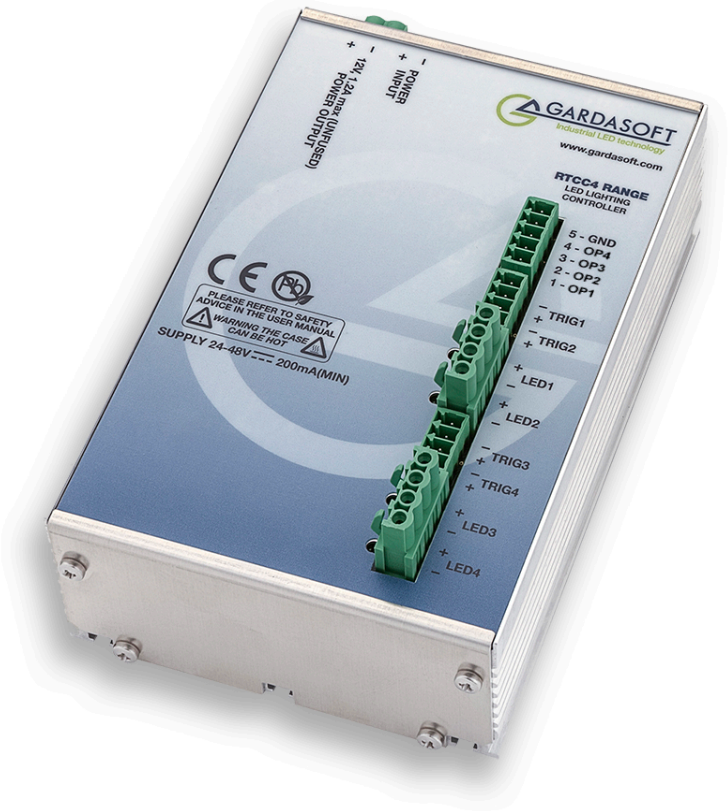
GARDASOFT
Industrial LED technology

# RTCC LED

# Lighting Controllers

**Issue 002**




# User manual

# Copyright and disclaimer notice



## EC conformity declaration

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

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# Contents

# 1 Getting started

This user manual describes the setting up and operation of the RTCC range of LED lighting controllers.

The RTCC range differs from the RTxxx lighting controller range in that it is has digital outputs which can be used to control the timing of other components in your machine vision system.

Read Section Safety (or Section 3, Sicherheit, or Section 4, Sécurité) and Section 13.1, Specification, and check the RTCC controller fulfils your requirements.

Mount the RTCC as described in Section 5, Mounting the RTCC and connect the RTCC up to a power supply as described in Section 6, Connections.

Read Section 8, Lighting setup. the current or voltage rating of the lights and then connect the lights. Set up the RTCC for the desired operation as described in the configuration sections; Section 11, Webpage configuration (RTCC420), and Section 12, Command configuration.

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

## 1.1 Summary of features

Throughout this manual, references to the RTCC refer to all variants in the RTCC range unless otherwise stated. The convention for the product number is:

**RTCCcd0-vv**

**RTCCcd0F-vv**

where:

| | |
|---|---|
| **c** | Number of channels: 4 |
| **d** | Configuration option: 2 = Ethernet, 6 = RS232 |
| **F** | Option for fast pulsing |
| **vv** | Maximum pulse current in amps: 2, 20 |

The table below lists the features on each model:

| | Number of channels | Ethernet setup | RS232 setup | Fast pulsing |
|---|---|---|---|---|
| RTCC420 | 4 | Yes | No | No |
| RTCC460 | 4 | No | Yes | No |
| RTCC420F | 4 | Yes | No | Yes |
| RTCC460F | 4 | No | Yes | Yes |

# 2 Safety

Read this before using the RTCC. Always observe the following safety precautions. If in doubt, contact Gardasoft Vision Ltd. The following symbols are used in this guide:

**Warning:** Read the instructions to understand the possible hazards.

**Warning:** Surface may get hot.

**Warning:** Possible hazardous voltage.

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

## 2.1 Heat

Ensure the RTCC is mounted correctly (see Section 5, Mounting the RTCC), and that you do not exceed any of the ratings for the unit (see Section 1.1, Specifications and ratings)

At its maximum ratings, the RTCC's enclosure can exceed 65°C which is sufficient to cause a burn if touched. Place in a position where personnel cannot accidentally touch it and ensure there is a free flow of air around the unit.

## 2.2 Electrical

The RTCC produces high energy pulses. Take care to connect the outputs correctly and protect the output wiring and load from any short-circuits. When switched off, energy remains stored in the RTCC for about 15 seconds.

The RTCC does not have complete electrical isolation of inputs (including triggering and communications ports) and outputs, therefore, please observe the following guidance:

- Computer equipment that is connected to the communication or trigger ports must be internally powered or separated from mains electricity by double insulation/reinforced isolation or be approved to IEC 60950-1 standard. All other equipment connected to the triggers or other ports must also have double insulation/reinforced isolation protection from the mains supply.
- The Power Supply Unit (PSU) used to energise the RTCC must provide double insulation/reinforced isolation from mains electricity and protected against short circuits and overloads. We recommend using a PSU that

limits its output current to the appropriate rating of the controller by design, by setting the current limit on the supply (if possible), or through over current protection. The PSU should be approved to either IEC 60950-1, IEC 60335-1, IEC 61010-1, IEC61558-1,-2,-16. The PSU may also be approved to equivalent or superior safety standards.

- Any energised conductors derived from mains electricity must also have Safety Extra Low Voltage (SELV) output. Refer to Section 13, Reference information for allowable voltage limits.
- At maximum ratings the temperature of the enclosure can exceed 65°C. Therefore, either all cabling must be rated to at least 100°C, or all cabling must be additionally insulated by an appropriately rated heat resistant sleeve or prevented from touching the metal enclosure of the controller, or its heatsink where fitted.
- Power supply cabling to the controller must be rated to at least 5A.
- The cabling from the channel output to the load must be rated higher than the maximum channel output current.
- If the controller is set up incorrectly, or in the event of failure, the energy provided by the power supply to the controller may become directly connected to any or all output channels. You must consider this during installation, and if necessary, provide adequate protection.
- The DC power supply to controller must be externally fused to 5A using a slow blow fuse (T5AH, 50V).
- The installer must provide a clearly marked, nearby and easily accessible switch as part of the installation to allow the controller to be disconnected from its energy source on both power conductors.
- Transients caused by inductive loads must be suppressed externally to the RTCC.

***Warning:*** This is a Class A product. Its use in residential areas may cause radio interference, and such use should be avoided unless special measures are taken by the user to restrict emissions to a level that allows the reception of broadcast transmissions.

## 2.3 General

The RTCC must not be used in an application where its failure could be 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.

## 2.4 Installation guidance (disclaimer)

This information is for guidance only. Installers must perform their own risk assessment specific to each installation. While Gardasoft Vision Ltd has taken every care in the preparation of this advice, Gardasoft Vision Ltd accept no liability for damages of any kind except those required by law.

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

# 3 Sicherheit

Bitte lesen Sie vor Verwendung des RTCC diese Informationen. Beachten Sie immer die folgenden Sicherheitshinweise. Wenden Sie sich im Zweifelsfall an Ihren Händler oder Gardasoft Vision. Die folgenden Symbole haben die folgende Bedeutung:

**Warnung:** Lesen Sie die Hinweise, um eine mögliche Gefahr zu verstehen.

**Warnung:** Oberfläche kann heiß werden.

**Warnung:** Mögliche gefährliche Spannung.

Wenn diese Symbole in der Anleitung auftauchen, enthält der Text Hinweise zu den zu ergreifenden Vorsichtsmaßnahmen.

## 3.1 Wärme

Stellen Sie sicher, dass der RTCC korrekt montiert ist (siehe Section 5, Mounting the RTCC) und dass Sie die Grenzwerte für das Gerät nicht überschreiten (siehe Section 13, Reference information).

Bei den maximalen Grenzwerten kann das Gehäuse des RTCC 65°C überschreiten, was ausreichend ist um bei einer Berührung zu Verbrennungen zu führen. Positionieren Sie das Gerät so, dass eine versehentliche Berührung durch das Personal ausgeschlossen ist und stellen Sie sicher, dass Luft frei um das Gerät zirkulieren kann.

## 3.2 Elektrik

Das RTCC erzeugt Impulse mit hoher Energie. Achten Sie darauf, die Ausgänge korrekt anzuschließen und schützen Sie die Ausgangsverkabelung und Last gegen Kurzschlüsse. Beim Ausschalten bleibt Energie für etwa 15 Sekunden im RTCC gespeichert.

Das RTCC verfügt über keine vollständige elektrische Trennung der Eingänge (einschließlich Trigger- und Kommunikationsports) und Ausgänge. Beachten Sie daher unbedingt die folgenden Hinweise:

- Computergeräte, die an die Kommunikations- oder Trigger-Ports angeschlossen sind, müssen über eine interne Stromversorgung verfügen oder vom Stromnetz durch eine doppelte Isolierung/verstärkte Isolierung getrennt sein oder nach dem Standard IEC 60950-1 zugelassen sein. Alle anderen Geräte, die an die Trigger- oder andere Ports angeschlossen sind, müssen ebenfalls durch eine doppelte Isolierung/verstärkte Isolierung vom Stromnetz getrennt sein.

- Das Netzgerät, das zur Stromversorgung des RTCC dient, muss durch eine doppelte Isolierung/verstärkte Isolierung von der Stromversorgung getrennt sein und gegen Kurzschlüsse und Überlastungen geschützt sein. Wir empfehlen die Verwendung eines Netzgeräts, das den Ausgangsstrom durch konstruktive Maßnahmen, durch Einstellen der Stromgrenze an der Versorgung (wenn möglich) oder durch einen Überstromschutz auf den geeigneten Nennstrom der Steuerung begrenzt. Das Netzgerät muss nach IEC 60950-1, IEC 60335-1, IEC 61010-1 oder IEC61558-1,-2,-16 zugelassen sein. Das Netzgerät kann auch nach gleichwertigen oder höheren Standards zugelassen sein.
- Alle stromführenden Leiter, die vom Stromnetz abgeleitet sind, müssen ebenfalls Sicherheitskleinspannung (SELV) am Ausgang erzeugen. Hinweise zu den zulässigen Spannungsgrenzwerten finden Sie im Section 13, Reference information.
- Bei den maximalen Grenzwerten kann die Temperatur des Gehäuses 65°C überschreiten. Daher muss entweder die gesamte Verkabelung für mindestens 100°C bemessen sein oder die gesamte Verkabelung muss zusätzlich mit einer angemessen dimensionierten wärmebeständigen Tülle isoliert sein oder gegen Kontakt mit dem Metallgehäuse der Steuerung oder deren Kühlkörper, sofern angebracht, geschützt sein.
- Die Verkabelung der Stromversorgung zur Steuerung muss für mindestens 5A bemessen sein.
- Die Verkabelung vom Kanalausgang zur Last muss höher als der maximale Kanalausgangsstrom dimensioniert sein.
- Wenn die Steuerung falsch eingerichtet ist oder im Fall eines Fehlers, kann es vorkommen, dass die von der Stromversorgung an die Steuerung abgegebene Energie direkt mit einem oder allen Ausgangskanälen verbunden wird. Sie müssen dies bei der Installation berücksichtigen und gegebenenfalls für einen geeigneten Schutz sorgen.
- Die Gleichstromversorgung der Steuerung muss extern durch eine träge Sicherung (T5AH, 50V) bis 5A gesichert sein.
- Der Installationstechniker muss einen deutlich gekennzeichneten, leicht zugänglichen Schalter als Teil der Installation in der Nähe vorsehen, mit dem die Steuerung an beiden Stromleitern von ihrer Stromquelle getrennt werden kann.
- Durch induktive Lasten verursachte Einschaltstöße zum RTCC müssen extern unterdrückt werden.

  ***Warnung:*** Es handelt sich hierbei um ein Produkt der Klasse A. Die Verwendung in Wohngebieten kann zu Funkstörungen führen und eine solche Verwendung sollte vermieden werden, es sei denn besondere Maßnahmen werden vom Anwender ergriffen, um die Emissionen auf ein Niveau zu begrenzen, das den Empfang von Rundfunkübertragungen ermöglicht.

## 3.3 Allgemein

Das RTCC darf nicht in Anwendungen eingesetzt werden, bei denen es durch einen Ausfall des Geräts zu einer Gefahr für die Gesundheit von Personen oder zur Beschädigung anderer Geräte kommen könnte.

Wenn das Gerät in einer anderen als der vom Hersteller vorgesehenen Weise verwendet wird, kann die Schutzvorrichtung des Geräts beeinträchtigt werden.

## 3.4 Installationsanleitung (Haftungsausschluss)

Diese Informationen dienen nur zur Orientierung. Installationstechniker müssen ihre eigene spezifische Risikobewertung für die jeweilige Installation durchführen. Auch wenn Gardasoft Vision Ltd diese Empfehlung mit größter Sorgfalt erstellt hat, übernimmt Gardasoft Vision Ltd keine Haftung für Schäden jeglicher Art, außer in dem gesetzlich erforderlichen Maße. Vorsätzliche Gefährdungs- oder Zerstörungshandlungen werden in diesem Dokument nicht behandelt und müssen vom Installationstechniker berücksichtigt werden.

# 4 Sécurité

Lisez ce document avant d'utiliser le RTCC. Respectez les mesures de sécurité suivantes en toutes circonstances. En cas de doute, contactez votre distributeur ou Gardasoft Vision. Les symboles ci-dessous auront la signification suivante:

**Attention:** Lisez les instructions pour comprendre quels sont les risques éventuels.

**Attention:** La surface peut devenir chaude.

**Attention:** Risque d'électrocution.

Lorsque ces symboles apparaissent dans le manuel, reportez-vous aux consignes pour connaître les précautions à prendre.

## 4.1 Chaleur

Veillez à ce que le RTCC soit monté correctement (voir Section 5, Mounting the RTCC) et à ne dépasser aucune valeur nominale pour l'unité (voir Section 13, Reference information).

Lorsqu'il atteint ses valeurs nominales maximales, le boitier RTCC peut dépasser les 65°C, ce qui est suffisant pour provoquer des brûlures en cas de contact. Placez l'appareil à un endroit où le personnel ne risque pas de le toucher par accident et veillez à ce que l'air circule librement autour de l'unité.

## 4.2 Électricité

Le RTCC produit des impulsions d'énergie élevées. Veillez à bien raccorder les sorties et à ce que les câbles de sortie et la charge soient à l'abri de tout court-circuit. Lorsque le RTCC est éteint, de l'énergie résiduelle reste dans l'appareil pendant environ 15 secondes.

Le RTCC ne possède pas d'isolation électrique complèt des entrées (notamment des ports de déclenchement et de communication) et des sorties. Par conséquent, respectez les consignes suivantes :

- L'équipement informatique connecté aux ports de communication et de déclenchement doit être alimenté en interne ou séparé de l'alimentation secteur par une isolation double/renforcée, ou être approuvé selon la norme CEI 60950-1. Tous les autres équipements branchés aux déclencheurs ou à d'autres ports doivent aussi posséder une isolation double/renforcée pour être protégés de l'alimentation secteur.

- Le boîtier d'alimentation utilisé pour mettre sous tension le RTCC doit fournir une isolation double/renforcée pour isoler le RTCC de l'alimentation secteur, et le protéger des courts-circuits et des surcharges. Nous recommandons d'utiliser un boîtier d'alimentation qui limite le courant de sortie de l'appareil à la valeur nominale appropriée du contrôleur, en réglant la limite de courant sur l'alimentation (si possible) ou via la protection contre les surcharges. Le boîtier d'alimentation doit être approuvé selon la norme CEI 60950-1, CEI 60335-1, CEI 61010-1 ou CEI61558-1,-2,-16. Le boîtier d'alimentation peut aussi être approuvé selon des normes de sécurité équivalentes ou supérieures.
- Tous les conducteurs sous tension dérivés depuis l'alimentation secteur doivent aussi posséder une sortie à tension de sécurité extra-basse. Se reporter à la Section 13, Reference information pour les limites de tension autorisées.
- Lorsqu'il atteint ses valeurs nominales maximales, le boîtier du RTCC peut dépasser les 65°C. Par conséquent, tout le câblage doit soit avoir une capacité minimale de 100°C, soit être en plus isolé par une gaine suffisamment résistante à la chaleur, soit ne pas toucher le boîtier en métal du contrôleur ou son dissipateur thermique s'il est installé.
- Le câblage d'alimentation vers le contrôleur doit avoir une capacité minimale de 5A.
- Le câblage reliant la sortie de la chaîne à la charge doit avoir une capacité supérieure au courant de sortie maximal de la chaîne.
- Si le contrôleur est mal réglé ou en cas de panne, l'énergie fournie par l'alimentation au contrôleur peut devenir directement connectée à n'importe quelle chaîne de sortie ou à toutes les chaînes de sortie. Vous devez prendre en compte ce paramètre durant l'installation et si nécessaire, fournir une protection adéquate.
- L'alimentation en courant continu vers le contrôleur doit être protégée par un fusible 5A en externe, plus précisément un fusible à action retardée (T5AH, 50V).
- Dans le cadre de l'installation, l'installateur doit fournir un interrupteur clairement marqué, qui soit à proximité et facilement accessible, pour permettre au contrôleur d'être déconnecté de sa source d'énergie sur les conducteurs d'alimentation.
- Les coupures causées par des charges inductives doivent être supprimées de manière externe vers le RTCC.

  ***Attention:*** Il s'agit d'un produit de classe A. Son utilisation en zone résidentielle peut causer des interférences radio. Ce type d'utilisation doit être évité, sauf si des mesures particulières sont prises par l'utilisateur pour restreindre les émissions à un niveau qui permet la réception des transmissions diffusées.

## 4.3 Généralités

Le RTCC ne doit pas être utilisé dans une application où la santé des personnes et l'intégrité des équipements seraient mises en danger s'il venait à tomber en panne.

Si l'équipement est utilisé autrement qu'aux fins prévues par le fabricant, la protection offerte par l'équipement pourrait en être altérée.

## 4.4 Guide d'installation (clause de non-responsabilité)

Ces informations sont seulement à titre indicatif. Les installateurs doivent effectuer leur propre évaluation des risques, pour chaque installation. Même si Gardasoft Vision Ltd a préparé minutieusement ces conseils, Gardasoft Vision Ltd décline toute responsabilité pour tout dommage, quel qu'il soit, à l'exception de ceux requis par la loi. La mise en péril volontaire ainsi que les actes de vandalisme ne sont pas couverts par le présent document et doivent être pris en compte par l’installateur.

# 5 Mounting the RTCC

In order to provide fixing points to mount the unit onto a flat surface or bracket, insert M3 nuts into one or more of the slots in the base, see the 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.

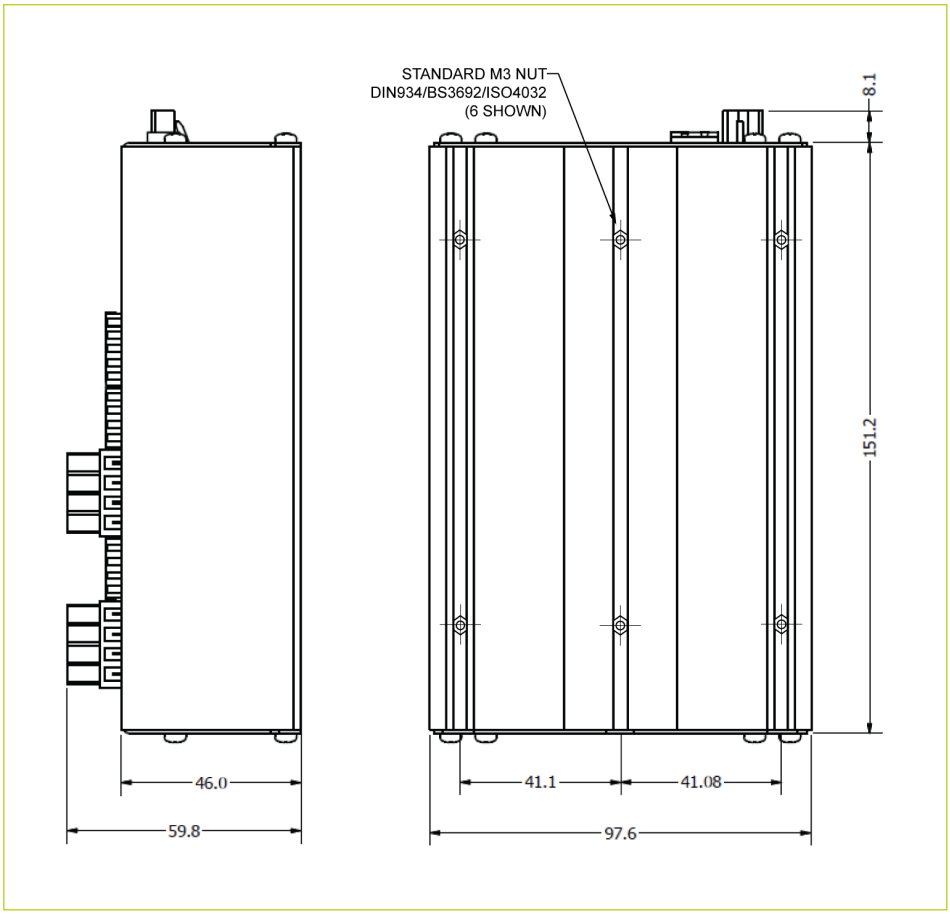
## 5.1 Environmental considerations

The 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 when mounted. Cable entries below the should be through glands that also have a flammability rating of UL94 V1 or better. The should be at least 10mm from any other part or side of the enclosure.

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

The illustration overleaf shows the dimensions of an RTCC controller:




## 5.2 Electrostatic discharge

Electrostatic discharge (ESD) can damage equipment and impair the electrical circuitry inside your RTCC. ESD damage occurs when electronic components are improperly handled and can result in complete or intermittent failures. On the RTCC, this is relevant only to the trigger connections and power input.

# 6 Connections

See Section 13, Reference information for information about connection ratings

## 6.1 Power supply

In the unlikely event of a fault in the RTCC, the maximum power dissipation in the unit can be:

**Power supply voltage x Max current delivered by power supply**

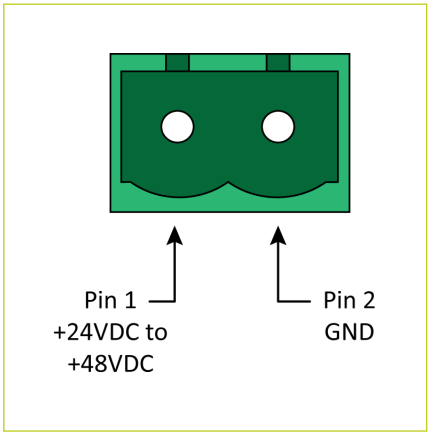
Either limit the power supply output current so that the RTCC cannot dissipate more than 30W, or mount the unit in a fire enclosure.

Choose a PSU that is designed to limit its output current, or by setting the current limit on the supply (if this feature exists), or use a fuse. 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.

We recommend you use a regulated power supply with 100% short circuit protection. If however a non-regulated power supply is used, then the maximum ripple voltage of the power supply must not exceed 10% of the DC voltage.

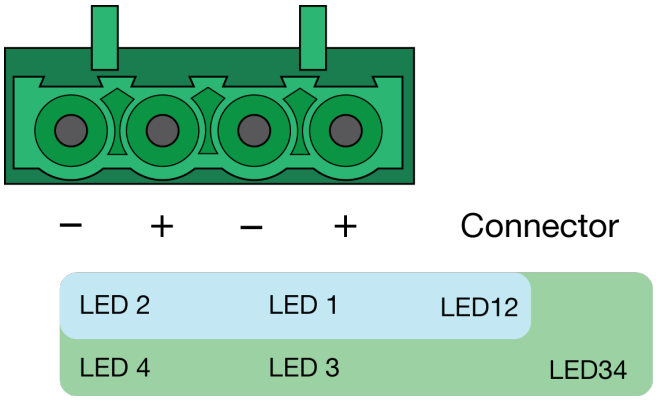
Route the low voltage and mains wiring separately. If they must be loomed together, ensure that the insulation rating of the low voltage wiring is sufficient, or that you use supplementary insulation. The input connections are illustrated below:




## 6.2 Lighting output

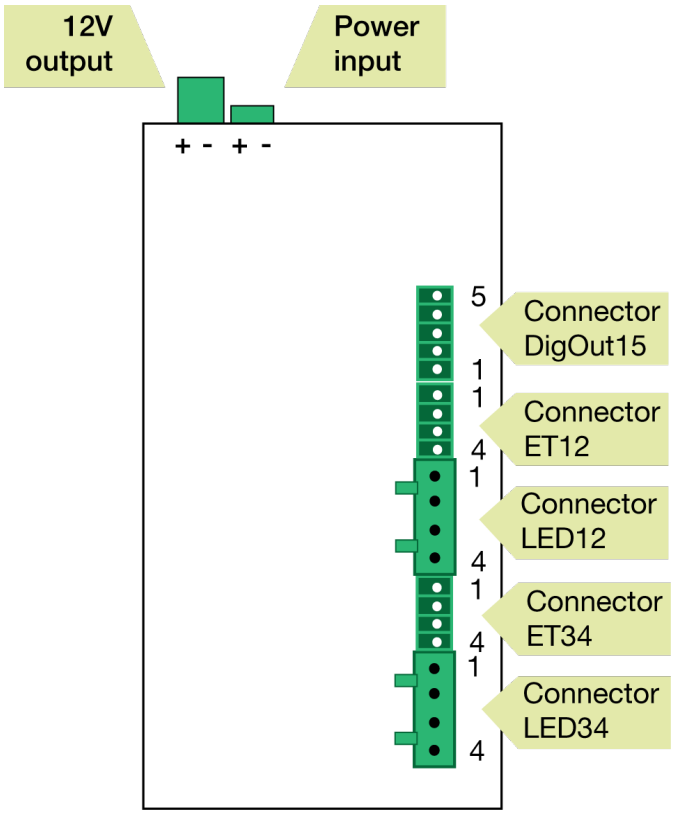
The lighting connections can exceed 46.7V but should not exceed 70V DC. Pulse peak voltages above 72V are considered hazardous. The lighting connections must be shielded so they cannot be being touched both within the light and along the whole length of the cable.

The lighting connections to an RTCC are made through 4-way connectors as shown below:




Ensure you set the current or voltage rating of your light before you connect it, see Section 8, Lighting setup.

The connectors fitted to , an RTCC series controller are shown in the illustrations below. You should refer to Section 6.3, Trigger inputs for the pin allocations of the trigger connectors, and Section 6.4, Digital outputs for the pin allocations of the digital outputs.



## 6.3 Trigger inputs

The trigger inputs are opto-isolated 3V to 24V input, drawing a minimum of 3mA. The table below describes the pin allocations for the RTCC controllers' trigger connectors:

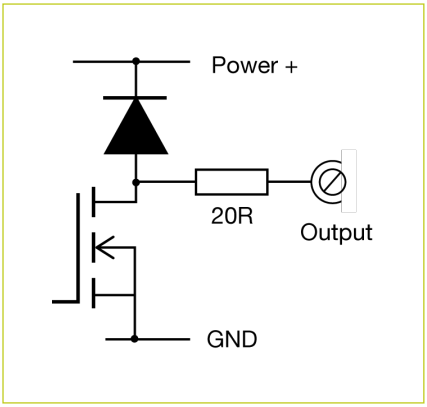
| Pin | Connector ET12 | Connector ET34 |
|---|---|---|
| 1 | TRIG1 – | TRIG3 – |
| 2 | TRIG1 + | TRIG3 + |
| 3 | TRIG2 – | TRIG4 – |
| 4 | TRIG2 + | TRIG4 + |

TRIG3 and TRIG4 can be used as inputs for an encoder. TRIG3 is not available as a trigger input if either encoder mode 1 or mode 2 is in use. TRIG 4 is unavailable if encoder mode 2 is in use.

## 6.4 Digital outputs

The digital outputs are open drain as shown in the diagram opposite. The voltage across the output must be no greater than 24V, and it can sink no more than 50mA.

***Note:*** The output may be damaged if it is shorted to a voltage higher than 5V.



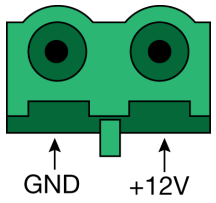

The table below describes the RTCC's digital output connections:

| Connector | Function |
|---|---|
| 1 | Open drain output 1 |
| 2 | Open drain output 2 |
| 3 | Open drain output 3 |
| 4 | Open drain output 4 |
| 5 | Common GND for outputs 1 to 4 |

## 6.5 12V Power output

RTCC controllers have one 12V power supply output. It can supply up to 1A at 12V for powering 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.

The pin allocation for the power supply output connector is shown opposite:



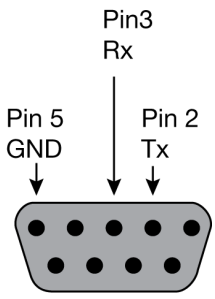

## 6.6 Ethernet connection

Ethernet connectivity is standard on RTCC420 controllers. 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).

## 6.7 Serial connection

The RS232 connector fitted to RTCC460 controllers is a standard 9-way female D-type. 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.

The pin allocation for the serial connector is shown opposite:




Rx = input to controller
TX = output from controller

## 6.8 Connectors

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

Should spare parts be required these can be obtained from Würth (www.we-online.com), Farnell (www.farnell.com), or Newark (www.newark.com). See the table overleaf for further information.

| Connector | Description | Würth part number | Farnell/Newark part number |
|---|---|---|---|
| Power input | 2W screw terminal free socket | 691-351-500-002 | 164 1952 |
| Trigger input | 4W screw terminal free socket | 691-361-100-004 | 184 1351 |
| 12V output | 2W screw terminal free plug | 691-348-500-002 | N/A |
| Digital outputs | 5W screw terminal free socket | 691-361-100-005 | 184 1352 |

# 7 Lighting controller operation

The RTCC series of current controllers provide repeatable intensity control of LED lighting for machine vision applications. This 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 series of controllers 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, in parallel, between two and four channels 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.

Controllers in the RTCC series are set up using an Ethernet port or serial port. The set up is non-volatile, so the RTCC resumes the same operation after a power cycle.

## 7.1 Output modes

The trigger inputs are used as described overleaf:

***Note:*** The P flag inverts the sense of the trigger input, see Section 6.3, Trigger inputs.

### 7.1.1 Continuous output, switched output, selected output

| Mode | Trigger input | Output |
|---|---|---|
| Continuous | Unused | Output is on |
| Switched | Trigger = off<br>Trigger = on | Output is off<br>Output is on |
| Selected | Trigger = off<br>Trigger = on | Output is continuous brightness 2<br>Output is continuous brightness 1 |
| Pulsed | Trigger rising edge<br>Trigger falling edge | Pulse is triggered if P flag = 1<br>Pulse is triggered if P flag = 0 |

In continuous mode the output current is fixed and continuous. Switched mode uses a trigger input to switch the output on or off.

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.

## 7.2 Pulsed output

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.

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 100µs.

When connected to a light, 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 table below shows the operating limits:

| 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% |

The duty cycle is limited by ignoring triggers which are too soon after the previous trigger.

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.

## 7.3 Fault detection

The RTCC controller detects the following errors. The error code is shown on the webpage of an Ethernet controller (see Section 11, Webpage configuration (RTCC420)),or the communications window of an RS232 controller (see Section 12, Command configuration). When the output current is less than 100mA, some fault detection is disabled.

You can issue a **GR** command to cancel the error (see Section 12, Command configuration). The RTCC controller re-senses the light.

| Error | Reason |
|---|---|
| 34, 37 | Internal power dissipation is too high. Output turned off. |
| 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. |
| 36 | If the output voltage is too low, the controller detects that the output is short circuited. |
| 37 | The voltage required for the lighting has increased too much. Check for ageing of the lighting or a failed LED. |
| 38 | The voltage required for the lighting has decreased too much. Check for ageing of the lighting or a failed LED. |

## 7.4 Light auto-sensing

When a channel does not have a light connected, the RTCC continually tries to supply 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 conected.

For voltage rated lights, the light is briefly driven at an increasing amount until 100% output brightness is achieved in order to sense the current rating of the light. This can generate the following errors:

| Comms error number | Reason |
|---|---|
| Err 21 | Current output is too low. This may be because the light has become disconnected. |
| Err 22 | The lighting required more than the maximum available current for the voltage rating. |
| Err 23 | Current output is not what was expected. The controller might need calibrating. |
| Err 23 | The power rating of the light exceeds the maximum power rating. |

## 7.5 Cold start

You can clear the RTCC configuration to its default settings - this clears the lighting ratings and sets all channels to 50% brightness continuous operation. You can do this by sending the **CL** command using Ethernet or serial connection.

# 8 Lighting setup

The rating of the light must be set by the user. 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.

You must enter the rating for the light before connecting it to the controller, or if you replace it with a different type of light. 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, use the current rating. If a voltage and wattage rating is given, use the voltage rating. Otherwise use the current rating. For 'homemade' lights using single LEDs or arrays of LEDs use the current rating from the LED datasheet.

You can set the current rating from 0.01A to 3A in steps of 0.01A, and you can set the voltage rating from 12V to 36V in steps of 1V.

When you connect a voltage rated light, 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.

To set the rating of a light on RS232 or Ethernet versions of the RTCC controller, use the **VL** command (see Section 12, Command configuration), or use the internal webpages on Ethernet versions of the RTCC controller (see Section 11, Webpage configuration (RTCC420)).

# 9 Timing controller operation

The RTCC timing controller has four digital inputs (through the trigger input connections), four digital outputs, and twelve virtual outputs (see Section 9.4, Virtual outputs). All outputs operate independently and are configured separately. Their 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.

## 9.1 Input modes

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

### 9.1.1 Encoder operation

The RTCC supports two types of encoder; one wire and two wire (see the table below). This can be configured using the **ZE** command, or through the RTCC's web pages.

| Mode | Connections | Operation | Maximum frequency |
|---|---|---|---|
| **En1** one wire encoder | IP3 is QEA | Simple encoder provides position information. All movement is assumed to be forward. | 700kHz |
| **En2** two wire encoder | IP3 is QEA<br>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 Section 9.2, Output Modes) are ignored.
- output pulses in PtE, Pet and PEE modes are not duplicated.

## 9.2 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 OP4 can also be used as a trigger. This parameter can be:<br>0 for the free-running timer<br>1 to 4 for IP1 to IP4<br>5 to 20 for OP1 to OP16 |
| 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:<br>0 for none<br>1 to 4 for IP1 to IP4<br>5 to 20 for OP1 to OP16<br><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. See Section 9.3, Flags. |

***Note:*** 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 configuration commands sent using Ethernet.

| Mode | Mode name | Operation |
|---|---|---|
| 0 | Set Low *(Off)* | The output is set to off or logic 0. If the output is inverted (flag O is set) then the output is logic 1. |
| 1 | Set High *(On)* | The output is set high (on) or logic 1. If the output is inverted (flag O is set) then the output is logic 0. |
| 2 | Pulse TT *(Ptt)* | Pulsed output triggered by a digital input. The delay and pulse width are set as fixed times. |
| 3 | Pulse TE *(PtE)* | Pulsed output triggered by a digital input. The delay is a fixed time. The pulse width is a number of encoder pulses. |
| 4 | Pulse ET *(PEt)* | Pulsed output triggered by a digital input. The delay is a number of encoder pulses. The pulse width is a fixed time. |
| 5 | Pulse EE *(PEE)* | Pulsed output triggered by a digital input. The delay and pulse width are a number of encoder pulses. |
| 6 | Divide Trig *(Pd)* | Pulse divider. Every <*Pulse Delay*> trigger pulses, the output is pulsed for <*Pulse Width*> time. |
| 7 | Divide Enc *(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 | Burst T *(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. See Section 9.2.1, Burst mode. |
| 9 | *(FrE)* | Not used. |

| Mode | Mode name | Operation |
|---|---|---|
| 10 | Buffer T *(buF)* | Buffer an input by making the output the same signal as the input. If the Gate Input parameter is set, then the gate input signal enables the output – if the Gate Input parameter is off, then the output is off. Flag **O** inverts the output and Flag **G** inverts the gate input.<br>The output can be delayed by a fixed time given by the <*Pulse Delay*> parameter.<br>***Note:*** Apply any Gate Input before the Pulse Delay.<br>The **E** flag can be set to indicate when the output changes state. |
| 11 | Buffer E *(buE)* | Same as *buF* mode, except the output signal can be delayed by a given number of encoder pulses. |
| 12 | Burst E *(brE)* | Same as *bur* mode, except the pulse width and pulse spacing is a given number of encoder pulses. |
| 13 | Counter *(Cou)* | Sets the output as a counter. The count does not start until the leading edge of the gate input. After that, the counter counts <*Pulse Delay*> leading edges on the trigger input. The output is then pulsed for a period of <*Pulse Width*>. |
| 14 | Min Pulse Trig *(iPF)* | The trigger pulse must be a minimum width to cause an output pulse. The output will pulse if the trigger signal stays valid for <*Pulse Delay*> time. The output pulse starts when the <*Pulse Delay*> time has completed (before the end of the trigger pulse). The output is pulsed for a period of <*Pulse Width*>. |
| 15 | Max Pulse Trig *(APF)* | The trigger pulse must be a maximum width to cause an output pulse. The output will pulse if the trigger signal stays valid for less than <*Pulse Delay*> time. The output starts on the trailing edge of the trigger pulse and lasts for a period of <*Pulse Width*>. |

| Mode | Mode name | Operation |
|---|---|---|
| 16 | D-Type Latch *(dLA)* | D-type latch. When a leading edge is received on the trigger input, the gate input signal is latched and is used to set the output. |
| 17 | RS Latch *(rLA)* | Edge triggered RS latch. The output is set when a leading edge is received on the trigger input, and cleared when a leading edge is received on the gate input. |

### 9.2.1 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.

## 9.3 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.

| 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 9.3.1, 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 9.3.2, FIFO flag (F) |
| 32 | R | Resync mode disabled. | Resync mode enabled. See Section 9.3.3, Resync flag (R). |
| 64 | P | Default to pulse in resync mode. | Default to no pulse in resync mode. See Section 9.3.4, Pulse flag (P) |

### 9.3.1 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<output>,<tag>
```

Where `<output>` is the channel number from 1 to 16 and `<tag>` is a number from 0 to 255. Multiple tag messages may be sent in one packet, separated by a semi-colon (**;**).

### 9.3.2 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. Other 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.

### 9.3.3 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, **E**. 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.

### 9.3.4 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 RTCC defaults to rejecting the product.

## 9.4 Virtual outputs

In addition to its four physical outputs, the RTCC has a further twelve virtual channels. These are numbered from 5 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.

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

# 9 Trigger timing examples

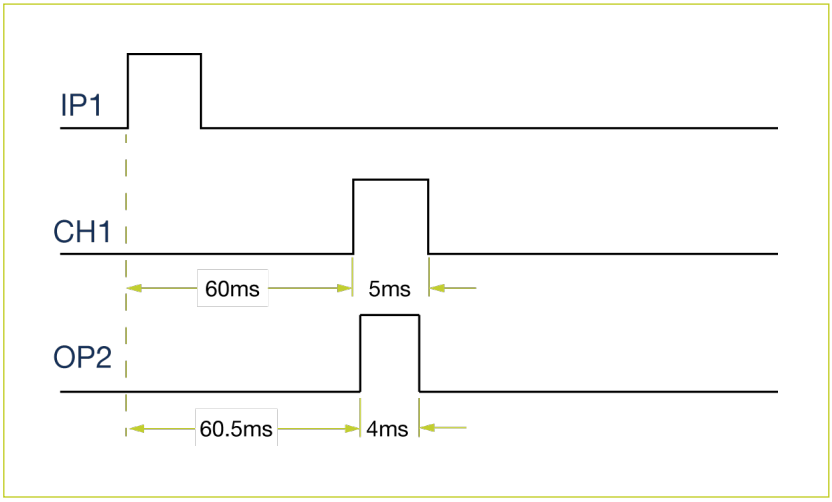
This section provides a range of examples of ways in which the RTCC controller may be configured for trigger timing. You can use these examples as a basis from which to set up your RTCC for your own application. A blank configuration form (see Appendix A - Configuration sheet) is available for download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

## 9.1 Synchronised camera and lighting

An input trigger arrives at 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 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 | 4ms | 4ms | 0 | - |

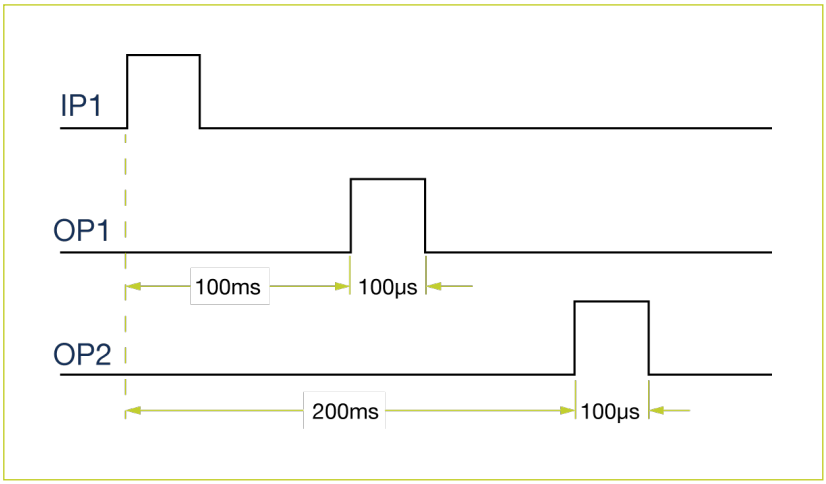



## 9.2 Sequenced pulses

A sensor detects the presence of a product . 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 overleaf:

| Output | Mode | Input | Gate input | Pulse delay | Pulse width | Retrigger 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.

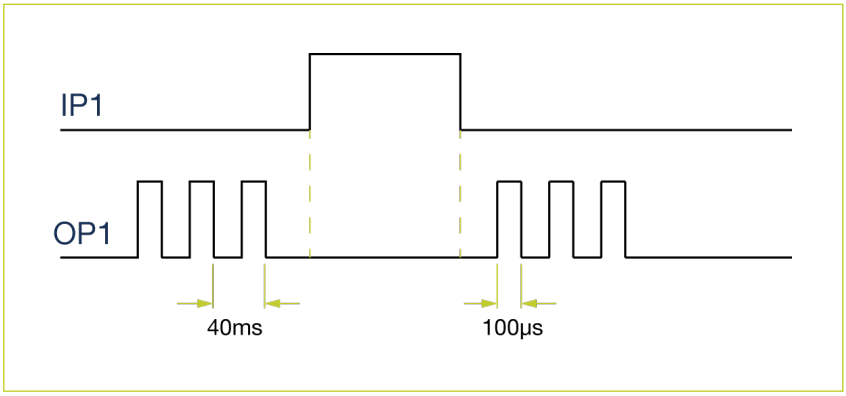



## 9.3 Gated pulses

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. The configuration details for this are shown below:

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

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 below:



## 9.4 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. The configuration details for this are shown below:

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

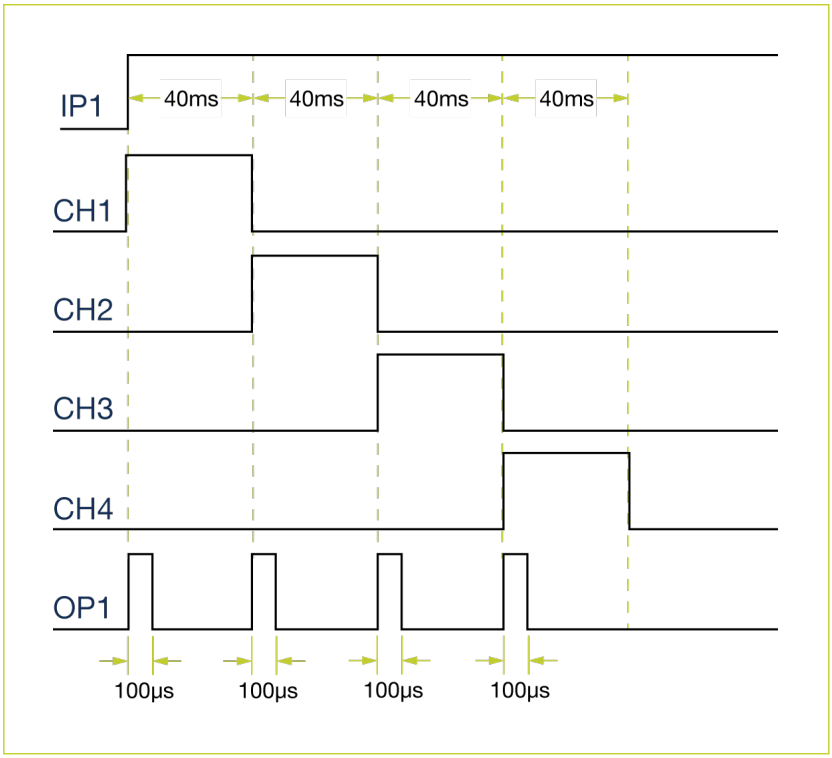
Both outputs are set into pulse mode. The pulse delay is a number of encoder pulses and the pulse width is a fixed time. The flags specify the trailing edge of the trigger signal and that the output pulse is active low.

## 9.5 Multiple exposures with different lighting

A sensor on IP1 detects the presence of a product. 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 | 100µs | 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, specifying four pulses). The timing diagram is shown overleaf:

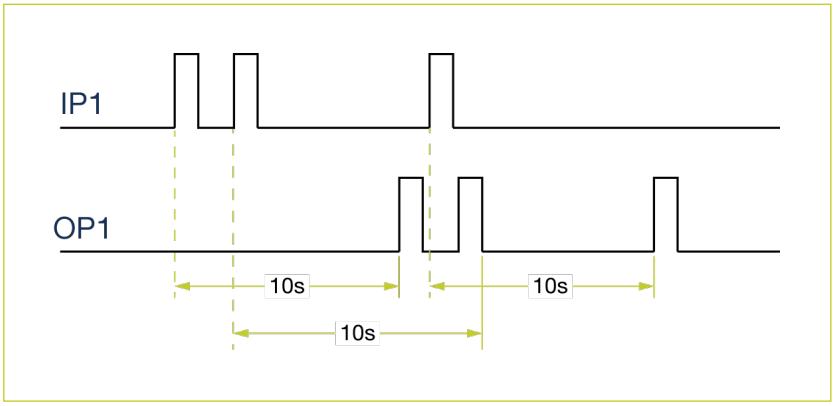



## 9.6 Simple FIFO mode

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 RTCC stores each of the triggers and then outputs a pulse after the correct delay. The configuration for this is shown below:

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



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

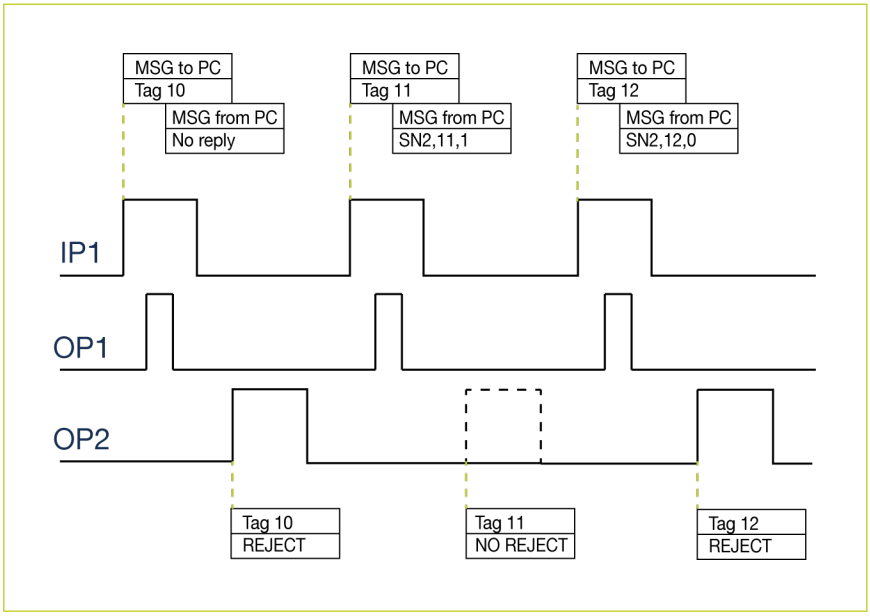
The reject gate is on OP2 and pulses high to reject the product. Products take 10 seconds to travel from the sensor to the reject gate, and take 1 second to move past the reject gate. The configuration details for this are shown below:

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

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

The camera trigger has the 'Send trigger message' flag set. So that when the 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 procesing software 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.

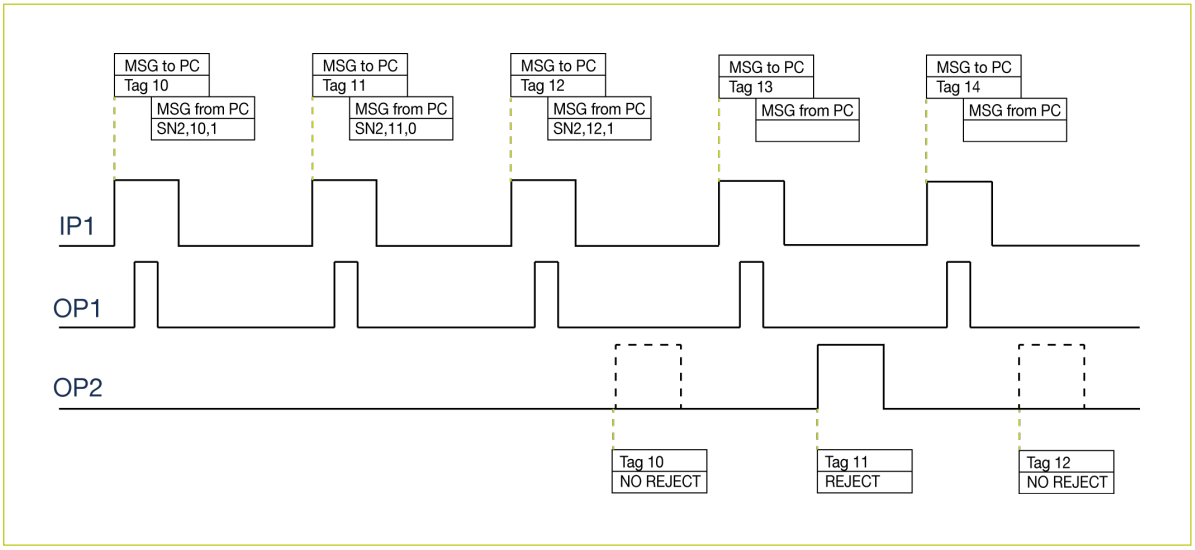
After the third trigger a Tag 12 messages was sent, with the reply 'SN2,12,0' (OP2, tag 12, fail), so the reject pulse on OP2 was not cancelled.

## 9.8 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 TR-HT. 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 | Input | Gate input | Pulse delay | Pulse width | Retrigger time | Flags |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 1 | 0 | 200ms | 100µs | 0 | |
| 2 | 2 | 1 | 0 | 10s | 1s | 0 | E, F, R (56) |



# 10 Ethernet communication (RTCC420)

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 RTCC.

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

## 10.1 Connection

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

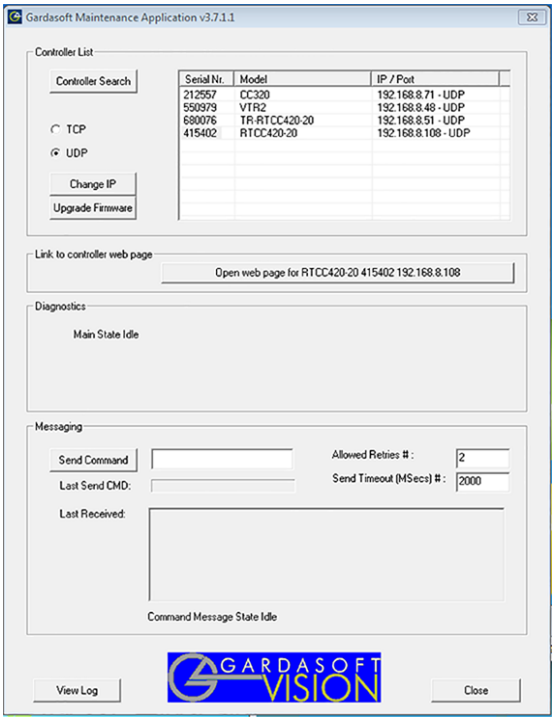
## 10.2 IP Address

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 using the GardasoftMaint program available at www.gardasoft.com.

The GardasoftMaint window is shown below:



GardasoftMaint allows you to view the controllers on your network, change their IP addresses and 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 12, Command configuration. You can also open the selected controller's web pages at the click of a button. For more information about the RTCC's web pages, see Section 11, Webpage configuration (RTCC420).

### 10.2.1 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. Go to the Control Panel.
ii. Select **Network Connections**.
iii. Right click on **Local Area Connection**. Select **Properties**.
iv. From the list, select **Internet Protocol (TCP/IP)**, press **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 following the steps below:

i. Go to the Control Panel.
ii. Select **Network Connections**.
iii. Right click on **Local Area Connection**. Select **Status**.
iv. Select the **Support** tab. The IP address is displayed.

### 10.2.2 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 RTCCs could be allocated addresses 192.168.1.201 and 192.168.1.202.

## 10.3 Automatic sensing

All the features below are implemented in sample C++ source code available for download from www.gardasoft.com.

The RTCC sends a 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.

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,RTCC420-20,000000,111111111111,22222222

(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 RTCC420-20, serial number 12345, IP address 192.168.1.103, MAC address 00.0B.75.01.80.99 the packet is formatted:

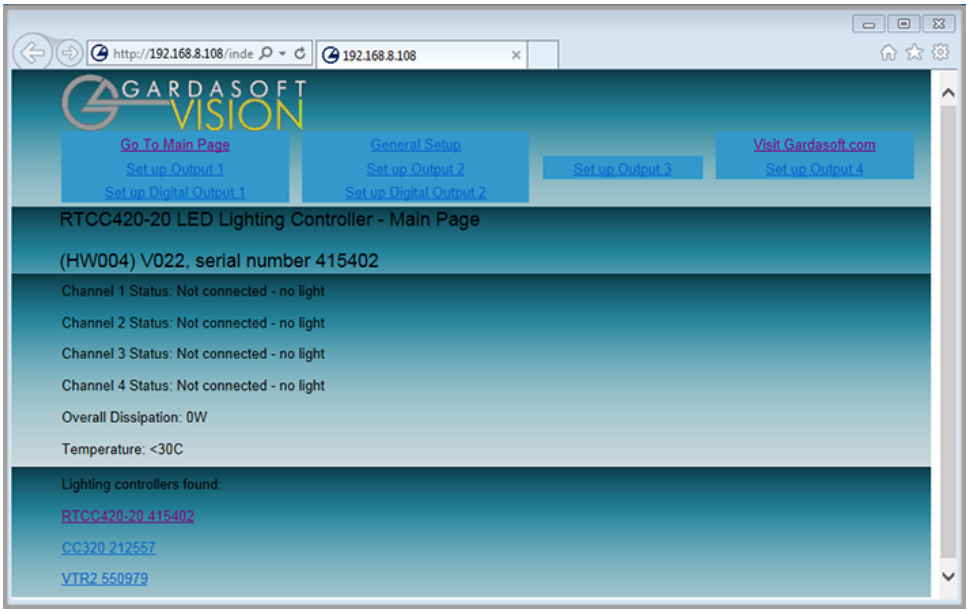
Gardasoft,RTCC420-20,012345,000B75018099,C0A8016

# 11 Webpage configuration (RTCC420)

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

## 11.1 Main page

The main page (shown below) is the first to open when you access the RTCC's webpages. This gives the controller's hardware and firmware revision levels and the serial number. It also tells you the power being dissipated and the RTCC's internal temperature.



## 11.2 Configuration page

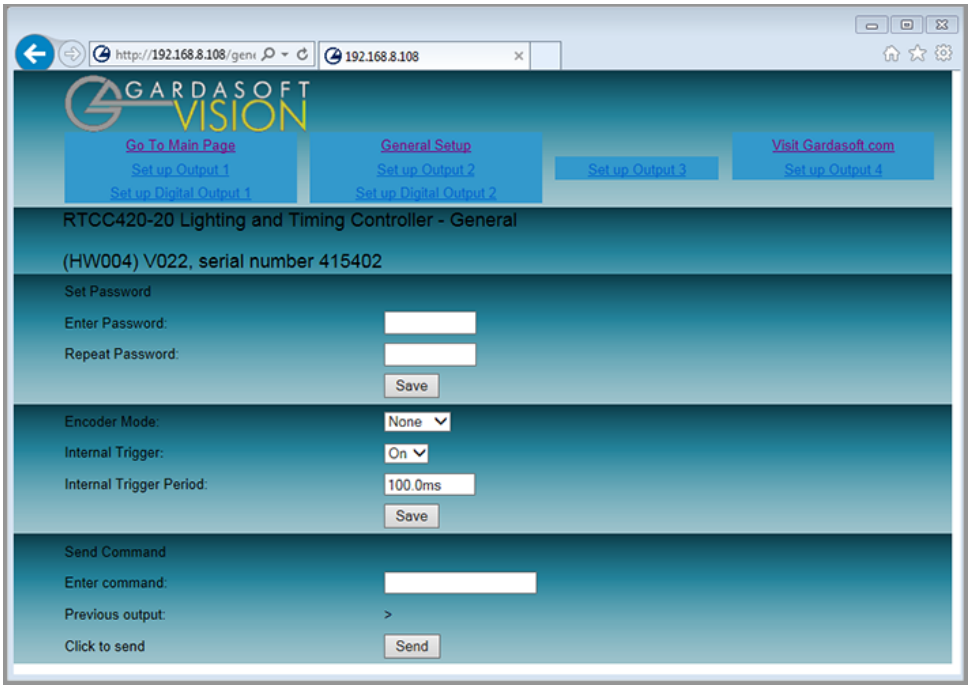
There is one configuration page for each output channel, as shown below:


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

- Change the current rating for the light.
- View some measured voltages and the actual output current.
- Set the output mode: continuous, pulsed, or switched.
- Set the pulse parameters.

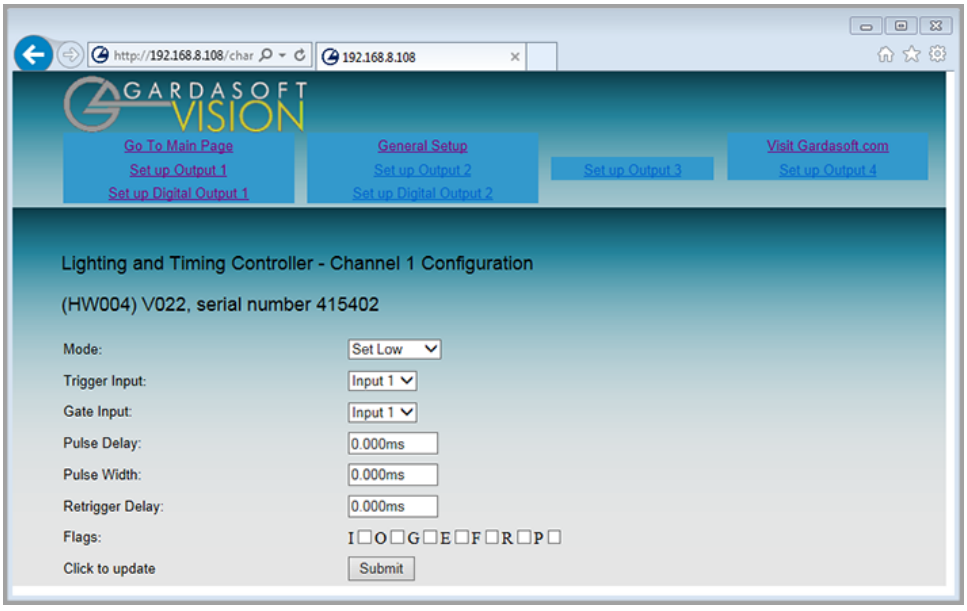
## 11.3 General setup page

The General Setup page allows you to set up or clear the webpage's password and set up the internal trigger. You can also enter any Ethernet command from Section 12, Command configuration.




## 11.4 Digital output configuration page

The digital output configuration page allows you to set up the timing parameters and flags for the digital outputs. For a description of these parameters and effect of setting flags, refer to Section 9, Timing controller operation. There is one configuration page for each digital output on the RTCC.



# 12 Command configuration

The RTCC can be configured through the Ethernet connection using UDP or TCP/IP. You can download sample C++, C#, VB.NET code from www.gardasoft.com to allow configuration.

## 12.1 Ethernet configuration (RTCC420)

For TCP, commands from a host should be sent to destination port 30313 with replies sent to destination port 30312. For UDP, commands from a host should be sent from source port 30312 to destination port 30313. Replies are sent from source port 30313 to destination port 30312.

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

## 12.2 RS232 configuration (RTCC460)

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

A carriage return (ASCII 13) character should be sent to terminate the command line.

## 12.3 Command structure

Communication consists of commands sent by the host (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 recommend 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 sends 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 unit is amps.

***Note:*** 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 millisecond |
| 200µs | 200 microseconds |
| 0.1s | 0.1seconds |
| 100ma | 100mA |
| 2.45A | 2.45A |
| 2.3 | 2300mA or 2.3A |

The command codes and their meaning are described in Section 12.3.1, General commands. The upper case commands are shown, followed by lower case letters denoting the numeric argument.

### 12.3.1 General commands

Any changes you make using Ethernet commands are not saved permanently until you send the **AW** command.

#### Report the version of firmware running in the RTCC

This command returns the firmware version. For example:

**VR** returns

```
RTCC420-20 (HW02) V031
```

#### 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 500µs (2KHz) |

### Save the settings to memory

**AW**

Once the settings are saved to memory they are 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**, and **AW** commands are all cleared.

### Show Configuration

**ST**

This command shows the operational parameters for all channels in the controller. A typical output for RTCC420 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,RA0.000
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:<br>1st setting used in all modes<br>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` | Rating of the light (after SafeSense has successfully completed sensing the light) |
| `RA` | Rating of the light (set using the **VL** command). |

When using Ethernet, use the following forms of the **ST** command:

**ST0**

Reports the general settings. A typical output is:

```
TM 1, TP 20.00ms
```

**STc**

Where:

**c** = the input channel (1 to 2, 4, or 8 depending on model).

This reports the settings for a single channel.

### Simulate an Input Trigger

**TRc**

Where:

**c** = the input channel (1 to 4).

This simulates a trigger pulse. If the channel is in pulse mode it pulses the output once.

### Enable Ethernet Messages

**GTm**

Where:

**m** = 0 to disable Ethernet messages, or

**m** = 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` = the channel number (1 to 4), or 0 for no channel

`e` = event value (see Section 13.5, Event codes).

### 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', and so on, to 90 is 'Z'.

You can set an unlock code. This can be used as a low-security way of allowing trusted users to unlock the keypad. Ethernet commands and the web pages still work. The setting of this command is restored after a power cycle.

### 12.3.2 Lighting channel 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, depending on model)

**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 switched mode

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

**RWc,s**

Where:

**c** = output channel (1 to 4)

**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 4)

**s** = brightness 1 setting in percent (s = 0 to 100)

**t** = brightness 2 setting in percent (t = 0 to s)

### 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.

**RTc,p,d,s**

**RTc,p,d,s,r**

Where:

**c** = output channel (1 to 4)

**p** = pulse width in milliseconds (0.02 to 999)

**d** = delay from trigger to pulse in milliseconds (0.02 to 999)

**s** = setting in percent (s = 0 to 999)

**r** = retrigger delay. This parameter is optional.

### Set the Option Flags

**REc,m**

Where:

**c** = output channel (1 to 4)

**m** = flags:

| | | |
|---|---|---|
| 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) |

### 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 or 2)

### 12.3.3 Trigger timing commands

#### Show status command

**ZZ**

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

This command sets the configuration for an output channel. See Section 9.2, Output Modes for a description of these parameters.

**ZSc,m,i,g,f**

Where:

**c** Output channel number (1 to 4)

**m** Mode

**i** The trigger input:

0 for free running timer

1 to 4 for IP1 to IP4

5 to 8 for OP1 to OP4

**g** The gate input:

0 for none

1 to 4 for IP1 to IP4

5 to 8 for OP1 to OP4

**f** Flags

For example, the following command sets output channel 1 to pulse mode (Ptt), triggered by input 2, no gate input and flags = 2 (invert the output).

ZS1,3,2,0,2

***Note:*** The flags parameter must be entered as a decimal number.

### Set the output pulse timing

This command sets the pulse width and delay timings. 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.

**ZTc,p,d**

Where:

**c** Output channel number (1 to 4)

**p** Pulse width (time or encoder pulses)

**d** Pulse delay (time or encoder pulses)

For example, the following command sets output 2 to provide a 3ms pulse after 5000 encoder pulses.

ZT2,3ms,5K

***Note:*** You should set the mode with the **ZS** command before setting the pulse timing.

### Set the retrigger time

The retrigger time is the minimum time from when an output is triggered to the next time.

**ZRc,r**

Where:

**c** Output channel number (1 to 4)

**r** Retrigger time (or number of encoder pulses)

For example, the following command sets output 2 so that it will not accept another trigger until 10ms after the previous one.

ZR2,10ms

***Note:*** You should set the mode with the **ZS** command before setting the retrigger time.

### Set Pass / Fail

In Resync mode, this command returns the pass or fail state of image processing for a given trigger tag.

**SNc,t,p**

Where:

**c** Output channel number (1 to 4)

**t** Trigger tag number

**p** = 1 for pass,
0 for fail

For example, the following command gives output 1, trigger tag 76 as a pass.

SN1,76,1

### Read / change the encoder count

This command returns `VL` followed by the encoder count:

**EN**

For example, `VL200` is returned 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 the encoder mode

This command sets the encoder type:

**ZEe**

Where:

**e** = 0 for 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:

**ZVc,v**

Where:

**c** Output channel (1 to 4)

**v** = 0 to set the output to a logic 0 (or 1 if the O flag is set)
1 to set the output to a logic 1 (or 0 if the O flag is set)

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**

Where:

**i** The input channel (1 to 4)

This command returns `VL0` if the input is logic 0, and `VL1` if the input is logic 1.

### 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** Input channel (1 to 4)

**v** = 0 to set the input to 'off'

= 1 to set the input to 'on'.

### Show the state of an ouput

**ZOc**

Where:

**c** The output channel (1 to 4)

This command returns `VL0` if the output is logic 0, and `VL1` if the output is logic 1.

### 12.3.4 General command summary

| Command | Example | Effect |
|---|---|---|
| **AW** | AW | Save changes. |
| **CL** | CL | Clear configuration. |
| **GT** | GT1 | Enable Ethernet messages. |
| **GR** | GR | Clear any error conditions |
| **EY** | EY65,66 | Set webpage password to 'AB'. |
| **VR** | VR | Read the firmware version. |
| **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 output 2 |
| **RE** | RE1,3 | Set channel 1 to ignore lighting errors and not prompt for the current rating of a light when it is connected. |
| **TT** | TT1,1ms | Set internal triggers every 1ms. |
| **TR** | TR2 | Trigger channel 2. |
| **ST** | ST2 | Show configuration for channel 2. |

### 12.3.5 Timing command summary

| Command | Example | Effect |
|---|---|---|
| **ZZ** | ZZ2 | Show onfiguration for output 2. |
| **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. |

| Command | Example | Effect |
|---|---|---|
| **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 | Set channel to to high level. |
| **ZI** | ZI2 | Read the state of input channel 2. |
| **MI** | MI4,0 | Simulate input 4 being off. |
| **ZO** | ZO1 | Read the state of output channel 1. |

# 13 Reference information

This section contains the specification for the RTCC and any restrictions on its use. Error and event codes are also listed.

## 13.1 Specification

The RTCC range of controllers has a 2 amp option with a '**-2**' suffix, and a fast pulsing option with an '**F**' suffix. The specification for these is shown below alongside standard versions.

| | RTCC4xx-20 | RTCC4xx-2 |
|---|---|---|
| Each output channel | 3A maximum continuous / 20A pulsed, 46V output and 30W average output power* | 2A maximum continuous / 2A pulsed, 46V output and 30W average output power* |
| Lighting rating | 12V to 36V in steps of 1V<br>100mA to 3A in steps of 5mA | 12V to 36V in steps of 1V<br>100mA to 2A in steps of 1mA |
| Operating modes | Continuous, strobe, switch, and selected | |
| Trigger input | Opto-isolated, standard or inverted operation<br>3V to 24V | |
| Digital outputs | Four 24V, 50mA open drain outputs | |
| Pulse width:<br>(RTCC4xx) | 20 microseconds to 1 second. Repeatable to 0.1 microseconds. | |
| Pulse width:<br>(RTCC4xxF) | 1 microsecond to 1 second. Repeatable to 0.1 microseconds. | |
| Trigger delay:<br>(RTCC4xx) | 20 microseconds to 1 second. Repeatable to 2 microseconds. | |
| Trigger delay:<br>(RTCC4xxF) | 2 microseconds to 1 second. Repeatable to 2 microseconds. | |
| Internal trigger timer | 0.2Hz to 1kHz | |
| Supply voltage | 24VDC to 48VDC regulated | |
| Heat dissipation | 10W maximum | |

*Refer to Section 13.2, Restrictions

## 13.2 Restrictions

The maximum output power for an RTCC4xx is 30W per channel or 50W total.

The following timings and restrictions are applied whenever settings are saved (using the **AW** command).

- **B.1 Continuous Mode**

  The maximum output current is 3A (2A for an RTCC4xx-2).

- **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 20A (2A for an RTCC4xx-2).

- **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 (2A for an RTCC4xx-2). For high current pulses the following limits apply:

| Pulse current | Pulse length limit |
|---|---|
| 20A | 100µs |
| 12A | 400µs |
| 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.

  For fast pulse controllers (RTCC4xxF) the minimum pulse delay is about 2µs. When overdriving or using the retrigger delay, the minimum delay is around 5µs.

  For pulse widths less than approximately 150us, 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%.

- **B5 Trigger timing**

  The following 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 1us and are not subject to variation even with other simultaneous events. Pulse widths above 4ms are repeatable to within 100µs 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 6.5µs +/-1µs

OP2 has delay 6.5µs +/-1µs

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.

## 13.3 Error codes

| Error number | Reason |
|---|---|
| Err 1 | A parameter value is invalid. |
| Err 2 | Command not recognised. |
| Err 3 | Numeric value is the 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 **RT** or 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 19 | A light has been connected to a channel but no rating has been set. |
| Err 8, 12 | EEPROM corrupt. The configuration has been cleared. |
| Err 9, 20 | Could not save settings to EEPROM. |
| Err 21, 22, 23 | Sensing error. See Section 6.2, Light auto-sensing. |
| Err 27 | Can't read Ethernet settings from EEPROM, so these may be incorrect. |
| Err 34, 47 | Internal power dissipation is too high. Output turned off. |
| Err 35 | Output current to lighting is too low. |

| Error number | Reason |
|---|---|
| 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 81 | Too many FIFO events have been used and the RTCC has run out of storage. |

## 13.4 Fatal error codes

| Error number | Reason |
|---|---|
| Err 44 | The RTCC is too hot. The RTCC has a thermal cutout which operates around 65°C to 70°C, depending on conditions. |
| Err 40, Err 41 Err 45 | One channel is outputting more current than expected. |
| Err 47 | Internal protection has prevented too much heat in the output driver. |

## 13.5 Event codes

Event messages are sent 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 (see table overleaf).

| Event number | Reason |
|---|---|
| 1 to 127 | An error has occurred. The error code is given by the event number. |
| 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. |
| 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 | An over temperature error occurred. |
| 131 | An over current error occurred. |
| 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. |

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