



### Features

- Wide range of operating supply voltage:
  - 1.62~5.50V(30~135MHz)
  - 1.62~3.63V(120~160MHz)
- Operating temperature range
  - XO5054Cx-DE/WF: -40 to 105°C
- High Performance(Low Phase Noise/Low Jitter)
- High Frequency Stability <+/-1.5ppm
- Ultra-Low Drive Level
- Standby function
- High impedance in standby mode, oscillator stops
- CMOS output duty level(1/2VDD)
- 50±10% output duty
- 15/30pF output drive capability
- Die form or Wafer form

### Application

- Used for crystal oscillator
- 7050, 5032 Crystal Oscillator(XO5054Cx-2/8)
- 3225, 2520,Crystal Oscillator(XO5054Cx-3/5)
- 2016 crystal Oscillator(XO5054Cx-4)

### Description

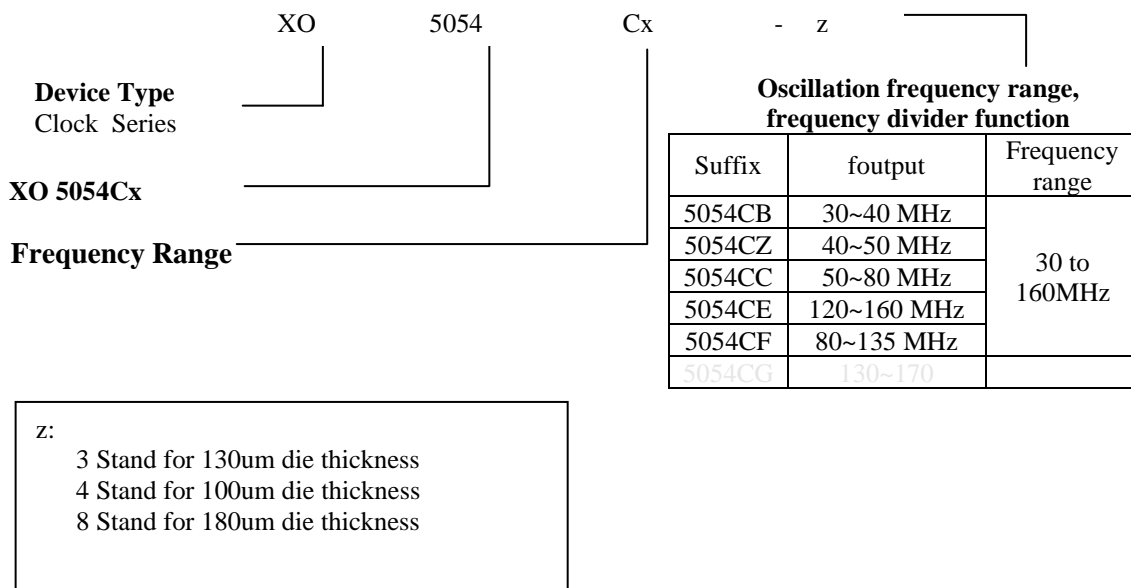
The XO5054Cx series are miniature crystal oscillator module ICs. The oscillator circuit stage has Voltage regulator, significantly reducing current consumption and crystal current, compared with existing devices, and significantly reducing the oscillator characteristics supply voltage dependency.

### Ordering Information

| Part no.     | Package type |
|--------------|--------------|
| XO5054Cx-zWF | Wafer form   |
| XO5054Cx-zDE | Die form     |

#### Note:

- 1.Below is the detailed definition of part no.
2. x: B/C/D/E, z: -3(130um), -4(100um), -8(180um)



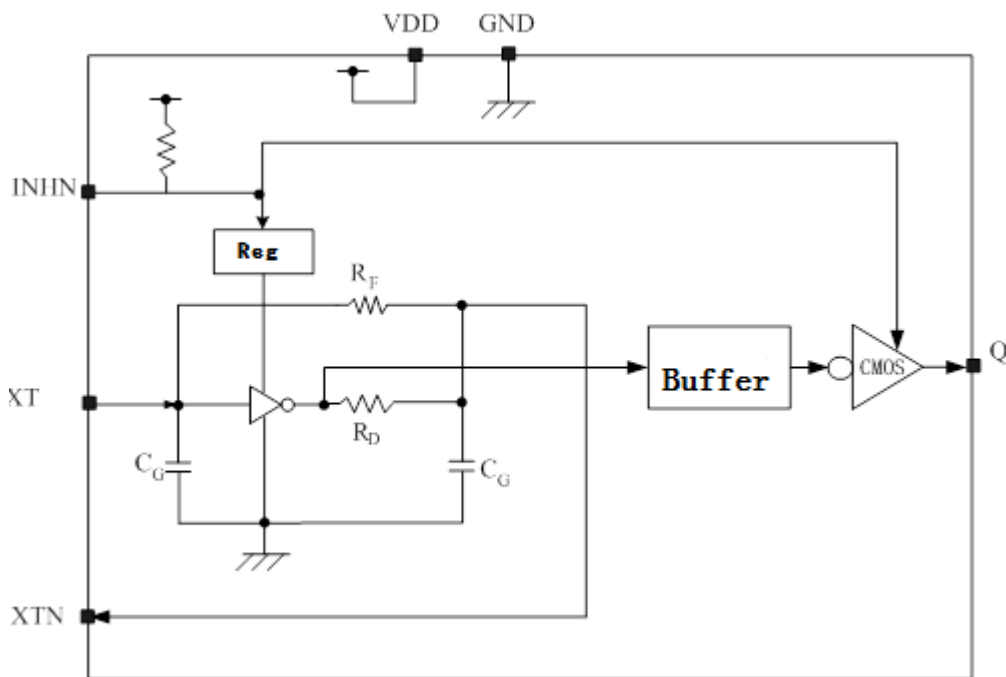


**Series Configuration**

| Part No. | Output frequency | Operating supply voltage range(V) | Oscillation mode         | Recommended oscillation frequency range <sup>*1</sup> (MHz) | Output drive capability(mA) | Standby mode             |              |
|----------|------------------|-----------------------------------|--------------------------|---|-----------------------------|--------------------------|--------------|
|          |                  |                                   |                          |   |                             | Oscillator stop function | Output state |
| XO5054CB | 30~40MHz         | 1.62 ~5.50                        | 3 <sup>rd</sup> Overtone | 30 to 170   | 16                          | Yes                      | Hi-Z         |
| XO5054CZ | 40~50MHz         | 1.62~ 5.50                        |                          |   |                             |                          |              |
| XO5054CC | 50~80MHz         | 1.62~ 5.50                        |                          |   |                             |                          |              |
| XO5054CE | 120~160MHz       | 1.62~ 3.63                        |                          |   |                             |                          |              |
| XO5054CF | 80~135MHz        | 1.62~ 5.50                        | 3 <sup>rd</sup> Overtone |   |                             |                          |              |
| XO5054CG | 130~170MHz       | 2.25~ 5.50                        | 3 <sup>rd</sup> Overtone |   |                             |                          |              |

**Note:** XO5054CE operating frequency depend on operating temperature, details see recommended operating condition.

**Block Diagram**





## Function Description

### Standby Function

When INHN goes LOW, the oscillator stops and the output on Q becomes high impedance.

| INHN           | Q                   | Oscillator       |
|----------------|---------------------|------------------|
| HIGH (or open) | fo output frequency | Normal operation |
| Low            | High impedance      | Stopped          |

### Power-saving Pull-up Resistor

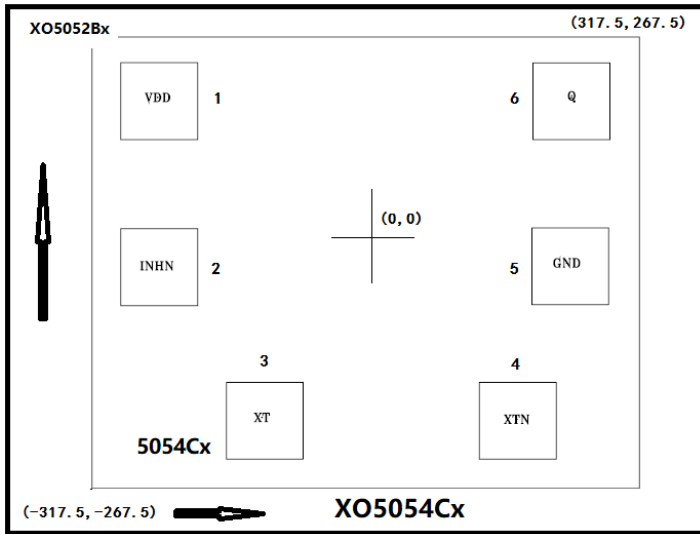
The INHN pin pull-up resistance RUP1 or RUP2 changes in response to the input level(HIGH or LOW). When INHN is tied LOW level, the pull-up resistance is large(RUP1),reducing the current consumed by the resistance. When INHN is left open circuit, the pull-up resistance is small(RUP2),which increases the input susceptibility to external noise. However, the pull-up resistance ties the INHN pin HIGH level to prevent external noise from unexpectedly stopping the output.

### Oscillation Detector Function

The XO5054Cx series also feature an oscillation detector circuit. This circuit functions make the outputs disable until the oscillator circuit starts and oscillation becomes stable. This alleviates the danger of abnormal oscillator output at oscillator start-up when power is applied or when INHN is switched.



**Pad Configuration**



| Pad Coordinate File |              |              |          |              |              |
|---------------------|--------------|--------------|----------|--------------|--------------|
| Pad Name            | X Coordinate | Y Coordinate | Pad Name | X Coordinate | Y Coordinate |
| 1                   | -214.85      | 168          | 4        | 158.35       | -164.6       |
| 2                   | -214.85      | -4.65        | 5        | 213.15       | -3.85        |
| 3                   | -105.1       | -164.6       | 6        | 214.2        | 167.9        |
|                     |              |              |          |              |              |

**Note:** Substrate is connected to GND or floating.  
**Die Size:** 630µm\*530µm (Including scribe line , Scribe Line Width 60um)  
**Die Thickness:** 130µm±15µm(-3) or 180um±20um(-8), 100µm±15µm(-4)  
**Pad Size:** 80µm\*80µm      **Substrate Level:** GND or Floating

**Pad Description**

| Sym.            | Type | Description  |   |
|-----------------|------|--|---|
| XTN             | O    | Amplifier output.  | Crystal oscillator connected between XT and XTN |
| XT              | I    | Amplifier input.   |   |
| INH             | I    | Output state control input. High impedance when LOW. Power-saving pull-up resistor built in. |   |
| V <sub>DD</sub> | P    | Supply voltage   |   |
| GND             | P    | Ground   |   |
| Q               | O    | Output. Output frequency determined by external crystal                                      |   |



Maximum Ratings

|  |                                |
|--|--------------------------------|
| Storage Temperature.....   | -65°C to +150°C                |
| Supply Voltage to Ground Potential (V <sub>DD</sub> to GND)..... | -0.5V to +7.0V                 |
| DC Input (All Other Inputs except V <sub>DD</sub> & GND) ...     | -0.5V to V <sub>DD</sub> +0.5V |
| DC Output.....   | -0.5V to V <sub>DD</sub> +0.5V |
| DC Output Current (all outputs) .....                            | 16mA                           |

Note:

Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Recommended Operating Conditions

(GND=0V, unless otherwise noted.)

| Sym.             | Parameter             | Series            | Conditions                                   | Min  | Typ | Max  | Unit |
|------------------|-----------------------|-------------------|--|------|-----|------|------|
| V <sub>DD</sub>  | Supply voltage        | XO5054CB/CZ/CC/CF | 30MHz~135MHz                                 | 1.62 | -   | 5.50 | V    |
| V <sub>DD</sub>  | Supply voltage        | XO5054CE          | 120~160MHz                                   | 1.62 | -   | 3.63 | V    |
| V <sub>IN</sub>  | Input voltage         | All series        | -  | GND  | -   | VDD  | V    |
| T <sub>A</sub>   | Operating temperature | All series        | 30~135MHz/1.62~5.5V<br>120~160MHz/1.62~3.63V | -40  | -   | +105 | °C   |
| f <sub>OUT</sub> | Output frequency      | XO5054CB/CZ/CC/CF | 1.62~5.50V                                   | 30   | -   | 135  | MHz  |
| f <sub>OUT</sub> | Output frequency      | XO5054CE          | 1.62~3.63V                                   | 120  | -   | 160  | MHz  |

Reliability Data

| Sym. | Parameter        | Series     | Conditions                 | Min     | Typ     | Max | Unit |
|------|------------------|------------|----------------------------|---------|---------|-----|------|
| ESD  | Human Body Model | All series | MIL-STD-883H Method 3015.8 | +/-3000 | +/-5500 |     | V    |

Note: Industrial Standard ESD: HBM Model +/-2000V



**DC Electrical Characteristics**

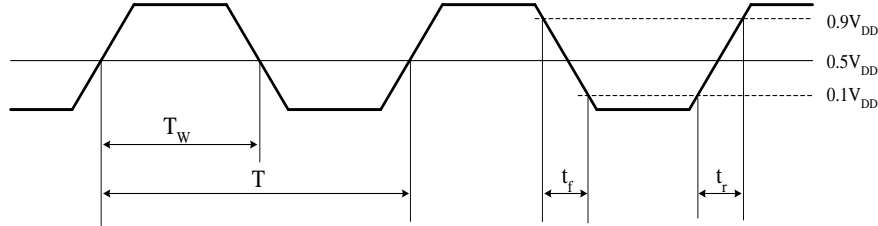
XO5054Cx (V<sub>DD</sub> = 1.62 to 5.50V, T<sub>A</sub> = -40 to 85°C, unless otherwise noted.)

| Sym.             | Parameter                           | Condition   | Rating                            |                            |                    | Unit |    |
|------------------|-------------------------------------|---|-----------------------------------|----------------------------|--------------------|------|----|
|                  |                                     |   | min                               | typ                        | max                |      |    |
| V <sub>OH</sub>  | HIGH-level output voltage           | Q: Measurement cct3, I <sub>OH</sub> =8mA                         | V <sub>DD</sub> -0.4              | -                          | -                  | V    |    |
| V <sub>OL</sub>  | LOW-level output voltage            | Q: Measurement cct3, I <sub>OL</sub> =8mA                         | -                                 | -                          | 0.4                | V    |    |
| V <sub>IH</sub>  | HIGH-level input voltage            | INH <sub>N</sub> , Measurement cct4                               | 0.7V <sub>DD</sub>                | -                          | -                  | V    |    |
| V <sub>IL</sub>  | LOW-level input voltage             | INH <sub>N</sub> , Measurement cct4                               | --                                | -                          | 0.3V <sub>DD</sub> | V    |    |
| I <sub>Z</sub>   | Output leakage current              | Q: Measurement cct5, IHNH=LOW                                     | V <sub>OH</sub> = V <sub>DD</sub> | -                          | -                  | 10   | uA |
|                  |                                     |   | V <sub>OL</sub> = GND             | -                          | -                  | 10   | uA |
| I <sub>DD</sub>  | Current consumption                 | Measurement cct 1, 5054CB/CZ<br>F <sub>out</sub> =40MHz           | V <sub>DD</sub> = 1.8V            |                            |                    | 8    | mA |
|                  |                                     |   | V <sub>DD</sub> = 3.3V            |                            |                    | 10   | mA |
|                  |                                     |   | V <sub>DD</sub> = 5V              |                            |                    | 12   | mA |
|                  |                                     | Measurement cct 1, 5054CC<br>F <sub>out</sub> =50MHz              | V <sub>DD</sub> = 1.8V            |                            |                    | 10   | mA |
|                  |                                     |   | V <sub>DD</sub> = 3.3V            |                            |                    | 12   | mA |
|                  |                                     |   | V <sub>DD</sub> = 5V              |                            |                    | 15   | mA |
|                  |                                     | Measurement cct 1, 5054CF<br>F <sub>out</sub> =125MHz<br>XO5054CF | V <sub>DD</sub> = 1.8V            |                            |                    | 20   | mA |
|                  |                                     |   | V <sub>DD</sub> = 3.3V            |                            |                    | 25   | mA |
|                  |                                     |   | V <sub>DD</sub> = 5.0V            |                            |                    | 35   | mA |
|                  |                                     | Measurement cct 1, 5054CE<br>F <sub>out</sub> =156.25MHz          | V <sub>DD</sub> = 1.8V            | -                          |                    | 30   | mA |
|                  |                                     |   | V <sub>DD</sub> = 3.3V            |                            |                    | 40   | mA |
|                  |                                     | I <sub>ST</sub>   | Standby current                   | Measurement cct1, INHN=LOW | -                  | -    | 10 |
| R <sub>UP1</sub> | INH <sub>N</sub> pull-up resistance | Measurement cct6  | 0.4                               | 1.5                        | 8                  | MΩ   |    |
| R <sub>UP2</sub> |                                     |   | 30                                | 70                         | 150                | KΩ   |    |
| C <sub>G</sub>   | Oscillator capacitance              | XO5054CB/CZ   |                                   | 5                          |                    | pF   |    |
| C <sub>D</sub>   |                                     |   |                                   | 6                          |                    | pF   |    |
| C <sub>G</sub>   | Oscillator capacitance              | XO5054CC  |                                   | 3                          |                    | pF   |    |
| C <sub>D</sub>   |                                     |   |                                   | 4                          |                    | pF   |    |
| C <sub>G</sub>   | Oscillator capacitance              | XO5054CF  |                                   | 2                          |                    | pF   |    |
| C <sub>D</sub>   |                                     |   |                                   | 2                          |                    | pF   |    |
| C <sub>G</sub>   | Oscillator capacitance              | XO5054CE  |                                   | 2                          |                    | pF   |    |
| C <sub>D</sub>   |                                     |   |                                   | 2                          |                    | pF   |    |



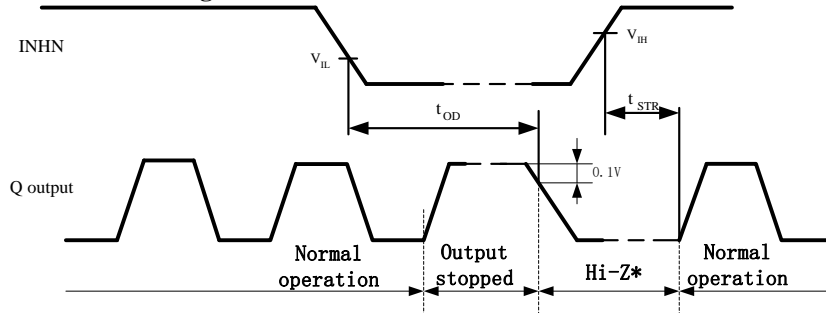
AC Electrical Characteristics

Output switching waveform



$$DUTY = T_W / T \times 100 (\%)$$

Output disable and oscillation start timing chart



When INHN goes HIGH to LOW, the Q output goes HIGH once and then becomes high impedance.

When INHN goes LOW to HIGH, the Q output from high impedance to normal output operation when the oscillation starts (oscillation is detected)

\*: the high impedance interval in the figure is shown as a LOW level due to the 1KΩ pull-down resistor connected to the Q pin(see“Measurement circuit 2”in the “Measurement circuits” section)

XO5054Cx Series(V<sub>DD</sub>=1.62 to 5.5V, T<sub>A</sub>=-40 to 85°C unless otherwise noted)

| Parameter  | Symbol                           | Condition   |                                  | Min | Type | Max | Unit |
|--|----------------------------------|---|----------------------------------|-----|------|-----|------|
| Output rise time<br>Output fall time<br>(XO5054CB/CZ/CC) | t <sub>r1</sub> /t <sub>f1</sub> | CL=15pF,<br>0.2V <sub>DD</sub> ~0.8V <sub>DD</sub>            | V <sub>DD</sub> =1.62 to 1.98V   | -   | 2.5  | 3.5 | ns   |
|  | t <sub>r2</sub> /t <sub>f2</sub> | CL=15pF,<br>0.1V <sub>DD</sub> ~0.9V <sub>DD</sub>            | V <sub>DD</sub> = 2.97 to 3.63 V | -   | 1.5  | 2.5 |      |
|  | t <sub>r2</sub> /t <sub>f2</sub> | CL=15pF,<br>0.1V <sub>DD</sub> ~0.9V <sub>DD</sub>            | V <sub>DD</sub> = 4.5 to 5.50 V  | -   | 1.2  | 2   |      |
| Output rise time<br>Output fall time<br>(XO5054CE/CF)    | t <sub>r1</sub> /t <sub>f1</sub> | CL=15pF,<br>0.2V <sub>DD</sub> ~0.8V <sub>DD</sub>            | V <sub>DD</sub> =1.62 to 1.98V   | -   | 2.0  | 3.0 | ns   |
|  | t <sub>r2</sub> /t <sub>f2</sub> | CL=15pF,<br>0.1V <sub>DD</sub> ~0.9V <sub>DD</sub>            | V <sub>DD</sub> =2.97 to 3.63 V  | -   | 1.0  | 2.0 |      |
|  | t <sub>r2</sub> /t <sub>f2</sub> | CL=15pF,<br>0.1V <sub>DD</sub> ~0.9V <sub>DD</sub>            | V <sub>DD</sub> =4.5 to 5.50V    | -   | 0.7  | 1.5 |      |
| Output duty cycle  | Duty                             | Measurement cct 1, T <sub>A</sub> =25°C, C <sub>L</sub> =15pF |                                  | 40  | 50   | 60  | %    |
| Output disable delay time                                | t <sub>OD</sub>                  | Measurement cct 1, T <sub>A</sub> =25°C, C <sub>L</sub> ≤15pF |                                  | -   | -    | 50  | us   |



**RSM**

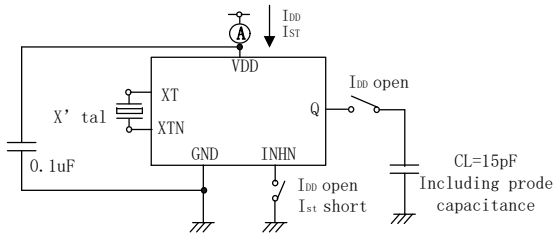
www.raystar-tek.com

**XO5054Cx Series  
High Performance  
3rd Overtone Crystal Oscillator IC**

**Measurement Circuit**

**Measurement cct1**

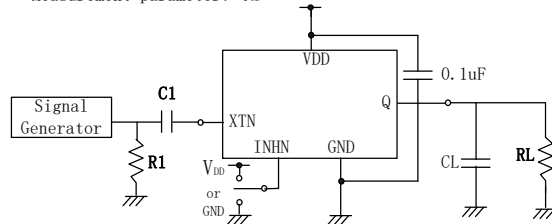
Measurement parameter:  $I_{DD}$ ,  $I_{ST}$ , Duty,  $t_r$ ,  $t_f$



Note: The AC characteristics are observed using an oscilloscope on pin Q

**Measurement cct2**

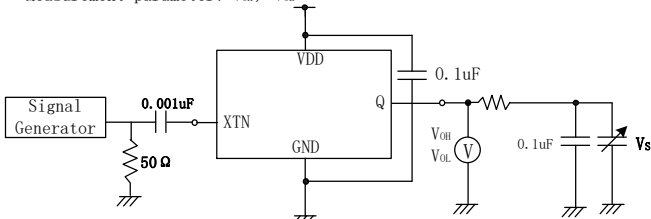
Measurement parameter:  $t_{00}$



XTN input signal: 1Vp-p, sina wave  
 $C1$ : 0.001uF  $CL$ : 15pF  
 $R1$ : 50  $\Omega$   $RL$ : 1K  $\Omega$

**Measurement cct3**

Measurement parameter:  $V_{OH}$ ,  $V_{OL}$



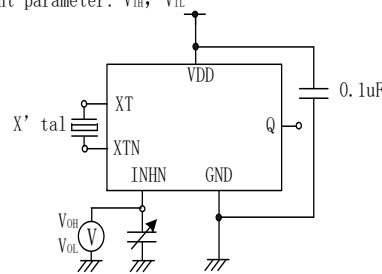
$V_s$  adjusted such that  $\Delta V = 50 \times I_{OH}$

$V_s$  adjusted such that  $\Delta V = 50 \times I_{OL}$

XTN input signal: 1Vp-p, sina wave

**Measurement cct4**

Measurement parameter:  $V_{IH}$ ,  $V_{IL}$



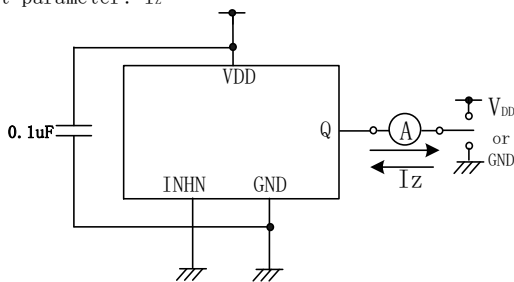
$V_{IH}$ : Voltage is 0V to  $V_{DD}$  transition that changes the output state.

$V_{IL}$ : Voltage is  $V_{DD}$  to 0V transition that changes the output state.

INHN has an oscillation stop function

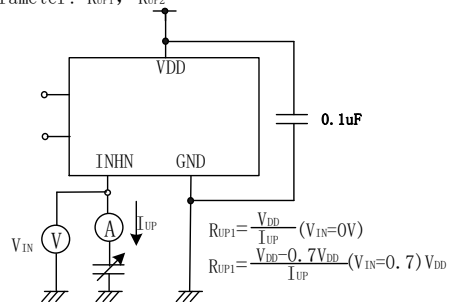
**Measurement cct5**

Measurement parameter:  $I_z$



**Measurement cct6**

Measurement parameter:  $R_{UP1}$ ,  $R_{UP2}$







**RSM**

www.raystar-tek.com

**XO5054Cx Series  
High Performance  
3rd Overtone Crystal Oscillator IC**

---

History Log:

| <b>Rev #</b> | <b>DCN NO.</b> | <b>REVISION HISTORY</b>                 | <b>DATE</b> |
|--------------|----------------|---|-------------|
| 3.6          | 230025         | Updated duty cycle 50%+/-10% (features) | 2023/2/17   |