



## 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-V: -40 to 125°C
- High Performance (Low Phase Noise/Low Jitter)
- High Frequency VS Vdd Stability <+/-1.5ppm
- Ultra-Low Drive Level
- Standby function
- High impedance in standby mode, oscillator stops
- CMOS output duty level(1/2VDD)
- 50±5% output duty
- 15/30pF output drive capability
- Die form or Wafer form
- AEC-Q 100 qualified. PPAP capable, and manufactured in IATF 16949 certified facilities.

## Description

The XO5054Cx-V 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.

## Application

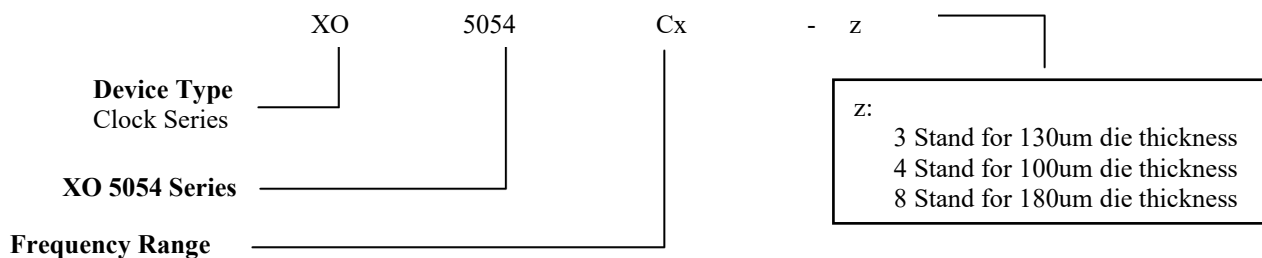
- Used for crystal oscillator
- 7050, 5032,3225,2520,2016 (XO5054Cx-4) Crystal Oscillator

## Ordering Information

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

**Note:** 1. Below is the detailed definition of part no.

**Note:** 2. x: B/C/D/E, z: -3(130um), -4(100um), -8(180um)



### Oscillation frequency range, frequency divider function

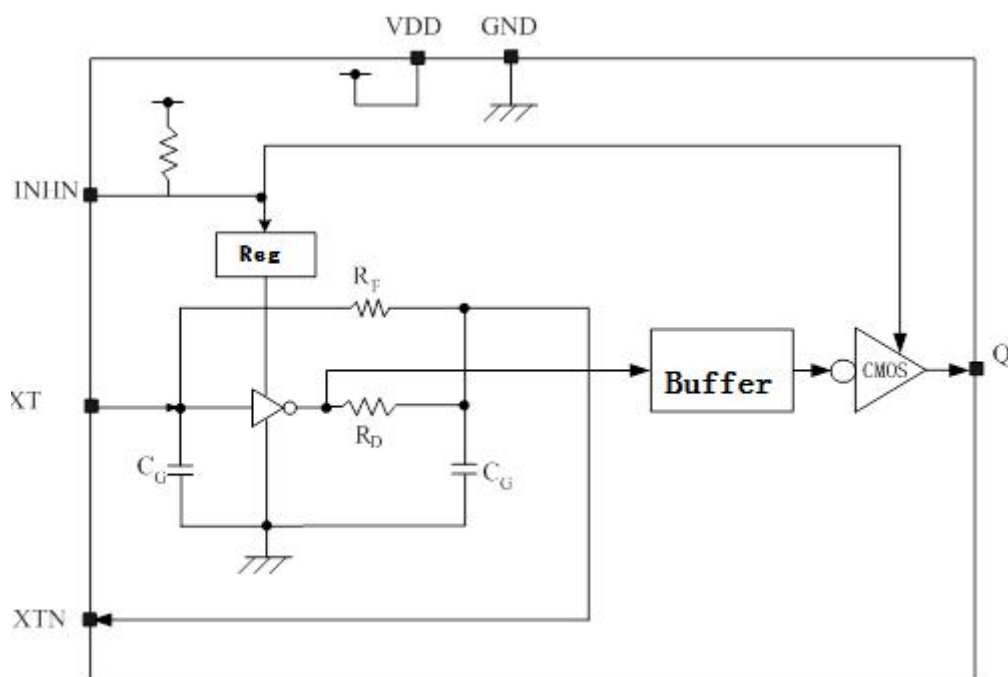
| Suffix     | Foutput     | Frequency range |
|------------|-------------|-----------------|
| XO5054CB-V | 30~40MHz    | 30 to 160MHz    |
| XO5054CZ-V | 40~50 MHz   |                 |
| XO5054CC-V | 50~80 MHz   |                 |
| XO5054CF-V | 80~135 MHz  |                 |
| XO5054CE-V | 120~160 MHz |                 |



## Series Configuration

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

## 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) | Output frequency | Normal operation |
| Low            | High impedance   | Stopped          |

### Power-saving Pull-up Resistor

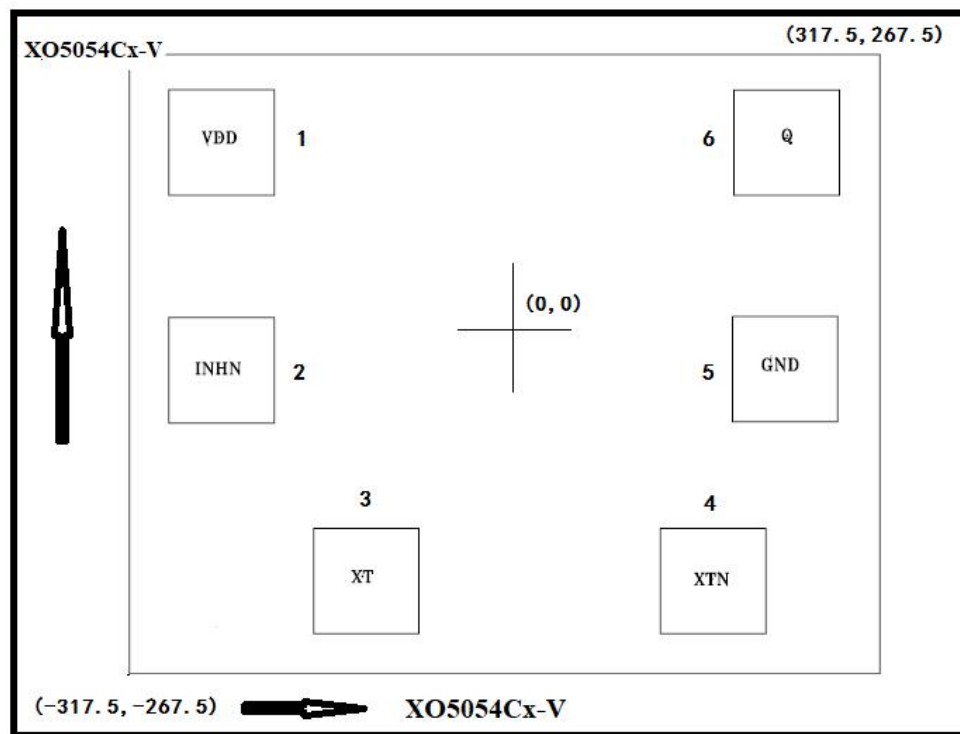
The INHN pin pull-up resistance RUP1 or RUP2 changes in response to the input level (HIGH or LOW). When INHN is tied LOW level, the pull-up resistance is large (RUP1), reducing the current consumed by the resistance. When INHN is left open circuit, the pull-up resistance is small (RUP2), which increases 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-V 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 60μm)

**Die Thickness:** 180μm±20μm (-8), 130μm±15μm (-3) or 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.                                                                             |                                                 |
| INHN            | 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 Rating

Storage Temperature..... -65°C to +150°C  
Supply Voltage to Ground Potential ( $V_{DD}$  to GND)..... -0.5V to +7.0V  
DC Input (All Other Inputs except  $V_{DD}$  & GND).. -0.5V to  $V_{DD}$  +0.5V  
DC Output..... -0.5V to  $V_{DD}$  +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 |
|-----------|-----------------------|---------------------|--------------|------|-----|----------|------|
| $V_{DD}$  | Supply voltage        | XO5054CB/CZ/CC/CF-V | 30MHz~135MHz | 1.62 | -   | 5.50     | V    |
| $V_{DD}$  | Supply voltage        | XO5054CE-V          | 120~160MHz   | 1.62 | -   | 3.63     | V    |
| $V_{IN}$  | Input voltage         | All series          |              | GND  | -   | $V_{DD}$ | V    |
| $T_A$     | Operating temperature | All series          |              | -40  | -   | +125     | °C   |
| $f_{OUT}$ | Output frequency      | XO5054Cx-V          |              | 30   | -   | 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

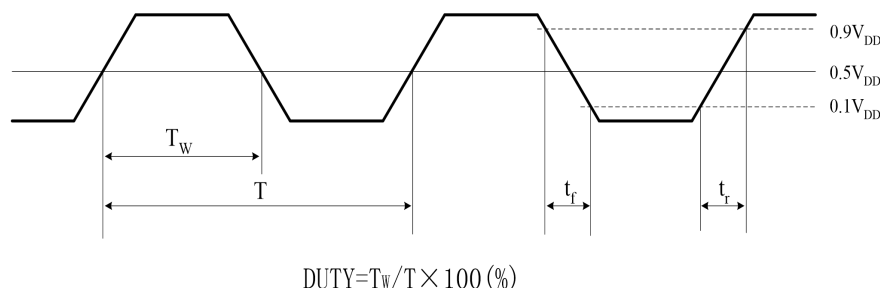
XO5054Cx-V ( $V_{DD} = 1.62$  to  $5.50V$ ,  $T_A = -40$  to  $125^{\circ}C$ , unless otherwise noted.)

| 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  | INHN, Measurement cct4                                 |                                  | 0.7V <sub>DD</sub>   | -    | -                  | V    |
| V <sub>IL</sub>  | LOW-level input voltage   | INHN, 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, 5054CZ-V<br>Fout=40MHz, No load     | V <sub>DD</sub> =1.8V            |                      |      | 8                  | mA   |
|                  |                           |                                                        | V <sub>DD</sub> =3.3V            |                      |      | 10                 | mA   |
|                  |                           | Measurement cct 1, 5054CC-V<br>Fout=50MHz, No load     | V <sub>DD</sub> =1.8V            |                      |      | 10                 | mA   |
|                  |                           |                                                        | V <sub>DD</sub> =3.3V            |                      |      | 12                 | mA   |
|                  |                           | Measurement cct 1, 5054CD-V<br>Fout=70MHz, No load     | V <sub>DD</sub> =1.8V            | -                    |      | 15                 | mA   |
|                  |                           |                                                        | V <sub>DD</sub> =3.3V            |                      |      | 18                 | mA   |
|                  |                           | Measurement cct 1, 5054CE-V<br>Fout=125MHz, No load    | V <sub>DD</sub> =1.8V            | -                    |      | 20                 | mA   |
|                  |                           |                                                        | V <sub>DD</sub> =3.3V            |                      |      | 25                 | mA   |
|                  |                           | Measurement cct 1, 5054CE-V<br>Fout=156.25MHz, No load | V <sub>DD</sub> =1.8V            | -                    |      | 25                 | mA   |
|                  |                           |                                                        | V <sub>DD</sub> =3.3V            |                      |      | 40                 | mA   |
| I <sub>ST</sub>  | Standby current           | Measurement cct1, INHN=LOW                             |                                  | -                    | -    | 10                 | uA   |
| R <sub>UP1</sub> | INHN pull-up resistance   | Measurement cct6                                       |                                  | 0.4                  | 1.5  | 8                  | M Ω  |
| R <sub>UP2</sub> |                           |                                                        |                                  | 30                   | 70   | 150                | K Ω  |
| C <sub>G</sub>   | Oscillator capacitance    | XO5054CB/CZ-V                                          |                                  |                      | 5    |                    | pF   |
| C <sub>D</sub>   |                           |                                                        |                                  |                      | 6    |                    | pF   |
| CG               |                           | XO5054CC-V                                             |                                  |                      | 3    |                    | pF   |
| CD               |                           |                                                        |                                  |                      | 4    |                    | pF   |
| CG               |                           | XO5054CF-V                                             |                                  |                      | 2    |                    | pF   |
| CD               |                           |                                                        |                                  |                      | 2    |                    | pF   |
| CG               |                           | XO5054CE-V                                             |                                  |                      | 2    |                    | pF   |
| CD               |                           |                                                        |                                  |                      | 2    |                    | pF   |

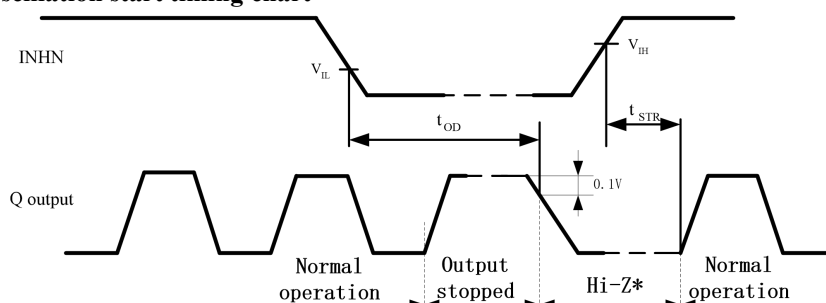


## AC Electrical Characteristics

**Output switching waveform**



**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 1K $\Omega$  pull-down resistor connected to the Q pin(see“Measurement circuit 2”in the “Measurement circuits” section)

### XO5054Cx-V Series (VDD=1.62 to 5.5V, Ta=-40 to 125°C unless otherwise noted)

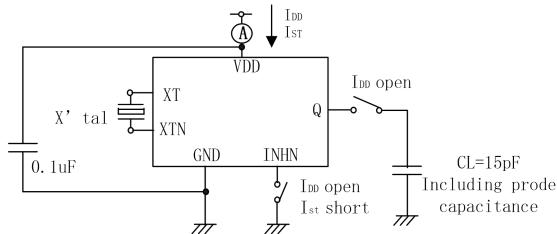
| Parameter                                               | Symbol          | Condition                           |                     | Min | Typ. | Max | Unit |
|---------------------------------------------------------|-----------------|-------------------------------------|---------------------|-----|------|-----|------|
| Output rise time<br>Output fall time<br>(XO5054CB/CC-V) | $t_{r1}/t_{f1}$ | CL=15pF,<br>0.2VDD~0.8VDD           | VDD=1.62 to 1.98V   | -   | 2.5  | 3.5 | ns   |
|                                                         | $t_{r2}/t_{f2}$ | CL=15pF,<br>0.1VDD~0.9VDD           | VDD= 2.97 to 3.63 V | -   | 1.5  | 2.5 |      |
|                                                         | $t_{r3}/t_{f3}$ | CL=15pF,<br>0.1VDD~0.9VDD           | VDD= 4.5 to 5.50 V  |     | 1.2  | 2   |      |
| Output rise time<br>Output fall time<br>(XO5054CD/CE-V) | $t_{r1}/t_{f1}$ | CL=15pF,<br>0.2VDD~0.8VDD           | VDD=1.62 to 1.98V   | -   | 2.0  | 3.0 | ns   |
|                                                         | $t_{r2}/t_{f2}$ | CL=15pF,<br>0.1VDD~0.9VDD           | VDD=2.97 to 3.63 V  | -   | 1.0  | 2.0 |      |
|                                                         | $t_{r3}/t_{f3}$ | CL=15pF,<br>0.1VDD~0.9VDD           | VDD=4.5 to 5.50V    |     | 0.7  | 1.5 |      |
| Output duty cycle                                       | Duty            | Measurement cct 1, TA=25°C, CL=15pF |                     | 40  | 50   | 60  | %    |
| Output disable delay time                               | tOD             | Measurement cct 1, TA=25°C, CL≤15pF |                     | -   | -    | 50  | us   |



## Measurement Circuit

### Measurement cct1

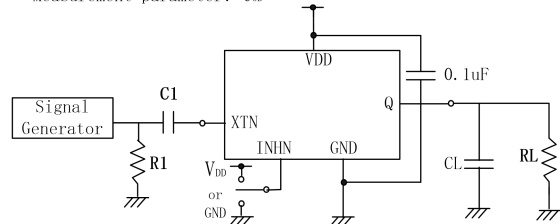
Measurement parameter:  $I_{DD}$ ,  $I_{ST}$ , Duty,  $t_r$ ,  $t_f$



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

### Measurement cct2

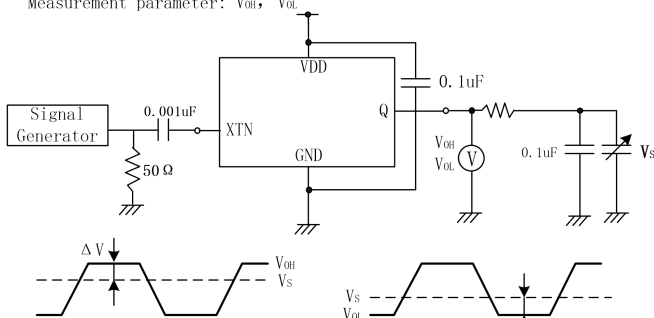
Measurement parameter:  $t_{DD}$



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

### Measurement cct3

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



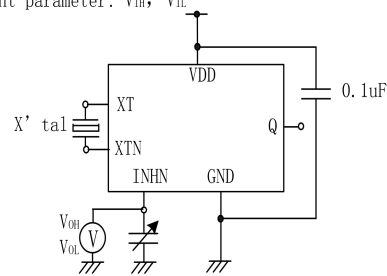
$V_S$  adjusted such that  $\Delta V = 50 \times I_{OH}$

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

XTN input signal: 1Vp-p, sine wave

### Measurement cct4

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



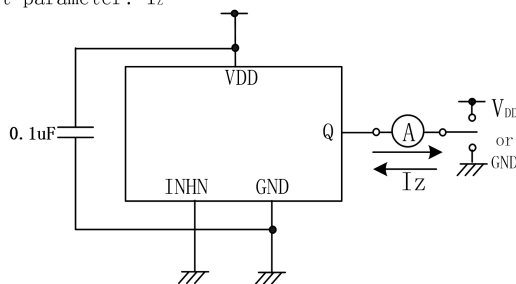
$V_{IH}$ : Voltage is 0V to  $V_{DD}$  transition that changes the output state.

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

INHN has an oscillation stop function

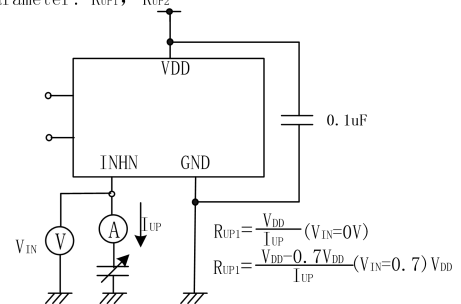
### Measurement cct5

Measurement parameter:  $I_Z$



### Measurement cct6

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



$$R_{UP1} = \frac{V_{DD}}{I_{UP}} \quad (V_{IN} = 0V)$$

$$R_{UP1} = \frac{V_{DD} - 0.7V_{DD}}{I_{UP}} \quad (V_{IN} = 0.7V_{DD})$$



## Revision History

| Revision | Description      | Date       |
|----------|------------------|------------|
| V1.0     | Official release | 2025/12/16 |