



USER MANUAL



PP600, PP602, PP610, PP612 LED Lighting Controllers

Revision 13

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1 Disclaimer

Except as prohibited by law:

- All hardware, software and documentation is 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.
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2 Getting Started

Read the sections on Safety and Specifications and check the PP600 fulfils your requirements. See inside the front cover for other Gardasoft Vision lighting controllers.

Connect the PP600 up to a supply and an LED lighting unit as described in “Connections.” Note that the supply voltage must be connected to three terminals. When the PP600 powers up it should show two alternating lines on the display to indicate that it is operating properly.

Read the section on “Operation” and use the Simple Set Up to make the PP600 supply a small continuous current to the LED unit. Check that the LED unit illuminates.

Users who have a PP610 or PP612 should refer to the PP610 section and read how to send RS232 commands.

Mount the PP600 as described in “Mechanical Fixing” using a DIN rail or the mounting holes. In particular read the notes on heatsinking.

Set up the PP600 for the desired operation and test.

See the appendix on Application Notes for additional information on the use of the PP600. Visit www.gardasoft.com for more Application Notes.

Throughout this manual, references to the PP600 refer to all variants in the PP600 range unless otherwise stated. The symbol “us” is used to denote microseconds.

3 Safety - English

3.1.1 PP600 – Safety

Please read this before using the PP600 family of products. If in doubt, contact your distributor or Gardasoft Vision.



Where this symbol appears in the manual, refer to the text for precautions to be taken.

3.1.2 Heat



The PP600 can get very hot. It should be positioned where personnel cannot accidentally touch it and away from flammable materials.

Do not exceed the power ratings given in the manual. Note that at the maximum ratings the case temperature can reach 80°C.

If the output load is short circuited then the heat dissipated within the unit will greatly increase, resulting in a further rise in temperature.

3.1.3 Electrical

The user must ensure that the potential difference between any combination of applied signals does not exceed the supply voltage. **WARNING:** Higher voltages may cause a danger to personal health.

The PP600 does not have complete tracking isolation of inputs and outputs.

Transients caused by inductive loads must be suppressed external to the PP600.

The metal case is not connected to PSU 0v. This is a change from previous revisions of the PP600.

3.1.4 General

The PP600 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 Safety - German

4.1.1 Sicherheitshinweis PP600



Bitte lesen Sie sich diesen Sicherheitshinweis gründlich durch, bevor Sie die Produkte der Serie PP600 benutzen. Sollten dennoch Zweifel Ihrerseits bestehen, zögern Sie nicht sich mit uns in Verbindung zu setzen. Die Stellen im Handbuch, an denen dieses Symbol erscheint, beziehen sich auf den Text zur Beachtung der Vorsichtsmaßnahmen.

4.1.2 Wärmeentwicklung



Die Geräte können während des Betriebes sehr heiss werden. Sie sollten daher dort untergebracht sein, wo Personen keine Brandverletzungen erleiden können und wo sich keine entflammaren Materialien befinden.

Überschreiten Sie nicht die im Manual angegeben Höchstspannungen. Beachten Sie, dass die Temperaturen bei der maximalen Spannung 80 °C betragen können.

Wird pro Kanal mit hohen Blitzspannungen und kurzen Blitzzeiten gearbeitet, steigen die Temperaturen nochmals an!

4.1.3 Elektrischer Betrieb

Stellen Sie sicher, dass die Spannungsdifferenz bei keiner Kombination der angelegten Signale die Versorgungsspannung übersteigt. ACHTUNG: Höhere Spannungen können sich Gesundheitsgefährdend auswirken.

Ein- und Ausgänge haben keine komplette Leiterbahnisolierungen. Überschläge, die aus Induktion resultieren können, müssen ausserhalb des PP600 abgehalten werden.

Das Metallgehäuse ist nicht mit PSU 0V verbunden. Dies ist eine Veränderung zu früheren Versionen des PP600!

4.1.4 Generell

Die Controller der PP600 Serie darf nicht in Applikationen eingesetzt werden, in welchen ein Fehlverhalten des Gerätes gesundheitliche Schäden verursachen könnte oder technische Ausrüstung zerstören könnte.

Wenn das Gerät auf nicht vom Hersteller spezifizierte Weise benutzt wird, können seine Schutzvorrichtungen beeinträchtigt werden.

5 General Description

The PP600 current controller provides repeatable intensity control of LED lighting for machine vision applications. It includes the power supply, 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. Currents can be specified in 0.25mA steps below 1A and in 1mA steps above 1A.

Three modes of operation are provided separately for each channel:

- **Continuous:**
In continuous mode the output is a continuous current.
- **Selected Continuous:**
In selected continuous mode one or both inputs can be used to select an output current. For each state of the inputs, the output current is fixed.
- **Strobed:**
In this mode output is pulsed once per trigger. One input is used as a trigger. The delay and pulse duration can range from 20us to 1 second in 20us or 2ms steps.

The PP600 is set up using four push buttons and a four digit seven-segment display.

Configurations are saved in non-volatile memory so that the PP600 will resume operation after a power cycle.

6 Specifications

| Parameter | Value | Notes |
|--|--|---|
| Digital supply voltage (VS+) | 7V DC (min) 40V DC (max) regulated | Ideally set this voltage as low as possible to reduce the total unit power dissipation. |
| Digital supply current (IS) | 125mA (max) | |
| Load supply voltage (LD+) | 48V DC (max) regulated | Must be at least 1V greater than the load potential difference at maximum required current |
| Input enable level (IP _H) | 24>IP _H >4.5 V | This is the voltage applied between the anode and cathode of each optically isolated input |
| Input disable level (IP _L) | IP _L <1 V | |
| Output current per channel (i _i) | 4A continuous or 10A pulsed | Maximum allowed current per channel. Average current when pulsing must not exceed the maximum allowed continuous output. |
| Ambient temperature during operation | 5°C to 40°C | |
| Maximum Relative Humidity during operation | 90%rH non-condensing | |
| Total unit power dissipation without heatsinking (P _D) | P _D =10 Watts (max) | This is the sum of $(V_S - V_F) * I_L$ for each current output where I _L = Output load current (Amps) V _F = Load forward voltage |

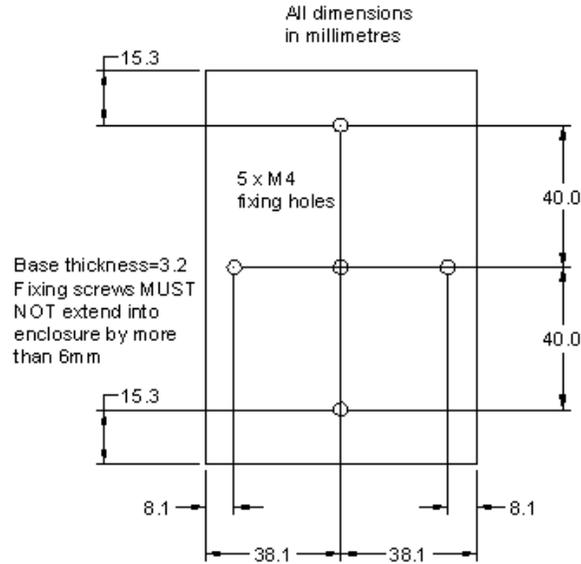
7 Mechanical Fixing

The PP600 can be mounted onto a flat surface using the threaded holes in the base, see diagram. The PP600 should only be mounted either vertically or with its base horizontal. It should be mounted at least 15mm away from the sides of plastic enclosures. Likewise leave a similar space between the PP600 and any parts which could be affected by high temperatures.



The enclosure of the PP600 is used to dissipate power in the form of heat. For this reason the material to which the unit is attached must be suitable, preferably metallic with ability to dissipate the produced heat. This is particularly important if the power dissipation of the PP600 (as defined by P_D the section on Specifications) exceeds 10 Watts.

The PP701 kit is available for mounting the PP600 on a DIN rail.



The PP600 does not have an IP rating and should be mounted so that moisture and dirt cannot enter the unit.



To avoid a fire hazard consider the implications of overheating in the unlikely event of a fault in the PP600. The power dissipation in a fault condition is approximately given by the sum of the following for the two channels:

$(\text{Power supply voltage} - \text{rated voltage for lighting}) * \text{max current delivered by Power supply}$

Either limit the power supply output current(s) so that not more than 30W can be dissipated in the PP600, or mount the unit in an enclosure.

To limit the power, set the power supply output voltages to the minimum value required by the LED light and the PP600 together. Chose a PSU that limits its output current by design, by setting the current limit on the supply (if this feature exists) or use fuses. Remember to derate the fuse, if mounted in an enclosure, as the temperature will be higher than ambient.

An enclosure may also be required for other parts of the system such as power supplies and will provide mechanical and environmental protection in industrial applications.

If an 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 PP600 when mounted. Cable entries below the PP600 should be via glands that have a flammability rating as before. Observe the specified gap between the PP600 and any other part or side of the enclosure.

8 Connections

8.1 General

All connections except RS232 are available on screw terminals. The opto-isolated inputs require a voltage between 4.5v and 24v DC for a positive logic level. Open circuit or less than 1v gives a negative logic level.



The case of the PP600 is not connected to the GND supply connection. On previous revisions of this product the case was connected to GND.

The input connector has connections as follows:

| Screw Terminal ID | Function |
|-------------------|------------------|
| IP1+ | Input 1 positive |
| IP1- | Input 1 negative |
| IP2+ | Input 2 positive |
| IP2- | Input 2 negative |

The power connector has the following connections:

| Screw Terminal ID | Function | |
|-------------------|------------------|----------------------------|
| GND1 | CHANNEL 1 | POWER SUPPLY (-) |
| VS1+ | | POWER SUPPLY (+) |
| LD1+ | | LOAD (+) |
| LD1- | | LOAD (-) |
| VS+ | | DIGITAL POWER SUPPLY (+) |
| GND | | DIGITAL POWER SUPPLY (GND) |
| LD2- | CHANNEL 2 | LOAD (-) |
| LD2+ | | LOAD (+) |
| VS2+ | | POWER SUPPLY (+) |
| GND2 | | POWER SUPPLY (-) |



GND, GND1 and GND2 must all be commoned. See section 8.2.

Ensure that the wire gauge used for these connections is appropriate for the current to be drawn. Ideally, wires should be double crimped or independently secured to ensure they cannot come loose. Route low voltage and mains wiring separately. If they must be loomed together ensure that low voltage insulation rating is sufficient or that supplementary insulation is used.

8.1.2 PP610 and PP612 Serial Connector

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 PP600 to a PC serial port.

| Pin | Function |
|----------|------------------------|
| 2 | TX (output from PP610) |
| 3 | RX (input to PP610) |
| 5 | GND |

8.1.3 PP602 and PP612 Japan Style Connector

Refer to section 12 for details on connecting to Japan style lighting.

8.2 Power Supply

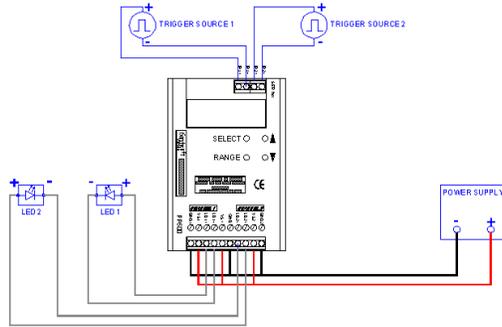
The PP600 has split power input connectors for the control circuit and the two output channels. This is so that crosstalk between the outputs can be minimised when one channel has a high output current.

Start by wiring the PP600 up as in section 9.2.1. It is possible to run the two channels and digital system from two or three separate supplies as shown in 9.2.2, though this will rarely be necessary.

Power supplies should be regulated with SELV compliant outputs (fault tolerant). Consideration should be given to fusing VS1+ and VS2+. The fuse value can be based on the average current output. Note that in Europe fuses are designed to pass at their rated current, while in the USA fuses are designed to blow at their rated current.

8.2.1 Single Supply Applications

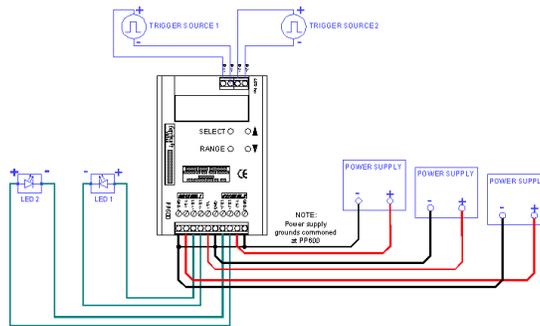
The diagram below shows the normal supply wiring scheme for the PP600. The three ground connections and VS connections are commoned.



8.2.2 Split Supply Applications

It is possible to run the two channels and digital system from two or three separate supplies as shown below, though this will rarely be necessary.

Note that it is essential that the ground of the three supplies are commoned close to the PP600.



9 Operation

The PP600 is set up using the push buttons and display on the front of the unit. The set up is non-volatile, so the PP600 will resume the same operation after a power cycle.

9.1 Startup

On power up, the PP600 will display “8.8.8.8.” to test the display is working, then “PP6”, followed by the version number, eg “017”, and then will be ready for operation. To show that the unit is operating normally, an alternating pattern is drawn on the display.

9.2 Cold Start

In the unlikely event that the non-volatile memory becomes corrupt the PP600 may not start up properly. In this case the memory can be cleared by powering up the PP600 while holding down the SELECT and DOWN buttons. The PP600 will display “COLD” for about 10 seconds while the memory is cleared.

9.3 Set Up

Each channel of the PP600 can operate in three ways:

- Continuous output
The output current is fixed.
- Selected continuous output
One or both inputs can be used to select an output current. For each state of the inputs, the output current is fixed.
- Pulsed output
The output is normally off. When a trigger occurs, there is an optional delay, then the output is pulsed for a specified time. A trigger is a leading edge on an input signal, that is a transition from 0V to 5V on the input.

Each output operates asynchronously. For example, one output can be pulsing while the other is triggered or has a different output current selected. Both outputs can be triggered off the same input.

9.3.1 Continuous Output and Selected Continuous Output

In mode “CON” the output current is fixed and continuous.

For selected continuous output the current is constant. The amount of current is selected using one or both digital inputs.

Mode “SE 1” uses INPUT1 to select between two current values. When INPUT1 changes state the output current changes. Mode “SE 2” uses INPUT2 to select between two output currents. Mode “SE12” uses the four combinations of INPUT1 and INPUT2 to select between four different output currents.

| Mode | Inputs | Output |
|------|--------------------|-------------------|
| CON | Don't care | Current setting 1 |
| SE 1 | INPUT1=0 | Current setting 1 |
| | INPUT1=1 | Current setting 2 |
| SE 2 | INPUT2=0 | Current setting 1 |
| | INPUT2=1 | Current setting 2 |
| SE12 | INPUT2=0, INPUT1=0 | Current setting 1 |
| | INPUT2=0, INPUT1=1 | Current setting 2 |
| | INPUT2=1, INPUT1=0 | Current setting 3 |
| | INPUT2=1, INPUT1=1 | Current setting 4 |

9.3.2 Pulsed Output

The output is off by default. When a trigger is received on one of the digital inputs, the PP600 will wait for a delay period and then pulse the output. The delay period, pulse width and pulse current are all configurable.

Mode “PU 1” will trigger from INPUT1, mode “PU 2” will trigger from INPUT2 and mode “PU12” will trigger on either input. Triggers occur on the leading edge of the input, that is on the transition from 0V to (for example) 5V input

9.3.3 Simple and Extended Set Ups

There are two ways to set up the PP600 – Simple and Extended. Simple Set Up can be used to set up:

- Continuous output in milliamps
- Pulsed output up to 99ms

Simple Set Up cannot be used to set up:

- Continuous output in steps of 0.25mA
- Continuous output, selected by digital input
- Setting current protection

Extended Set Up can be used to set all features but is slightly more difficult to use.

9.3.4 Current Protection

Current protection can be used to provide the LED loads protection from being overdriven. This is not absolute protection but does provide some safety when setting up the PP600.

Use Extended Set Up to set the maximum current rating for each output channel. The PP600 will then ensure that the current, averaged over approximately 200ms, to the LEDs does not exceed the rating.

If the rating is exceeded, the output is turned off and the display shows “EC 1” or “EC 2” to show which channel has exceeded its rating. If one of these messages is displayed press the SELECT button to clear it.

Note that after a cold boot (and the factory default) the maximum rating is set to 4A.

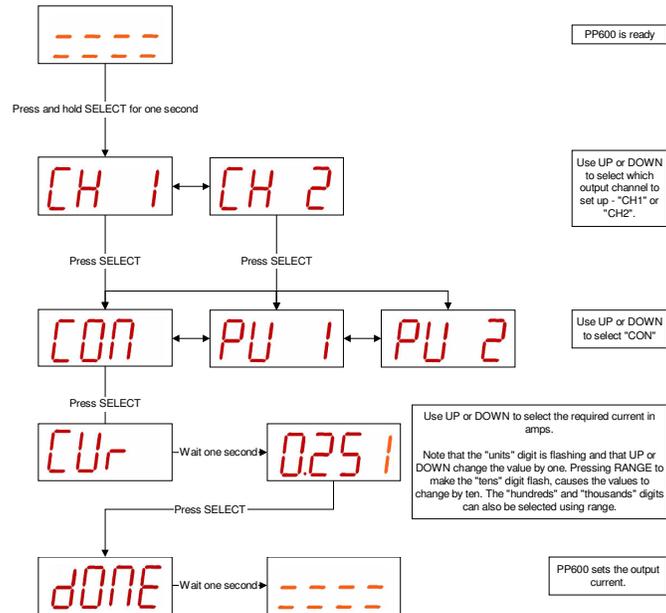
9.3.5 Setting Numeric Values

When the PP600 displays numeric values for the user to change, the right hand digit will be flashing to indicate that the Up and Down buttons change the lowest digit. Pressing the Range button selects another digit to flash, which will then be change when Up or Down are pressed.

9.3.6 Setting Up Continuous Output

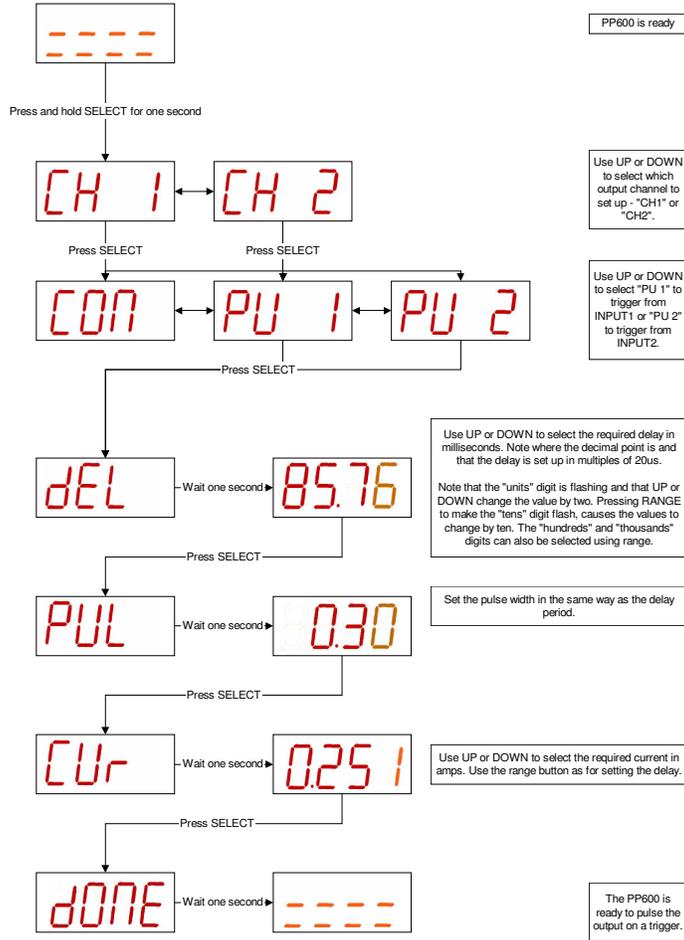
Continuous output can be set up using Simple Set Up.

Set up continuous mode as follows. Note that pressing and holding MODE at any time will cancel the operation. Do not set the output current higher than the rating for the LEDs.

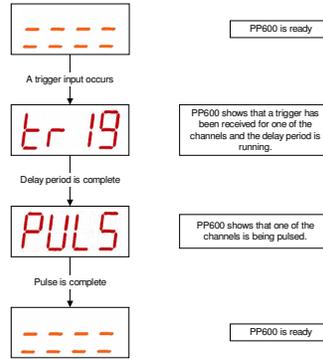


9.3.7 Setting Up Pulsed Operation

Pulsed operation can be set up using Simple Set Up.



When the lights are pulsed, the display shows that a trigger has occurred as follows.

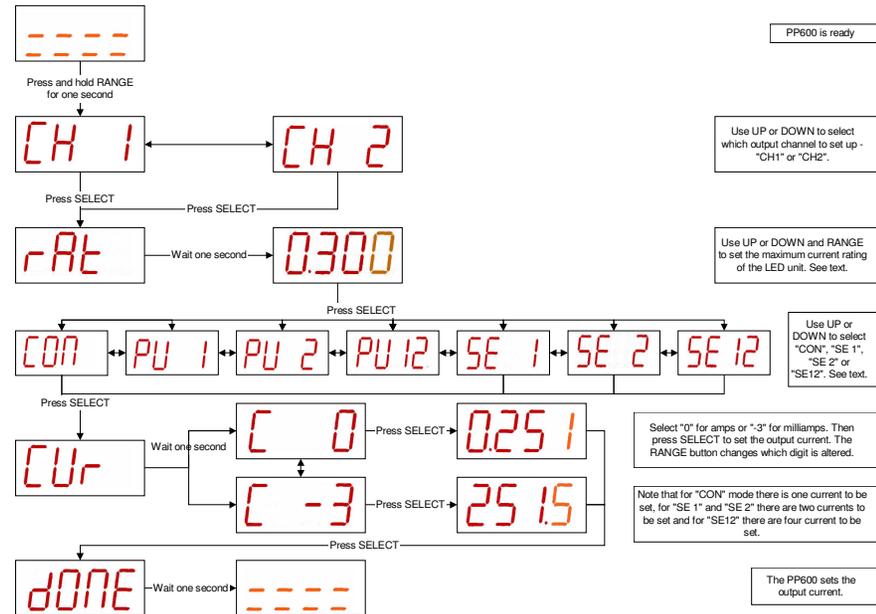


9.3.8 Extended Set Up

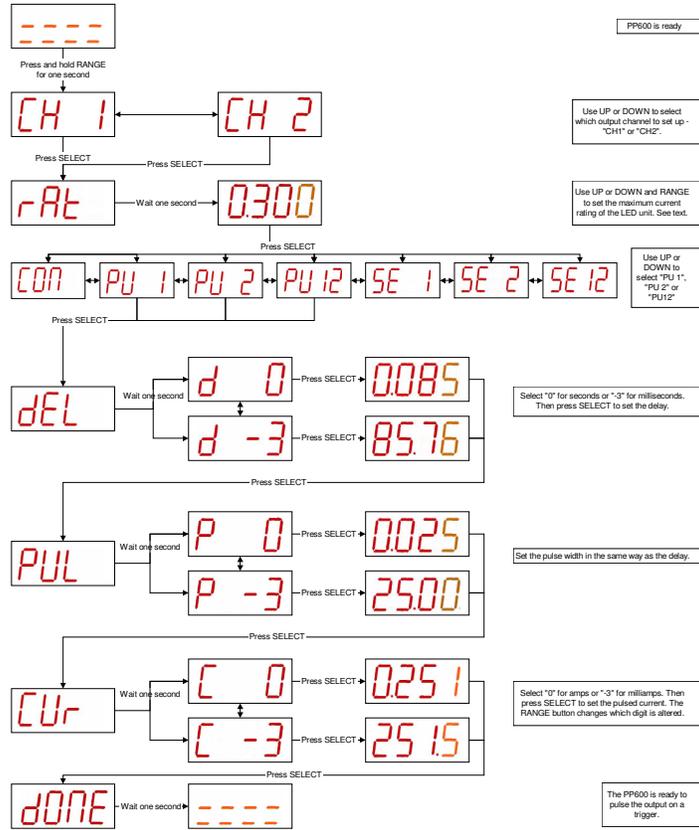
Extended Set Up allows all the features of the PP600 to be set up. It is entered by holding the RANGE button down for one second.

In order for the whole range of timing values to be entered, it is necessary to specify whether the delay is in seconds or milliseconds. This is done by selecting an exponent of "0" (for seconds) or "-3" for milliseconds. The same applies for setting currents. See the diagrams below for how this works.

Continuous output is set up as follows. Extended setup allows the current to be set up in steps of 0.25mA, where as Simple Set Up only allows 1mA steps.



Extended Set Up can be used to set pulsed output as follows.



10 PP610 and PP612

10.1 Command Structure

The PP610 and PP612 can be programmed via a serial communications link either from within the user's custom code using MSCOMMS32.OCX or using the PP600COM DLL or OCX provided by Gardasoft Vision (see www.gardasoft.com). Alternatively a utility such as HyperTerminal running on a PC can be used to program an individual unit.

The communications port should be set to 9600 baud, no parity, 8 data bits, 1 stop bit.

The commands comprise a code of two upper case letters followed by the parameters (if any) needed for the command. Spaces in the commands are ignored. A carriage return character should be sent to terminate the command.

Some commands need the output or input channel to be specified. For these the channel number, either 1 or 2, immediately follows the two letter command.

Where more parameters are needed, they consist of a single upper case letter defining the parameter, followed by a numeric value.

The numeric values are single digits, with the exception of time and current, which are formatted thus:

Time is defined in milliseconds:

| | |
|------|-------------|
| 0.02 | 20us |
| 8 | 8ms |
| 1300 | 1.3 seconds |

Current is in milliAmps, rounded up to the next multiple of 0.25mA

| | |
|-------|---------|
| 0.2 | 0.25mA |
| 25.7 | 25.75mA |
| 1000 | 1 Amp |
| 10000 | 10 Amps |

The command codes and their meaning are described below. The single upper case letter codes for the parameters are also shown, followed by lower case letters denoting the numeric argument.

All responses from the PP610 are terminated with a '>' character to indicate that the transaction is complete.

If a command is invalid, one of the following error codes is echoed as well as being displayed on the LEDs.

E33 Unrecognised command or parameters.

E44 Illegal mode or channel number in command.

Commands take effect immediately they are issued. Because of this, if the settings are being changed from high current Pulsed Output mode to a Continuous Output mode, it is advisable to set the current values to 0 using the RC command before changing mode. This prevents overload conditions occurring.

Any changes made using RS232 commands are not saved permanently until the AW command has been issued.

10.1.1 General Commands

- **AW** Save the settings to memory.

Syntax: **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.

- **ST** Report the current settings for the outputs

Syntax: **ST**

The 1st and 2nd lines of the response report the output settings. The format is either:

fMmEeVa,b,c,d For Constant or Selected Mode

Or:

fMmEeCaDdelPp For Pulsed Output Mode

Where:

f output channel (1 or 2)

m is one of:

0 Continuous Output

1 Trigger on Input 1

2 Trigger on Input 2

3 Trigger on both inputs

4 Select on Input 1

5 Select on Input 2

6 Select using both inputs

a Output current 1

| | |
|-----|--------------------------------|
| b | Output current 2 |
| c | Output current 3 |
| d | Output current 4 |
| e | Maximum current rating of LEDs |
| p | Pulse width (ms) |
| del | Delay before pulse (ms) |

The 3rd line is for factory use

The 4th and 5th lines are the debounce period for each input

TiDd

Where:

| | |
|---|------------------------|
| I | Input channel (1 or 2) |
| D | Debounce period (ms) |

▪ Example of Reading Settings

If output channel 1 is set up for four currents of 0.25mA, 25.7mA, 0.5A, 1.5A, selected using combinations of inputs 1 and 2 and output channel 2 set up to pulse a current of 5.35A for 100ms, using input 1 as trigger and a delay of 15ms, with a debounce period of 20ms. The result of the ST command will be:

```
01 M 06 E 1000 V 0.2, 25.7, 500, 1500,
02 M 01 E 7000 V5350.0 D 15.0 P 0.10
P1 M 00 U
T01 D 20.00
T02 D 0.00
```

▪ GR Clears error display from LEDs.

Syntax: **GR**

This command has 4 possible responses.

Responses:

| | |
|--------|--|
| > | No overcurrent operation |
| EC1 | Channel 1 has been over current since last GR |
| EC2 | Channel 2 has been over current since last GR |
| ET | The PP600 has overheated and has switched off both outputs |
| EC1EC2 | Both channels have been over current since last GR |

ET response was introduced in firmware revision 017.

VR Report the version of firmware running in the PP610

Syntax: **VR**

Response: version

10.1.2 Continuous Output Mode

In this case the mode of operation is selected and a single current output value defined.

- **RS** Set the mode of operation
 Syntax: **RSfSm**
 Where:
 f = output channel (1 or 2)
 m = 0 for continuous current
- **RC** Set the output current for the selected channel
 Syntax: **RCfCcVvEe**
 Where:
 f = output channel (1 or 2)
 c = output selection (in this case 0)
 v = output current (mA)
 e = (optional) maximum current rating of the LEDs.
 If it is not required, leave the Ee off the command.

- **Example of Continuous Output Mode**

Set a continuous current of 0.5A on output channel 1

RS1S0

Select continuous current

RC1C0V500

Current = 500mA

10.1.3 Selected Continuous Output Mode

In this case the mode of operation is selected and a current output is defined for each output required in the selected mode.

- **RS** Set the mode of operation
 Syntax: **RSfSm**
 Where:
 f = output channel (1 or 2)
 m = 4 for 2 currents selected using input 1
 m = 5 for 2 currents selected using input 2
 m = 6 for 4 currents selected using both inputs
- **RC** Set the current for the selected output channel.
 Syntax: **RcfCcVvEe**
 Where:
 f = output channel (1 or 2)
 c = output selection (0, 1, 2, or 3)

v = output current (mA)

e = (optional) maximum current rating of the LEDs.

If it is not required, leave the Ee off the command.

Note: This command must be sent for all output selections defined by the mode command. If a single input is selected two current settings are needed for selections 0 and 1. If both inputs are selected four current settings are needed for selections 0, 1, 2 and 3.

- **Example of Selected Continuous Output Mode**

Set four currents on output channel 1 of 0.25mA, 25.7mA, 0.5A, 1.5A selected using combinations of inputs 1 and 2.

RS1S6

Use both inputs for selection

RC1C0V0.2

Current0 = 0.25mA

When input 1 is 0 and input 2 is 0

RC1C1V25.7

Current1 = 25.7mA

When input 1 is 0 and input 2 is 1

RC1C2V500

Current2 = 500mA

When input 1 is 1 and input 2 is 0

RC1C3V1500

Current3 = 1.5A

When input 1 is 1 and input 2 is 1

10.1.4 Pulsed Output Mode

- **RT** Set the pulse parameters.

This command sets the trigger source mode of pulsing, the pulse width and delay. The mode can be 1 for triggering on input 1, 2 for triggering on input 1 or 3 for triggering on either input.

Syntax: **RTfMmPpDd**

Where:

f = output channel (1 or 2)

m is the Mode

1 = Trigger on Input 1

2 = Trigger on Input 2

3 = Trigger on both Inputs

p = pulse width (ms)

d = delay before pulse (ms)

- **RC** Set the output current for the selected channel

Syntax: **RCfCvVvEe**

Where:

f = output channel (1 or 2)

c = output selection, in this case 0

v = output current (mA)

e = (optional) maximum current rating of the LEDs.

If it is not needed, leave the Ee off the command.

- **Example of Pulsed Mode**

Set output channel 2 to pulse a current of 5.35A for 100ms triggered by input 1, with a delay of 15ms, a debounce period of 20ms and the maximum current rating of the LEDs is 7A

RT2M1P0.1D15

Pulse channel 2 triggered by input1

delay = 15ms, pulse width = 100us

RC2C0V5350E7000

Current = 5.35A, Max current 7000mA

11 PP602 & PP612

The PP602 and PP612 have the same screw terminals as on the PP600 and PP610. In addition they also have connectors for Japan style lights. Power input and the digital inputs are only available on the screw terminals. The connectors are not labelled on the case. See the diagram below for the layout.

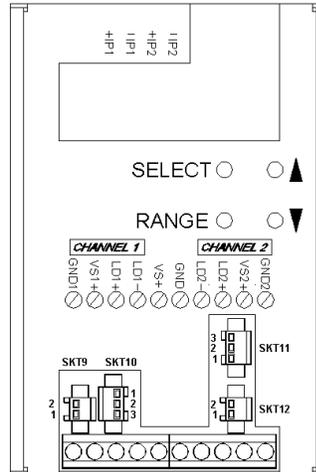
| Connector | Channel | Use |
|-----------|---------|--------------------|
| SKT9 | 1 | 12V lights |
| SKT10 | 1 | 24V and HLV lights |
| SKT12 | 2 | 12V lights |
| SKT11 | 2 | 24V and HLV lights |

12V lights always have a 2 pin connector. 24V and HLV lights always have a 3 pin connector.

Japan style lights are labelled with a voltage and wattage rating, but the PP600 family is constant current supply. To calculate the maximum continuous current that the lights can take apply the following formula:

<Maximum continuous current in Amps>

$$= \frac{\text{<Rated wattage in Watts>}}{\text{<Rated voltage in Volts>}}$$



A. Timing

The following timings apply for PP600 V017.

A.1 Selected Continuous Mode

The maximum delay from an input changing to the output current changing is 500us.

A.2 Pulse Mode

For short delays and pulse widths the actual timings are repeatable but not exact. Timings are dependent on the output current as described in the two tables below.

The timings given are for channel 1 and assume a trigger input signal of 5V. The delays are about 8us shorter for a 24V trigger input. The delays for channel 2 will be greater. All times are in microseconds.

| Programmed | | Actual timing Output current = 100mA | | Actual timing Output current = 1 A | |
|------------|-------------|---|-------------|---------------------------------------|-------------|
| Delay | Pulse Width | Delay | Pulse Width | Delay | Pulse Width |
| 20 | 20 | 41 | 11 | 29 | 23 |
| 20 | 40 | 41 | 30 | 29 | 41 |
| 40 | 20 | 58 | 14 | 48 | 22 |
| 40 | 40 | 58 | 32 | 48 | 40 |
| 60 | 60 | 72 | 52 | 61 | 62 |
| 100 | 100 | 112 | 92 | 101 | 102 |

Variations in the delay and pulse widths are caused when events happen on both channels simultaneously. Without simultaneous events, the variation is +/- 1us.

B. Error Codes

Error codes may be displayed by the PP600. These are shown as “E nn”, where nn gives the number of the error. To cancel the error message, press “SELECT”. The error codes are:

- EC 1, EC 2
The current to one of the outputs has been turned off because the maximum output energy has been exceeded. To fix this, reduce the pulse width or increase the maximum output energy allowed.
- Et (**introduced in firmware revision 017**)
The PP600 has a thermal cutout. If the internal temperature reaches 62°C, which corresponds to a case temperature of approximately 70°C, the output currents are turned off. This message will persist until the PP600 has cooled down below 62°C.
- E 16
When the unit has powered up the non-volatile memory was corrupt and has been cleared. Set up the unit again.
- E 25, E 26
The PP600 is calibrated during manufacture. This stored calibration has become invalid. Make a note of the number and contact your distributor.
- E 00, E 01, E 02, E 03, E 04, E 05, E 06, E 07, E 18, E 42, E 43
A hardware error has occurred. Try power cycling the unit and trying again to see if the fault clears. If not, make a note of the number and contact your distributor.
- E 33, E 44, E 49, E51
A serial command has been received which is invalid. E 33 is generated if the command format is wrong and the other messages if a parameter has an illegal value. Correct the command and re-send it. If these errors are intermittent then check the integrity of the serial link.
Note that these error messages are also output on the serial port but the number is sent in hexadecimal, so the four errors are sent as “E21”, “E2C”, “E31” and “E33” respectively.
- E 17, E 40, E 41, E 64, E 65, E 67, E 74
An internal software error has occurred. Make a note of the number and contact your distributor.

Gardasoft LED Lighting Controllers

The following products are available at the time of writing. New products will be introduced. See www.gardasoft.com for details of the current range.

PP600 Range

- 2 output channels up to 10A each
- 2 digital inputs

PP600 Lighting controller
PP602 Lighting controller with Japan style connectors
PP610 Lighting controller with RS232
PP612 Lighting controller with Japan style connectors and RS232

PP701 DIN Rail mounting clip for PP600 and PP600F range

PP600F Range

- Same as the PP600 range but with fast pulsing
- Pulse delay from 10us to 9.9ms in 1us steps
- Pulse width from 1us to 9.9ms in 1us steps

PP600F Lighting controller
PP602F Lighting controller with Japan style connectors
PP610F Lighting controller with RS232
PP612F Lighting controller with Japan style connectors and RS232

PP900 Range

- 1 output channel up to 1A
- Safe-Sense autosensing (patent pending)
- Lighting fault detection
- Light sensor input

PP900 Lighting controller
PP910 Lighting controller with RS232

PP860

- High current, high accuracy controller
- 8 output channels up to 20A each
- Pulses accurate to 0.1 microseconds
- RS232 configuration