XO6501-Q

Programmable Spread Spectrum Crystal Oscillator IC

Features

- Spread Spectrum Crystal oscillator IC (Programmable)
- Operating frequency range:20MHz~27MHz
- 0.25~160MHz Output Frequency range
- Operating voltages: 1.62 V to 3.63V
- Operating temperature: -40℃ to +125℃
- Configurable spread spectrum settings:
  7 kinds of spread:
  ±0.25%, ±0.5%, -0.25%, -0.5%, -1.0%, -1.5%, -2.0%
- OE disable function
- 3 kinds of Rise time/Fall time:
  Default mode, Fast mode and Slow mode
- Modulation Frequency: F_{IN}/804
- Spread Profile: Triangle
- Used for Fundamental Crystal Oscillator
- Used for 7050/5032/3225/2520 package

Benefits

- Reduction in EMI
- System cost saving
- Reduced system complexity
- Faster time to market

Description

The XO6501-Q are Programmable Crystal Oscillator IC series with CMOS output.

This series offer the easy programmability of frequencies and other parameters, they also have a wider operating temperature range, from -40℃ to +125℃. Users will be able to program the products to the required output frequency, as well as to the required spread spectrum settings.

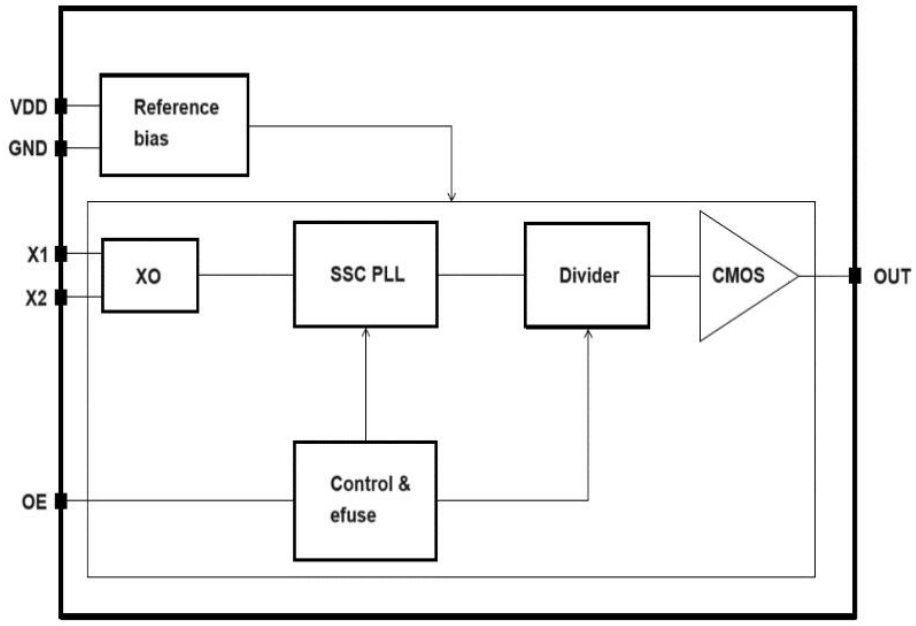
This will also significantly contribute to performance, lower power requirements, fast development cycles, and low-volume production.

Ordering Information

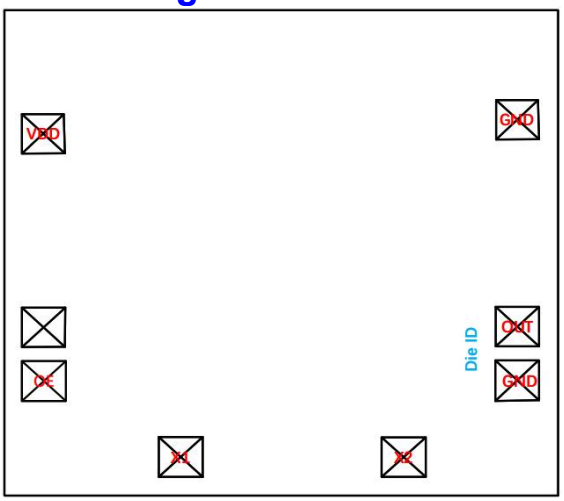
Part no.	Package type
XO6501-xDE-Q	Die form
XO6501-xWF-Q	Wafer form

Note:
1. "-x" shows the die thickness,"-3" Stand for thickness 130+/-15um
2. "DE" stands for chip form, "WF" stands for Wafer form

Block Diagram



Pad Configuration



Pad Coordinate File					
Pad Name	**X Coordinate**	**Y Coordinate**	**Pad Name**	**X Coordinate**	**Y Coordinate**
VDD	-320.695	174.55	X2	166.99	-305.695
NC	-320.695	-113.075	GND	320.695	-192.82
OE	-320.695	-193.075	OUT	320.695	-112.82
X1	-135.95	-305.695	GND	320.695	193.96
Note: Substrate is connected to GND or floating					
Die Size: 750um * 720um (Not including scribe line, Scribe line with 60um) **Dize thickness:** 130um±15um(-3), 100um±15um(-4) **Pad size:** 60um * 60um Substrate level: GND or Floating					

Pad Description

Sym.	Type	Description
VDD	P	Supply voltage.
X1	I	Oscillator input pin.
X2	O	Oscillator output pin.
GND	P	Ground (-).
OE or $\overline{ST}$	I	OE: H: Normal output; L: Disable output, Oscillation normal work; $\overline{ST}$: H: Normal output; L: Disable output, Oscillation normal work; Note: Can trimming to OE or $\overline{ST}$
OUT	O	Output pin
NC		No Connection

Note: * Please do not use the OE/ $\overline{ST}$ terminal in the open state.

Maximum Rating

Supply Voltage to Ground Potential……..……4V
OE pin …… ……..…V_{DD}+0.9V
Storage Temperature…….……-55°C to +150°C

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 sec-tions 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
F_{IN}	Input Frequency	-	20	-	27	MHz
F_O	Output frequency		0.25	-	160	MHz
V_{DD}	Supply voltage	-	1.62	-	3.63	V
VIN	Input voltage	OE/$\overline{ST}$ terminal	0	-	V_{DD}	V
T_A	Operating temperature	-	-40	25	+125	°C
L_CMOS	CMOS load condition	-	-	-	15	pf

Note:
* 0.1μF or over bypass capacitor should be connected between VCC and GND pins located close to the device

DC Characteristics

V_{DD}= 1.62V to 3.63V, Ambient Temperature -40 to +125°C

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
I_{DD}	Current consumption	V_{DD}=1.8V No load	2MHz		5.02		mA
			10MHz	-	5.8		mA
			25MHz	-	6.2		mA
			50MHz	-	6.6		mA
			100MHz	-	7.4		mA
			160MHz	-	8.1		mA
		V_{DD}=2.5V No load	2MHz		5.03		mA
			10MHz	-	6.4		mA
			25MHz	-	6.91		mA
			50MHz	-	7.4		mA
			100MHz	-	8.3		mA
			160MHz	-	9.3		mA
		V_{DD}=3.3V No load	2MHz		5.04		mA
			10MHz		6.6		mA
			25MHz		7.2		mA
			50MHz		7.8		mA
			100MHz		9.1		mA
			160MHz		10.4		mA
I_{DIS}	Disable current	V_{DD}=1.8V			5.9		mA
		V_{DD}=2.5V			6.6		mA
		V_{DD}=3.3V			6.7		mA
I_{STD}	Standby current	V_{DD}=1.8V		-	1.0	-	mA
		V_{DD}=2.5V		-	1.0	-	mA
		V_{DD}=3.3V		-	1.0	-	mA
V_{OH}	Output high voltage	V_{DD}=1.8V, I_{OH} = -2.5mA		0.9V_{DD}	-	-	V
		V_{DD}=2.5V, I_{OH} = -4.0mA					
		V_{DD}=3.3V, I_{OH} = -5.0mA					
V_{OL}	Output low voltage	V_{DD}=1.8V, I_{OL} = 2.5mA		-	-	0.15V_{DD}	V
		V_{DD}=2.5V, I_{OL} = 4.0mA					
		V_{DD}=3.3V, I_{OL} = 5.0mA					
V_{IH}	HIGH level input voltage	OE/$\overline{ST}$ terminal		0.8V_{DD}	-		V
V_{IL}	LOW level input voltage	OE/$\overline{ST}$ terminal		-	-	0.2V_{DD}	V
C_{IN}	Input pull-up resistance	OE/$\overline{ST}$ terminal		-	2.5	5	pf
R_{UP1}	Input pull-up resistance	OE/$\overline{ST}$= 80 % V_{DD}		20	-	150	kΩ
R_{UP2}		OE/$\overline{ST}$= 20 % V_{DD}		5	-	60	MΩ
R_{DN}	Output pull-down	OE = GND, OUT = V_{DD}		0.5		5	MΩ

AC Characteristics

V_{DD}= 1.62V to 3.63V, Ambient Temperature -40 to +125°C

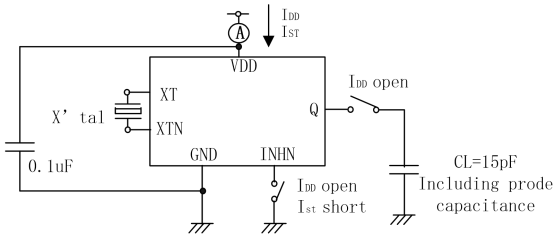
Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
T_{STR}	Start-up time	VDD>1.62V		-	-	5	ms
Duty cycle	Output duty cycle	Load=15pf, 50%V_{DD}		45	50	55	%
Tr/Tf	Rise time/Fall time (20%V_{DD}~80%V_{DD})	fo ≤ 20 MHz (Slow mode)				10	ns
		fo ≤ 40 MHz (Default)				6	ns
		fo > 40 MHz (Default)				3	ns
		Fast mode				3	ns
Tstp_OE	Output disable time (OE)	OE terminal HIGH → LOW				1	µs
Tstp_ST	Output disable time (ST)	$\overline{ST}$ terminal HIGH → LOW				1	µs
Tsta_OE	Output enable time (OE)	OE terminal LOW → HIGH				1	µs
Tsta_ST	Output enable time (ST)	$\overline{ST}$ terminal LOW → HIGH				3	ms
t_{c-c}	Cycle to Cycle jitter (Clock cycle > 50 000)	V_{DD}=1.8V load=15pf	10MHz			312.1	ps
			20MHz			225.3	ps
			50MHz			91.7	ps
			100MHz			70.4	ps
			160MHz			65.6	ps
		V_{DD}=2.5V load=15pf	10MHz			292.9	ps
			20MHz			136.6	ps
			50MHz			48.7	ps
			100MHz			37.6	ps
			160MHz			40	ps
		V_{DD}=3.3V load=15pf	10MHz			290.1	ps
			20MHz			128.8	ps
			50MHz			44.6	ps
			100MHz			31.3	ps
			160MHz			29.5	ps
fmod	Modulation frequency				Fin/804		KHz

Note: Typical condition is on room temperature at 25°

Measurement Circuit

Measurement cct1

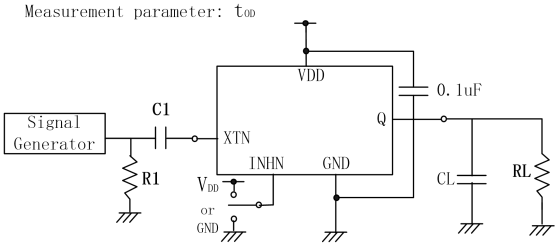
Measurement parameter: I_{DD}, I_{ST}, Duty, t_r, t_f



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

Measurement cct2

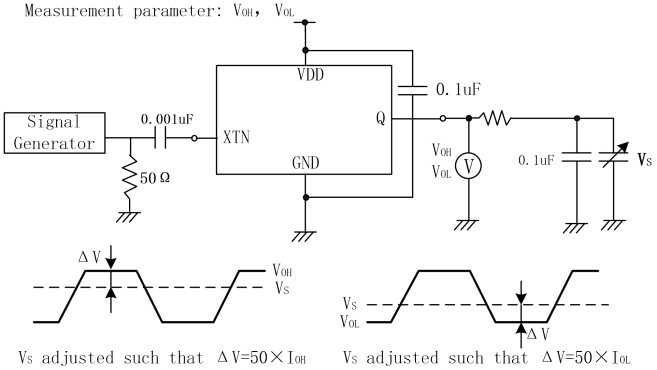
Measurement parameter: t_{OD}



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

Measurement cct3

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

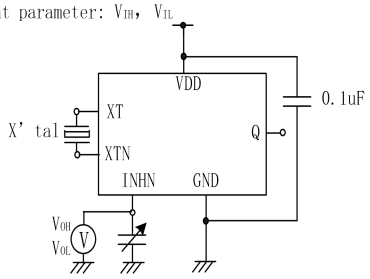


VS adjusted such that ΔV=50×IOH VS adjusted such that ΔV=50×IOL

XTN input signal:1Vp-p,sina wave

Measurement cct4

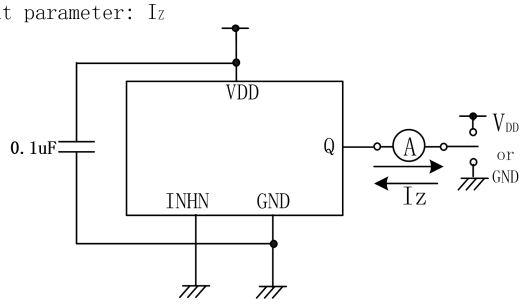
Measurement parameter: V_{IH}, V_{IL}



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

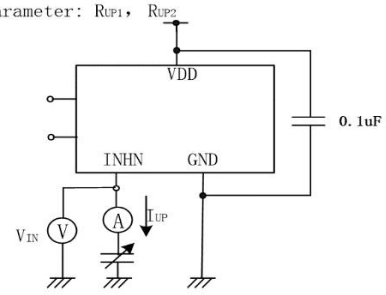
Measurement cct5

Measurement parameter: I_Z



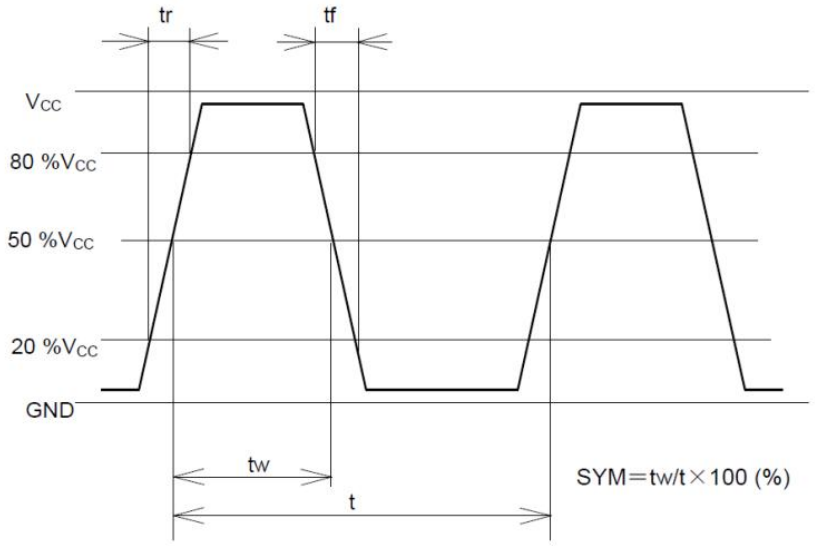
Measurement cct6

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



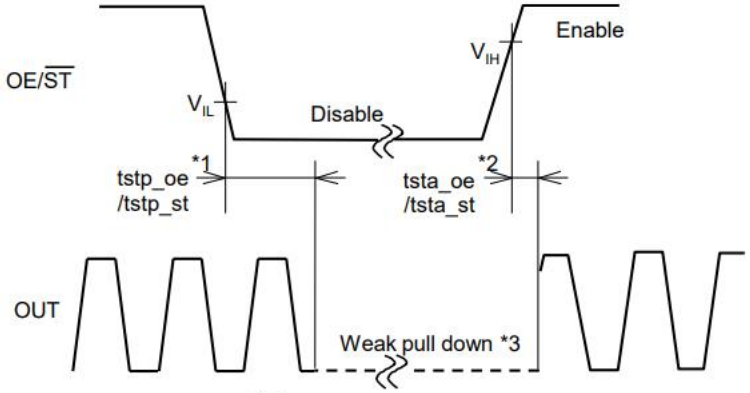
Timing Chart

(1) Output Waveform and Level



(2) OE/$\overline{ST}$ Function and Timing

OE/$\overline{ST}$ terminal	Osc. circuit	Output status
"H"	Oscillation	Specified frequency: Enable
"L"	OE: Oscillation	Low (Weak pull down*3): Disable
	$\overline{ST}$: Oscillation stop	



*1 The period from OE/$\overline{ST}$ = V_{IL} to OUT = Low (weak pull down) (Disable)

*2 The period from OE/$\overline{ST}$ = V_{IH} to OUT = Enable

*3 Pulled down with Output pull down resistance (R_{DN})

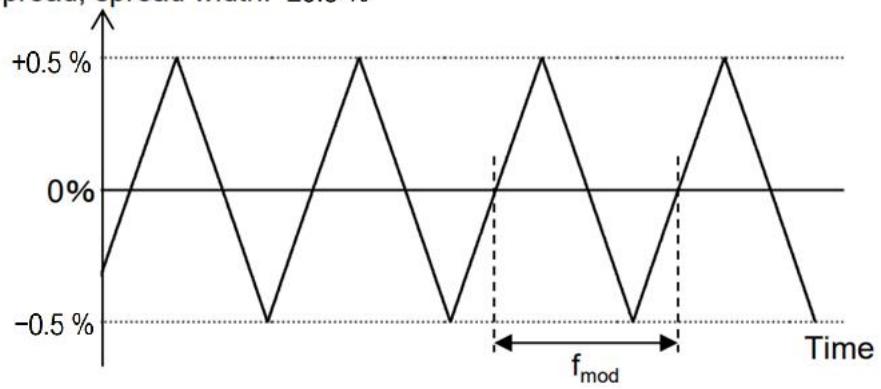
* Judging the start of output when output waveform is observed.

* OE/$\overline{ST}$ terminal voltage level should not exceed supply voltage when using OE/$\overline{ST}$ function. Please note that OE/$\overline{ST}$ rise time should not exceed supply voltage rise time at the start-up.

* Please do not use the OE/$\overline{ST}$ terminal in the open state. Typically the output will be enable when OE/ST is open state, but the input pull resistance is large and OE/$\overline{ST}$ terminal may drop to "L" level and be disable due to noise or leakage current.

3) Triangle

Center spread, spread width: ±0.5 %



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Revision History

Revision	Description	Date
1.0	Initial release	2025/10/31
1.1	Update Measurement Circuit;Update Pad Description	2026/7/13