or voltage rating for a light before connecting it. See the Lighting Setup (Section 7) for details on this.

Light output is on 4-way pluggable screw terminal sockets. The lighting output connections must not be commoned or grounded in any way.

Pin	LED12	LED34
1	CH1 lighting out +ve	CH3 lighting out +ve
2	CH1 lighting out –ve	CH3 lighting out -ve
3	CH2 lighting out +ve	CH4 lighting out +ve
4	CH2 lighting out –ve	CH4 lighting out –ve

5.3 Trigger Inputs

There is one trigger input per channel.

The trigger inputs are opto-isolated 3V to 24V input, drawing approximately 3mA.

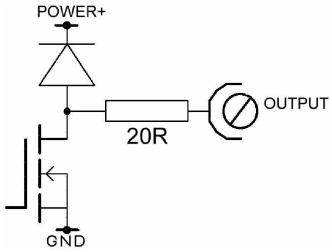
Pin	ET12 connector	ET34 connector
1	TRIG1 -ve	TRIG3 -ve
2	TRIG1 +ve	TRIG3 +ve
3	TRIG2 –ve	TRIG4 –ve
4	TRIG2 +ve	TRIG4 +ve

5.4 Digital Outputs

The digital outputs are open drain/open collector.

The voltage across the output 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.



Connector	Function
1	No connect
2	Open drain output 1
3	No connect
4	Open drain output 2
5	Common GND for outputs 1, 2

5.5 12V Power Output

A 12V power supply output is provided. This can supply up to 1.2A at 12V for powering external cameras and other devices. Do not connect inductive loads or devices that take large peak currents. Do not exceed the current rating as these outputs are not fused.

Pin	PW1 connector
1	GND
2	+12V

5.5.1 Ethernet Connection (RTCC420 models)

The RJ45 Ethernet connector requires a straight through cable to connect into a network switch, hub or router. It operates at 10Mbits per second (10Base-T).

5.5.2 Serial Connector (RTCC460 models)

The RS232 connector is a standard 9-way female D-type connected as follows. A standard straight through cable can be used to connect the controller to a PC serial port. The communications port settings are 115Kbaud, no parity, 8 data bits and 1 stop bit.

Pin	Function
2	TX (output from controller)
3	RX (input to controller)
5	GND

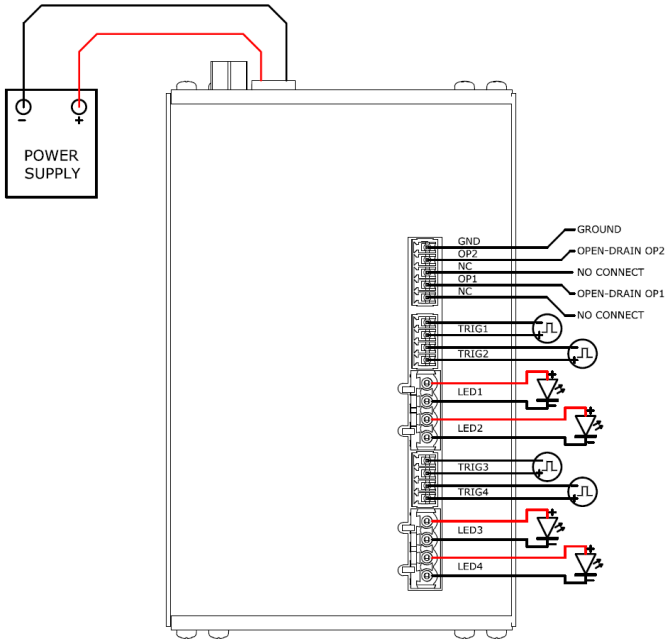
5.5.3 Connectors

The RT packaging includes mating connectors for the power supply input, trigger inputs, 12V power output, Lighting output and digital outputs.

Should spare parts be required these can be obtained as follows:

Connector	Description	Wuerth part number www.we-online.com	Newark or Farnell part number www.newark.com www.farnell.com
Power Input	Wuerth 351 series 2W screw terminal free socket	691-351-500-002	164-1952
Trigger Input	Wuerth 361 series 4W screw terminal free socket	691-361-100-004	1642-001
12V Output	Wuerth 348 series 2W screw terminal free plug	691-348-500-002	N/A
Lighting Output	Wuerth 348 series 4W screw terminal free plug	691-348-500-004	N/A
Digital Output	Wuerth 361 series 5W screw terminal free socket	691-361-100-005	1642-002

5.6 Wiring Diagram



6 Lighting Operation

The RTCC current controller provides repeatable intensity control of LED lighting for machine vision applications. It includes the intensity control, timing and triggering functions required for machine vision systems.

LED lighting needs a constant current supply as small variations in voltage can cause large variations in light output. The RTCC can set currents in steps of 0.1% (with a lower limit of 2.5mA steps) to give very fine control of intensity.

Several modes of operation are separately available for each channel:

- **Continuous:**

  In continuous mode the output is a continuous brightness.

- **Pulse (Strobe):**

  In pulse mode output is pulsed once per trigger. One trigger input is used as a trigger. The delay from trigger to pulse, the pulse duration and the brightness can be set.

- **Switched:**

  In switched mode a trigger input is used to switch the output current on and off. The output is only enabled when the trigger input has a voltage on it.

- **Selected:**

  In selected mode a trigger input is used to select between two different intensities.

- **Tandem:**

  It is possible to connect between two and four channels in parallel to provide additional power for lighting. The operation of tandem mode is beyond the scope of this users' manual and further information is available from your local distributor or Gardasoft Vision. Do not select this mode without reading the documentation for it.

The RTCC is set up using the webpages, Ethernet commands or RS232 commands, which is described in sections 10 and 11. The setup is non-volatile, so the RTCC resumes the same operation after a power cycle.

6.1 Output Modes

6.1.1 Continuous Mode, Selected Mode

In continuous mode the output current is fixed and continuous.

Selected mode uses a trigger input to select between the two different brightness settings. Brightness 1 must be greater than brightness 2. The P flag can be used to invert the trigger input.

The output current can be varied from 0% to 100% of full brightness.

6.1.2 Pulse Mode

The output is off by default. When the RTCC is triggered it waits for a delay and then pulses the output. The delay, pulse width, retrigger delay and pulse intensity are all configurable.

In pulsed mode, the brightness can be set up to 1000% of its rating, but only for short periods and at low duty cycles, so that the lighting does not overheat and get damaged. The duty cycle is limited by ignoring triggers which are too soon after the previous trigger.

Output Brightness	Maximum Pulse Width	Maximum Duty Cycle
0 to 100%	999ms	100%
101% to 200%	30ms	30%
201% to 300%	10ms	20%
301% to 500%	2ms	10%
501% to 1000%	1ms	5%

So for example, if the brightness is set to 250%, then the RTCC does not allow pulses greater than 10ms long. With 10ms pulses, if a trigger occurs within 50ms of a previous trigger (so that the duty cycle would be greater than 20%) the trigger is ignored.

The retrigger delay is the minimum allowed time from one trigger to the next. Any triggers that happen too soon after the previous trigger are ignored. The retrigger delay is set in multiples of 100us. The retrigger delay is the maximum of:

User configured retrigger time
Delay + pulse width
100 * [pulse width] / [max duty cycle percentage]

The last expression is the limit which ensures that the maximum duty cycle cannot be exceeded when overdriving.

6.1.3 Switched Mode

Switched mode uses a trigger input to switch the output on or off.

Switched mode can be used to drive the light at up to 1000% brightness for short periods. It has the same limits as pulse mode.

6.1.4 Triggers

The RT has one trigger inputs for each output channel. However any trigger input can be used to trigger any output. Each channel can use a trigger input active high or active low.

The default is:

CH1 triggered by TRIG1

CH2 triggered by TRIG2

etc

The P flag (set using the webpages or the ZS command) sets whether a channel uses an input is used active high or active low. Two channels could trigger from different edges of the same input.

The trigger inputs are used as follows:

Mode	P Flag	Output
Continuous	Unused	Output is on.
Switched	P Flag = 1	Output is off when trigger is off Output is on when trigger is on
	P Flag = 0	Output is on when trigger is off Output is off when trigger is on
Selected	P Flag = 1	Output is brightness 2 when trigger is off Output is brightness 1 when trigger is on
	P Flag = 0	Output is brightness 1 when trigger is off Output is brightness 2 when trigger is on
Pulsed	P Flag = 1	Pulse is triggered on rising edge
	P Flag = 0	Pulse is triggered on falling edge

Note that the P flag inverts the sense of the trigger input.

Normally it is necessary to synchronise pulsing to an external camera signal. However there is an internal trigger which can be used to generate regular triggers. The period of the internal trigger can be set in steps of 100us from 200us upwards.

A command is available to individually trigger a channel.

6.1.5 Flags

Flags (true or false values) are available for changing the operation of each output channel. These can be set using the webpage configuration or the ZS command.

The following configuration flags are available for each channel:

E Flag

This enables or disables fault detection on the channel (see section 6.1.6). The default is that error checking is enabled.

P Flag

This specifies whether the trigger input used for this channel is active high or active low. The default is active high.

When a trigger is active high:

in pulse mode pulses are triggered by the rising edge of a trigger pulse

in switched mode the light is on when the trigger input is high

When a trigger is active low:

in pulse mode pulses are triggered by the falling edge of a trigger pulse

in switched mode the light is on when the trigger input is low

S Flag

When this flag is cleared it removes the SafeSense light detection so that the controller always assumes a light is connected. This cannot be used with a voltage rating. The default is for SafeSense to be enabled.

6.1.6 Fault Detection

The RTCC detects the following errors. When the output current is less than 100mA, some fault detection is disabled.

Error	Reason
Err 34, 47	Internal power dissipation is too high. Output turned off.
Err 35, 43	Output current to lighting is too low. The light is open circuit or there is not enough supply voltage for the requested output current.
Err 36, 42	If the output voltage is too high, the controller detects that the output is short circuited.
Err 37	The voltage required for the lighting has increased too much. Check for ageing of the lighting or a failed LED.
Err 38	The voltage required for the lighting has decreased too much. Check for ageing of the lighting or a failed LED.

6.2 Cold Start

The RTCC configuration can be cleared to its default settings - this clears the lighting ratings and sets all channels to 50% brightness continuous operation. This can be done by sending the CL command using the General Webpage, Ethernet or RS232.

7 Lighting Setup

Lighting is labelled with either a voltage or current rating. This rating is the supply to the lighting that should be used to get 100% continuous brightness from the light.

The RTCC is compatible with both current and voltage rated lighting.

Before connecting a light the rating of the light must be entered. If a light is replaced with a different type of light, then the rating must be set first. If a light is replaced with the same type of light then the previous rating still applies.

Consult the specification or labelling for the light. For commercially available lighting modules, if a voltage and current rating is given, it is usually correct to use the voltage rating. If a voltage and wattage rating is given, use the voltage rating. Otherwise use the current rating. In all cases the light is still driven with a constant current. For “homemade” lights using single LEDs or arrays of LEDs use the current rating from the LED datasheet.

The current rating can be set from 0.01A to 3A in steps of 0.01A. The voltage rating can be set from 12V to 36V in steps of 1V.

When a voltage rated light is connected, the RTCC automatically senses the current rating of the light.

Voltage and current rated lights are both driven with a constant current. This gives better brightness stability and allows the RTCC to prevent the light being driven with too much power.

7.1 Setting the Rating for a Light

To set the rating of a light on the RS232 and Ethernet versions of the RTCC, use the VL command or the internal webpages.

7.2 Light Auto-Sensing

When a channel does not have a light connected, the RTCC continually tries to put out a very small current.

When a light is connected, it flashes for a short time (the light is not damaged by this) until the RTCC detects that it is connected.

8 Timing Controller Operation

The RTCC Trigger Timing Controller has four digital inputs and two digital outputs.

All outputs operate independently and are configured separately. Configuration is very flexible to provide solutions for a wide variety of timing problems.

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

8.1 Input Modes

All inputs are general purpose trigger inputs except for IP3 and IP4, which can be used for an encoder or as general inputs.

8.1.1 Encoder Operation

The RTCC supports two types of encoder. This can be configured using the ZE command or on the General Webpage.

Mode	Connections	Operation	Max frequency
EN 1 - one wire encoder	IP3 is QEA	Simple encoder provides position information. All movement is assumed to be forward.	700KHz
EN 2 – two wire encoder	IP3 is QEA IP4 is QEB	Quadrature encoder provides position and direction information.	200KHz

For 2 wire encoders the RTCC correctly handles reversed movement. When the belt is in a reversed position:

triggers for PEt and PEE modes (see below) are ignored
output pulses in PtE, Pet and PEE modes are not duplicated

8.1.2 Free Running Trigger

An internal timer is available for use as a trigger. See the TT RS232 /Ethernet command.

8.2 Output Modes

Each output operates independently. By combining which outputs are triggered by which inputs and which mode each output is in, it is possible to configure complex sequences of operation.

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

For each output, the following parameters can be set.

Parameter	Use
Mode	Specifies how the output operates.
Input	Specifies which input is used for triggering. An output signal OP1 to OP2 can also be used as a trigger. This parameter can be: 0 for the free running timer 1 to 4 for IP1 to IP4 5 to 6 for OP1 to OP2
Gate Input	Specifies an input which enables/disables the output. This is also used to specify the number of pulses in “burst” mode. This parameter can be: 0 for none 1 to 4 for IP1 to IP4 5 to 6 for OP1 to OP2 <number of pulses> for burst mode
Pulse Delay	Specifies the delay from trigger to pulse output. This can either be a time period or a number of encoder pulses, depending on the mode.
Pulse Width	Specifies the width of the pulse output. This can either be a time period or a number of encoder pulses, depending on the mode.
Retrigger time	The retrigger time is the minimum time from when an output is triggered to the next time. This can be used to debounce noisy inputs or when a product sensor fires more than once for one product. The retrigger time uses the same dimension (encoder pulses or time period) as the Pulse Delay.
Flags	Specifies other options.

When pulsing, the Pulse Delay and Pulse Width parameters can either be fixed times or can be a number of encoder pulses.

The following operating modes are available for each output. The Mode Number is used for Ethernet commands.

Mode	Mode Name	Operation
0	OFF	The output is set off. If the output is inverted (flag O is set) then the output is logic 1, otherwise logic 0.
1	On	The output is set high (on). If the output is inverted (flag O is set) then the output is logic 0, otherwise logic 1.
2	Ptt	Pulsed output triggered by a digital input. The delay and pulse width are set as fixed times.
3	PtE	Pulsed output triggered by a digital input. The delay is a fixed time. The pulse width is a number of encoder pulses.
4	PEt	Pulsed output triggered by a digital input. The delay is a number of encoder pulses. The pulse width is a fixed time.
5	PEE	Pulsed output triggered by a digital input. The delay and pulse width are a number of encoder pulses.
6	Pd	Pulse divider. Every <Pulse Delay> trigger pulses, the output is pulsed for <Pulse Width> time.
7	Enc	Pulsed output triggered by encoder pulses. The output is pulsed for <Pulse Width> encoder pulses with the pulses separated by <Pulse Delay> encoder pulses. The Input and Gate Input parameters are not used.
8	bur	Burst output. When triggered, <Gate Input> pulses are output. Each pulse is <Pulse Width> long and the time between the end of one pulse and the start of the next is given by <Pulse Delay>. The maximum number of pulses that can be output is 250.
9	FrE	Outputs a constant high frequency square wave. The frequency is configurable. Further details available from Gardasoft.
10	buF	Buffer an input by making the output the same signal as the input. If there is gate input set, then the gate input signal enables the output – if the gate input is off then the output is off. Flag O inverts the output and Flag G inverts the gate input. The output can be delayed by a fixed time given by the <Pulse Delay> parameter. Note that any Gate Input is applied before the delay. The E flag can be set to indicate when the output changes state.

11	buE	Same as buF mode, except the output signal can be delayed by a given number of encoder pulses.
12	brE	Same as bur mode, except the pulse width and pulse spacing is a given number of encoder pulses.

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.

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.

8.2.1 Burst Mode

In burst mode, an output is pulsed several times in response to a trigger. The periods are timed (not encoder counts).

The following parameters are used:

Mode is 8 for burst mode

Gate Input specifies the number of pulses (1 to 250)

Pulse Width specifies the pulse width

Pulse Delay specifies the separation between the start of one pulse and the start of the next

Pulse Delay must be longer than Pulse Width.

8.2.2 Ethernet Message Flag (E)

When the RTCC 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 RTCC.

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 RTCC 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 4 and <tag> is a number from 0 to 255. Multiple tag messages may be sent in one packet, separated by ";".

8.2.3 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 RTCC. The RTCC 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.

8.2.4 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 RTCC and a pulse is generated for each trigger at the correct time.

8.2.5 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 RTCC defaults to rejecting the product.

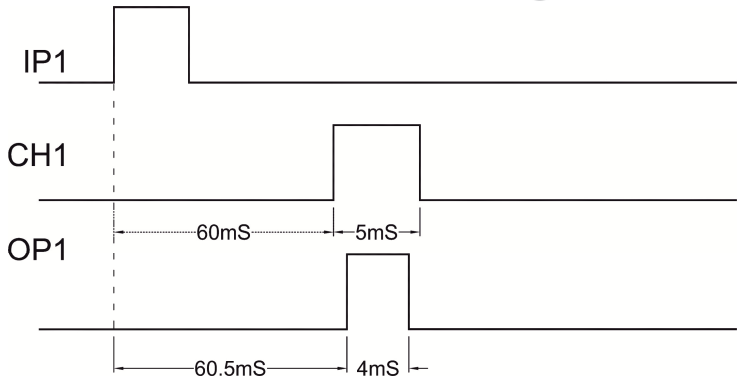
8.3 Examples

8.3.1 Synchronised Camera and Lighting

An input trigger comes in via IP1 and the leading edge is used to pulse a light after 60ms and then a camera exposure 0.5ms later. OP1 is used to trigger the camera and lighting channel CH1 is connected to the light.

OP1 can be used to trigger a fixed exposure time or can be used to generate the exposure time.

Output	Mode	Input	Gate Input	Pulse Delay	Pulse Width	Retrigger Time	Flags
CH1	Pulse	1		60ms	5ms	0	
OP1	2	1	0	60.5ms	4ms	0	

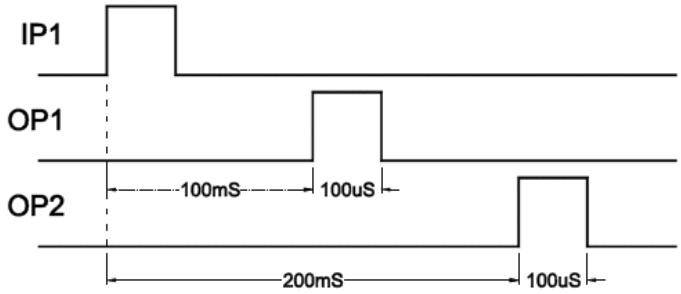


8.3.2 Sequenced Pulses

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.

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.

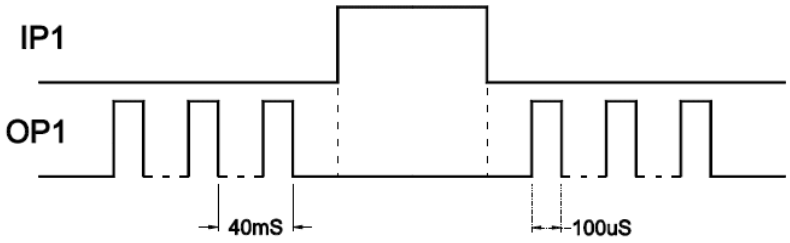


8.3.3 Gated Pulses

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.

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 = 4 to invert the sense of IP1. If Flags = 0, then OP1 only triggers when IP1 is high.



8.3.4 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.

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 input mode to 2-wire encoder.							

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.

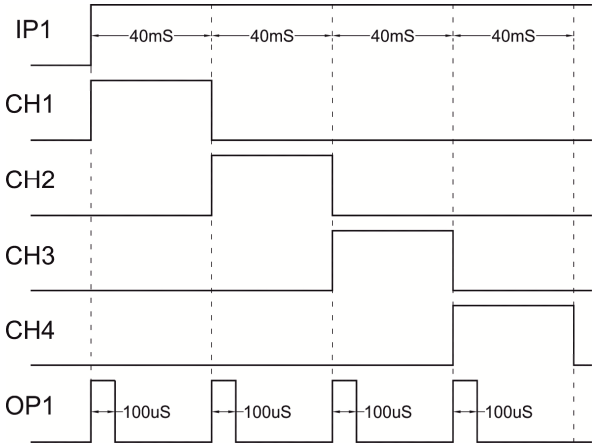
8.3.5 Multiple Exposure with Different Lighting

A sensor on IP1 detects product presence. Four images need to be taken from one camera using four different lights at 40ms intervals. CH1, CH2, CH3 and CH4 are the four lighting outputs. OP1 is used to trigger the camera four times, synchronised to the lights.

Output	Mode	Input	Gate Input	Pulse Delay	Pulse Width	Retrigger Time	Flags
CH1	Pulse	1		0ms	40ms	0	
CH2	Pulse	1		40ms	40ms	0	
CH3	Pulse	1		80ms	40ms	0	
CH4	Pulse	1		120ms	40ms	0	

OP1	8	1	4	40ms	100us	0	0

CH1 to CH4 are pulsed for 40ms in sequence. As each one is pulsed, OP1 is also pulsed for a short time to trigger the camera (Gate Input = 4 specifies four pulses).

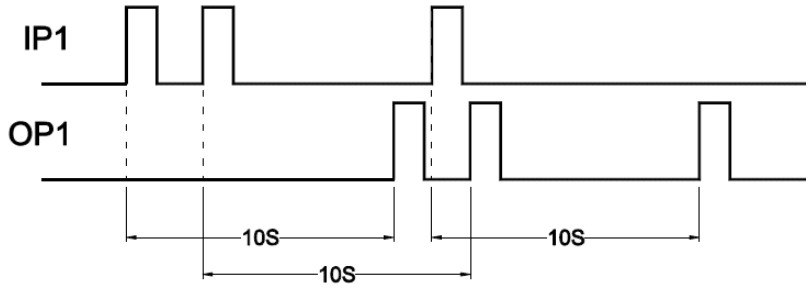


8.3.6 Simple FIFO Mode

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

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



8.3.7 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 RTCC. The pass/fail is re-synchronised to the original product presence and the reject gate is opened if necessary.

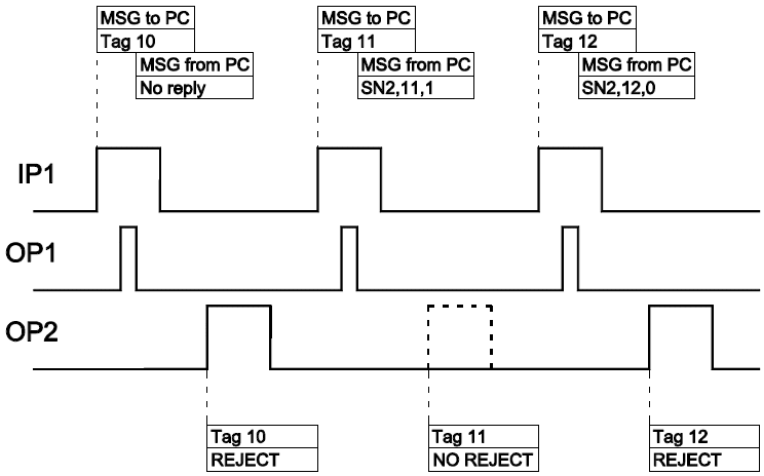
The reject gate is on OP2 and pulses high to reject the product. Products take 10 seconds to travel from the sensor to the reject gate and take 1 second to move past the reject gate.

Output	Mode	Input	Gate Input	Pulse Delay	Pulse Width	Retrigger Time	Flags
1	2	1	0	200ms	100us	0	
2	2	1	0	10 seconds	1 second	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 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.



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

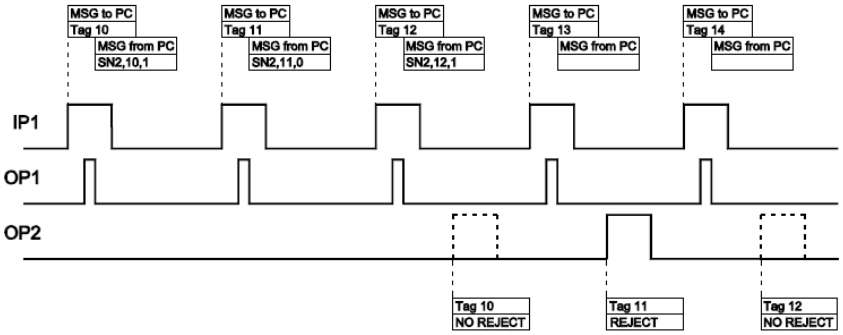
An Ethernet message with tag number 10 was sent to the host computer when the first trigger was received, but for some reason a reply was not received, so the product was rejected for fail-safe operation. After the second trigger a Tag 11 message was sent, with the reply “SN2,11,1” (OP2, tag 11, pass) 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.

8.3.8 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 RTCC. The pass/fail is re-synchronised to the original product presence and the reject gate is opened if necessary.

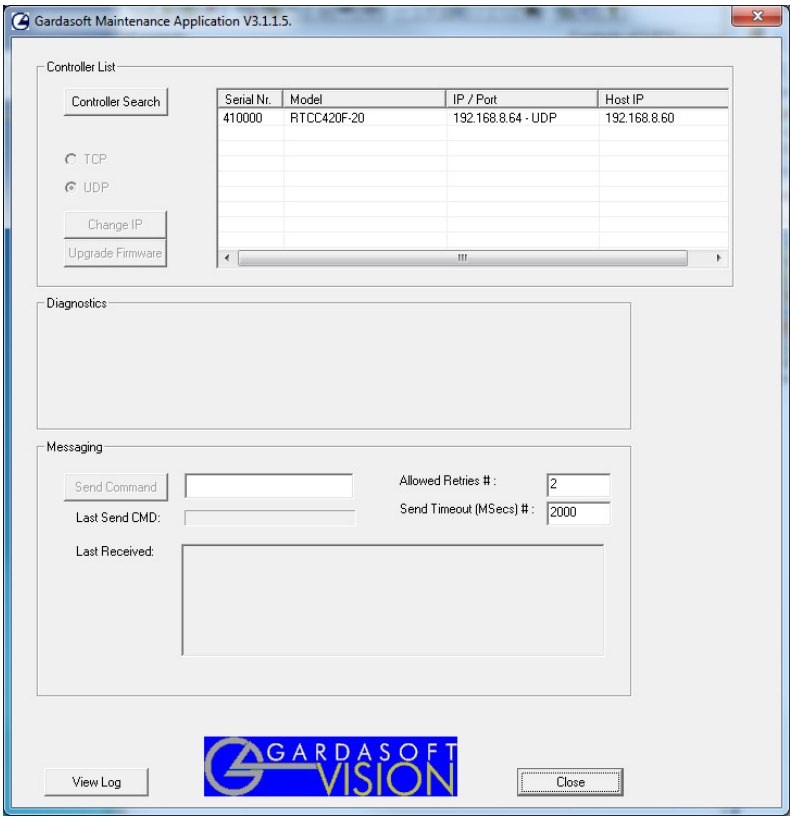
Output	Mode	Input	Gate Input	Pulse Delay	Pulse Width	Retrigger Time	Flags
1	2	1	0	200ms	100us	0	
2	2	1	0	10 seconds	1 second	0	E, F, R (56)



9 Ethernet Communication (RTCC420)

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

You will need to download GardasoftMaint from the RTCC software downloads at www.gardasoft.com. This program allows the IP addresses of controllers to be managed.



Application note “APP923 Troubleshooting Ethernet problems” is available on the Gardasoft website.

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

9.1 Connection

The Ethernet link uses a 10Base-T connection on an RJ45 connector. The RTCC is usually connected to a network switch (or hub or router) but it is possible to connect it directly into the network port on a PC using a crossover cable.

When connecting direct to a PC, see “APP923 Troubleshooting Ethernet problems” for information on how to set up the IP addresses.

9.2 IP Address

The RTCC 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 RTCC acquires its IP address, subnet mask and gateway address from a DHCP server. Otherwise the RTCC has a fixed IP address, subnet mask and gateway address.

DHCP mode or the IP address can be set and read the GardasoftMaint Program available for download at www.gardasoft.com.

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:

Go to Control Panel

Select Network Connections

Right click on Local Area Connection. Select Properties

From the list, select “Internet Protocol Version 4 (TCP/IPv4)”, click Properties

If “Obtain an IP address automatically” is set, then DHCP is probably used. However, there may be an alternative fixed IP address on the “Alternative Configuration” tab.

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

Go to Control Panel

Select Network Connections

Right click on Local Area Connection. Select Status

Select the Support tab. The IP address is displayed

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 RTCCs, the RTCCs could be allocated addresses 192.168.1.201 and 192.168.1.202.

9.2.1 Automatic Sensing

The RTCC sends a message on three events:

On power up

When an IP address is received or renewed by DHCP

When an enquiry message is received

On the first two events, the message is broadcast. On the third it is a reply to a single IP address.

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 RTCC is a UDP packet from source port 30311, destination port 30310. It is formatted as:

Gardasoft,RTCC,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 RTCC (420F-20) serial number 12345, IP address 192.168.1.103, MAC address 00.0B.75.01.80.99 the packet is formatted:

Gardasoft,RTCC 420F-20,012345,000B75018099,C0A80167

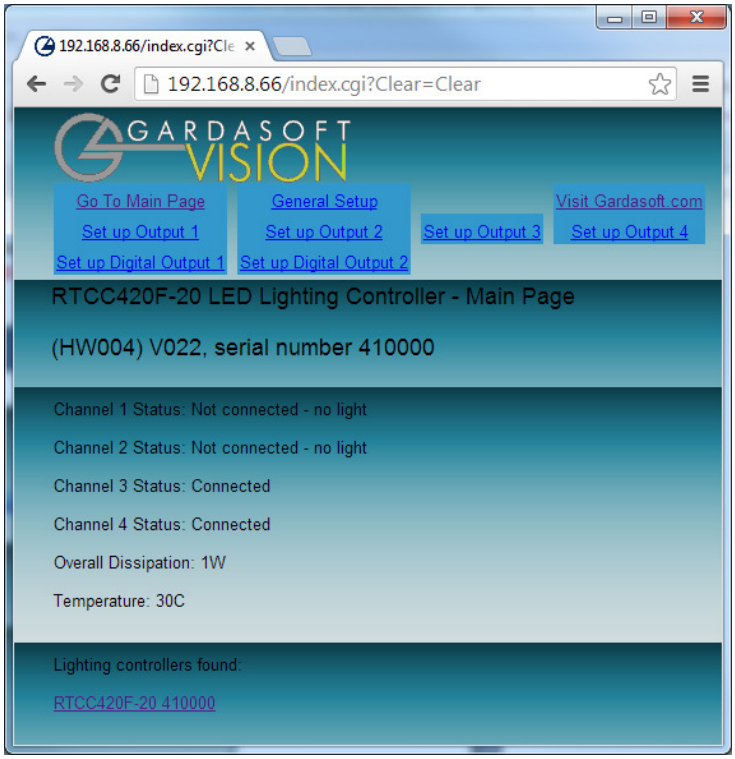
10 Webpage Configuration (RTCC420)

The RTCC has a webserver inside, so that it can be configured from a standard web browser, such as Internet Explorer.

The IP address of the RTCC must be known. All Gardasoft devices on a network can be discovered This can be discovered (see section 9 on Ethernet Communication. Open a web browser window and type the IP address (for example 192.168.8.34) of the RTCC into the URL box at the top. The main page of the RTCC webserver should be shown.

10.1 Main Page

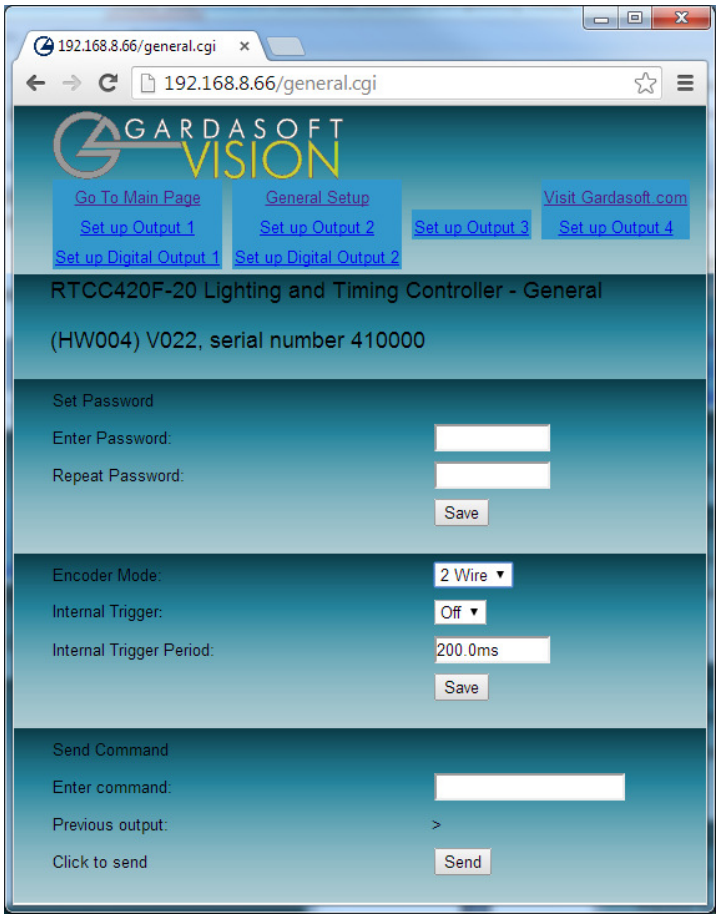
The main page shows general information about the RTCC. Links are provided to the configuration pages.



10.2 General Setup Page

The General Configuration page allows the webpage protection password to be set or cleared and the internal trigger to be set up.

Any Ethernet command from Section 11 can be entered using the Enter Command box.



10.3 Channel Configuration Pages

There is one configuration page for each lighting output channel. All the parameters for each output channel can be set up. Pressing the Submit button updates the RTCC configuration and save the changes to non-volatile memory.

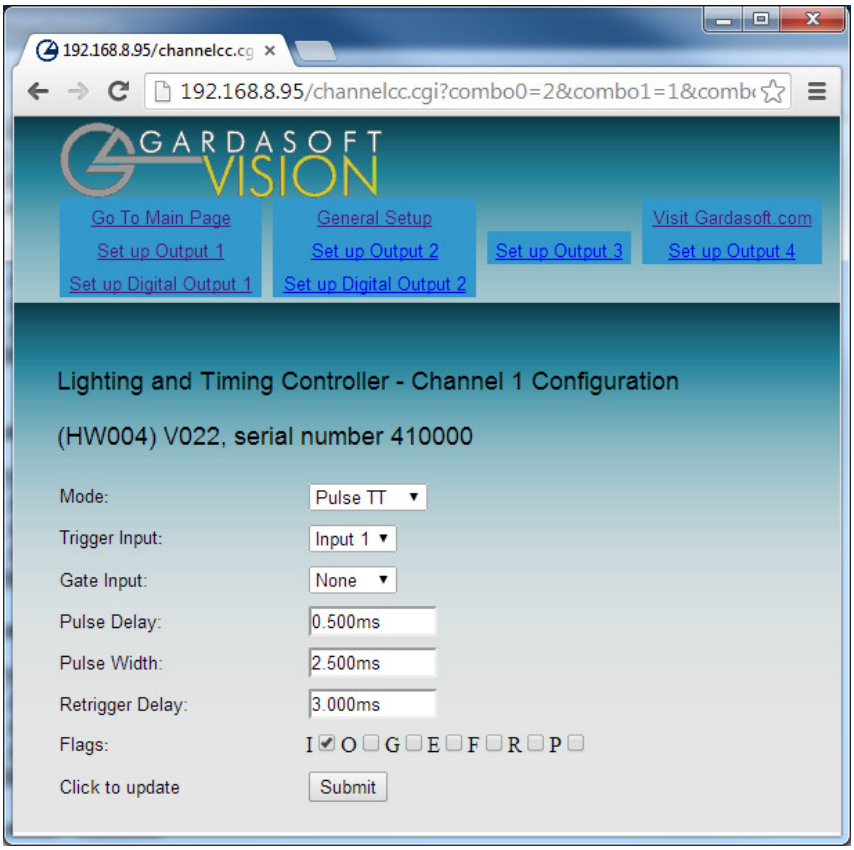
The current rating for the light can be changed. Use this with care.

Some measured voltages and the actual output current are displayed on this page.

10.4 Digital Output Configuration Pages

There is one configuration page for each digital output channel. All the parameters for each output channel can be set up. Pressing the Submit button updates the RTCC configuration and save the changes to non-volatile memory.

Some measured voltages and the actual output current are displayed on this page.



11 Command Configuration

The RTCC can be configured via the Ethernet connection using UDP or TCP/IP. A Configuration Program with source code is available for download from www.gardasoft.com.

11.1 Ethernet Communication (RTCC420)

Commands sent from a PC in UDP and TCP pac12kets should be sent to destination port 30313. Replies will be sent back to the source port (so in the reply the source and destination ports will be swapped).

A TCP/IP connection timeouts and closes if it is idle for more than 10 seconds. The host must send regular commands or keepalive packets to keep the link open.

A carriage return (ASCII 13) character should be sent to terminate the command line, in case multiple TCP packets get joined together.

11.2 RS232 Communication (RTCC460)

When using RS232 the COM port should be set to 115200baud, 8 data bits, no parity, 1 stop bit, no handshaking.

A carriage return character should be sent to terminate the command line.

Hyperterminal or other RS232 terminal programs can be used to send commands manually. The “>” reply character (see below) then acts as a prompt for the next command.

11.3 Command Structure

Communication consists of commands sent by the host (controlling PC). The command and any reply output generated by the command is returned in reply UDP or TCP/IP packets followed by <LF> <CR>. The last character sent is a “>” prompt (“greater than” symbol). Once this is received, the host knows that the command has been completed.

For example when sending the VR command the reply might be:

VRRTCC (HW001) V002<LF><CR>>

Where

The red text is the command reflected back

The green text is the reply data

The blue text is control codes ASCII 10, ASCII 13

The black text is the prompt “>”

If there is an error (see error codes below) then a typical reply is:

VTErr 2<LF><CR>>

It is 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.

Several commands can be put into one command line by separating them by a semi-colon (";").The RTCC send any replies to the commands followed by a ">" character to show that the command line has completed.

All commands comprise a code of two letters followed by any optional parameters. All spaces in the commands are ignored.

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. For currents, "a" or "ma" can be added to indicate "amps" or milliamps". **The default is amps.**

Note that parameters are in "USA/UK" format so that a half is written "0.5" not "0,5"

For example:

Parameter	Meaning
0.1	0.1 milliseconds
200us	200 microseconds
0.1s	0.1 seconds
100ma	100mA
2.45A	2.45A
2.3	2300mA or 2.3A

The command codes and their meaning are described below. The upper case commands are shown, followed by lower case letters denoting the numeric argument.

If a command is invalid in any way an error message is returned before the <LF> <CR> ">" reply.

Error number	Reason
Err 1	A parameter value is invalid
Err 2	Command not recognised

Err 3	Numeric value is wrong format
Err 4	Wrong number of parameters
Err 5	(This is only a warning) The command is accepted but a timing parameter was out of range and has been adjusted to a valid value.

Any changes made using Ethernet commands are not saved permanently until the AW command has been issued.

11.3.1 General Commands

Report the version of firmware running in the RTCC

This command returns the firmware version. For example:

VR

RTCC420F-20 (HW004) V022

Clear any Errors

GR

If Ethernet messages are not enabled, the last event or error number can be read by this command. Any error displayed on the unit is cleared, so if there was a lighting error, the RTCC resumes auto-sensing on that channel.

The reply is in the same form as the GT command above. If there are no outstanding events or errors, then only the prompt ">" is returned.

Set/Clear the Webpage Password

EY

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

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

Save the settings to memory

AW

Once the settings are saved to memory they are then retained when the unit is switched off. If this is not done, changes to the settings are volatile, and if the unit is switched off they revert to those in force when the last AW command was issued.

Clear Configuration

CL

Clears the channel configuration and lighting ratings and sets all channels to 50% continuous operation. The results of the VL, RS, RW, RU, RT, RE, RP, TT, AW, ZS, ZT, ZR, ZE commands are all cleared.

Enable Ethernet Messages

GTm

m = 0 to disable Ethernet messages
= 1 to enable Ethernet messages
When Ethernet messages are enabled, any error reports are sent to the most recent UDP or TCP address from which a command has been received.
Messages are of the form:

Evtc,e

Where	c	zero for no channel or channel number (1 to 4)
	v	event value, see appendix E

11.3.2 Lighting Commands

Set the rating of a light

This command sets the current or voltage rating for a light. If a current rating is being set, then the voltage rating value should be 0.

VLo,v,c

Where:
o = output channel (1 to 4)
v = voltage rating (0 or 12 to 36)
c = current rating (0 or 10mA to 3A)

Set continuous mode

The output is set to continuous mode at a percentage of full brightness.

RSc,s

Where:
c = output channel (1 to 4)
s = setting in percent (s = 0 to 100)

Set pulse mode

The output can be set up to pulse on a trigger input. The delay from trigger to the start of the pulse, the length of the pulse and the brightness are configurable.

An error is generated if the brightness setting requires a current greater than 20A or if the combination of pulse width and setting is not allowed.

Note that for the non-fast pulse models the timing will be rounded to a minimum of 20us and a multiple of 20us.

If the retrigger time is omitted, then the minimum allowed retrigger time is set.

RTc,p,d,s
RTc,p,d,s,r
Where:
c = output channel (1 to 2 or 4 or 8 [depending on model])
p = pulse width in milliseconds (0.001 to 999)
d = delay from trigger to pulse in milliseconds (0.002 to 999)
s = setting in percent (s = 0 to 999)
r = retrigger delay. This parameter is optional.

Set switched mode

The output is set to switched mode at a percentage of full brightness.
RWc,s
Where:
c = output channel (1 to 2 or 4 or 8 [depending on model])
s = setting in percent (s = 0 to 100)

Set selected mode

The output is set to selected mode with two brightness settings.
RUc,s,t
Where:
c = output channel (1 to 2 or 4 or 8 [depending on model])
s = brightness 1 setting in percent (s = 0 to 100)
t = brightness 2 setting in percent (t = 0 to s)

Set the Option Flags

REc,m
Where:
c = output channel (1 to 2 or 4 or 8 [depending on model])
m = flags:

bit 0	Not used`	
bit 1 =	0	E flag set (error detection enabled)
	1	E flag cleared (error detection disabled)
bit 2 =	0	P flag set (positive triggers)
	1	P flag cleared (negative triggers)
bit 3 =	0	S flag set (SafeSense enabled)
	1	S flag cleared (SafeSense disabled)

Show Configuration

ST

This command shows the operational parameters for all channels in the controller. A typical output for the RTCC controller is:

```
CH1,MD0,S50.0,0.0,DL1.000ms,PU1.000ms,RT0.0us,IP1,FL0,CS0.000A,RA0.000A
CH2,MD0,S50.0,0.0,DL1.000ms,PU1.000ms,RT0.0us,IP2,FL0,CS0.000A,RA0.000A
CH3,MD0,S50.0,0.0,DL1.000ms,PU1.000ms,RT0.0us,IP3,FL0,CS0.000A,RA0.000A
CH4,MD0,S50.0,0.0,DL1.000ms,PU1.000ms,RT0.0us,IP4,FL0,CS0.000A,RA0.000A
```

Where:

CH	Channel number
MD	Mode: 0 = continuous, 1 = pulse, 2 = switched, 3 = select
S	Brightness percentage settings: 1st setting used in all modes 2nd setting only used for select mode
DL	Pulse delay
PU	Pulse width
RT	Retrigger delay
IP	Input Trigger (set using the RP command)
FL	Flags (set using the RE command)
CS	Current rating of the light (after SafeSense™ has successfully completed sensing the light)
RA	Configured voltage or current rating of the light (set using VL command)

When using Ethernet, use the following forms of the ST command as the command above will generate more data than can be sent in a reply packet.

ST0

Reports the general settings. Typical output is:

TM 1, TP 20.00ms

STc

Where c is which input channel (1 to 4). Reports settings for a single channel.

Simulate an Input Trigger

TRc

c which input channel (1 to 4)

Simulates a trigger pulse. If the channel is in pulse mode it pulses the output once and shows “PUL” on the display.

Set Internal Trigger

Enable or disable the internal trigger. When enabled, all outputs are triggered simultaneously using an internal trigger signal. This setting can be saved to non-volatile memory using the AW command.

TT0	Disable internal trigger
TT1	Enable internal trigger (uses previously set period)
TT1,p	Enable internal trigger and set the period

Where:
p= period of the triggers in milliseconds

- For example:

TT1,200	Set the internal trigger to 200ms (5Hz)
TT1,500US	Set the internal trigger to 500us (2KHz)

Set the Trigger Input

This command sets which input is used for pulse and switch output modes.
RPc,p
Where:
c = output channel (1 to 4)
p = trigger input (1 to 4)

11.3.3 Trigger Timing Commands

Show Status command

This command shows the operational parameters of the digital outputs. A typical output for the RTCC controller is:

```
Encoder: 1 line
OP1: MD=2, IP=1, GT=-, DL= 10.000ms, PL=  2.000ms, RT=  0.000ms, IoGefrp
OP2: MD=5, IP=2, GT=-, DL=  0.000K, PL=  0.001K, RT=  0.000K, iogefrp
```

Where:

OP	Output channel number
MD	Mode for the output
IP	Input used for triggering
GT	Gate input for enabling/disabling the output
DL	Pulse delay
PL	Pulse width
RT	Retrigger delay
iogefrp	Flags used by output

Set the output mode

ZSc,m,i,g,f

c	which output channel (1 to 2)	
m	mode	
i	which trigger input:	0 for free running timer 1 to 4 for IP1 to IP4 5 to 6 for OP1 to OP2
g	which gate input:	0 for none 1 to 4 for IP1 to IP4 5 to 6 for OP1 to OP2
f	flags	

Sets the configuration for an output channel. See section 8 for a description of these parameters.

For example:

ZS1,3,2,0,2

sets output channel 1 to be pulse mode (Ptt), triggered by input 2, no gate input and flags = 2 (invert the output). The flags parameter must be entered as a decimal number.

Set the output pulse timing

ZTc,p,d

c	which output channel (1 to 2)
p	Pulse width (time or encoder pulses)
d	Pulse delay (time or encoder pulses)

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

The mode should be set with the ZS command before the pulse timing is set.

For example:

ZT2,3ms,5K	Output 2, 3ms output pulse after 5000 encoder pulses

Set retrigger time

ZRc,r

c	which output channel (1 to 2)
r	Retrigger time or encoder pulses

The retrigger time is the minimum time from when an output is triggered to the next time. The mode should be set before the retrigger time.

For example:

ZR2,10ms	Output 2 won't accept another trigger until 10ms after the previous one

Set the internal free running timer

ZB1,p

p Period of timer

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

ZB1,1ms Set period to 1ms (1000Hz)
ZB1,3s Set period to 3s (once per 3 seconds)
ZB1,40 Set period to 40ms (25Hz)

If the period is zero, then the internal timer is turned off.

Set Pass/Fail

SNc,t,p

c which output channel (1 to 2)
t the trigger tag number
p 1 = pass, 0 = fail

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

SN1,76,1 Output 1, trigger tag 76 is a pass

Read/change the encoder count

EN Read the encoder count

This command returns "VL" and the encoder count. For example, the reply is "VL200" if 200 encoder counts have been received since the RTCC was turned on. The count is a 32 bit unsigned number and wraps to 0 when it reaches 2^{32}.

Set encoder mode

ZEe

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

Sets the encoder type.

Set an output

ZVc,v

c which output channel (1 to 2)
v = 0 to set the output to a logic 0 (logic 1 if O flag is set)
= 1 to set the output to a logic 1 (logic 0 if O flag is set)

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.

Show the state of an input.

ZIi

i which input channel (1 to 4)

Replies “VL0” if the input is logic 0 and “VL1” if the input is logic 1.

Show the state of an output

ZOc

c which output channel (1 to 2)

Replies “VL0” if the output is logic 0 and “VL1” if the output is logic 1.

11.3.4 General Command Summary

Command	Example	Effect
AW	AW	Save changes
CL	CL	Clear configuration
GT	GT1	Enable Ethernet messages
GR	GR	Clear any error condition.
EY	EY65,66	Set webpage password to “AB”
VR	VR	Read the firmware version

11.3.5 Lighting Command Summary

Command	Example	Effect
VL	VL1,0,0.5	Set the rating of channel 1 to 0.5A
RS	RS2,65	Set channel 2 to 65% brightness continuous
RW	RW1,50	Set channel 1 to 50%, switch mode
RU	RU1,75,25	Set channel 1 to selected mode at 75% and 25%
RT	RT2,3,4,50	Set channel 2 to 3ms pulses, delayed by 4ms, at 50% brightness
RP	RP1,2	Output channel 1 is triggered using input 2
RE	RE1,6	Set channel 1 to ignore lighting errors and make its

		trigger input active low.
TT	TT1,1ms	Set internal triggers every 1ms
TR	TR2	Trigger channel 2
ST	ST2	Show Configuration for channel 2

11.3.6 Controller Command Summary

Command	Example	Effect
ZZ	ZZ2	Show configuration for OP2
SN	SN1,76,1	Output 1, trigger tag 76 is a pass
ZT	ZT2,1,10	Set channel 2 to 1ms pulse and 10ms delay
ZR	ZR2,15	Set retrigger time to 15ms for channel 2
ZS	ZS2,3,4,0,0	Set channel 2 to Pulse TE with gate on IP4
ZB	ZB1,200	Set internal trigger period to 200ms
ZE	ZE1	Set encoder mode to single input
EN	EN	Read the encoder count
ZV	ZV2,1	Sets channel 2 to high level
ZI	ZI2	Read state of input channel 2
ZO	ZO1	Read state of output channel 1

A. Specification

Output current	-2 option: Up to 2A per channel continuous or 2A pulsed in steps of 1mA. -20 option: Up to 3A per channel continuous or 20A pulsed in steps of 5mA.
Output Power	Max 30W per channel
Trigger inputs	4 opto-isolated digital inputs. Require 3V to 24V
Digital outputs	Two 24V, 50mA open collector outputs
Timing	Standard: From 20us to 999 milliseconds in steps of 20us/100us Fast: From 1us to 999 milliseconds in steps of 1us/100us
Delay from trigger to pulse	Standard: From 20us to 999 milliseconds in steps of 20us/100us Fast: From 3us to 999 milliseconds in steps of 1us/100us
Timing repeatability	Delay + Pulse up to 10ms: 0.1us for pulse width and 3us for delay. Otherwise 100us
Output voltage	0V to 46V
Supply voltage	Regulated 24V to 48V
Dimensions	159mm long by 97mm wide by 62mm high (excluding DIN fixing)
Weight	400g
Mounting	Panel mounting. DIN rail mount option

B. Restrictions

The following timings and restrictions are applied when commands are entered. Exceeding these values will cause an error to be returned.

The controller prevents values outside these limits being entered.

B.1 Continuous Mode

The maximum output current is 3A.

B.2 Switched Mode

The maximum delay from a trigger input changing to the output current being turned on or off is 10us. The maximum output current is 10A.

B.3 Selected Mode

The maximum delay from a trigger input changing to the output current being turned on or off is 5ms. The maximum output current is 0.5A.

B.4 Pulse Mode

The maximum output current is 20A. For high currents pulses the following limits apply:

Pulse Current	Pulse Length Limit
20A	100us
12A	400us
10A	1ms
5A	3ms

Pulses of 2A or more for pulse widths longer than 2ms may cause an error or have a lower current towards the end of the pulse.

On the fast pulse controllers (with an “F” on the end) The minimum pulse delay is about 2us. When overdriving or using the retrigger delay, the minimum delay is around 5us.

For pulse widths less than approximately 120us the output voltage and current cannot be measured. Because of this, fault detection is disabled and the following restrictions apply:

For pulse currents greater than 0.5A, the duty cycle is restricted to 1%

For pulse currents less than or equal to 0.5A, the duty cycle restricted to 10%

B.5 Trigger Timing

The following timings apply for RTCC V022. All these timing 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 100us for each input.

Pulse widths below 4ms are repeatable to within 1us 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.

PTT mode 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 OP2 all meeting the first condition:

OP1 has delay 6.5us +/-1us
OP2 has delay 6.5us +/-1us

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 20us between the input changing and the output changing.

C. Error Codes

Error number	Reason
Err 1	A parameter value is invalid
Err 2	Command not recognised
Err 3	Numeric value is wrong format
Err 4	Wrong number of parameters
Err 5	This is a warning, not an error. One of the parameters is out of range. The value of the parameter has been adjusted. For example, sending an ZT command with a delay of 0 gets a reply of “Err 5”. The command is accepted but the delay is set to the minimum allowed value.
Err 5	Can’t read EEPROM.
Err 6, 12, 16	EEPROM corrupt. The configuration has been cleared.
Err 8, 25	Can’t read settings from EEPROM
Err 9, 17, 20	Can’t save settings to EEPROM
Err 13	SN command: the resync event cannot be found. The channel/tag values may be wrong or the delay period may have completed.
Err 21, 22, 23	Sensing error. See section 7.2.
Err 27	Can’t read Ethernet settings from EEPROM, so these may be incorrect.
Err 34, Err 47	Internal power dissipation is too high. Output turned off.
Err 35	Output current to lighting is too low.
Err 43	The requested output current requires too high a voltage.
Err 36	The output is short circuit.
Err 42	The output current is too high.
Err 37	The voltage required for the lighting has increased too much. Check for ageing of the lighting or a failed LED.
Err 38	The voltage required for the lighting has decreased too much. Check for ageing of the lighting or a failed LED.

Err 39	Internal protection has prevented SafePower voltage going too high.
Err 46	The channel power output is greater than the maximum allowed 30W.
Err 49	Ethernet hardware not working
Err 51	Can't read Ethernet settings from EEPROM, so these may be incorrect.
Err 52	Can't save Ethernet settings to EEPROM.
Err 81	Too many FIFO events have been used and the RTCC has run out of storage.

Any other errors are internal errors.

D. Fatal Error Codes

Error number	Reason
FAT, Err 44	The RTCC is too hot. The RTCC has a thermal cutout which operates around 65^{o}c to 70^{o}c, depending on conditions.
FAC, Err 40, Err 41, Err 45	One channel is outputting more current than expected.
FAS, Err 47	Internal protection has prevented too much heat in the output driver.

E. Event Codes

Event messages are sent by Ethernet or RS232 when a light is connected or an error occurs. The format of these is

Evt<channel>,<event code>;

These event messages are only sent after the GT1 command has been sent.

Event number	Reason
1 to 127	An error has occurred. The error code is given by the event number (except event 10).
128	A light has been connected and is working.
129	A light has been connected but doesn't have a current or voltage rating.
130	Over temperature error occurred (FAT)
131	Over current error occurred (FAC)
132	An error has occurred while autosensing the rating of a light.
138	SafePower trainup has completed.
139	SafePower trainup has failed or been cancelled.
140	In switch output mode, the light has been turned off because the duty cycle is too high.
10	This event is generated in Resync Mode and is formatted as 'Evt10,xxx' where 'xxx' is the id tag for the current product. The id tag is used to send reject or accept statements back to the RTCC.

Gardasoft Traffic Strobe Lights

The products available at the time of writing include the following. Other products are also available. See www.gardasoft.com for details of the current range.

VTR1 Range

- Up to 300W per steradian output power
- Infra red 740nm, 850nm, 940nm and white options
- Ethernet and RS232 options
- Trigger input and trigger output options
- 12 degree and 30 degree beam angle options

VTR2 Range

- Up to 3000W per steradian output power
- Infra red 740nm, 850nm, 940nm and white options
- Ethernet, RS232 and RS422 options
- Trigger input and trigger output options
- 12 degree and 30 degree beam angle options

Gardasoft LED Lighting Controllers

The products available at the time of writing include the following. Other products are also available. See www.gardasoft.com for details of the current range.

RT Range

- 2, 4 or 8 output channels
- 2A and 20A maximum current version available
- 2, 4 or 8 trigger inputs
- SafePower™ and SafeSense™
- Front panel, RS232 or Ethernet configuration
- Fast pulsing option

RTCC-20	Lighting controller: 2 channels up to 20A pulsing, front panel
RTCC-20	Lighting controller: 2 channels up to 20A pulsing, Ethernet
RT260-20	Lighting controller: 2 channels up to 20A pulsing, RS232
RTCCF-20	Lighting controller: 2 channels up to 20A fast pulsing, front panel
RTCCF-20	Lighting controller: 2 channels up to 20A fast pulsing, Ethernet
RT260F-20	Lighting controller: 2 channels up to 20A fast pulsing, RS232
RT420-20	Lighting controller: 4 channels up to 20A pulsing, Ethernet
RT420F-20	Lighting controller: 4 channels up to 20A fast pulsing, Ethernet
RT820F-20	Lighting controller: 8 channels up to 20A fast pulsing, Ethernet
RT860F-20	Lighting controller: 8 channels up to 20A fast pulsing, RS232

PP704	DIN Rail mounting clip for RT range

PP Range

- 2, 4 or 8 output channels up to 20A each
- 2, 4 or 8 trigger inputs
- SafeSense™ option
- Front panel, RS232 or Ethernet configuration
- Fast pulsing option

Machine Vision Timing Controller

CC320 Controller

- 8 digital inputs
- 8 digital outputs
- 1 or 2 wire Encoder input
- Very flexible operation
- Ethernet control
- Front panel configuration

PP703	DIN Rail mounting clip for CC320