XO5024ALx series
Fundamental Crystal Oscillator IC

Features

- Wide range of operating supply voltage: 2.5V to 5.5V
- Regulated voltage drive oscillator circuit for reduced power consumption and crystal drive current
- Optimized low crystal drive current oscillation for miniature crystal units
- Recommended oscillation frequency range
- Low frequency Fundamental: 10MHz to 60MHz
- Multi-stage frequency divider for low-frequency output support
- Frequency divider built-in:
  -Selectable by version: f0, f0/2, f0/4, f0/8, f0/16, f0/32
- -40 to 85℃ operating temperature range
- CMOS output duty level(1/2VDD)
  -50±5% output duty
- Die form or Wafer form

Description

The XO5024 series are miniature crystal oscillator module ICs. The oscillator circuit stage has voltage regulator drive, 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
- Full size and Half size package
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Ordering Information

Part no.	Package type
XO5024ALxT	SOT23-6L

Note: "x" stand for 1,2,3,4,5(f0,f0/2,f0/4,f0/8,f0/16)

XO 5024ALx T

Device Type
Clock Series

XO 5024Series

Pad layout type

SOT23-6 Package

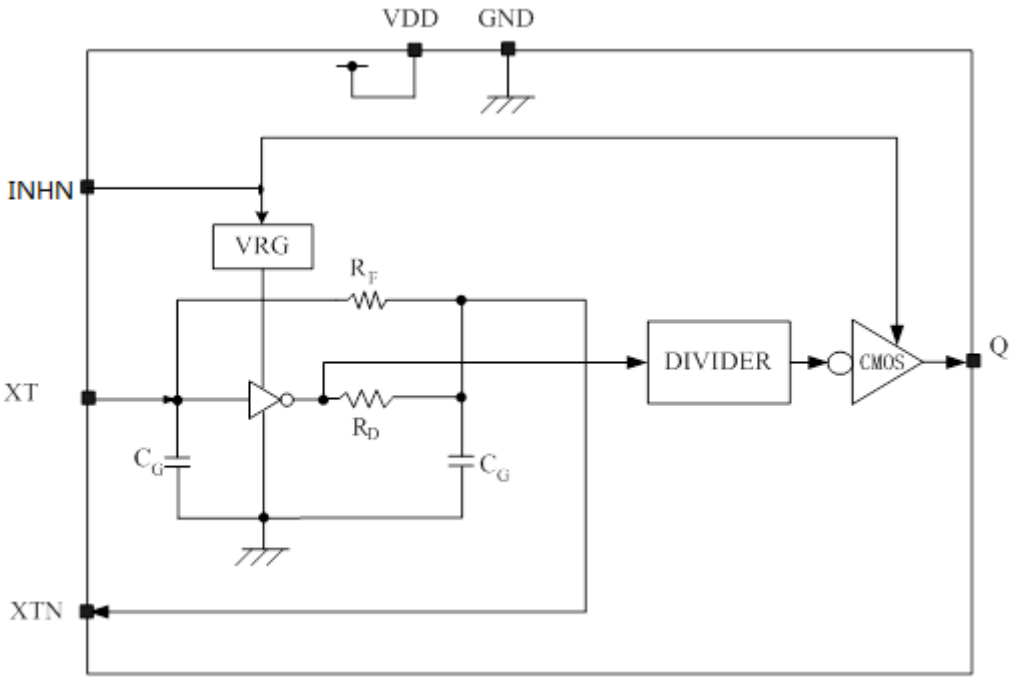
Oscillation frequency range, frequency divider function

Suffix x	f_{output}	Frequency range
1	f_O	10 to 60MHz
2	$f_O/2$	
3	$f_O/4$	
4	$f_O/8$	
5	$f_O/16$	
6	F0/32	

Series Configuration

Part No.	Output frequency	Operating supply voltage range(V)	Oscillation mode	Recommended oscillation frequency ragne[*1](MHz)	Output drive capability(mA)	Standby mode	
						Oscillator stop function	Output state
XO5024AL1	f0[*2]	2.5~5.5	Fundamental	10 to 50	4	Yes	Hi-Z
XO5024AL2	f0/2						
XO5024AL3	f0/4						
XO5024AL4	f0/8						
XO5024AL5	f0/16						
XO5024AL6	f0/32						

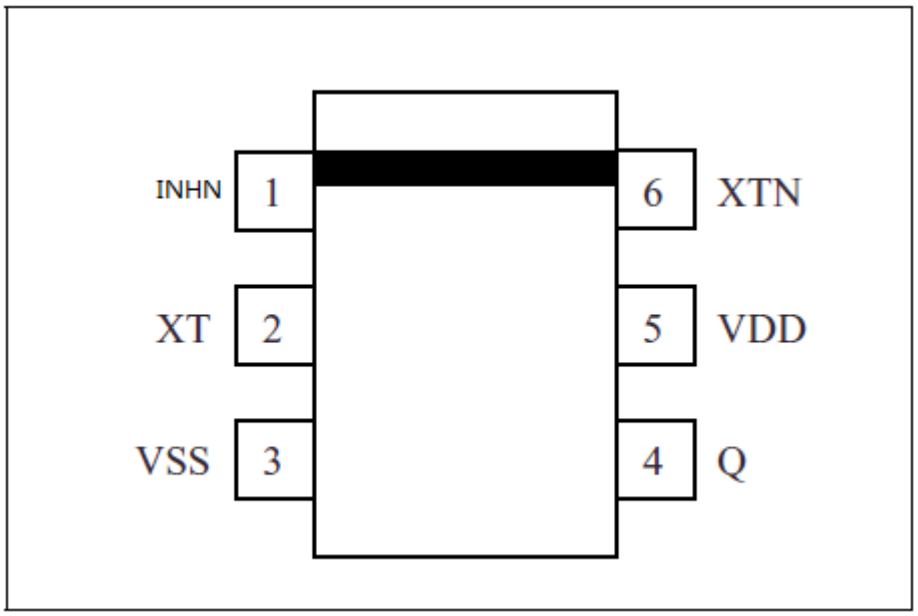
Block Diagram



Function Description

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 XO5024ALx 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

Pin Assignment



Pad Description

Sym.	Pin No	Type	Description	
XTN	6	O	Amplifier output.	Crystal connected between XT and XTN
XT	2	I	Amplifier input.	
V_{DD}	5	P	Supply voltage	
Vss	3	P	Ground	
Q	4	O	Output. Output frequency determined by internal circuit to one of f0,f0/2,f0/4,f0/8,f0/16,	
INHN	1	I	Output state control input. High impedance when LOW. Power-saving pull-up resistor built in.	

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 (all outputs) 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	Series	Conditions	Min	Typ	Max	Unit
V_{DD}	Supply voltage	All series	C_L = 15pF	2.5	-	5.5	V
V_{IN}	Input voltage	All series	-	GND	-	VDD	V
T_A	Operating temperature	All series	-	-40	-	+85	℃
f0	Oscillation frequency*1	5024x1-5024x6	Vdd=2.5V~5.5V -	10	-	50	MHz
f_{OUT}	Output frequency	5024x1-5024x6	Vdd=2.5V~5.5V	1	- -	50	MHz

Reliability Data

Sym.	Parameter	Series	Conditions	Min	Typ	Max	Unit
ESD	Human Body Model	All series	MIL-STD-883H Method 3015.8	+/-3000	+/-6500		V
					-		

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

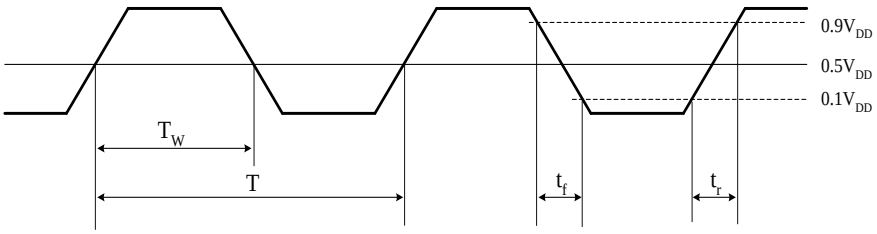
DC Electrical Characteristics

XO5024x1 to XO5024x6 (V_{DD} = 2.5 to 5.5V, T_A = -40 to 85℃, unless otherwise noted.)

Sym.	Parameter	Condition		Rating			Unit
				min	typ	max	
V_{OH}	HIGH-level output voltage	Q: Measurement cct3, I_{OH}=4mA		V_{DD}-0.4	-	-	V
V_{OL}	LOW-level output voltage	Q: Measurement cct3, I_{OL}=4mA		-	-	0.4	V
V_{IH}	HIGH-level input voltage	INHN, Measurement cct4		0.7V_{DD}	-	-	V
V_{IL}	LOW-level input voltage	INHN, Measurement cct4		-	-	0.3V_{DD}	V
I_Z	Output leakage current	Q: Measurement cct5, IHNH=LOW	V_{OH} =V_{DD}	-	-	10	uA
			V_{OL}=GND	-	-	10	uA
I_{DD}	Current consumption	Measurement cct 1, XO5024AL1(f0),no load INHN=open,f0=48MHz f_{OUT}=48MHz	V_{DD} =3.3V	-	1.6	2.4	mA
			V_{DD} =2.5V	-	1.3	2.0	mA
			V_{DD} =1.8V	-	1.0	1.5	mA
		Measurement cct 1, XO5024AL2(f0/2),no load INHN=open,f0=48MHz f_{OUT}=24MHz	V_{DD} =3.3V	-	1.5	2.3	mA
			V_{DD} =2.5V	-	1.2	1.8	mA
			V_{DD} =1.8V	-	0.9	1.4	mA
		Measurement cct 1, XO5024AL3(f0/4),no load INHN=open,f0=48MHz f_{OUT}=12MHz	V_{DD} =3.3V	-	1.3	2.0	mA
			V_{DD} =2.5V	-	1.0	1.5	mA
			V_{DD} =1.8V	-	0.8	1.2	mA
		Measurement cct 1, XO5024AL4(f0/8),no load INHN=open,f0=48MHz f_{OUT}=6MHz	V_{DD} =3.3V	-	1.1	1.7	mA
			V_{DD} =2.5V	-	0.9	1.4	mA
			V_{DD} =1.8V	-	0.75	1.15	mA
		Measurement cct 1, XO5024AL5(f0/16),no load INHN=open,f0=48MHz f_{OUT}=3MHz	V_{DD} =3.3V	-	1.05	1.6	mA
			V_{DD} =2.5V	-	0.85	1.3	mA
			V_{DD} =1.8V	-	0.7	1.1	mA
R_f	Oscillator feedback resistance	-		50	100	200	K Ω
C_G	Oscillator capacitance	Design value(a monitor pattern on a wafer is tested),Excluding parasitic capacitance		4.8	6	7.2	pF
C_D				8	10	12	pF

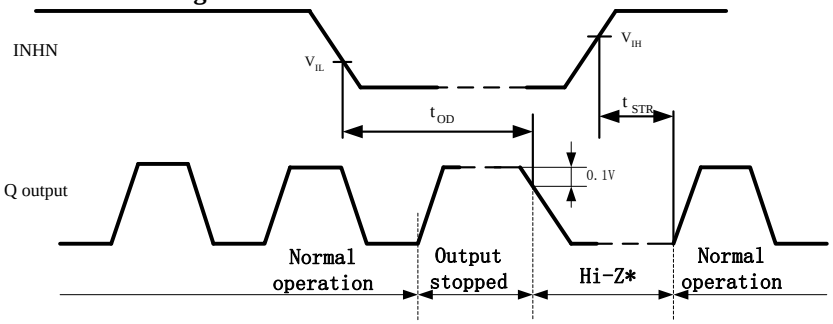
AC Electrical Characteristics

Output switching waveform



DUTY=Tw/T×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)

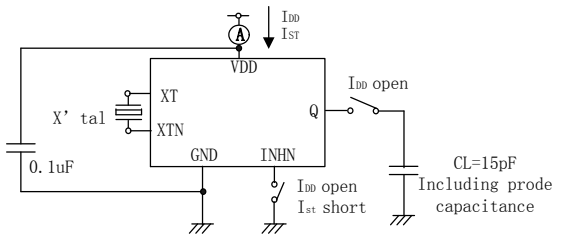
XO5024 Series(V_{DD}=1.40 to 5.5, Ta=-40 to 85℃ unless otherwise noted)

Parameter	Symbol	Condition		Min	Type	Max	Unit
Output rise time	t_{r1}	Measurement cct1,CL=15Pf, 0.1V_{DD} to 0.9V_{DD}	V_{DD}=2.25 to 3.36 V	-	2.0	4.5	ns
	t_{r2}		V_{DD}=1.60 to 2.25V	-	3.0	5.0	ns
Output fall time	t_{f1}	Measurement cct1,CL=15Pf, 0.1V_{DD} to 0.9V_{DD}	V_{DD}=2.25 to 3.36 V	-	2.0	4.5	ns
	t_{f2}		V_{DD}=1.60 to 2.25 V	-	3.0	5.0	ns
Output rise time	t_{r1}	Measurement cct1,CL=50Pf, 0.1V_{DD} to 0.9V_{DD}	V_{DD}=2.25 to 3.36 V	-	4.8	9.6	ns
	t_{r2}		V_{DD}=4.5 to 5.5V	-	3.8	7.6	ns
Output fall time	t_{f1}	Measurement cct1,CL=50Pf, 0.1V_{DD} to 0.9V_{DD}	V_{DD}=2.25 to 3.36 V	-	4.8	9.6	ns
	t_{f2}		V_{DD}=4.5 to 5.5 V	-	3.8	7.6	ns
Output duty cycle	Duty	Measurement cct 1, T_A=25℃,C_L=15pF		45	50	55	%

Measurement Circuit

Measurement cct1

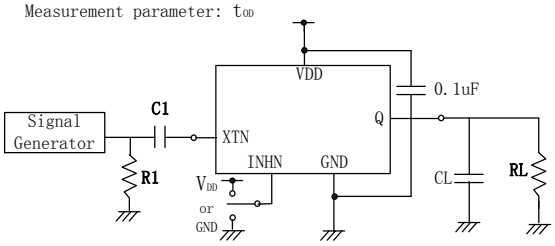
Measurement parameter: I_{DD}, I_{ST}, Duty, t_r, t_f



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

Measurement cct2

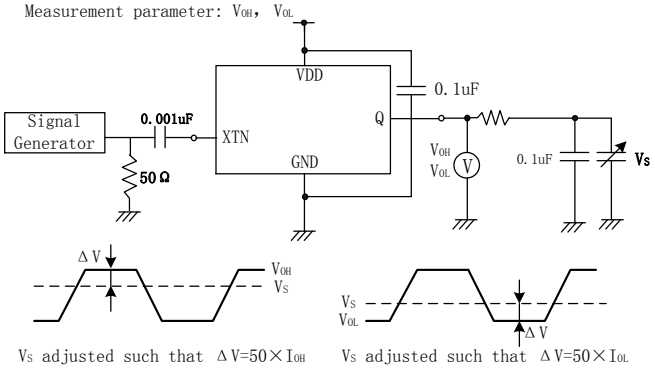
Measurement parameter: t_{OD}



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

Measurement cct3

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

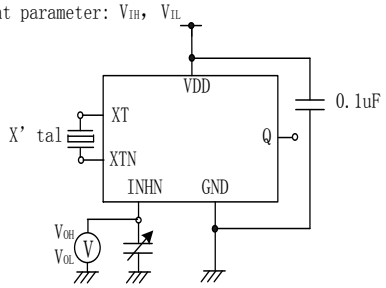


V_S adjusted such that $\Delta V=50\times I_{OH}$ V_S adjusted such that $\Delta V=50\times I_{OL}$

XTN input signal:1Vp-p,sina wave

Measurement cct4

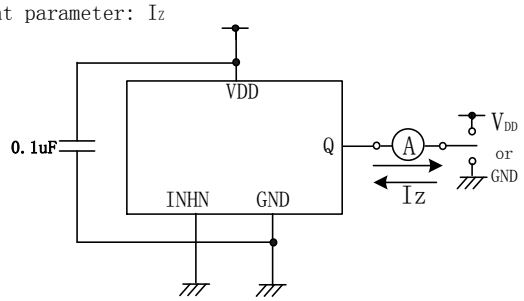
Measurement parameter: V_{IH}, V_{IL}



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

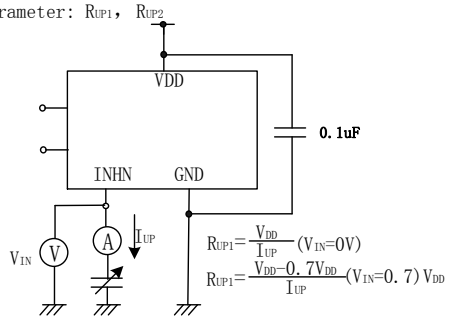
Measurement cct5

Measurement parameter: I_Z



Measurement cct6

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



Package Information

(Unit: mm)