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

Middle board

- PMIC
- DC-DC
- LDO
- USB Connector
- Battery

Upper board

- MCU
- Wi-Fi SoC
- Bluetooth SoC
- Display Driver
- Touch Screen Controller
- LED Driver
- I/O Expander
- LCD panel
- Isolation/Switch

Thermostat

- MCU
- Photorelay
- Control circuit

Variable Valve Controller

- MCU
- Photorelay

HVAC System:
- Heating, Cooling, Heat Pump, Fan, Humidifier, Dehumidifier, etc.
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</td>
<td>DIP4</td>
<td>DIP8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(6.3 × 7.0 × 2.1 mm)</td>
<td>(4.58 × 7.62 × 3.65 mm)</td>
<td>(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></td>
<td></td>
<td></td>
<td>1a</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></td>
<td></td>
<td>50 mW</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>Max. 2.0 ms</td>
<td>Max. 5.0 ms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-OFF time (tOFF)</td>
<td>Max 1.0 ms</td>
<td>Max 1.0 ms</td>
<td>Max 0.5 ms</td>
<td>Max 1.0 ms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating temperature (Topr)</td>
<td>-40°C to +85°C</td>
<td>-40°C to +110°C</td>
<td>-40°C to +110°C</td>
<td></td>
<td></td>
<td></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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