Choosing a controller

If a simple controller is required which meets the following requirements then an RT220-20 is recommended:

- Lighting rating up to 0.5A or up to 12W
- One or two lights
- Continuous output or pulsing up to 100Hz

Otherwise the questions below are designed to help choose a lighting controller. Gardasoft provide a wide range of products and provide the highest performance possible.

In most cases the RT controllers are the best choice for Systems Integrators and PP controllers for OEMs.

For the following situations, it is recommended that Gardasoft is consulted:

- Pulse currents of 10A or more
- Continuous currents of 3A or more
- Average output power of 20W or more
- Trigger rates > 1KHz
- Any unusual requirements

A list of all controllers can be downloaded from here:

www.gardasoft.com/LED-Controllers/

Range characteristics

The general characteristics of each range are summarised here:	
RCxxx RTxxx Ideal for systems integrators wanting to drive a light	SafeSense™ technology: light detection, error detection, safe overdriving. SafePower™ technology: more flexible power supply choice, low heat dissipation. Some limits on high power output Pulsing up to 1KHz. Can take time to retrain when the configuration changes (maybe 300ms).
PP5xx PP4xx Ideal for system integrators and OEMs wanting fast configuration changes for a small number of lights	SafeSense™ technology: light detection, error detection, safe overdriving. No SafePower™ technology: power supply voltage needs to be greater than lighting voltage. No theoretical limits on high power output, but need to check heat dissipation (Gardasoft can help). Pulsing up to 50KHz. Instant configuration changes.

The general characteristics of each range are summarised here:	
PP8xx PP16xx Ideal for systems requiring high performance, high frequency, high current output. Also ideal for systems with many lights.	No SafeSense™. Power output is set directly with no limitation.No lighting error detection. No SafePower™ technology: power supply voltage needs to be greater than lighting voltage. No theoretical limits on high power output, but need to check heat dissipation (Gardasoft can help). Large current storage for high frequency, high current pulses. Pulsing up to 100KHz. Instant configuration changes.
HTxxx Ideal for systems needing high average power output	SafeSense™ technology: light detection, error detection, safe overdriving . SafePower™ technology: more flexible power supply choice, low heat dissipation. Up to 150W average power output. Pulsing up to 1KHz. Can take time to retrain when the configuration changes (maybe 300ms).

How many lights need to be driven?	
Choose between 1, 2, 4, 8, 16 channel controllers	
<= 16	PP16xx
<= 8	PP8xx, RT8xx
<= 4	PP4xx, RT4xx
<= 2	PP5xx, RT2xx
1	RCxxx

What output current is needed?

What is the current rating of the lighting?

What is the voltage rating of the lighting?

The controller needs to be able to supply at least the highest current rating of the lights connected to it.

It is usually best to choose a controller with enough pulse current for the highest current that will be used, including overdriving. This will give the most stable light output and smallest steps in output current. For example if four lights are to be driven at up to 1.5A, then the RT420-2 could be used instead of the RT420-20.

For most controllers the maximum pulse current is divided into 3600 steps to give the resolution of the output current.

For PPxxx controllers it is necessary to use a power supply voltage greater than the maximum lighting voltage needed. When overdriving, normally a 48V supply is needed. See the heat dissipation application notes.

For RTxxx, RCxxx, HTxxx controllers usually any power supply voltage can be used with any light.

RCxxx cannot overdrive 24V lights very much. Depending on the light 200% might be possible.

Do not connect lights which have an internal power supply or controller to a lighting controller as this will not work correctly.

Pulse or continuous current?	
Max pulse current required?	
<= 50A	HTxxx
<= 20A	PP8xx, pp16xx, RTxxx (<400µs)
<= 10A	PP5xx, PP4xx
Max continuous current required?	
<= 5A	HTxxx
<= 3A	RTxxx
<= 2A	PP5xx, PP4xx, PP8xx, PP16xx
<= 1A	All controllers

Is overdrive needed?

» For PP controllers this helps determine the minimum the PSU voltage, which must be at least 2V higher than the required lighting voltage. When overdriving the required voltage is difficult to estimate but as a rough idea:

<*required voltage*> = <*voltage rating*> x (<*overdrive percent*> / 300 + 0.66)

"*overdrive percent*" is the percentage of normal brightness, so 100% is normal brightness and 400% is overdriving 4 times. For example a 24V light driven at 400% might require 48V.

» RT controllers can use any voltage from 24V to 48V. The average output power must be <= 30W per channel.

Is remote control from a PC or other device needed?

Choose between front panel, Ethernet or RS232 configuration.

Is a multiple light assembly being used?

» Multiple lights can be connected in parallel to one channel if they are identical and don't need independent control.

- RT controllers need 2 separate wires for each light. Lights on different channels must not have any common connection.
- PP controllers can drive common-anode lights.
- Gardasoft does not produce a controller that can drive common-cathode lights.

What approximate pulse width is required?	
Any pulse width from 1µs	RTxxxF
	PP5xxF
	PP4xxF
	PP8xx
	PP16xx
	HTxxx
≥ 20µs in steps of 20µs	RT8xxx
	PP5xxx
	PP4xxx
100µs to 100ms in steps of 100µs	RCxxx

Are triniti features needed?

Usually this would be because:

- The GigE Vision protocol is needed.
- The controller is driving a Triniti light.
- Triniti software support will be used, such as the C++, .NET SDK, Vision Utility.

Would it help to have camera triggers or other digital I/O?

Some controllers have CC functions which provide:

- Trigger timing functions like the CC320 or a PLC
- Very flexible timing
- Camera trigger outputs
- Part sensor inputs
- Encoder input
- Other digital I/O functions

What is the maximum trigger frequency?	
Depending on conditions, the approximate maximum trigger frequencies are as shown below. These are ideal and may not be achieved for all cases.	
RCxxx	100Hz
RTxxx	1kHz (for pulse widths ≥ 150µs)
PP5xx	50kHz
PP4xx	50kHz
PP8xx	100kHz
PP16xx	100kHz
HT	100kHz

Are special firmware features needed?

	S15 Sequences of pulses where the brightness can be changed for each step	S69 Sequences of pulses where the pulse width can be changed for each step	S52 Lights are pulsed in rotation
RCxxx	No	No	No
RTxxx	No	No	No
PP5xx, PP4xx	Yes (up to 200Hz)	No	Yes (up to 10kHz)
PP8xx	Yes (up to 200Hz)	Yes (up to 50kHz)	No
PP16xx	Yes (up to 200Hz)	Yes (up to 50kHz)	No
HTxxx	No	No	No

What quantity of controllers are required?

Most OEMs use PPxxx controllers as they are lower cost than the RTxxx controllers. Most systems integrators use the RT controllers as they are more flexible about the power supply voltage.

Specification checklist

- For PP controllers at high currents, check the heat dissipation with the relevant Gardasoft application note. Suggest heatsinking if necessary
- For PP controllers check that the PSU voltage is high enough for the lighting, especially when overdriving
- Check that the PSU can deliver enough current
- Check that trigger signals to the controller are 3V to 24V at 3mA

Summary of characteristics

	RC1x0	RC122	RT2xx	RT4xx	RT8xx	PP5xx	PP4xx	PP8xx	PP16xx	HTxxx
Number of lighting channels	1	1	2	4	8	2	4	8	16	2
Max continuous current	1.2A	2A	3A	3A	3A	2A	2A	2A	2A	5A
Max pulse current	2A	7A	2A/20A options	2A/20A options	2A/20A options	10A	10A	2A/5A/20A options	2A/5A/20A options	50A
Modes: C = continuous P = pulse O = switch S = selected	CPOS	CPOS	CPOS	CPOS	CPOS	CPO	CPO	CPO	CPO	CPO
SafeSense	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes
SafePower	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes
Triniti version	Yes	triniti only	Yes	Yes	Not yet	No	No	Not yet	Not yet	Yes
Configuration options	Ethernet, front panel	Ethernet, front panel	Ethernet, RS232, front panel	Ethernet, RS232	Ethernet, RS232	Ethernet, front panel	Ethernet	Ethernet, RS232	Ethernet, RS232	Ethernet, RS232, front panel

Choosing a controller

	RC1x0	RC122	RT2xx	RT4xx	RT8xx	PP5xx	PP4xx	PP8xx	PP16xx	HTxxx
GigE Vision protocol	On TR	On TR	On TR	On TR	On TR	No	No	No	No	Yes
Tandem channels	N/A	N/A	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Number and type of trigger inputs	1 smart input	1 smart input	2 opto	4 opto	8 opto	2 opto	4 opto	8 opto common cathode	8 opto common cathode	4 opto
Max theoretical output power per controller	25W	30W	40W	50W	100W	96W	96W	576W	576W	300W
Max trigger frequency	100Hz	100Hz	1kHz for pulses >150µs	1kHz for pulses >150µs	1kHz for pulses >150µs	50kHz	50kHz	100kHz	100kHz	100kHz
Min pulse width	100µs	100µs	20µs, 1µs Pulses <150µs limited tp lower-frequency	20µs, 1µs Pulses <150µs limited tp lower-frequency	20µs, 1µs Pulses <150µs limited tp lower-frequency	20µs, 1µs	20µs, 1µs	1µs	1µs	1µs
Fast pulse (<20µs) option	N/A	N/A	Yes	Yes	Yes	Yes	Yes	Standard	Standard	Standard

	RC1x0	RC122	RT2xx	RT4xx	RT8xx	PP5xx	PP4xx	PP8xx	PP16xx	HTxxx
Max output voltage	32V	48V	46V but 40V more practical	46V but 40V more practica	46V but 40V more practica	48V, must be less than PSU voltage	48V, must be less than PSU voltage	48V, must be less than PSU voltage	48V, must be less than PSU voltage	72V but 66V more practical
PSU voltage	24V	24V	24-48V	24-48V	24-48V	24-48V	24-48V	24-48V	24-48V	24-48V
Max theoretical power per channel	25W	30W	30W	30W	30W	96W	96W	96W	96W	150W
Max allowed heat dissipation with DIN rail mount	N/A	N/A	See APP954	See APP954	See APP954	8W, see APP926, APP939	8W, see APP951	16W, see APP918, APP941	16W, see APP977	N/A
Max allowed heat dissipation with panel mount	N/A	N/A	See APP954	See APP954	See APP954	24W, see APP926, APP939	24W, see APP951	32W, see APP918, APP941	32W, see APP977	N/A
Fast configuration change	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes

	RC1x0	RC122	RT2xx	RT4xx	RT8xx	PP5xx	PP4xx	PP8xx	PP16xx	HTxxx
CC functions	No	No	No	RTCC option with full CC operations. 4 open collector outputs	No	No	No	No	Option. Simple functions. 8 TTL outputs	Full CC operations. 4 open collector outputs
Lighting connector (non-triniti)	Pluggable screw terminal	N/A	Pluggable screw terminal	Pluggable screw terminal	Pluggable screw terminal	Screw terminal	Screw terminal	Pluggable screw terminal	Pluggable screw terminal	Pluggable screw terminal
Lighting connector (triniti)	triniti M12	triniti M12	triniti M12	triniti M12	N/A	N/A	N/A	N/A	N/A	Pluggable screw terminal
Driving common anode lights	No	No	No	No	No	Yes	Yes	Yes	Yes	No
Mechanical size (excluding DIN rail clip)	104mm x 35mm x 120mm	104mm x 58mm x 120mm	112mm x 97mm x 62mm	159mm x 97mm x 62mm	267mm x 97mm x 62mm	118mm x 76mm x 27mm	118mm x 76mm x 27mm	215mm x 54mm x 86mm	280mm x 54mm x 78mm	256mm x 140mm x 61mm
Mounting	DIN rail only	DIN rail only	DIN rail or panel mount	DIN rail or panel mount	DIN rail or panel mount	DIN rail or panel mount	DIN rail or panel mount	DIN rail or panel mount	DIN rail or panel mount	Panel mount only

	RC1x0	RC122	RT2xx	RT4xx	RT8xx	PP5xx	PP4xx	PP8xx	PP16xx	HTxxx
DIN rail kit	Included as standard	Included as standard	PP706	PP706	PP706	PP701	PP701	PP705	PP705	N/A

Weblinks			
RC1xx	http://www.gardasoft.com/LED-Controllers/RC-Series/	PP5xx	http://www.gardasoft.com/LED-Controllers/RT-PP/PP500.aspx
RT2xx	http://www.gardasoft.com/LED-Controllers/RT-PP/RT200.aspx	PP6xx	http://www.gardasoft.com/LED-Controllers/RT-PP/PP600.aspx
RT4xx	http://www.gardasoft.com/LED-Controllers/RT-PP/RT400.aspx	PP8xx	http://www.gardasoft.com/LED-Controllers/RT-PP/PP800.aspx
RT8xx	http://www.gardasoft.com/LED-Controllers/RT-PP/RT800.aspx	PP16xx	http://www.gardasoft.com/LED-Controllers/RT-PP/PP1600.aspx
RTCC4xx	http://www.gardasoft.com/LED-Controllers/RTCC4/	PPCC16xx	http://www.gardasoft.com/LED-Controllers/RT-PP/PPCC16.aspx
PP4xx	http://www.gardasoft.com/LED-Controllers/RT-PP/PP400.aspx	HTxxx	http://www.gardasoft.com/LED-Controllers/TR-HT/

Technical details

PP advantages over RT, RC, HT controllers

When to use a PPxxx rather than an RTxxx, RCxxx, or HTxxx controller. SafePower™ is a very flexible technology, but there are some times when a non-SafePower™ controller will have advantages.

Feature	
Power output	The RT/RC is restricted to 25W/30W output. The power output is lower at some points. When the power supply voltage and lighting voltage are close together then the output power could be reduced. For LED voltages less than 5V it might not be possible to get the full 3A output. The PP controllers are not restricted by the output power, but do have restrictions on internal heat dissipation. See APP918, APP926.
Pulses less than 150µs	For pulses less than 150us, the RT/RC/HT controllers cannot measure the LED voltage and so has to take a pessimistic view. This means that it sets very safe limits for the duty cycle, resulting in a low trigger rate. Approximately: *<max duty cycle (%)> = 3 / <pulse current (A)>*
Trigger frequency	The RT/RC/HT controllers are limited to a trigger frequency of 1KHz. PP5xx, PP4xx controllers can be triggered at 50KHz. PP8xx, PP16xx controllers can be triggered at 100KHz.
Fast intensity changes	The PP controllers can change the intensity in approximately 3ms. The RT/RC/HT controllers can take up to 500ms to adjust intensity. APP981 has information on a way to speed up intensity change for RT controllers.
High current pulses	On the RT/RC controllers there is a limit on the pulse width for high current pulses: 20A pulses — Maximum 100us 12A pulses — Maximum 400us 10A pulses — Maximum 1ms 5A pulses — Maximum 3ms For comparison PP controllers can output 10A or 20A pulses for long pulses, as long as the power supply can supply the current. In addition, the PP8xx and PP16xx have internal storage and can output up to 20A for 4ms without requiring a high current power supply.

Tandem channels

Tandem channels means converting two or more channels in parallel. It is a way of getting more power or pulse current for a light.

RTxxx, HTxxx	Up to 4 channels can be connected in parallel. Gardasoft can supply instructions.
PP5xx, PP4xx	Cannot have channels connected in parallel.
PP8xx, PP16xx	Channels can be connected in parallel and no special precautions are needed.

triniti compatibility

Product	SDK	Dalsa Sherlock support	Property grid/ lighting manager	Vision Utility and LabVIEW support	triniti lighting	GigE Vision protocol
TR-RT2xx	Yes	Yes	Yes	Yes	Yes	Yes
TR-RCxxx	Yes	Yes	Yes	Yes	Yes	Yes
RCx2x	Commands only SDK Q1 2018	Q1 2018	Q1 2018	Q1 2018	No	No
RTx2x	Yes	Yes	Yes	Yes	No	No
RTx6x	No	No	No	No	No	No
PP82x	Commands only SDK Q1 2018	No	No	No	OEM requests only	Q2 2018
PP162x	Commands only SDK Q1 2018	No	No	No	OEM requests only	Q2 2018
PP5xx, PP4xx	Commands only SDK Q1 2018	Q1 2018	Q1 2018	Q1 2018	No	No
TR-HTx2x	Yes	Yes	Yes	Yes	Yes	Yes
TR-HTx6x	No	No	No	No	Yes	No

Timing details

Controller	Timing range	Step size	Minimum delay	Timing jitter
RTxxx HW01 serial numbers 41xxxxx	20µs to 13ms	20µs	20µs	0.2µs
	13ms to 400ms	20µs	20µs	6.4µs
	400ms to 1s	100µs	20µs	100µs

Controller	Timing range	Step size	Minimum delay	Timing jitter
RTxxx HW02 serial numbers 68xxxxx	20µs to 930µs	20µs	20µs	0.1µs
	930µs to 230ms	20µs	20µs	4µs
	230ms to 1s	100µs	20µs	100µs

Controller	Timing range	Step size	Minimum delay	Timing jitter
RTxxxF HW02 serial numbers 68xxxxx	0 to 930µs	0.1µs	4µs to 10µs	0.1µs
	930µs to230ms	4µs	4µs to 10µs	1µs
	230ms to 1s	100µs	4µs to 10µs	100µs

Controller	Timing range	Step size	Minimum delay	Timing jitter
RC120	0µs to 1ms	100µs	4µs to 10µs	0.1µs
	1ms to 65ms	100µs	4µs to 10µs	1µs
	65ms to 100ms	100µs	4µs to 10µs	100µs

Controller	Timing range	Step size	Minimum delay	Timing jitter
PP5xx, PP4xx	20µs to 5ms	20µs	20µs	0.1µs
	5ms to 100ms	20µs	20µs	2.6µs
	100ms to 3s	100µs	20µs	100µs

Choosing a controller

Controller	Timing range	Step size	Minimum delay	Timing jitter
PP5xxF, PP4xxF	0µs to 5ms	0.1µs	4µs to 10µs	0.1µs
	5ms to 100ms	2.6µs	4µs to 10µs	2.6µs
	100ms to 3s	100µs	4µs to 10µs	100µs

Controller	Timing range	Step size	Minimum delay	Timing jitter
PP8xx	0µs to 1ms	0.1µs	4µs to 10µs	0.1µs
	1ms to 160ms	2.6µs	4µs to 10µs	2.6µs
	160ms to 5s	100µs	4µs to 10µs	100µs

Controller	Timing range	Step size	Minimum delay	Timing jitter
PP16xx	0µs to 1ms	0.1µs	4µs to 10µs	0.1µs
	1ms to 250ms	4.3µs	4µs to 10µs	4.3µs
	250ms to 5s	100µs	4µs to 10µs	100µs

Controller	Timing range	Step size	Minimum delay	Timing jitter
HTxxx	0µs to 930µs	0.1µs	4µs to 10µs	0.1µs
	930µs to 230ms	4µs	4µs to 10µs	4µs
	> 230ms	100µs	4µs to 10µs	100µs

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