Light Emitting Diode LED

PhotoResistor

Light-Sensitive Voltage Divider

As the intensity of light increases, the resistance of the photoresistor decreases, so $V_{out}$ in the top circuit gets smaller as more light hits it, whereas $V_{out}$ in the lower circuit gets larger.
PhotoDiode

PhotoTransistors

Source: Scherz, Practical Electronics for Inventors, 2nd & 3rd Editions
**LED Current Limiting**

\[ R_S = \frac{V_{IN} - V_{LED}}{I_{LED}} \]

- \( V_{LED} \) = LED forward voltage
- \( I_{LED} \) = LED forward current

**LEDs in Series**

\[ R_S = \frac{V_{IN} - (V_{D1} + V_{D2} + V_{D3})}{I_{D,\text{max}}} \]

**LEDs in Parallel**

Reference: Scherz, Practical Electronics for Inventors, 2nd & 3rd Editions

Page 3 of 6.
AC-DC Polarity Indicator

![Diagram of AC-DC Polarity Indicator]

<table>
<thead>
<tr>
<th>$V_{in}$</th>
<th>LED 1</th>
<th>LED 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>On</td>
<td>Off</td>
</tr>
<tr>
<td>-</td>
<td>Off</td>
<td>On</td>
</tr>
<tr>
<td>AC</td>
<td>On</td>
<td>On</td>
</tr>
</tbody>
</table>

Voltage-Level Indicator

![Diagram of Voltage-Level Indicator]

\[
R_s = \frac{V_{in} - [V_Z + V_{LED}]}{I_{LED}}
\]

\[
V_{in(minimum)} = R_s I_{LED} + V_Z + V_{LED}
\]

Driving LEDs from 120VAC

![Diagram of Driving LEDs from 120VAC]

Reference: Scherz, Practical Electronics for Inventors, 2nd & 3rd Editions
LED Applications - continued

**Voltage Dropper**

**DC application**

- D1: IN914 +5V
- D2: IN914 +4.4V
- D3: IN914 +3.8V
- R: IK 3.2mA

---

**Voltage Regulator**

- VW +5V
- Rs = (Vw - Vout) / I
- R: IK 3.18mA
- D1 IN4148
- D2: IN4148 1.36mA
- D3: IN4148 1.82mA
- Vout +1.8V

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**Light-Sensitive Voltage Divider**

For fixed R1,

\[ V_{out} = \frac{R_2}{R_1 + R_2} V_{in} \]

As the intensity of light increases, the resistance of the photoresistor decreases, so Vout in the top circuit gets smaller as more light hits it, whereas Vout in the lower circuit gets larger.

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Scherz, Practical Electronics for Inventors, 2nd & 3rd Editions

Page 5 of 6.