Driving circuit examples of laser diodes

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When a constant current is injected, optical output power; $P_o$ of LD changes by the temperature. The example when 30mA is injected to LD on graph 1 is as follows. If case temperature; $T_c$ is 25 degrees Celsius, $P_o$ becomes about 6mW. If $T_c$ is 60 degrees, $P_o$ might be about 1mW. If $T_c$ is over 70 degrees, $P_o$ is only LED light.

In other words, if **auto current control; ACC** is adopted, it is possible to destroy LD by over power and to use no LD light.

Therefore ROHM recommend **auto power control; APC**. When photo diode is built in LD, $P_o$ is known by monitor current; $I_m$. It is designed to keep almost same value regardless of $T_c$. If the injection current to LD on graph 2 is changed with keeping $I_m$ constant, $P_o$ becomes 5mW regardless of $T_c$.

<table>
<thead>
<tr>
<th>Mark</th>
<th>LD common</th>
<th>PD common</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>cathode</td>
<td>cathode</td>
</tr>
<tr>
<td>N</td>
<td>anode</td>
<td>cathode</td>
</tr>
<tr>
<td>P</td>
<td>cathode</td>
<td>anode</td>
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</tbody>
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Polarity shown by the sixth character from the left of the type name. It is ROHM original mark.
The optical output of the laser diode varies largely by the ambient temperature even when using a constant current. Therefore an APC circuit (as described in the following sections) which is not influenced by an ambient temperature is used.
Auto Power Control drive circuit example for M type LDs

When LD is turned on, monitor current (Im) flows. Im is proportional to the amount of light. And Voltage become: \( V1 = \text{Im}(R3+R4) \).

At same time, reference voltage \( V2 \) is generated by zenner diode and volume. OP2 always control the base current for output transistor so that it is always \( V1 = V2 \) and constant current flows into LD.

**Note** \( V1 \) must not exceed 0.5V
When LD is turned on, monitor current \( (I_m) \) flows. \( I_m \) is proportional to the amount of light. And Voltage become: \( V_1 = I_m(R_3 + R_4) \). At same time, reference voltage \( V_2 \) is generated by zener diode and volume. OP2 always control the base current for output transistor so that it is always \( V_1 = V_2 \) and constant current flows into LD.
Auto Power Control drive circuit example for N type LDs

When LD is turned on, monitor current (Im) flows. Im is proportional to the amount of light. And Voltage become: \( V1 = Im(R3+R4) \).
At same time, reference voltage \( V2 \) is generated by zenner diode and volume. OP2 always control the base current for output transistor so that it is always \( V1 = V2 \) and constant current flows into LD.
Auto Power Control drive circuit example for N type LDs (without Op-amp.)

The voltage between A-B will be the one between the base-emitter of the transistor. (It's about 0.55V in the case of an upper figure.)
For example

Po adjustment area : 0.5- 2 mW
Im of that case : 0.018 - 0.072mA

\[ R4 = \frac{0.55}{0.072} = 7.64 \text{ [kΩ]} \]
\[ R3+R4 = \frac{0.55}{0.018} = 30.6 \text{ [kΩ]} \]
\[ \therefore R3 = 22.9 \text{ [kΩ]} \]