



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
- Crystal frequency Fundamental: 10MHz to 60MHz
- Input Signal: 10MHz to 120MHz
- 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°C 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.

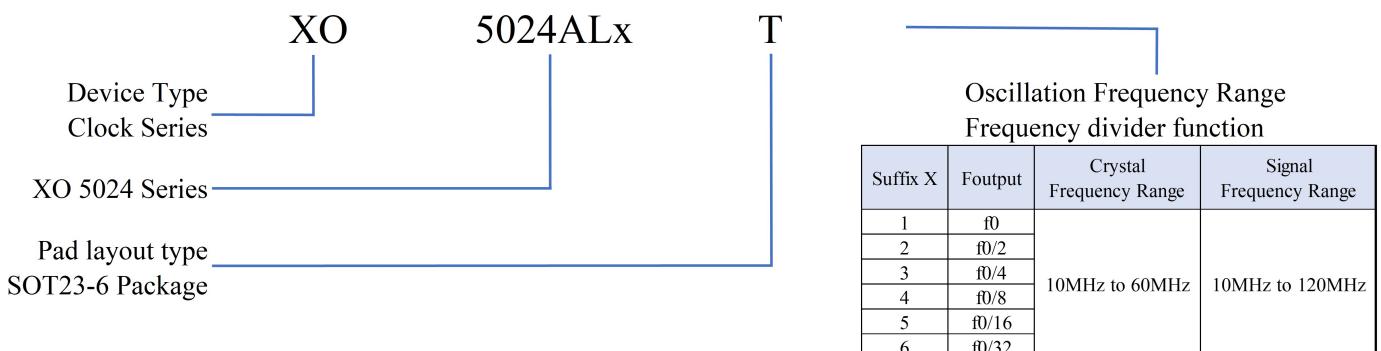
Application

- Used for crystal oscillator
- Full size and Half size package
- Use for buffer

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)

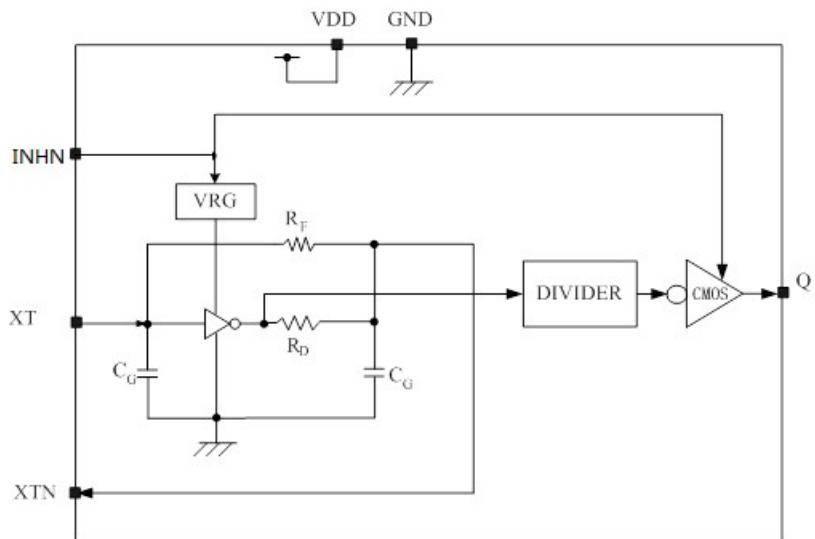




Series Configuration

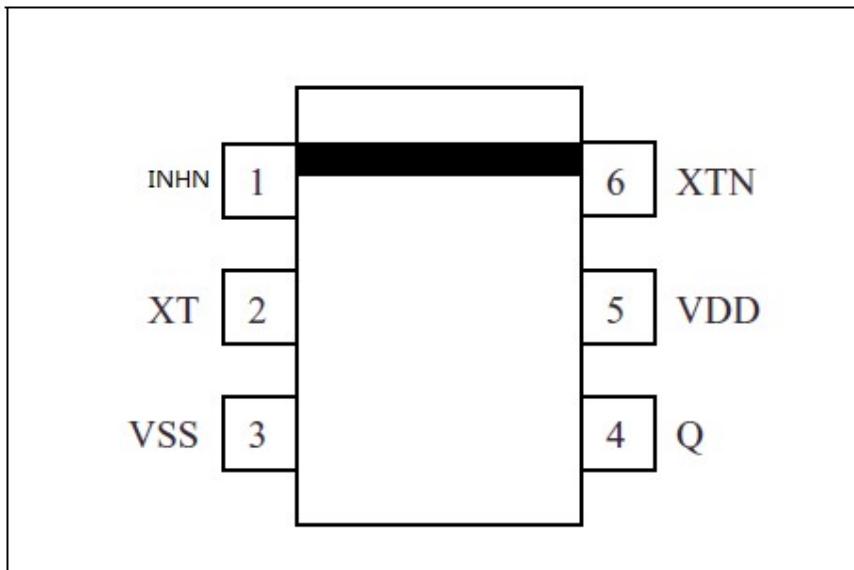
Part No.	Output frequency	Operating supply voltage range(V)	Oscillation mode	Recommended frequency range (MHz)	Output drive capability(mA)	Standby mode				
						Oscillator stop function	Output state			
XO5024AL1	f0	2.5~5.5	Fundamental	Crystal:10~60	4	Yes	Hi-Z			
XO5024AL2	f0/2									
XO5024AL3	f0/4			Signal: 10~120						
XO5024AL4	f0/8									
XO5024AL5	f0/16									
XO5024AL6	f0/32									

Block Diagram





Pin Assignment



Pad Description

Sym.	Pin No	Type	Description
XTN	6	O	Crystal output pin
XT	2	I	Crystal input pin or Signal input
V _{DD}	5	P	Supply voltage
V _{SS}	3	P	Ground
Q	4	O	Output. Output frequency determined by internal circuit to one of f ₀ , f ₀ /2, f ₀ /4, f ₀ /8, f ₀ /16,
INHN	1	I	Output state control input. High impedance when LOW. Power-saving pull-up resistor built-in.

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



XO5024ALx series Crystal Oscillator and Buffer IC

Maximum Ratings

Parameter	Min	Typ.	Max	Unit
Storage Temperature	-60		150	°C
Supply Voltage to Ground Potential (V _{DD} to GND)	-0.5		7.0	V
DC Input (All Other Inputs except V _{DD} & GND)	-0.5		V _{DD} +0.5V	V
DC Output	-0.5		V _{DD} +0.5V	V
DC Output Current (all outputs)			20	mA

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	-	V _{DD}	V
T _A	Operating temperature	All series	-	-40	-	+85	°C
f ₀	Crystal Oscillator	All series	V _{DD} =2.5V~5.5V	10	-	60	MHz
	Buffer	All series	V _{DD} =2.5V~5.5V	10	-	120	MHz
f _{OUT}	Output frequency	All series	V _{DD} =2.5V~5.5V	1	-	120	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



XO5024ALx series Crystal Oscillator and Buffer IC

DC Electrical Characteristics

XO5024 Series (V_{DD} = 2.5 to 5.5V, T_A = -40 to 85°C, unless otherwise noted.)

Sym.	Parameter	Condition	Min	Typ.	Max	Unit	
V_{OH}	HIGH-level output voltage	Q: Measurement cct3, $I_{OH}=4\text{mA}$	$V_{DD}-0.4$	-	-	V	
V_{OL}	LOW-level output voltage	Q: Measurement cct3, $I_{OL}=4\text{mA}$	-	-	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, INHN=LOW	$V_{OH}=V_{DD}$	-	-	10	uA
			$V_{OL}=\text{GND}$	-	-	10	uA
I_{DD}	Current consumption	Measurement cct 1, XO5024AL1(f0),no load INHN=open,f0=48MHz $f_{OUT}=48\text{MHz}$	$V_{DD}=3.3\text{V}$	-	1.6	2.4	mA
			$V_{DD}=2.5\text{V}$	-	1.3	2.0	mA
			$V_{DD}=1.8\text{V}$	-	1.0	1.5	mA
		Measurement cct 1, XO5024AL2(f0/2),no load INHN=open,f0=48MHz $f_{OUT}=24\text{MHz}$	$V_{DD}=3.3\text{V}$	-	1.5	2.3	mA
			$V_{DD}=2.5\text{V}$	-	1.2	1.8	mA
			$V_{DD}=1.8\text{V}$	-	0.9	1.4	mA
		Measurement cct 1, XO5024AL3(f0/4),no load INHN=open,f0=48MHz $f_{OUT}=12\text{MHz}$	$V_{DD}=3.3\text{V}$	-	1.3	2.0	mA
			$V_{DD}=2.5\text{V}$	-	1.0	1.5	mA
			$V_{DD}=1.8\text{V}$	-	0.8	1.2	mA
		Measurement cct 1, XO5024AL4(f0/8),no load INHN=open,f0=48MHz $f_{OUT}=6\text{MHz}$	$V_{DD}=3.3\text{V}$	-	1.1	1.7	mA
			$V_{DD}=2.5\text{V}$	-	0.9	1.4	mA
			$V_{DD}=1.8\text{V}$	-	0.75	1.15	mA
R_f	feedback resistance	-	50	100	200	KΩ	
			4.8	6	7.2	pF	
			8	10	12	pF	



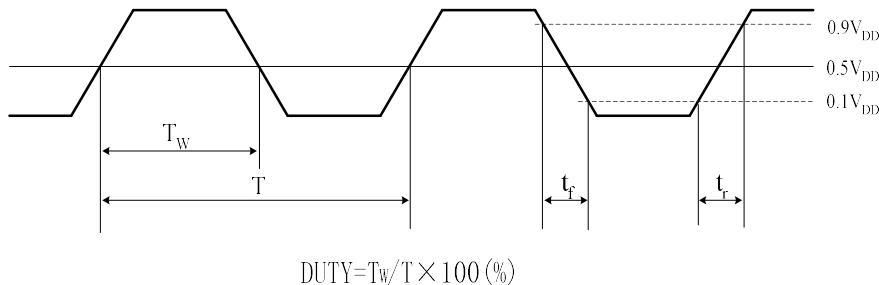
XO5024ALx series Crystal Oscillator and Buffer IC

AC Electrical Characteristics

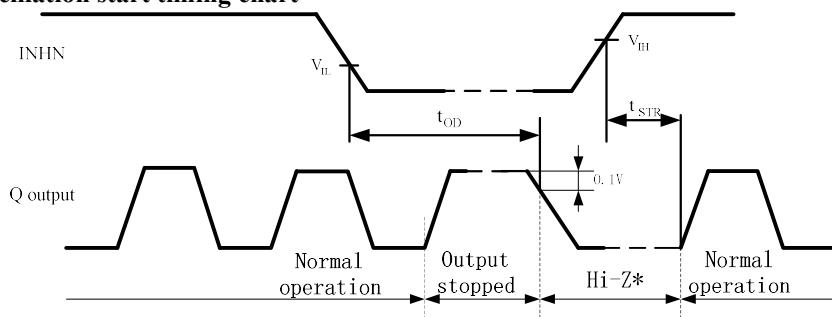
XO5024 Series ($V_{DD}=1.40$ to 5.5 , $T_a=-40$ to $85^\circ C$ unless otherwise noted)

Parameter	Sym.	Condition		Min	Typ.	Max	Unit
Output rise time	t_{r1}	Measurement cct1, $CL=15\text{pF}$, $0.1V_{DD}$ to $0.9V_{DD}$	$V_{DD}=2.25$ to 3.36 V	-	2.0	4.5	ns
	t_{r2}		$V_{DD}=1.60$ to 2.25 V	-	3.0	5.0	ns
Output fall time	t_{f1}	Measurement cct1, $CL=15\text{pF}$, $0.1V_{DD}$ 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, $CL=50\text{pF}$, $0.1V_{DD}$ to $0.9V_{DD}$	$V_{DD}=2.25$ to 3.36 V	-	4.8	9.6	ns
	t_{r2}		$V_{DD}=4.5$ to 5.5 V	-	3.8	7.6	ns
Output fall time	t_{f1}	Measurement cct1, $CL=50\text{pF}$, $0.1V_{DD}$ 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, $T_A=25^\circ C, CL=15\text{pF}$		45	50	55	%

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

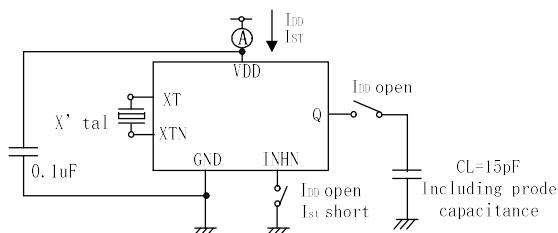


XO5024ALx series Crystal Oscillator and Buffer IC

Measurement Circuit

Measurement cct1

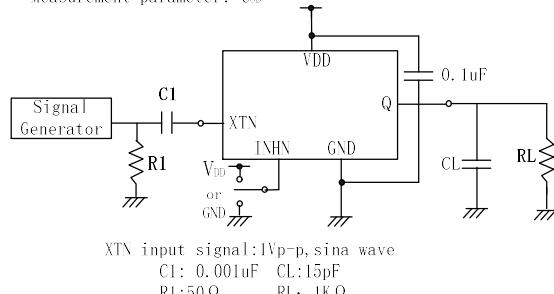
Measurement parameter: I_{DD} , I_{ST} , Duty, t_r , t_f



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

Measurement cct2

Measurement parameter: t_{DD}



XTN input signal: 1Vp-p, sına wave

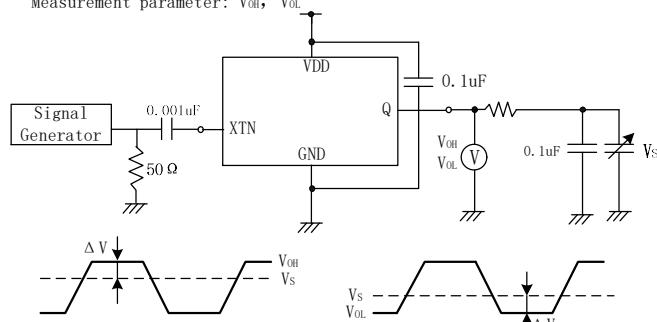
C1: 0.001uF CL: 15pF

R1: 50Ω

RL: 1kΩ

Measurement cct3

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



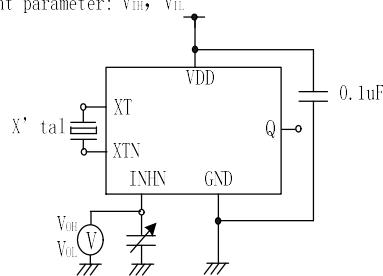
V_S adjusted such that $\Delta V = 50 \times I_{OH}$

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

XTN input signal: 1Vp-p, sına wave

Measurement cct4

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



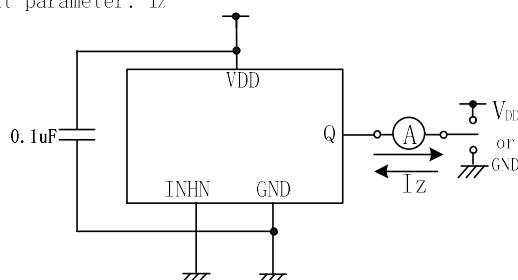
V_{IH} : Voltage is 0V to V_{DD} transition that changes the output state.

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

INHN has an oscillation stop function

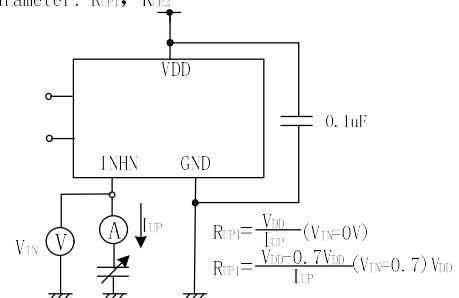
Measurement cct5

Measurement parameter: I_Z



Measurement cct6

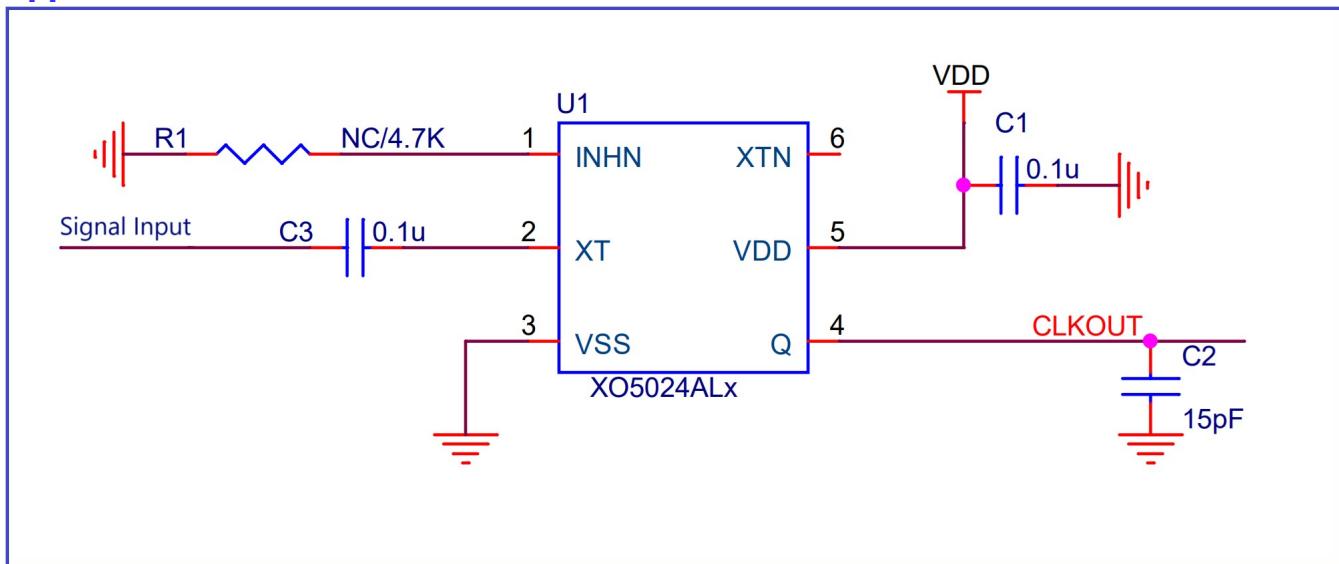
Measurement parameter: R_{P1} , R_{P2}



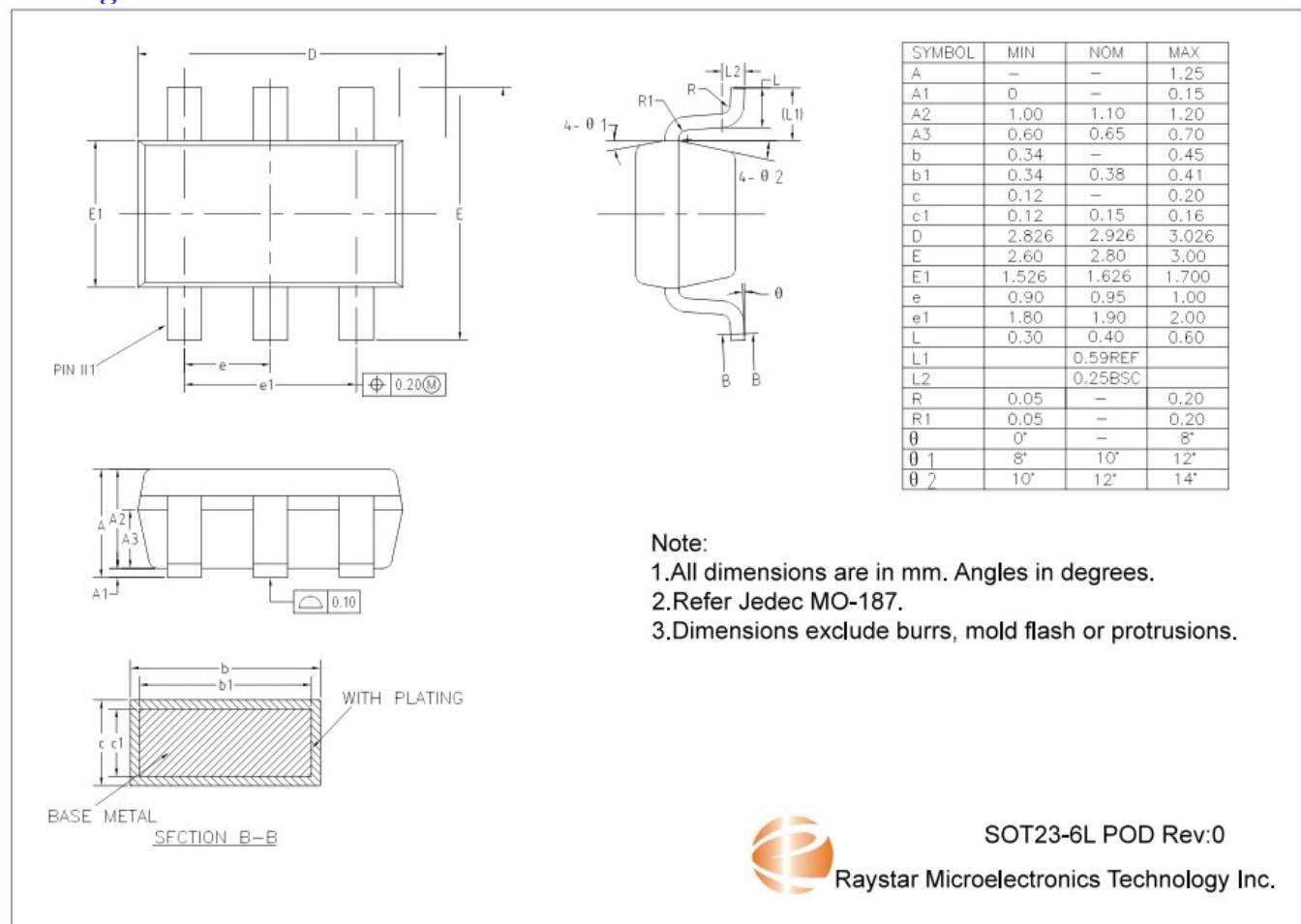
$$R_{P1} = \frac{V_{DD}}{I_{UP}} \quad (V_{IN}=0V)$$
$$R_{P2} = \frac{V_{DD}}{I_{UP}} \quad (V_{IN}=0.7V_{DD})$$



Application Circuit for Buffer



Package Information





**XO5024ALx series
Crystal Oscillator and Buffer IC**

Revision History:

Revision	Description	Date
V1.0	Initiated	2013/1/2
V1.5	Modify datasheet format and add buffer function	2024/11/12