Build an LED Emitter:

\[ \begin{align*}
\text{+5 V} & \quad \text{100 } \Omega \\
\text{Ground} & \\
\end{align*} \]

Build a Digital Photodetector:

\[ \begin{align*}
\text{+5 V} & \quad \text{10 k } \Omega \\
\text{Output} & \\
\end{align*} \]

\[
\begin{align*}
\text{+5 V} & \quad \text{NPN 222A} \\
\text{Ground} & \\
\end{align*} \]

Build a Digital Photodetector with latch and reset:

\[ \begin{align*}
\text{+5 V} & \quad \text{10 k } \Omega \\
\text{Output} & \\
\end{align*} \]

\[
\begin{align*}
\text{+5 V} & \quad \text{NPN 222A} \\
\text{Ground} & \\
\end{align*} \]

\[
\begin{align*}
\text{Reset} & \\
\end{align*} \]
Analog Photodiode Detector, Version 2:

This circuit generates an output voltage as follows:

“Dark” → 5.00 volts.
“Bright” → 0.05 volts.

For this circuit, the numerical value of $R_B$ is pretty unimportant. I’ve tested it with values between 100Ω and 10kΩ.

For this circuit, the choice of $R_C$ affects the kind of illumination you can easily detect.

If $R_C$ is large (e.g., 10 kΩ), then generic room lighting creates an output voltage of about 1.0 V.
If $R_C$ is small (e.g., 1 kΩ), then generic room lighting creates an output voltage of about 4.0 V.

You should adjust $R_C$ (possibly using a potentiometer) so that the bulk of the illumination range you want (whether darker levels than background, or brighter) occupy most of the output voltage space. So, if you want to measure differences in light that is generally pretty bright, then use a small $R_C$. If you want to measure differences in light that is generally pretty dark, then use a larger $R_C$.

Parts List:

1. Photodiodes: Mouser # 638-PD333-2C/HOL2
2. Bright Red LEDs: Mouser # 638-333-2SURCS5306
3. 100 ohm resistors: Mouser # 791-RC1/4-101JB
4. 10 kohm resistors: Mouser # 791-RC1/4-103JB
5. NPN Transistors: Mouser # 610-PN2222A
6. Alternate Photodiode: Mouser # 512-QSD2030
7. Alternate Bright LED: Mouser # 638-333-2USOC/S530-A6