# 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

VCC

Freq. output

crystal

IC

Tri-state

GND
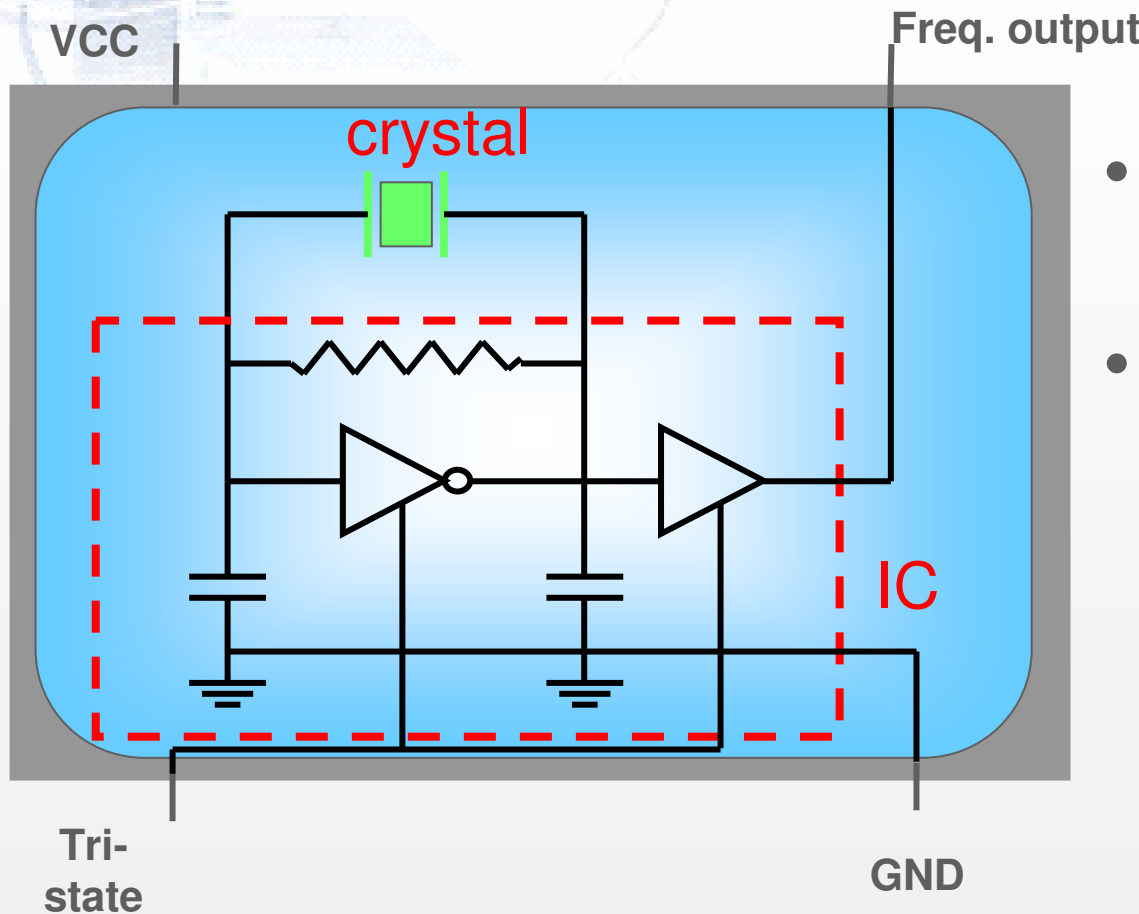
- Advantage :
  Lower standby current

- Drawback :
  Longer startup time:
    (Fundamental mode > 0.2mS)
    (3rd Overtone mode > 2mS)

# Oscillator Operating Mode in Tri-state: Oscillator Circuits On

VCC

Freq. output

crystal

IC

Tri-state

GND
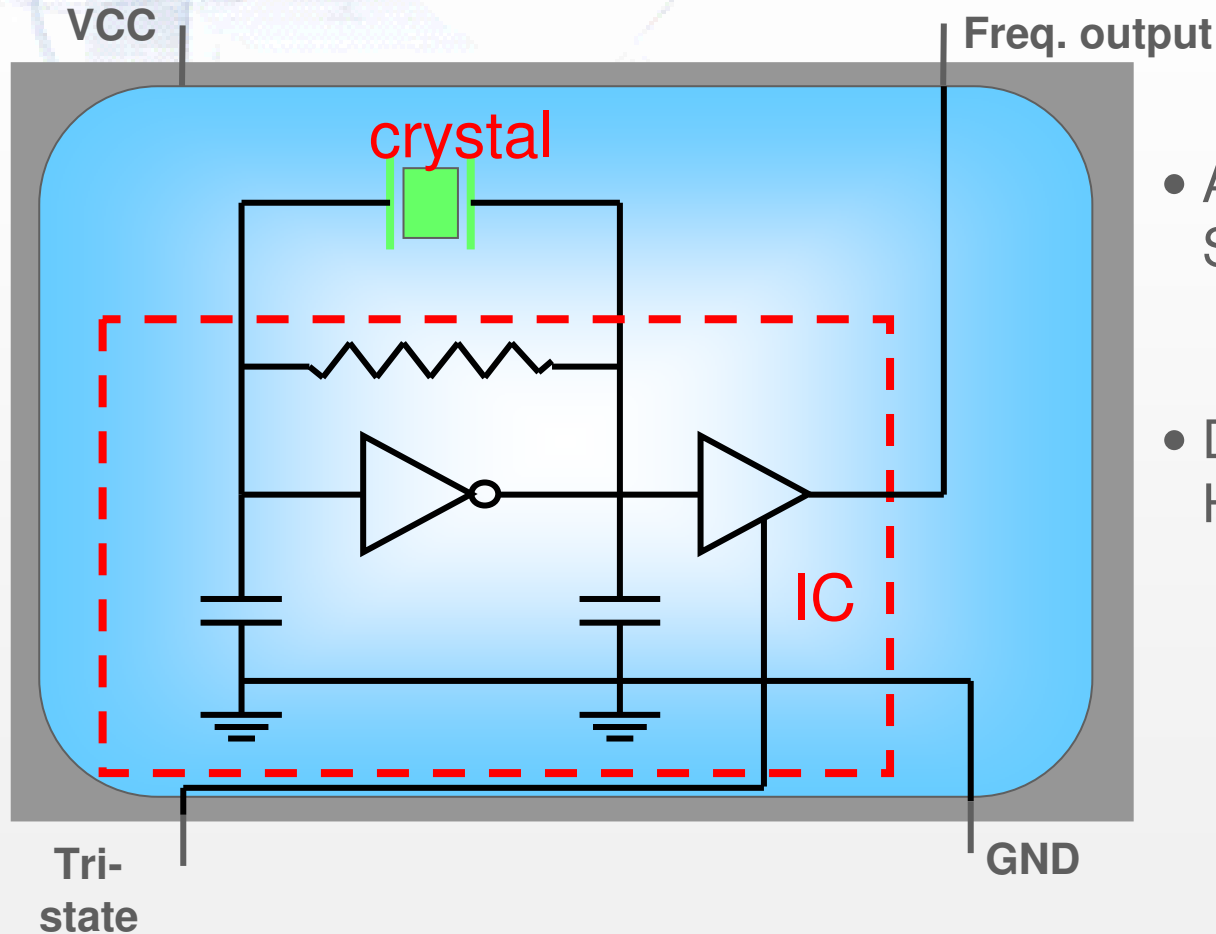
- Advantage:
  Shorter output enable time
  (< 0.1mS)

- Drawback:
  Higher standby current

Standby Current Comparison between Different Oscillator Operating Mode

Standby Current						
Supply Voltage(V$_{DD}$)		1.8V	2.5V	2.8V	3.3V	5V
Oscillator off	**22MHz**	0.4uA	0.5uA	1.1uA	1.6uA	4.1uA
	44MHz	0.4uA	1.5uA	1.7uA	2.3uA	6.1uA
Oscillator on	**22MHz**			0.33mA	0.5mA	1.16mA
	44MHz			2.1mA	3.4mA	13.5mA

- 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

VCC   **Freq. Output**
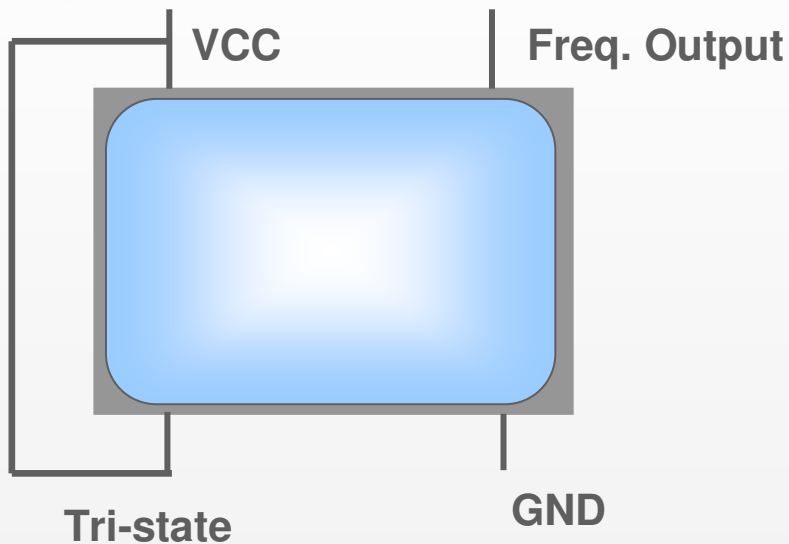
Tri-state   **GND**

- If Tri-state function is no needed, the Tri-state pin shall be connected to the Vcc pin or left floating. There is a 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.