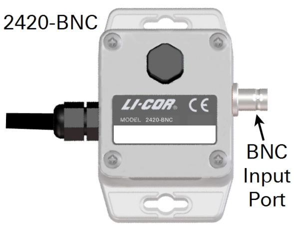
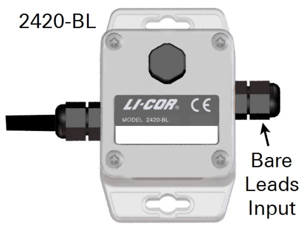
2420 Light Sensor Amplifier

Quick Start Guide

The 2420 Light Sensor Amplifier converts the current (µA) signal from the light sensor into a voltage that can be measured by most dataloggers and system controllers. Two amplifier models are available:





Precautions: The 2420 Amplifier is weather resistant **with the lid properly attached**, but if it is to be left outdoors and unattended for long periods of time, it should be installed in an enclosure or sheltered location.

2420 Amplifier Gain Settings

The 2420 Amplifier provides 15 discrete gain settings to accommodate a variety of full-scale light intensities, full-scale voltage ranges, and sensor types. This section shows how to determine the correct gain settings and voltage multiplier. Gather the following information:

- Calibration constant for your light sensor (C)
- Maximum full-scale light to be measured (I_{max})
- Full scale input voltage of the datalogger or 5 V--whichever is lower (V_{max})

Follow these steps:

1 Calculate the ideal amplifier gain (G_{ideal}).

$$G_{ideal} = \frac{V_{max}}{I_{max} \cdot C}$$

Example: A sensor with the following parameters:

- Calibration constant: C = 6.5 µA per 1000 µmol m^{-2} s^{-1}
- Full-scale light intensity: I_{max} = 2000 µmol m^{-2} s^{-1}
- Data logger full-scale channel voltage or 5 V (which ever is lower): V_{max} = 5.0 V

$$G_{ideal} = \frac{5.0\text{V}}{\left(2000\ \mu\text{mol m}^{-2}\ \text{s}^{-1}\right)\left(\frac{6.5\ \mu\text{A}}{1000\ \mu\text{mol m}^{-2}\ \text{s}^{-1}}\right)} = .3846\ \text{V}\ \mu\text{A}^{-1}$$

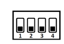
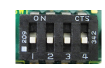
2 Select the gain setting (G) from the Gain Settings Table that is less than or equal to the ideal gain from step 1.

Example: The ideal gain computed in step 1 is G_{ideal} = 0.3846 V µA^{-1}. On the table, the closest actual gain that is less than or equal to this value is G = 0.375 V µA^{-1}.

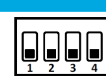
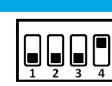
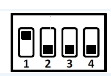
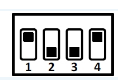
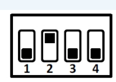
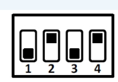
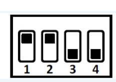
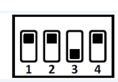
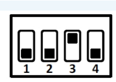
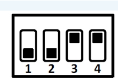
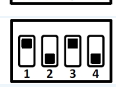
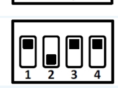
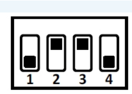
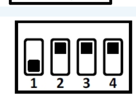
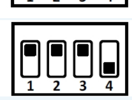
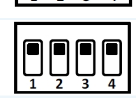
3 Use a number 2 Phillips screwdriver to remove the amplifier lid. Alternate the four screws, pulling the lid up as you go so that the screws do not bind with the lid.

4 Using a small screwdriver, set the switches in the center of the circuit board based on the amplifier gain determined in step 2.

Example: The gain determined in step 2 (G = 0.375 V µA^{-1}) requires all switches to be in the off position:

 G=0.375: all switches off 

2420 Gain Settings Table

DIP Switch	Gain (V/µA)	DIP Switch	Gain (V/µA)
	G = 0.375 (all switches off)		G = 0.175
	G = 0.350		G = 0.150
	G = 0.325		G = 0.125
	G = 0.300		G = 0.100
	G = 0.275		G = 0.075
	G = 0.250		G = 0.050
	G = 0.225		G = 0.025
	G = 0.200		Do Not Use (all switches on)

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5 Re-install the lid. Torque the screws to 0.45 Nm (64 oz-in.) if using a torque screwdriver.

6 Calculate the voltage multiplier (*M*). The voltage multiplier is used to convert the voltage measured by the datalogger into a light intensity. For Quantum sensors, the units for *M* are μmol m^{-2} s^{-1} V^{-1}.

$$M = \frac{1}{G \cdot C}$$

Example: Calculate *M* using G = 0.375 V μA^{-1} from step 2 and *C* = 6.5 μA per 1000 μmol m^{-2} s^{-1} from step 1:

$$M = \frac{1}{\left(0.375\ \frac{\text{V}}{\mu\text{A}}\right)\left(\frac{6.5\ \mu\text{A}}{1000\ \mu\text{mol}\ \text{m}^{-2}\ \text{s}^{-1}}\right)} = 410.26\ \mu\text{mol}\,\text{m}^{-2}\ \text{s}^{-1}\ \text{V}^{-1}$$

Connecting to a Datalogger

NOTE: The 2420 Amplifier requires a power supply, usually from the data logger (white wire, +3.8 to +28 VDC). The logger should wait a minimum of 0.12 seconds (120 ms) after providing power before reading the output voltage from the amplifier.

White: +3.8 to +28 VDC power supply input

Black: Power supply ground (⏚)

Brown: Negative (-) amplifier output

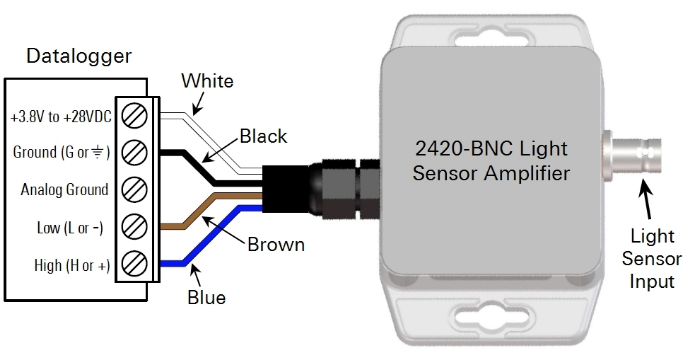
Blue: Positive (+) amplifier output

Figure 1. Amplifier Output Terminal Block Wiring

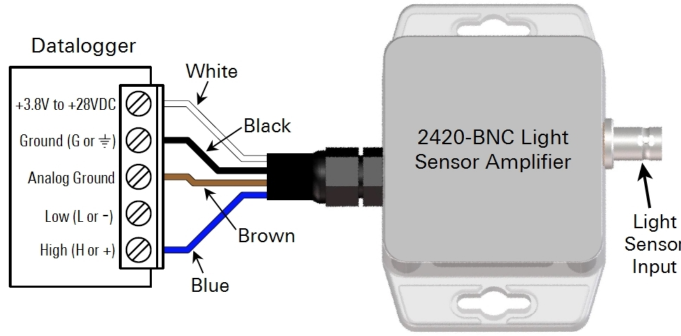
The 2420-BNC and 2420-BL Amplifier output wires (included) can be connected to a data logger in both differential and single-ended configurations, as shown in the following diagrams. The differential configuration can give better noise rejection and lower offset voltages.

NOTE: Avoid extending the output wire length. The amplifier and data logger should be kept close together to avoid excess voltage drop and the introduction of noise.

Data Logger Wiring, Differential



Data Logger Wiring, Single-ended



Important Note! In the single-ended configuration, use the following steps to check for ground loops. This procedure only applies when the 2420 is in the single-ended configuration.

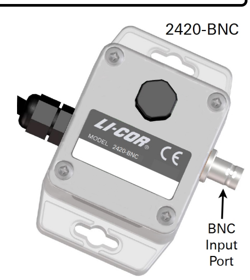
1 Disconnect the light sensor from the amplifier.

2 Using a multiplier of 1 and an offset of 0 in the data logger program, monitor the "dark offset" mV measurement from the amplifier.
- If the dark offset is >1 mV, try disconnecting either the brown or black lead (but not both) to minimize the offset.
- If the offset is minimized by removing either the brown or black wire, then move this wire off to the side and cover it with a piece of electrical tape.

3 Reconnect the light sensor to the amplifier and reset the multiplier and offset in the data logger program.

Connecting a Light Sensor

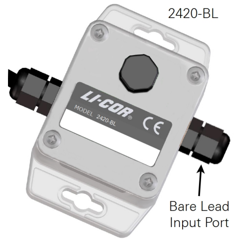
Important Note: The 2420 Amplifier requires a current (μA) signal from the light sensor. It will not work with a millivolt adapter or with a light sensor that produces a voltage output.



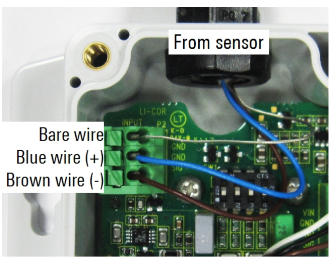
LI-COR quantum, pyranometer, and photometric sensors are compatible with the 2420 Amplifier. These sensors come with bare leads or a BNC connector.

2420-BNC Light Sensor Amplifier: connects to a BNC type light sensor. Attach the BNC connector to the BNC input port on the Amplifier.

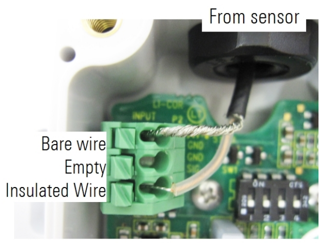
2420-BL Light Sensor Amplifier: connects to a bare leads type sensor with these steps:



1. Use a number 2 Phillips screwdriver to remove the amplifier lid. Alternate the four screws, moving the lid up with the screws so that the screws do not bind with the lid.
2. Loosen (but do not remove) the black plastic nut on the input port.
3. Feed the sensor cable through the nut and input port far enough that the black shielded portion extends inside the amplifier, then hand tighten the nut.
4. Press down the connector's spring release and insert the sensor wires into the terminal block as shown below.



For 3-wire bare leads sensors



For 2-wire bare leads sensors

5. Re-install the lid. Torque the screws to 0.45 Nm (64 oz-in.) if using a torque screwdriver.

Equation Summary

Output Voltage

The 2420 Light Sensor Amplifier output voltage is calculated based on the equation:

$$V_{out} = G \cdot i$$

Variable	Units	Description
V_{out}	V	Amplifier output voltage
G	V µA^{-1}	Amplifier gain setting
i	µA	Light sensor photocurrent signal

Ideal Gain

The ideal gain (G_{ideal}) is the gain needed by the 2420 Amplifier to scale the full-scale light sensor output to the full-scale input voltage of the data logger. The 2420 Amplifier uses 15 discrete gain settings, so the ideal gain must be rounded **down** to the nearest supported gain of the 2420 Amplifier. Ideal gain is computed with:

$$G_{ideal} = \frac{V_{max}}{I_{max} \cdot C}$$

Variable	Units	Description
G_{ideal}	V µA^{-1}	Ideal amplifier gain
V_{max}	V	Datalogger full-scale input voltage
I_{max}	µmol m^{-2} s^{-1}	Quantum sensor full-scale light
	W m^{-2}	Pyranometer full-scale light
	klux	Photometric sensor full-scale light
C	µA per 1000 µmol m^{-2} s^{-1}	Quantum sensor calibration coefficient
	µA per 1000 W m^{-2}	Pyranometer calibration coefficient
	µA per 100 klux	Photometric sensor calibration coefficient

Voltage Multiplier

The voltage multiplier M converts the voltage measured by the datalogger into a light intensity. The multiplier is found by:

$$M = \frac{1}{G \cdot C}$$

Variable	Units	Description
M	µmol m^{-2} s^{-1} V^{-1}	Quantum sensor voltage multiplier
	W m^{-2} V^{-1}	Pyranometer voltage multiplier
	klux V^{-1}	Photometric sensor voltage multiplier
G	V µA^{-1}	Amplifier gain setting
C	µA per 1000 µmol m^{-2} s^{-1}	Quantum sensor calibration coefficient
	µA per 1000 W m^{-2}	Pyranometer calibration coefficient
	µA per 100 klux	Photometric sensor calibration coefficient

Note: The amplifier is not compatible with the LI-210R Photometric Sensor in indoor applications due to limitations in the resolution of most dataloggers. Contact us if you have questions about the suitability of the 2420 or the LI-210R for your application.

Performance Characteristics

The 2420 Amplifier generates an output signal up to 5.0 V and down to –2.5 V over the entire input supply voltage range (+3.8 to +28 VDC). The output is linear with the current signal provided by the light sensor with an offset of ± <10 µV, meaning that 0 µA of input current yields a 0 V ± <10 µV output voltage.

NOTE: The 2420 Amplifier is capable of driving a resistive load of 10 kΩ or greater. Most data logger voltage inputs have an input impedance (resistance) much higher than 10 kΩ, satisfying the output loading requirements of the 2420. Loading the output with a resistance less than 10 kΩ may cause erroneous readings.

2420 Light Sensor Amplifier Specifications	
Power Requirements:	+3.8 to +28 VDC (1 mA over full range)
Operating Temperature Range:	–40 °C to 50 °C
Turn-on Time:	120 ms
Amplifier Bandwidth:	10 Hz (over all gain settings)
Amplifier Output:	–2.5 to 5.0 V
Output Offset Voltage:	–10 to 10 µV
Amplifier Gain Range:	0.025 to 0.375 V μA^{-1}
Amplifier Gain Accuracy:	±0.1% typical (±0.15% max) of gain setting
Amplifier Output Noise:	0.5 µV rms (0.375 V μA^{-1} Gain, 0.1 to 10 Hz Bandwidth)
Amplifier Output Loading:	≥10 kΩ

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

2420-BL

Component Name	Hazardous Substances or Elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Chromium VI Compounds (Cr^{6+})	Polybrominated Biphenyls (PBB)	Polybrominated Diphenyl Ethers (PBDE)
Amplifier Bare Lead Assembly	X	O	O	O	O	O

O: this component does not contain this hazardous substance above the maximum concentration values in homogeneous materials specified in the SJ/T 11363-2006 Industry Standard.

X: this component does contain this hazardous substance above the maximum concentration values in homogeneous materials specified in the SJ/T 11363-2006 Industry Standard (Company can explain the technical reasons for the "X")

2420-BL

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr^{6+})	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
放大器裸导线总成	X	O	O	O	O	O

O: 表示该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T 11363-2006 标准规定的限量要求以下。

X: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出 SJ/T 11363-2006 标准规定的限量要求。(企业可在此处，根据实际情况对上表中打 "X" 的技术原因进行进一步的说明。)

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2420-BNC

Component Name	Hazardous Substances or Elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Chromium VI Compounds (Cr^{6+})	Polybrominated Biphenyls (PBB)	Polybrominated Diphenyl Ethers (PBDE)
Amplifier BNC Assembly	X	O	O	O	O	O

O: this component does not contain this hazardous substance above the maximum concentration values in homogeneous materials specified in the SJ/T 11363-2006 Industry Standard.

X: this component does contain this hazardous substance above the maximum concentration values in homogeneous materials specified in the SJ/T 11363-2006 Industry Standard (Company can explain the technical reasons for the "X")

2420-BNC

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr^{6+})	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
放大器BNC大会	X	O	O	O	O	O

O: 表示该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T 11363-2006 标准规定的限量要求以下。

X: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出 SJ/T 11363-2006 标准规定的限量要求。(企业可在此处，根据实际情况对上表中打 "X" 的技术原因进行进一步的说明。)

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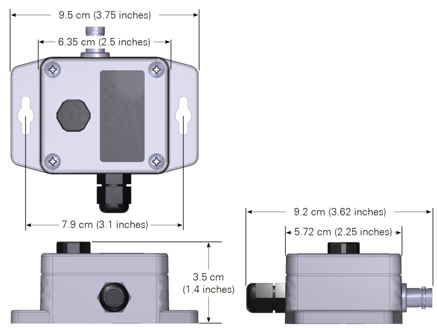

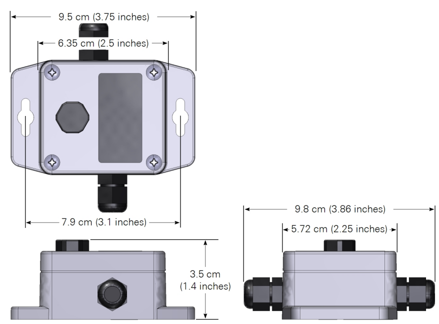

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