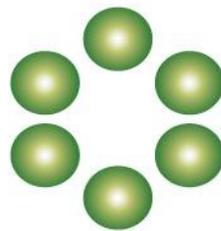


**Model RL16QT / RL28QT / RL16XT / RL28XT
Ring Light with QD02 Controller**

User Guide | Version 1.0.0 | December 2015



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Introduction

Orled models RL16QT, RL28QT, RL16XT and RL28XT are compact, rugged, high intensity LED ring lights with patented laser targeting crosshairs (XT models) and independent light quadrants. LED light is refracted through an innovative optical system to provide up to 85,000 lux, and Fresnel optics are used to evenly distribute the light and reduce surface reflections. The body is sealed against dust and splattering fluids. A high performance heat exchanger cools the state-of-the-art, high-intensity LEDs to ensure long lifetimes.



Orled's advanced ring light controller, model QD02, is included with every ring light. The controller can activate any combination of light quadrants to provide uniform lighting or create highlight shadows. Two illumination modes and eight brightness levels allow lighting to be optimized for both direct optical viewing and electronic imaging. Ultra-bright strobed operation is also supported, with precise timing control and software and hardware triggering. The controller has a solid-state touchpad for manual control and USB for remote control and advanced configuration.

Excellent reliability, flexible lighting control, and environmentally sealed construction make these ring lights ideally suited for a broad range of manual and automated lighting applications.

Included equipment

- RL16QT, RL28QT, RL16XT or RL28XT ring light with three soft-point set screws
- QD02 ring light controller
- 9015C1 ring light cable; connects QD02 to ring light
- AC adapter with cable
- 9015C3 USB cable; connects QD02 to a computer

Optional accessories

- **Polarizer:** The ring light can be supplied with built-in polarizer film and an analyzer filter (shown at right). This feature reduces glare from shiny surfaces and allows inspection of details and defects that would otherwise be concealed by reflected light. The analyzer filter screws into threads in the ring light body. The polarizer film must be factory installed; please specify this option when ordering.
- **Dark field adapter:** Orled's dark field adapter refracts the light from the ring light so as to illuminate the subject from the edge. As a result, the observer will see a subject with illuminated edges on a black background. This is an excellent and indispensable tool for inspecting edge detail and viewing defects within transparent objects.
- **Strobe trigger cable (9015C2):** This cable connects a camera to the QD02 controller so that the camera can trigger ring light strobes. One end of the cable plugs into the QD02 external trigger input connector; the other end plugs into the PC socket found on most camera hot-shoe adapters.



Installation

Mounting

In many cases, the ring light can be mounted to a microscope or other optical system with the three included soft-point set screws. These fasteners (shown at right) are designed to secure the ring light to the optical system without marring or otherwise damaging it. This mounting method accommodates a range of optical system diameters.



There are also four #4-40 threaded holes in the rear of the ring light that can be used for custom mounting solutions. Contact Orled technical support for detailed information and instructions.

Ring light	Mounting diameter	Lens diameter
RL16X	2.1" to 3.0"	62 mm
RL28X	3.8" to 4.7"	105 mm

The inside diameter of the ring light body is threaded and sized to accept a standard lens filter (commonly used to protect a microscope objective or camera lens).

Controller address

It is not necessary to connect the QD02 light ring controller to a computer unless it will be remotely controlled or you must configure advanced settings such as illumination mode or strobe timing. If USB is not used, or if only one QD02 will be connected to your computer then you may disregard this section.

One computer can control up to eight ring lights over USB. The computer communicates with a particular ring light via its address, which is determined by the position of the QD02 device address switch. The address may be set to any value between zero (factory default) and seven by rotating the device address switch with a small screwdriver .



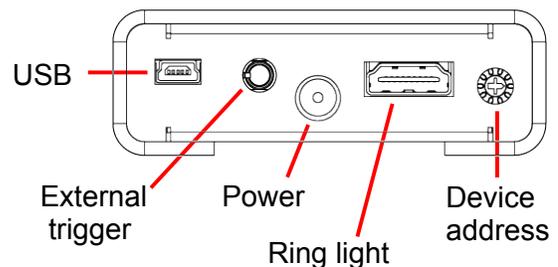
Do not use addresses above seven (reserved for factory use)

If a computer will control multiple ring lights then each QD02 must be assigned a unique device address. This is done by setting the device address switches so that every QD02 has a different address setting.

Electrical connections

Perform these steps to prepare the QD02 for operation:

1. Connect the QD02 to the ring light with the 9015C1 cable.
2. Plug the power adapter's cable into the QD02 power connector.
3. If the ring light will be controlled or monitored by a computer, connect the QD02 to the computer with the 9015C3 cable. [Set the device address](#) as necessary.
4. If a camera or other device will be used to control flash strobing, connect it to the external trigger input with a 9015C2 cable (optional; not included).
5. Plug the power adapter into a 100-240 VAC, 50/60 Hz power outlet.



Operation

Control methods

The ring light may be controlled manually from the QD02 keypad or by a computer through USB. It is possible to use both control methods at the same time, but this is not recommended because unexpected keypad activity might interfere with automated computer control of the ring light system. An external signal can be used to initiate light strobes when the controller is operating in the [strobe illumination mode](#).

Illumination modes

The QD02 controller has three ring light illumination modes: two that produce steady-state light (constant color, constant light) and one for generating flash strobes. The mode can be changed through the USB interface.

 *The factory default mode is constant color*

Constant color (digital) mode

In constant color mode the brightness is controlled by digitally modulating the LED current. This results in a consistent color spectrum at all intensity levels, and allows for a full range of intensity levels.

Digital modulation causes the LEDs to rapidly flash on and off. This flashing is too fast to be seen by the human eye, but some cameras are sensitive to it. In the case of video cameras, flash sensitivity typically causes uneven or fluctuating brightness in the displayed video. If you encounter this problem, consider these solutions:

- Switch to the QD02's constant light mode; this will eliminate all interference.
- Close the camera's iris as much as possible (and increase ring light intensity to compensate).
- Enable the camera's flicker reduction mode. Cameras employ various methods to reduce flicker, so results can vary. Some manufacturers use alternative terminology for this function, and some cameras do not support this feature; refer to your camera documentation for details.

Constant light (analog) mode

In this mode the brightness is controlled by linearly regulating the LED current, resulting in continuous light with variable brightness. This causes the color temperature to change slightly as the intensity changes, but eliminates any possibility of camera interference.

The ring light cannot be fully dimmed in constant light mode. Consequently, the intensity range is limited in this mode, thus making one or more of the lowest intensity levels unavailable (*i.e.*, the ring light will not visibly dim when a lower level is selected). The number of unavailable levels depends on the [maximum intensity](#) setting: at 100% (factory default setting), the two lowest levels will be unavailable; additional levels will become unavailable as the maximum intensity decreases.

Strobe mode

The ring light LEDs are strobed in this mode, meaning they emit light for only a brief, precisely timed interval (the [strobe duration](#)). In strobe mode, the controller keeps the LEDs turned off while it waits for a trigger. When triggered, it pauses for a specific length of time (the [trigger delay](#)) and then turns on all enabled quadrants, to a brightness that exceeds the maximum level available in constant color or constant light modes. The strobe duration and trigger delay are USB configurable.

 *Strobe triggers are ignored in constant color and constant light modes*

Strobes can be triggered by USB command or by signals applied to the QD02's trigger input connector. The trigger input circuit detects closure of an external mechanical contact such as the shutter switch in a camera, which is typically accessible through a hot-shoe connector. Applications include stop motion photography, balance calibration, and analysis of vibration and cyclical motion.

Intensity range

When the QD02 is operating in constant color or constant light mode, the keypad or USB can be used to set the LED intensity to any of eight discrete levels. Each level step changes the brightness (as perceived by the human eye) by approximately 12.5%.

In some applications the highest intensity setting may be unusable because it is too bright. In such cases you can [reduce the intensity range setting via USB](#).

The intensity range setting determines the brightness of the highest intensity level as a percentage of maximum possible brightness, and proportionally scales the brightness of the other seven intensity levels. By default this is set to 100% (maximum), meaning that each intensity level is as bright as it can possibly be. Changing it to 50% will cause each intensity level to be half as bright as it would be at 100%.

Quadrant control

Ring light quadrants can be independently enabled or disabled by the keypad or USB. All quadrants are initially enabled when power is first applied to the QD02. This behavior is fixed and cannot be reconfigured.

Only enabled quadrants will emit light. This applies to all illumination modes, including strobe mode. In strobe mode, upon receiving a trigger, the QD02 will only strobe the enabled quadrants.

Laser crosshairs

Ring light models RL16XT and RL28XT utilize built-in laser diodes to generate targeting crosshairs. When the lasers are turned on (via keypad or USB), the QD02 will automatically dim all ring light LEDs so as to enhance crosshair visibility while still providing minimal illumination.

 *Crosshairs are disabled in strobe mode*

The QD02 automatically detects the ring light type. If the ring light has no crosshairs function (*e.g.*, models RL16QT and RL28QT) then the QD02 will disable crosshair control (LEDs will not be dimmed if the user attempts to turn on crosshairs).

Thermal protection

Thermal foldback is used to prevent excessively high ring light temperatures. When any ring light quadrant becomes too hot (*i.e.*, its [thermal foldback threshold](#) temperature is exceeded), the QD02 will assert a Temp (over-temperature) fault and automatically limit light intensity to cool the ring light.

When a Temp fault occurs in the constant color and constant light modes, the QD02 will first reduce the intensity by one step. If necessary, the intensity will be further reduced, one step at a time, until the ring light is no longer too hot. The resulting intensity becomes the new, maximum allowed level; the QD02 will not allow the keypad or USB to set the intensity above this level while a Temp fault is asserted.

In strobe mode, the QD02 will ignore strobe triggers while a Temp fault is asserted.

To clear a Temp fault, turn the QD02 off and then back on. This will restore user control of the full intensity range in constant light/color modes, and re-enable strobe triggering in the strobe mode.

In general, a Temp fault indicates that the ring light may need a cooling air flow (e.g., from a fan) or an external heat sink. In some cases it may be possible to avoid Temp faults by reducing the [intensity range](#).

Fault conditions

Several critical subsystems are monitored by the QD02 ring light controller. If a problem is detected, the controller will notify the user and the external computer (if connected via USB) and attempt to take corrective action. The user is notified by means of flashing indicator lights on the keypad.

Three fault types are recognized and reported by the QD02:

Fault type	Indication on keypad	Problem	Solution
Keypad	All indicators flashing	Hardware malfunction in the solid-state keypad	Disconnect AC power adapter from QD02, then reconnect
Cable	Flashing lightbar	QD02 is disconnected from ring light	Check cable connection
Temp	Flashing quadrant enables	Ring light is too hot	See Thermal protection

Keypad

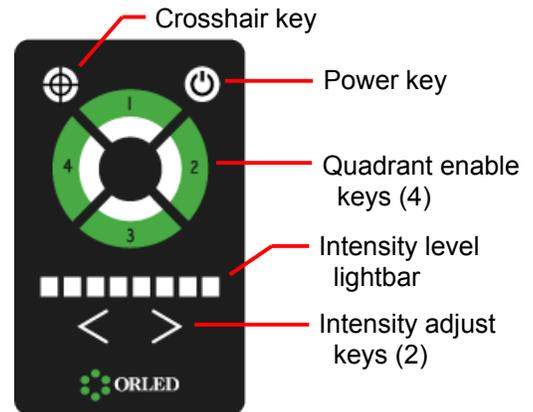
Indicator lights

All keypad indicator lights function as described below, except when lights are flashing (due to a [fault condition](#)).

Power

This key toggles system power on/off. It lights when system power is on. When power is off, all other keys are disabled and the ring light and crosshairs are dark.

 *The QD02 responds to USB when power is off.*



Quadrant enables

These four keys toggle enable/disable of the ring light quadrants. Each key lights when the associated quadrant is enabled.

Intensity adjust

These two keys decrease (<) or increase (>) the brightness of all enabled quadrants. Press a key to step the intensity up or down. To change several steps, press and hold a key until the desired level is reached.

Intensity lightbar

A lightbar is located immediately above the intensity adjust keys. When operating in constant color or constant light mode, the lightbar will indicate the ring light intensity level.

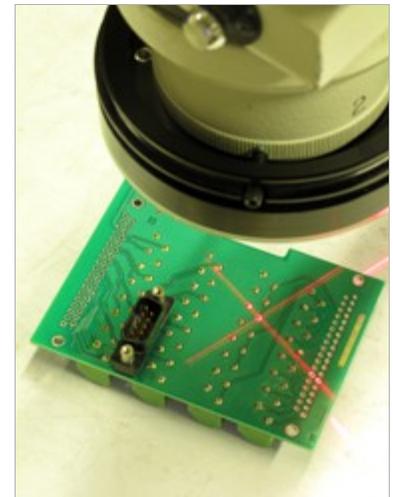
In strobe mode, the lightbar will display a scrolling (“bouncing”) pattern. This is normal and indicates the intensity level cannot be changed (high intensity is always used for flash strobes).

Crosshair

This unlighted key controls the laser crosshairs. When the key is tapped (momentarily pressed), the crosshairs will turn on and then automatically turn off after a few seconds, or it may be tapped again to immediately turn them off. The default on-time is [configurable via USB](#).

Alternatively, you may press and hold the crosshair key. This causes the crosshairs to remain on while the key is pressed, and to turn off when the key is released.

The crosshairs are especially useful for expediting sample viewing under a microscope. Simply activate the crosshairs and position a sample's area of interest at the crosshair intersection. Now turn off the crosshairs and view the properly aligned sample through the eyepiece.



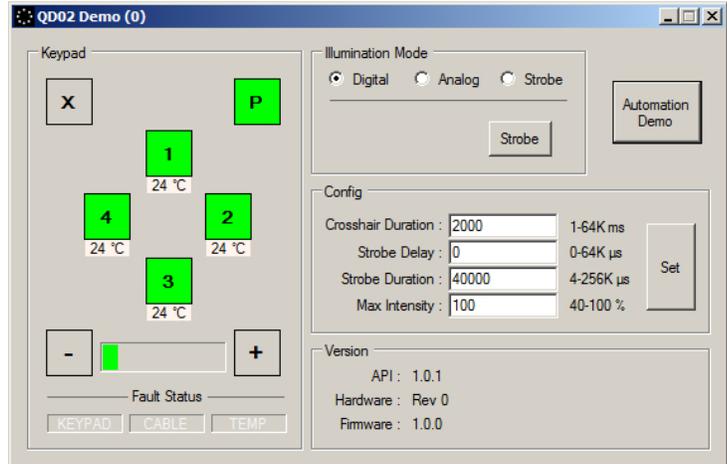
Remote operation

When the QD02 is connected to a computer with USB, the computer can use software to control ring light operation. Orled provides a Windows demo program (shown below) that demonstrates computer control of the ring light and provides access to configuration functions. The demo program is distributed with source code examples and API in a free, downloadable software development kit (SDK).

Demo program

When the demo program is running, the main window's title bar will indicate (in parenthesis) the device address of the QD02 you are controlling.

The main window will open automatically if your computer is connected to one QD02. If multiple QD02s are connected, you will be asked to choose one to control before the main window opens.



Keypad

This virtual keypad allows you to remotely activate QD02 keys and monitor key presses on the QD02 keypad. The **X** (crosshair) key is visible only when the QD02 is connected to a ring light with crosshair lasers.

The temperature of each ring light quadrant is displayed below its quadrant control button.

The fault status boxes indicate a [fault condition](#) by turning red.

Illumination mode

Click any of these radio buttons to change the ring light [illumination mode](#). The selected mode will become the default illumination mode; it will remain in effect until it is changed again, even if power is removed from the QD02.

When operating in strobe mode, you can click **Strobe** to trigger a strobe over USB.

Automation demo

When **Automation Demo** is clicked, the computer will exercise the QD02 to demonstrate how a computer can automatically control the ring light.

Config

The config section can be used to change various configuration settings. Change the values as desired and then click **Set** to program the new values. Programmed values will become the new default values; they will remain in effect even if power is removed from the QD02. There are four programmable values:

Crosshair duration

This is the length of time (in milliseconds) the crosshairs will remain on when the Crosshair key is tapped. For example, set to 2,000 for two seconds.

Strobe delay

Upon receiving a strobe trigger, this is the length of time the controller will wait (in microseconds) before activating the ring light. For example, when set to 10,000, each light strobe will begin 0.01 seconds after its trigger is received.

Strobe duration

This specifies the strobe length in microseconds. For example, set to 40,000 to generate strobes that last 0.04 seconds. This is automatically rounded to the nearest 4 μ s.

Max intensity

This setting specifies the ring light's [intensity range](#).

Version

This section displays version information:

- API – version number of the API executable (OrledQD02.dll)
- Hardware – revision letter of the QD02 device circuitry
- Firmware – version number of the QD02's internal firmware

Specifications

Ring light	RL28QT / RL28XT	RL16QT / RL16XT
High output LEDs	28	16
Color temperature	RL28xx-2700: 2700 K RL28xx-4300: 4300 K RL28xx-6000: 6000K	RL16xx-2700: 2700 K RL16xx-4300: 4300 K RL16xx-6000: 6000K
Working distance (wd) range	4.5" – 8"	2.5" – 6"
Spot diameter	2.0" @ wd=6.0"	1.5" @ wd=3.0"
Spot illumination	65000 lux @ wd=3.0"	85000 lux @ wd=3.0"
Inside diameter	4.05"	2.45"
Mounting diameter	4.70"	3.05"
Outside diameter	5.45"	3.74"
Ingress protection rating	IP63	IP63
QD02 quadrant controller		
Keypad type	Solid-state, capacitive touch sensing	
Remote control interface	USB 2.0	
Illumination modes	Constant color, constant light, strobe (flash)	
Intensity levels	8 @ 12.5% per step (based on human visual perception)	
Thermal foldback threshold	RL16XT/RL28XT: 70°C RL16QT/RL28QT: 85°C	
Flash mode	Manual	
Strobe duration	4 µs – 262.14 ms, in 4 µs steps	
Strobe delay	0 – 65.525 ms, in 1 µs steps	
Mechanical dimensions	3.0" x 4.0" x 1.0" (W x H x D)	
AC adapter		
Input power	100-240 VAC, 50/60 Hz	
Output power	12 VDC @ 2 A max.	
Included cables		
9015C1	QD02 to ring light interconnect cable, 3'	
9015C3	USB cable, 6', with Type A and Mini-B connectors	
Optional cables		
9015C2	Strobe trigger cable, 6', with 3.5 mm TRS and PC Sync plugs	