



## Features

- Wide range of operating supply voltage: 1.6V to 5.5V
- Low crystal drive current oscillation for miniature crystal units
- XO5052Cx/Bx-C-Q series: for Wire Bonding
  - XO5052Cx-C-Q: C type package
  - XO5052Bx-C-Q: B type package (2016)
- -45 to 125°C operating temperature range
- Crystal frequency (10MHz~60MHz)
- Output Freq: Crystal Freq divided by 1/2/4/8/16/...
- Very low standby current
- 50±5% output duty cycle
- 50pF output drive capability (2.25~5.5V)
- 15pF output drive Capability (1.6~5.5V)
- Die form or Wafer form
- AEC-Q 100 qualified. PPAP capable, and manufactured in IATF 16949 certified facilities

## Applications

- Fundamental Crystal Oscillator
- 7050, 5032, 3225, 2520, 2016 crystal oscillator

## Description

The XO5052xx-C-Q series are miniature crystal oscillator module ICs. The oscillator circuit stage has constant current drive, significantly reducing current consumption and crystal current, compared with existing devices, and significantly reducing the oscillator characteristics supply voltage dependency.

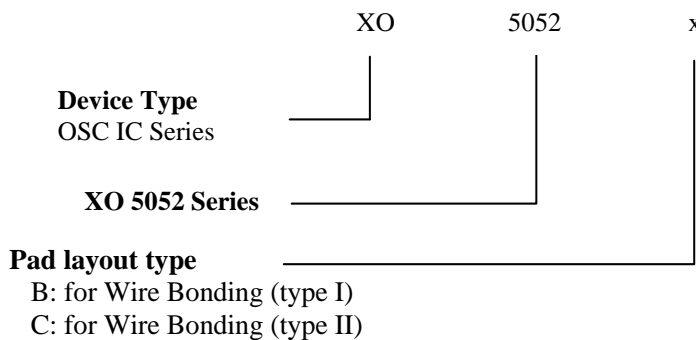
## Ordering Information

Part no.	Package type
XO5052xy-zWF-C-Q	Wafer form
XO5052xy-zDE-C-Q	Die form

Note 1: x: B suitable for B Base, C suitable for C base

Note 2: y: 1/2/3/4(1/2/4/8/16/...)

Note 3: z: -8(180um) or -3(130um), -4(100um),

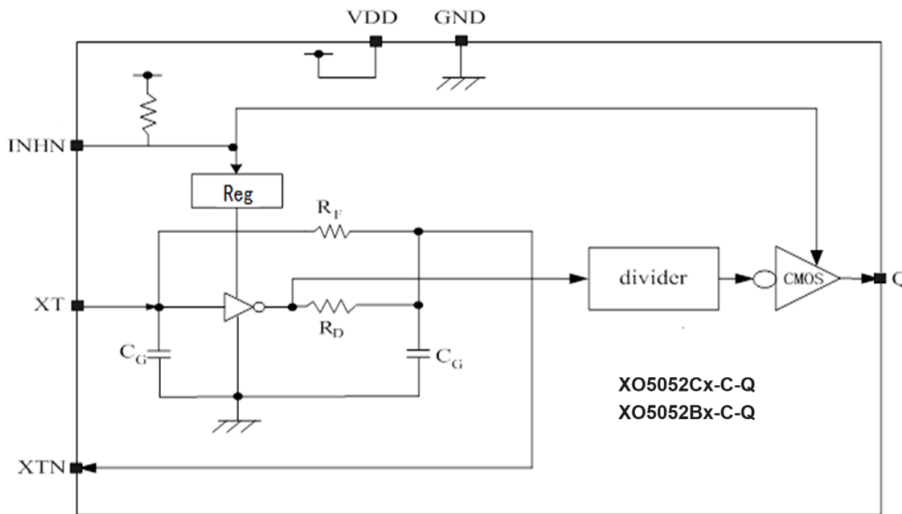


**Oscillation frequency range, frequency divider function**

Suffix	f <sub>output</sub>	Frequency range
1	f <sub>o</sub>	10 to 60MHz
2	f <sub>o</sub> /2	
3	f <sub>o</sub> /4	
4	f <sub>o</sub> /8	
5	f <sub>o</sub> /16	
6	f <sub>o</sub> /32	
7	f <sub>o</sub> /64	
8	f <sub>o</sub> /128	
9	f <sub>o</sub> /256	



## Block Diagram



## Function Description

### Standby Function

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

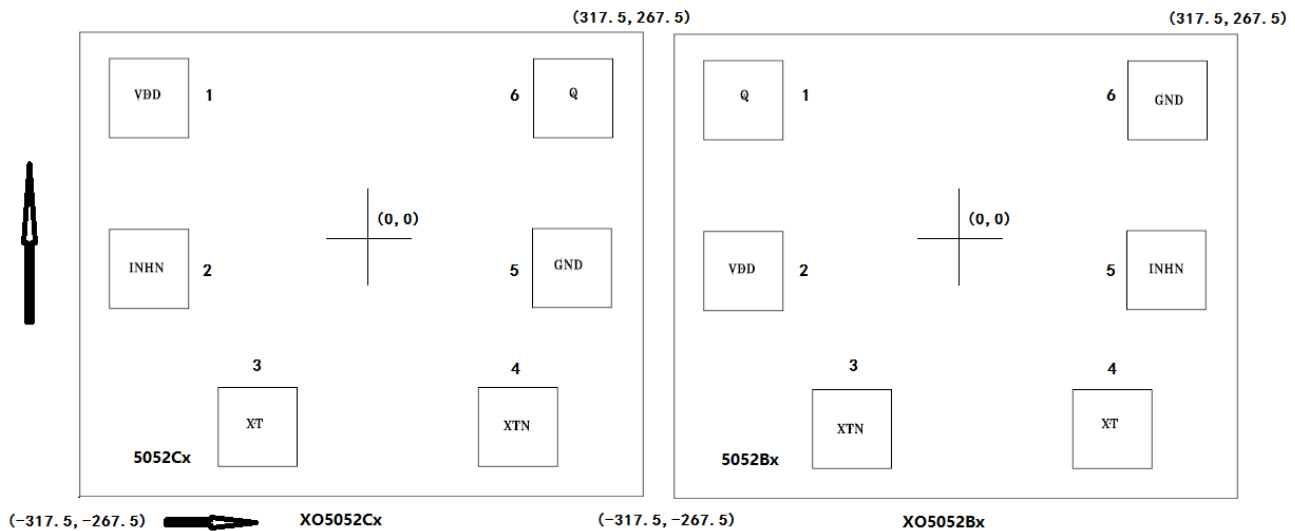
INHN	Q	Oscillator
HIGH (or open)	F0/2/4/8/16/... output frequency	Normal operation
Low	High impedance	Stopped

### Power-saving Pull-up Resistor

The INHN pin pull-up resistance  $R_{UP1}$  or  $R_{UP2}$  changes in response to the input level (HIGH or LOW). When INHN is tied LOW level, the pull-up resistance is large ( $R_{UP1}$ ), reducing the current consumed by the resistance. When INHN is left open circuit, the pull-up resistance is small ( $R_{UP2}$ ), 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.



## Pad Configuration



Pad Coordinate File					
Pad Name	X Coordinate	Y Coordinate	Pad Name	X Coordinate	Y Coordinate
1	-214.85	168.00	4	158.35	-164.60
2	-214.85	-4.65	5	213.15	-3.85
3	-105.10	-164.60	6	214.20	167.90

**Note:** Substrate is connected to GND or floating.

**Die Size:** 630 $\mu$ m\*530 $\mu$ m (Including scribe line, Scribe Line Width 60 $\mu$ m)

**Die Thickness:** 130 $\mu$ m $\pm$ 15 $\mu$ m (-3) or 180 $\mu$ m $\pm$ 20 $\mu$ m (-8), 220 $\mu$ m $\pm$ 20 $\mu$ m (-2), 100 $\mu$ m $\pm$ 15 $\mu$ m (-4)

**Pad Size:** 80 $\mu$ m\*80 $\mu$ m      **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. Output High 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 fundamental crystal (f <sub>0</sub> divided by 1/2/4/8/16/...)	



## Maximum Ratings

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 (Q output) .....	20mA

### 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	Conditions	Min	Typ.	Max	Unit
$V_{DD}$	Supply voltage	-	1.6	-	5.5	V
$T_A$	Operating temperature	-	-45		+125	°C
$f_0$	Oscillation frequency	-	10		60	MHz



## DC Electrical Characteristics

XO5052xx-C-Q ( $V_{DD} = 1.6$  to  $5.5V$ ,  $T_A = -45$  to  $125^\circ C$ , unless otherwise noted.)

Parameter	Sym	Conditions	Min	Typ.	Max	Unit
HIGH-level output voltage	$V_{OH}$	$I_{OH}=1mA$	$V_{DD}-0.4$	-	-	V
LOW-level output voltage	$V_{OL}$	$I_{OL}=1mA$	-	-	0.4	
HIGH-level input voltage	$V_{IH}$	OE Measurement	$0.7V_{cc}$	-	-	V
LOW-level input voltage	$V_{IL}$	OE Measurement	-	-	0.4	
Operating current	$I_{DD}$	$V_{DD}=1.8V(25MHz)$ , no loading	-	0.65	1.3	mA
Operating Current	$I_{DD}$	$V_{DD}=3.0V(25MHz)$ , no loading	-	1.4	2.8	mA
Operating Current	$I_{DD}$	$V_{DD}=1.8V(25MHz)$ , 15pf loading	-	1.3	2.0	mA
Operating Current	$I_{DD}$	$V_{DD}=3.0V(25MHz)$ , 15pf loading	-	2.5	3.5	mA
Standby Current	$I_{sb}$	OE=off			10	$\mu A$
OE pull-up resistance	$R_{PULL}$	$V_{DD} = 3.3V$	-	2	-	$M\Omega$
Output leakage current	$I_z$	OE=OFF			10	$\mu A$

## AC Characteristics

XO5052xx-C-Q,  $T_A=-45$  to  $125^\circ C$  unless otherwise noted

Parameter	Sym	Condition	Min	Typ.	Max	Unit
Output Disable Delay	$T_{OD}$	Output Disable Function (OE)	-	-	100	ns
Output Enable Delay	$T_{STR}$	Output Enable Function (OE)	-	-	2	ms
Output rise time	$T_R$	$C_L=15pf$ , $0.1V_{DD}$ to $0.9V_{DD}$		1.6	2.5	ns
Output fall time	$T_F$	$C_L=15pf$ , $0.1V_{DD}$ to $0.9V_{DD}$		1.6	2.5	ns
Output duty cycle	Duty	$T_A=25^\circ C$ , $C_L=15pF$	45	50	55	%
$V_{DD}$ Sensitivity		Frequency vs. $V_{DD}\pm 10\%$	-1.5	-	+1.5	ppm
OSC frequency range	$f_R$	Fundamental Crystal	10		60	MHz

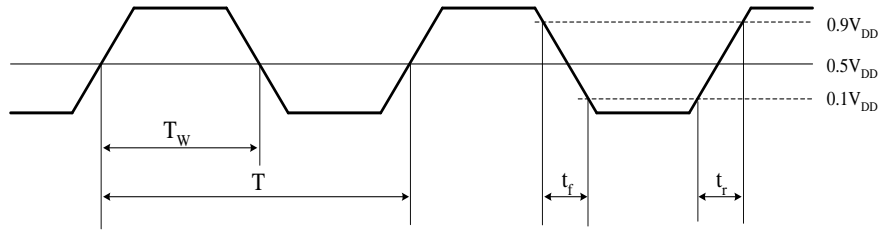
## Crystal Specifications

Parameters	Sym	Conditions	Min	Typ.	Max	Units
Fundamental Crystal Resonator Frequency (XO5052xx-C-Q)	$F_{XIN}$	-	10		60	MHz
Maximum Sustainable Drive Level		-	-	-	200	$\mu W$
Operating Drive Level		-	-	30	-	$\mu W$
Crystal Shunt capacitance	$C_O$	-	-	-	4	pF
Effective Series Resistance, Fundamental, 10-60MHz	ESR	-	-	-	40	$\Omega$



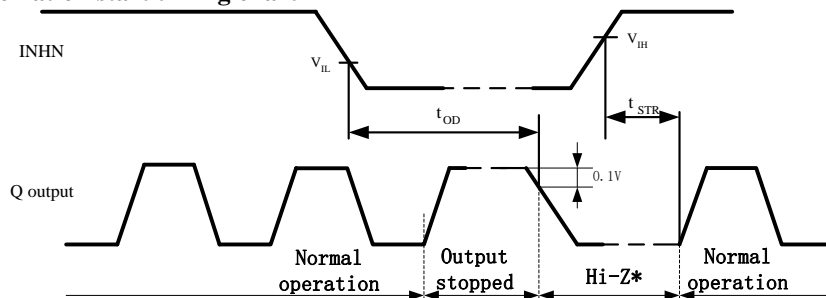
## AC Electrical Characteristics

### Output switching waveform



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

### 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)

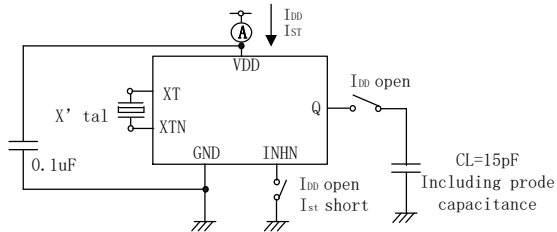
\*: the high impedance interval in the figure is shown as a LOW level due to the  $1K \Omega$  pull-down resistor connected to the Q pin (see "Measurement circuit 2" in the "Measurement circuits" section)



## Measurement Circuit

### Measurement cct1

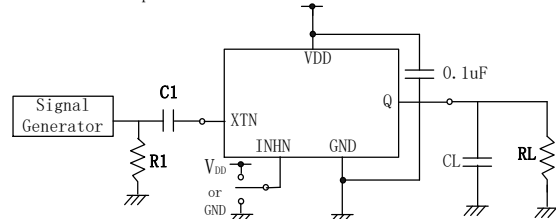
Measurement parameter:  $I_{DD}$ ,  $I_{ST}$ , Duty,  $t_r$ ,  $t_f$



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

### Measurement cct2

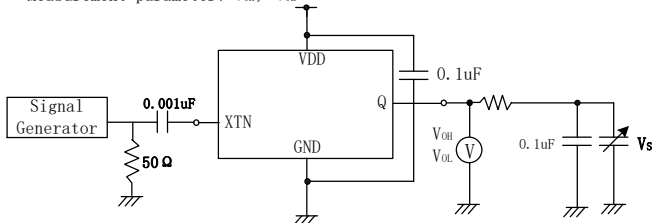
Measurement parameter:  $t_{DD}$



XTN input signal: 1Vp-p, sine wave  
C1: 0.001uF CL: 15pF  
R1: 50Ω RL: 1KΩ

### Measurement cct3

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

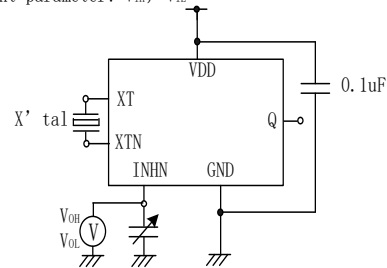


$V_s$  adjusted such that  $\Delta V = 50 \times I_{OH}$   $V_s$  adjusted such that  $\Delta V = 50 \times I_{OL}$

XTN input signal: 1Vp-p, sine wave

### Measurement cct4

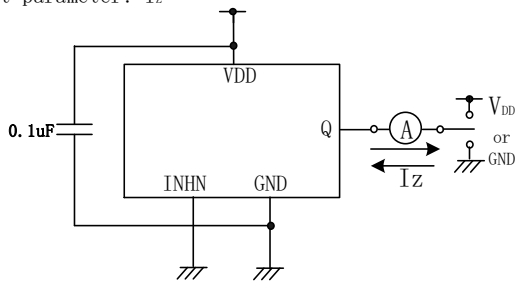
Measurement parameter:  $V_{IH}$ ,  $V_{IL}$



$V_{IH}$ : 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

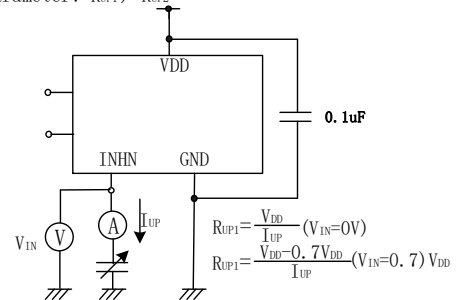
### Measurement cct5

Measurement parameter:  $I_z$



### Measurement cct6

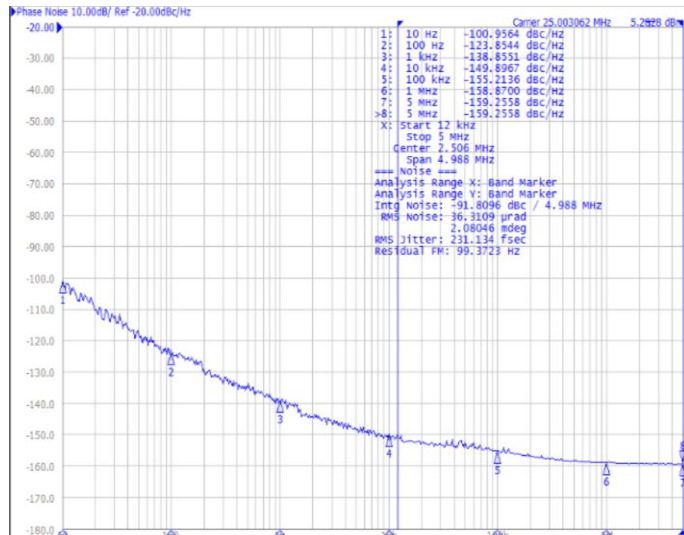
Measurement parameter:  $R_{UP1}$ ,  $R_{UP2}$



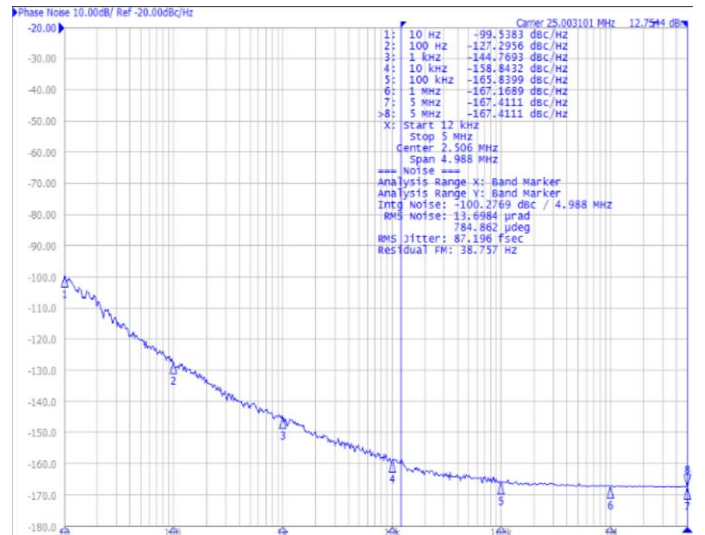


Phase noise test figures:

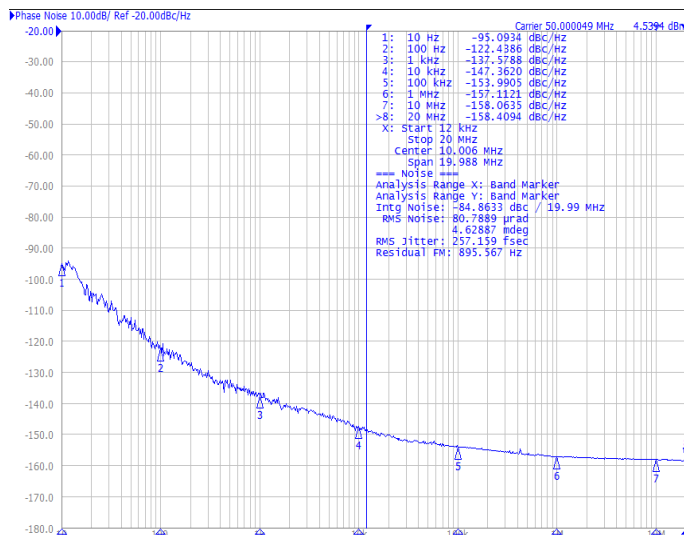
25MHz/15pf/1.8V



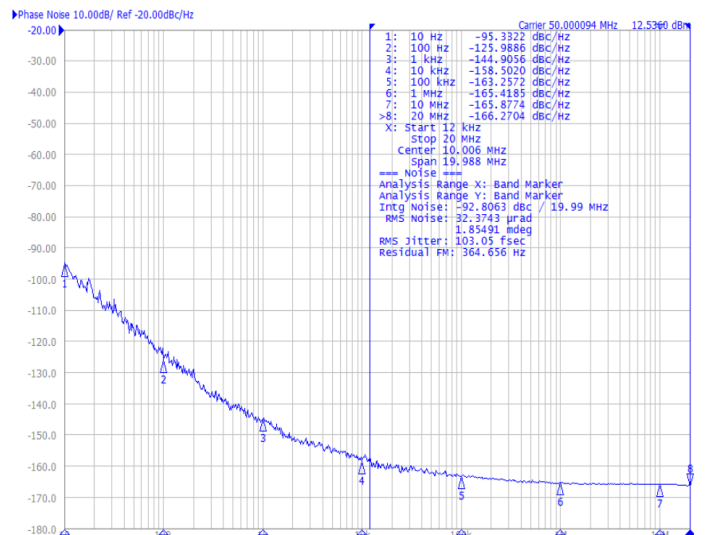
25MHz/15pf/3.3V



50MHz/15pf/1.8V



50MHz/15pf/3.3V







### **Revision History**

<b>Revision</b>	<b>Description</b>	<b>Date</b>
V1.0	Initial release	2024/7/3