Application example of photorelay, replacing from Mechanical relay (Thermostat)
Block Diagram for Thermostat

Main board

- Temperature Sensor
- Light Sensor
- Humidity Sensor
- Proximity Sensor
- SDRAM
- Flash Memory

- PMIC
  - DC-DC
  - LDO
- MCU
  - Wi-Fi SoC
  - Bluetooth SoC
  - Display Driver
  - Touch Screen Controller
  - LED Driver
  - I/O Expander
  - LCD panel
- MCU, Touch Screen Controller
- SDRAM, Flash, Wi-Fi, Bluetooth, Display Driver, LED
- I/O Expander, Isolation/Switch

I/O board

- HVAC System: Heating, Cooling, Heat Pump, Fan, Humidifier, Dehumidifier, etc.

Thermostat
- MCU
- Photorelay
- Control circuit

Variable Valve Controller
- MCU
- Photorelay

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Rev. 1.0
Device solution for customer’s problems

Regarding to design thermostat, there are important point of “Space saving”, “Long life time, Maintenance free”, “Low power consumption”, we will propose 3 solutions from our point of view.

- **Space saving**
  - Industry the Smallest package

- **High reliability**
  - No wear & tear
  - Long life time

- **Low power consumption**
  - High efficiency
  - Low loss
# Mechanical relay common specifications for Thermostats

<table>
<thead>
<tr>
<th>Package Size</th>
<th>10 x 6 x 5.7 mm ~ 16 x 10 x 8 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coil voltage range</td>
<td>1.5 ~ 48 VDC</td>
</tr>
<tr>
<td>Contact arrangement</td>
<td>DPDT (2 form C) or SPDT (1 form C)</td>
</tr>
<tr>
<td>Initial contact resistance</td>
<td>&lt;100 mΩ</td>
</tr>
<tr>
<td>Normal operating current</td>
<td>~ 5.0 VDC, 40.0 mA</td>
</tr>
<tr>
<td>Max. switching power</td>
<td>60 W, 62.5 VA</td>
</tr>
<tr>
<td>Max. switching voltage</td>
<td>250 VAC, 220 VDC</td>
</tr>
<tr>
<td>Max. switching current</td>
<td>3 A</td>
</tr>
<tr>
<td>Operate time [Set time]</td>
<td>~ 5 ms</td>
</tr>
<tr>
<td>Release time [Reset time]</td>
<td>~ 5 ms</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-40°C to +85°C</td>
</tr>
</tbody>
</table>
## Recommendation for Mechanical Relay Replacement

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>TLP3103</th>
<th>TLP3107</th>
<th>TLP3109</th>
<th>TLP3555A</th>
<th>TLP3556A</th>
<th>TLP3823</th>
<th>TLP3825</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>2.54SOP6 (6.3 x 7.0 x 2.1 mm)</td>
<td>DIP4 (4.58 x 7.62 x 3.65 mm)</td>
<td>DIP8 (9.66x7.62x3.65 mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward voltage @IF = 10mA</td>
<td>1.18 V(min), 1.33 V(typ), 1.48 V(max)</td>
<td>1.5 V(min), 1.64 V(typ), 1.8 V(max)</td>
<td>1.5 V(min), 1.64 V(typ), 1.8 V(max)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contact arrangement</td>
<td>1a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-state resistance (RON)</td>
<td>70 mΩ</td>
<td>60 mΩ</td>
<td>70 mΩ</td>
<td>100 mΩ</td>
<td>200 mΩ</td>
<td>150 mΩ</td>
<td>500 mΩ</td>
</tr>
<tr>
<td>Diode power dissipation (PD)</td>
<td></td>
<td></td>
<td></td>
<td>50 mW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off-state output terminal voltage (VOFF)</td>
<td>60 V</td>
<td>100 V</td>
<td>60 V</td>
<td>100 V</td>
<td>100 V</td>
<td>200 V</td>
<td></td>
</tr>
<tr>
<td>On-state current (ION/IONP)</td>
<td>2.3 A/7 A</td>
<td>3.3 A/10 A</td>
<td>2 A/6 A</td>
<td>3 A/9 A</td>
<td>2 A/6 A</td>
<td>3 A/9 A</td>
<td>1.5 A/4.5 A</td>
</tr>
<tr>
<td>Turn-ON time (tON)</td>
<td>Max. 5.0 ms</td>
<td></td>
<td></td>
<td>Max. 2.0 ms</td>
<td></td>
<td>Max. 5.0 ms</td>
<td></td>
</tr>
<tr>
<td>Turn-OFF time (tOFF)</td>
<td>Max 1.0 ms</td>
<td></td>
<td></td>
<td>Max 1.0 ms</td>
<td>Max 0.5 ms</td>
<td>Max 1.0 ms</td>
<td></td>
</tr>
<tr>
<td>Operating temperature (Topr)</td>
<td>-40°C to +85°C</td>
<td></td>
<td></td>
<td>-40°C to +110°C</td>
<td></td>
<td>-40°C to +110°C</td>
<td></td>
</tr>
</tbody>
</table>
| Comment                          | ■ TOSHIBA photo relays (VOFF = 90 to 600 VDC) are recommended for thermostats mechanical relay replacement.  
■ Space savings can be achieved using DIP4, 2.54SOP6 package.  
■ Photo relays are more reliable and last longer than mechanical relays. |
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