Application Notes: Tri-State Function in Crystal Oscillators
What is Tri-State Function?

• In oscillator with Tri-state function, oscillator output can be controlled by the Tri-state pin as follows:
  – Logic High : Output Enable
  – Logic Low : Output Disable

• The Tri-state function would allow output pin to assume high-impedance state, effectively removing the oscillator output from the circuit.

• Oscillator circuits can remain on or be turned off while output is disabled in Tri-State.
Oscillator Operating Mode in Tri-state: Oscillator Circuits Off

- Advantage: Lower standby current
- Drawback: Longer startup time:
  - (Fundamental mode > 0.2mS)
  - (3rd Overtone mode > 2mS)
Oscillator Operating Mode in Tri-state: Oscillator Circuits On

- Advantage: Shorter output enable time (< 0.1mS)
- Drawback: Higher standby current
# Standby Current Comparison between Different Oscillator Operating Mode

<table>
<thead>
<tr>
<th>Supply Voltage ($V_{DD}$)</th>
<th>1.8V</th>
<th>2.5V</th>
<th>2.8V</th>
<th>3.3V</th>
<th>5V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oscillator off 22MHz</td>
<td>0.4uA</td>
<td>0.5uA</td>
<td>1.1uA</td>
<td>1.6uA</td>
<td>4.1uA</td>
</tr>
<tr>
<td>Oscillator off 44MHz</td>
<td>0.4uA</td>
<td>1.5uA</td>
<td>1.7uA</td>
<td>2.3uA</td>
<td>6.1uA</td>
</tr>
<tr>
<td>Oscillator on 22MHz</td>
<td></td>
<td></td>
<td>0.33mA</td>
<td>0.5mA</td>
<td>1.16mA</td>
</tr>
<tr>
<td>Oscillator on 44MHz</td>
<td></td>
<td></td>
<td>2.1mA</td>
<td>3.4mA</td>
<td>13.5mA</td>
</tr>
</tbody>
</table>

- Only PX/PY series have oscillator on/off option when output is disabled.
- All other oscillator series have oscillator turned off in Tri-state.
How to Disable Tri-State Function

- If Tri-state function is no needed, the Tri-state pin shall be connected to the Vcc pin or left floating. There is an internal pull-up resistor which would enable output if Tri-state pin is left floating.

- TAITIEN recommends connecting Tri-State pin to VCC if Tri-state function is not needed.