

Microscopy Light Source ZLED60-RT



Operations Guide

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Introduction

This guide explains how to use the remote interfaces of the ZLED60-RT Microscopy Light Source.

Remote Operation

Two connectors enable remote operation on the rear of the ZLED60-RT, labeled USB and IN/OUT. The IN/OUT port is a standard 9-pin D subminiature receptacle that combines the RS232 signal lines with additional digital and analog signals

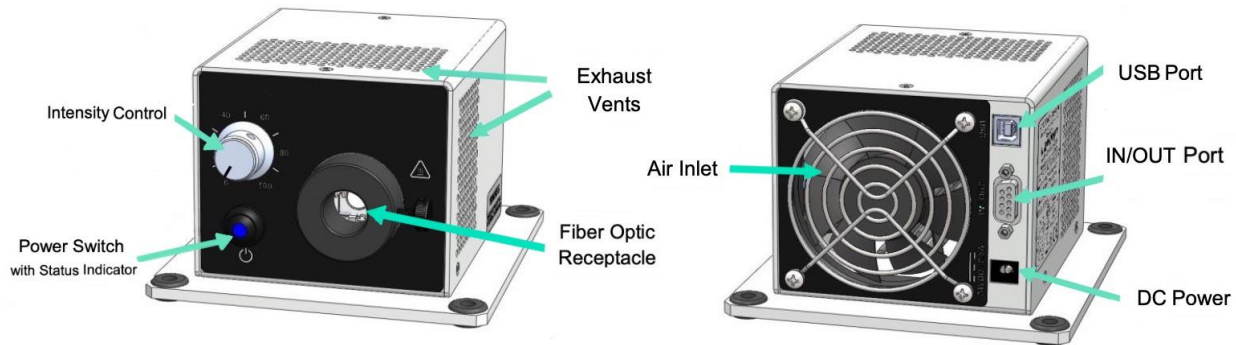


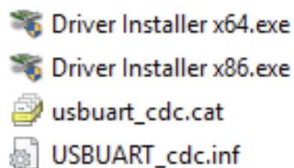
Figure 1 – Front Controls

USB Port

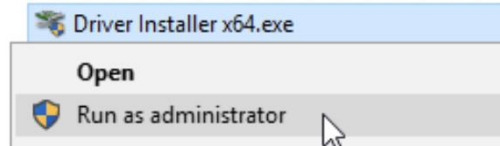
The USB port is a standard USB B receptacle that functions as a virtual COM port. In Windows, the port enumerates with the name “Cypress USB UART.” The serial commands are described in the Serial Communication Protocol section.

USB Driver Installation

Windows drivers are available for download from the _____ website. The driver package contains the following files:

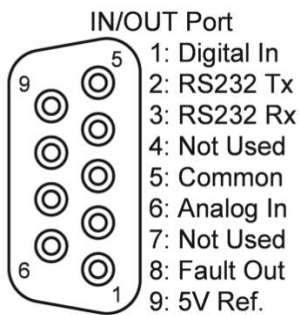


Install the drivers by running Driver Installer x64.exe for 64-bit Windows systems and Driver Installer x86.exe for 32-bit Windows systems. The driver installation program may need to be run as an administrator, which is typically done by right-clicking the file name and selecting "Run as administrator" from the context menu.



IN/OUT Port

The IN/OUT port contains an RS232 port for serial communication and discrete digital and analog signals for basic remote control. The connector on the device is a standard female 9-pin D-Sub receptacle. Refer to information below for further description of the pinout.



IN/OUT Port Pinout

Pin	Name	Specification
1	Digital In	Digital input, 10kΩ input impedance. Low < 0.7V, High > 3.7V Internal pull-up causes input to be high when disconnected.
2	RS232 Tx	RS232 transmit
3	RS232 Rx	RS232 receive
4	Reserved	Do not connect
5	Common	Common pin for all signals
6	Analog In	Analog input for LED intensity adjustment. Range: 0-5V, 16kΩ input impedance
7	Reserved	Do not connect
8	Fault Out	Digital output, open collector Rated for 30V/10mA
9	5V Ref.	5V/10mA output

IN/OUT Port Pin Specification

RS232 Signals

The RS232 interface uses three pins: 2 (Tx), 3 (Rx), and 5 (Common). The port is configured to operate at 9600 baud, 8 data bits, 1 stop bit, and no parity. The serial commands are described in the section [Serial Communication Protocol](#).

NOTE: Some PC serial ports and USB-Serial converter cables have a low impedance connection between Pins 1 and 5, which drives the digital input pin low, disabling the LED output when the serial cable is plugged in. In this case, change the polarity of the digital input pin to "Low = LED on" using the serial command "&J1". See section [J – Digital Input Polarity](#). The setting change reverts to the previous value when power is cycled. To save the setting, see section [S – Save Settings](#).

Analog/Digital Control

Four pins are provided on the IN/OUT port for simple on/off control, intensity adjustment, and fault monitoring using just a few external components. Refer to image below for an example circuit for a remote control application.

The digital input pin has an internal pull-up that causes the input to be "high" when disconnected. Connecting the pin to Common (pin 5) drives the input low ("active low").

When the pin is not active, the LED output turns on and off as expected (e.g., when the front button is pressed or the appropriate serial command is received). When the pin is active (low by default), the LED output turns off regardless of any other input.

The active state of the digital input can be reversed with the J – Digital Input Polarity command. For example, if the "&J1" command is sent, the LED turns off when the input pin is high and operates normally when the pin is low.

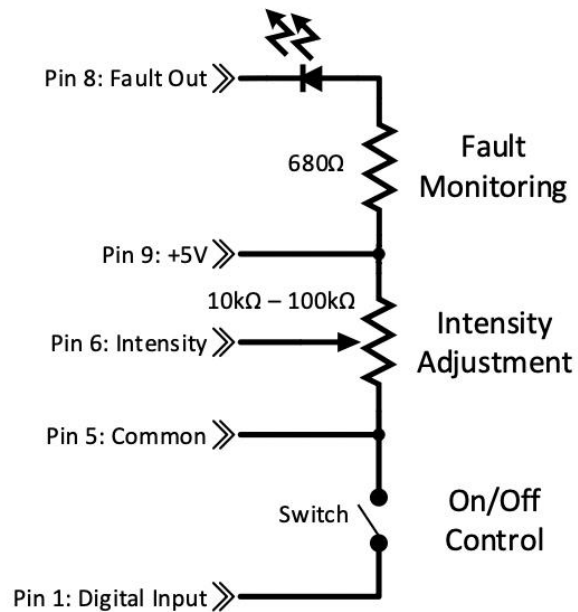
Additionally, the functional behavior of the digital input can be changed to accommodate different types of switches with the JM – Digital Input Mode. For example, the digital input can be configured to turn on/off the LED with a toggle or rocker switch, where the state of the output is dependent on whether the switch is opened or closed. The digital input can also switch the LED on/off with a momentary pushbutton or footswitch where the LED output toggles on or off with each switch press.

The J and JM commands allow for any type of switch to be used to enable or disable the light source, such as a rocker switch or a pushbutton switch. Refer to the individual command descriptions for details.

Serial Communication Protocol

Remote communication with the device follows a command-response pattern. A command must be sent to control the unit or query an operating parameter. Once received, the unit performs the requested action and sends a response.

The unit accepts commands through the serial interfaces in the form of ASCII strings. Commands are used to control (e.g., disable/enable the LED output, adjust intensity, change settings, etc.) or query the unit's operational status (e.g., LED enabled/disabled, intensity, temperature, voltage, etc.).



Example Remote Control Circuit

Unless otherwise noted in the command descriptions below, configuration changes are not saved until the **S – Save Settings** command is sent. On power-up, the ZLED60-RT reverts to the last saved settings or the factory default if no saved settings exist.

Command Structure

The structure of the string for the ZLED60-RT serial command is organized as follows:

<Start><Command><Parameter><Terminator>

Position	Format	Description
<Start>	&	A command string always starts with the ampersand (&) character. The parser ignores all characters until this character is received, indicating the start of a command.
<Command>	1-3 Letters	Consists of one, two, or three letters indicating the desired command. The unit does not distinguish between upper and lowercase characters; however, responses are always lowercase.
<Parameter>	? Or 1-5 alphanumeric digits	If '?' follows the Command Mnemonic, the command is a query. No other characters may follow the '?' except for the termination character. If a question mark does not immediately follow the command mnemonic, the command is a parameter. Parameters are used to change a setting or control the operation of the unit.
<Terminator>	Carriage Return	The termination character ends the command or response. The command string is processed once the termination character is received. The carriage return is ASCII code 13 (0x0D) and is denoted as '\r' in many programming languages.

Responses

The ZLED60-RT responds to input commands with a string of characters as described in the following sections. The maximum length of the response is 64 characters (63 characters + terminator character), though most responses are fewer than 10 characters. All responses end with the Terminator character as described in the table above.

Acknowledgment (No Error)

If the command was received and processed without error, the response is as described in the command's description below. Generally, the response to a control command is identical to the string that was initially sent. The response to a query command starts with the command string, followed by the requested parameter.

Negative Acknowledgement (Error)

The following table describes the types of negative acknowledgments:

Type	Response
Invalid Character Received	<p>Response: &nX^Y</p> <p>&n = Negative acknowledgement X = Characters in the command string that were parsed correctly ^ = Invalid character location start Y = Invalid character received</p> <p>Examples: Command: &L5 Response: &nI^5 (5 is not a valid parameter for this command)</p> <p>Command: &HLZ Response: &nHl^z Explanation: The characters "HL" are the first letters of a valid command, but the Z is not.</p>
Buffer Overflow	<p>Response: "USB receive buffer error" or "Uart receive buffer error," depending on which port experienced the overflow. The error message is transmitted after a Start Character (&) is received, followed by 63 non-Termination Characters.</p>
Termination Character received before Start Character	<p>Response: "Invalid Command"</p>
Timeout	<p>Response: &n</p> <p>Once the Start character is received, a timer is started. Whenever another character is received, the timer is reset. If 10 seconds elapses since the last character was received and that character wasn't the Terminator, the device responds as described.</p> <p>The timeout timer stops when a timeout occurs or if the Terminator is received.</p>

Command Details

A0 - Knob and Input Value

&A0?	Get the front knob position as a percentage on a full scale
	<u>Response:</u> &a0\$
	<u>Value (\$):</u> 0000 to 1000 as a percentage of full-range
	<u>Example response:</u> &A00514 (the front knob is at the 51.4% position)

A1 - Rear Analog Input Value

&A1?	Get the rear analog input as a percentage on a full scale (0-5V).
	<u>Response:</u> &a1\$
	<u>Value (\$):</u> 0000 to 1000 as a percentage of full scale
	<u>Example response:</u> &A10230 (the analog input is 23.0% of full scale or $5V \cdot 0.23 = 1.15V$)

BT - Board Temperature

&BT?	Get the current temperature of the internal PCB in Celsius
	<u>Response:</u> &bt\$
	<u>Value (\$):</u> 00.0-99.9

C - System Faults

&C?

Get the system faults as a bit field.

Response:

&c\$

Value (\$):

A hexadecimal value that represents the errors present. Errors are determined by converting the decimal value to an 8-bit binary value. A "1" at a particular bit position indicates an error. Refer to the table below

Bit	Fault	Description
0	LED	LED disconnected or open-circuit
1	Fan	Fan not turning
2	Input voltage	Input voltage <20V or >30V
3	LED heatsink temperature	Heatsink temperature >70°C
4	Board temperature	Internal PCB temperature >60°C
5	<i>Reserved</i>	
6	<i>Reserved</i>	
7	<i>Reserved</i>	

Example #1: response **&c02** → 2 hex = 00000010 binary

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	BIT 0
0	0	0	0	0	0	1	0

Bit 1 (fan) is the source of the error

Example #2: response **&c15** → 15 hex = 00010101 binary

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	BIT 0
0	0	0	1	0	1	0	1

In this case, there are three faults: bit 0 (LED), bit 2 (input voltage), and bit 4 (internal PCB temperature)

D0 - Front Switch State

&D0?	Get the state of the front switch <u>Response:</u> &d00 = switch not pressed &d01 = switch pressed
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D1 - Remote Digital Input State

&D1?	Get the state of the digital input of the IN/OUT port (pin 1) <u>Response:</u> &d10 = low &d11 = high NOTE: This input will read “high” when pin is disconnected.
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F - Firmware Version

&F?	Get the firmware version of the unit <u>Response:</u> &f\$ <u>Value (\$):</u> A string containing the version number <u>Example response:</u> &f1.0 = Firmware version “1.0”
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G - Fan Speed

&G?	Get the fan speed in RPM <u>Response:</u> &g\$ <u>Value (\$):</u> Fan speed in RPM
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HLF - Front Control Lockout

&HLF#	Enable or disable the front panel knob and button controls <u>Parameter (#):</u> 0 = disable the analog input 1 = enable the analog input (default) ? = query the current state <u>Response:</u> &hlf0 = the control is disabled &hlf1 = the control is enabled See also K-Contol Lockout
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HLM - Remote Analog Control Lockout

&HLM#	<p>Enable or disable the remote analog input</p> <p><u>Parameter (#):</u> 0 = disable the analog input 1 = enable the analog input (default) ? = query the current state</p> <p><u>Response:</u> &hlf0 = the control is disabled &hlf2 = the control is enabled</p> <p>NOTE: The digital input is not disabled by this command. See also K-Control Lockout</p>
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I - LED Intensity

&I#	<p>Set or get the LED intensity with 8-bit precision</p> <p><u>Parameter (#):</u> A 2-digit hexadecimal value between 0 and FF (decimal 255) where 0 is minimum intensity (i.e., off) and FF is maximum intensity. The current light intensity can be queried by sending '?' as the parameter.</p> <p><u>Response:</u> &i\$ <u>Value(\$):</u> The intensity value as a 2-digit hexadecimal value (see parameter explanation)</p>
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IP - LED Intensity (Precision)

&IP#	<p>Set or get the LED intensity with 11-bit precision</p> <p><u>Parameter (#):</u> A 3-digit hexadecimal value between 0 and 7FF (decimal 2047) where 0 is minimum intensity (i.e., off) and 7FF is maximum intensity. Any value higher than 7FF is interpreted as 7FF. The current light intensity can be queried by sending '?' as the parameter.</p> <p><u>Response:</u> &ip\$ <u>Value (\$):</u> The intensity value as a 3-digit hexadecimal value (see parameter explanation)</p>
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J - Digital Input Polarity

&J#	<p>Get or set the active polarity of the digital input pin of the IN/OUT port (pin 1). Used in conjunction with the &JM# command, the pin can be configured to enable/disable the LED output using either a toggle switch or momentary pushbutton switch.</p> <p><u>Parameter (#):</u> 0=LED off when low or toggle on falling edge (default) 1=LED off when high or toggle on rising edge ?=query current setting</p> <p><u>Response:</u> &j0=LED off when low &j1=LED off when high</p>
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JM - Digital Input Mode

&JM#	<p>Get or set the switching mode of the digital input pin of the IN/OUT port (pin 1). When used in conjunction with the "J" command, the pin can be configured to enable/disable the LED output using either a toggle switch or momentary pushbutton switch.</p> <p><u>Parameter (#):</u> 0= level triggered (default) 1= edge triggered ?= query current setting</p> <p><u>Response:</u> &jm0= level-triggered (toggle switch) &jm1=edge triggered (momentary switch)</p>
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K - Control Lockout

&K#	<p>Get or set the control lockout setting</p> <p><u>Parameter (#):</u> 0= all controls enabled (default) 1= front knob and switch disabled 2=analog input disabled 3=front knob, switch, and analog inputs disabled ?= query current setting</p> <p><u>Response:</u> &k0 = all controls enabled (default) &k1 = front knob and switch disabled &k2 =analog input disabled &k3 =front knob, switch, and analog inputs disabled</p> <p>See also HLF - Front Control Lockout and HLM - Remote Analog Control Lockout</p>
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L- LED Output Enable

&L#	Enable or disable the LED output. This command enables the LED driver and fan, even if the intensity is set to the minimum value. <u>Parameter (#):</u> 0 = LED disabled (default) 1 = LED enabled ? = query current setting <u>Response:</u> &I0 = LED disabled &I1 = LED enabled
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LT - LED Heatsink Temperature

&LT?	Get the heatsink temperature in degrees Celsius <u>Response:</u> &lt;\$ <u>Value (\$):</u> -5.0 to 99.9
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M - Control Source

&M?	<p>Get the interface that is controlling the unit. An interface gains control of the unit if it adjusts the intensity or enables/disables the LED.</p> <p>The RS232 and USB ports claim control whenever the "L", "I", or "IP" commands are sent.</p> <p>The front panel or rear analog input claim control when the power button is pressed, the digital input is toggled, or the light intensity is adjusted.</p> <p><u>Response:</u> &m\$</p> <p><u>Value (\$):</u></p> <table border="1"><thead><tr><th>Value</th><th>Meaning</th></tr></thead><tbody><tr><td>0</td><td>Front Panel Control</td></tr><tr><td>1</td><td>Rear Analog Control</td></tr><tr><td>2</td><td>RS232 Port</td></tr><tr><td>3</td><td><i>Reserved</i></td></tr><tr><td>4</td><td>USB port</td></tr><tr><td>5</td><td><i>Reserved</i></td></tr><tr><td>6</td><td><i>Reserved</i></td></tr><tr><td>7</td><td>None</td></tr></tbody></table> <hr/>	Value	Meaning	0	Front Panel Control	1	Rear Analog Control	2	RS232 Port	3	<i>Reserved</i>	4	USB port	5	<i>Reserved</i>	6	<i>Reserved</i>	7	None
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7	None																		

O - Restore Factory Defaults

&O	<p>Restore the unit to the factory default settings. This command resets the unit to the factory default settings.</p> <p><u>Response:</u> &o\$</p> <p><u>Value (\$):</u> 0=success 1= reset failure</p>
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O4 - Reboot System

&O4	<p>Reboot the firmware. This command has the same behavior as power cycling the unit</p> <p><u>Response:</u> none</p>
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S - Save Settings

&S	<p>Saves the <u>unit's current operating state</u> to internal memory, overwriting any previous settings that may have been stored. The unit immediately begins operating using these saved settings the next time power is cycled or when the <u>T – Restore Settings</u> command is used. The current operating state includes the following settings:</p> <ul style="list-style-type: none"> - LED output status (see L - LED Output Enable) - Intensity (see IP-LED Intensity Precision) - Control Source (see M - Control Source) - Control Lockout Status (See K - Control Lockout) - Switch Polarity (See J - Digital Input Polarity) - Switch Mode (See JM - Digital Input Mode) <p><u>Response:</u> &s\$</p> <p><u>Value(\$):</u> 0=success</p> <p style="padding-left: 40px;">1=failure</p>
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T - Restore Settings

&T	<p>Restores the unit to the currently saved settings. See <u>S – Save Settings</u> for details on which settings are restored.</p> <p><u>Response:</u> &t\$</p> <p><u>Value (\$):</u> 0=success</p> <p style="padding-left: 40px;">1=failure</p>
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VI - Input Voltage

&VI?	<p>Gets the input voltage</p> <p><u>Response:</u> &vi\$</p> <p><u>Value (\$):</u> The input voltage as a decimal number in the format ##.##</p>
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W - System Warnings

&W?	Get the system warnings as a bit field																											
	<p><u>Response:</u> &w\$ <u>Value (\$):</u> A hexadecimal value indicating the warnings that are present. The response id formatted identically to <u>C-System Faults</u></p>																											
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XS - Status Summary

<p>&XS\$</p>	<p>Gets a comma-delimited listing of various status values by combining the output of several commands into a single response</p> <p><u>Response:</u> &xs\$ <u>Value (\$):</u> A comma-delimited list of various status and control values in the following format” &xs, A,B,C,D,E,F,G,H,I,J,K,L,M</p> <table border="1" data-bbox="414 504 1031 1102"> <thead> <tr> <th>ID</th> <th>Response from Command</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>&C?</td> <td>System faults</td> </tr> <tr> <td>B</td> <td>&W?</td> <td>System warnings</td> </tr> <tr> <td>C</td> <td>&IP?</td> <td>Intensity (Precision)</td> </tr> <tr> <td>D</td> <td>&L?</td> <td>Light output enable status</td> </tr> <tr> <td>E</td> <td>&BT?</td> <td>Board temperature</td> </tr> <tr> <td>F</td> <td>&LT?</td> <td>LED heatsink temperature</td> </tr> <tr> <td>G</td> <td>&G?</td> <td>Fanspeed</td> </tr> <tr> <td>H</td> <td>&VI?</td> <td>Input voltage</td> </tr> <tr> <td>I</td> <td>&A0?</td> <td>Front knob position</td> </tr> <tr> <td>J</td> <td>&A1?</td> <td>Analog input value</td> </tr> <tr> <td>K</td> <td>&D0?</td> <td>Front button state</td> </tr> <tr> <td>L</td> <td>&D1?</td> <td>Digital input state</td> </tr> <tr> <td>M</td> <td>&M?</td> <td>Control source</td> </tr> </tbody> </table> <p><u>Example response:</u> &xs00,00,222,1,+26.5,+24.2,2518,23.45,0503,0200,0,1,4 00 no errors 00 no warnings 222 LED intensity is 0x222 → 546 decimal → 546/2047 = 26.7% 1 LED enabled 26.5 Temperature of control board is 26.5°C 24.2 Temperature of heatsink is 24.2°C 2518. Fan speed 2518 RPM 23.45 Input voltage is 23.45V 0503 Front knob is set to 50.3% 0200 Analog input is 21.1% of full scale (5V * 20.0% → 1.0V) 0 Front button is not pressed 1 Digital input is high 4 Control source is the USB port</p>	ID	Response from Command	Description	A	&C?	System faults	B	&W?	System warnings	C	&IP?	Intensity (Precision)	D	&L?	Light output enable status	E	&BT?	Board temperature	F	<?	LED heatsink temperature	G	&G?	Fanspeed	H	&VI?	Input voltage	I	&A0?	Front knob position	J	&A1?	Analog input value	K	&D0?	Front button state	L	&D1?	Digital input state	M	&M?	Control source
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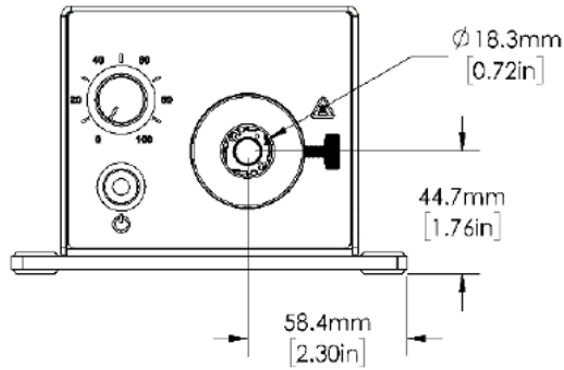
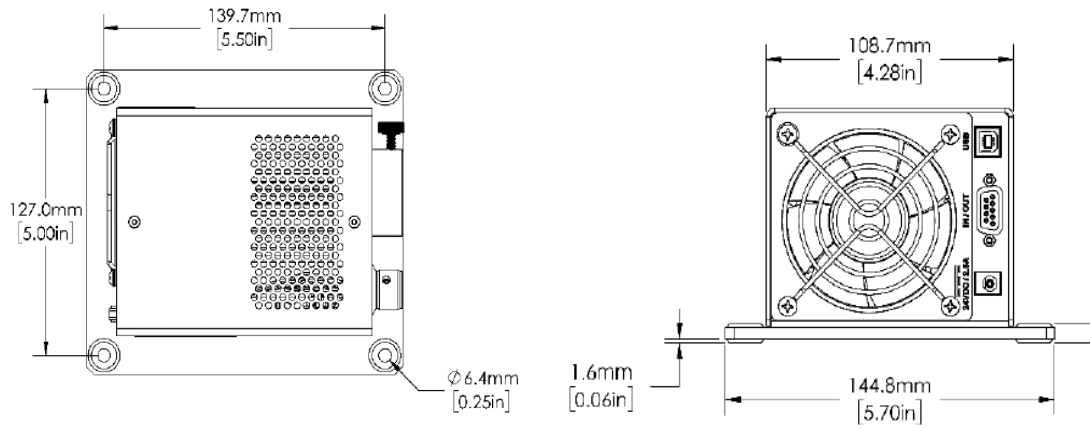
Z - Serial Number

&Z\$	Get the unit's serial number Response: &z\$ Value(\$): A string containing the unit's serial number. Example response: &z000001 (serial number 1)
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Characteristic

Dimensions	Length: 158 mm (6.2 inches) Width: 145 mm (5.7 inches) Height: 98 mm (3.9 inches)	
Weight	2.0 kg (4.62 lbs)	
Operating Temperature	0° C (32° F) to 40° C (104° F)	
Color Temperature	5400 K	
Power Input Rating	100-240VAC, 50/60Hz, 1.5A	
Power Consumption	60 Watts	
Lifetime	50,000 hours	

Dimension



Warranty and Liability

OPTECALI-ZEPTO warrants our light sources to be free from defective workmanship and materials. All Products described here are warranted for a period of twelve (12) months from the date of shipment. Consumables / spare parts (whether sold as separate Products or constituting components of other Products) are warranted for a period of ninety (90) days from the date of shipment.

WARRANTY EXCLUSIONS

The above warranty does not apply to Products which are (a) repaired, modified or altered by any party other than Optecali-Zepto; (b) used in conjunction with equipment not provided or authorized by Optecali; (c) subjected to unusual physical, thermal, or electrical stress, improper installation, misuse, abuse, accident or negligence in use, storage, transportation or handling, alteration, or tampering, or (d) considered a consumable item or an item requiring repair or replacement due to normal wear and tear.

Our obligation is limited to repair or replacement. OPTECALI-ZEPTO will not be held responsible for consequential damages, transportation, installation, adjustment, or other expenses arising in connection with our products or parts. This warranty is in lieu of all other statements or guarantees, written or implied, by OPTECALI-ZEPTO.

Servicing

There are no user-serviceable components inside the ZLED60-RT. All repairs must be made by an authorized repair facility. Opening the housing of the unit voids the warranty. Please contact a sales representative for technical support.

Contact Information

Customer and Technical Support

OPTECALI-ZEPTO

Email: info@optecali.com

Website: www.optecali.com