

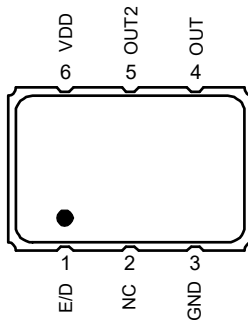
## Description

The Renesas XA devices are ultra-precision crystal oscillators with 750 to 890fs typical phase jitter over 12kHz to 20MHz bandwidth. Available in a wide frequency range from 0.750MHz to 1350MHz, the XA series crystal oscillators utilize a family of proprietary ASICs, with a key focus on noise reduction technologies.

The 3rd order Delta Sigma Modulator reduces noise to the levels that are comparable to traditional Bulk Quartz and SAW oscillators. With short lead-time, low cost, low noise, wide frequency range, excellent ambient performance, the XA devices are an excellent choice over the conventional technologies. The XA devices have stabilities as tight as  $\pm 25$ ppm with extremely quick delivery for both standard and custom frequencies.

## Pin Assignments

**NOTE:** To minimize power supply line noise, a 0.01 $\mu$ F bypass capacitor should be placed between  $V_{DD}$  (Pin 6) and GND (Pin 3).



**Table 1. Pin Description**

Pin #	Pin Name	Description
1	E/D	Enable/Disable <sup>[a][b]</sup>
2	NC	No connect
3	GND	Connect to ground
4	OUT	Output
5	OUT2	Complementary output <sup>[c]</sup>
6	$V_{DD}$	Supply voltage

[a] Pulled high internally.

[b] Low = output disabled.

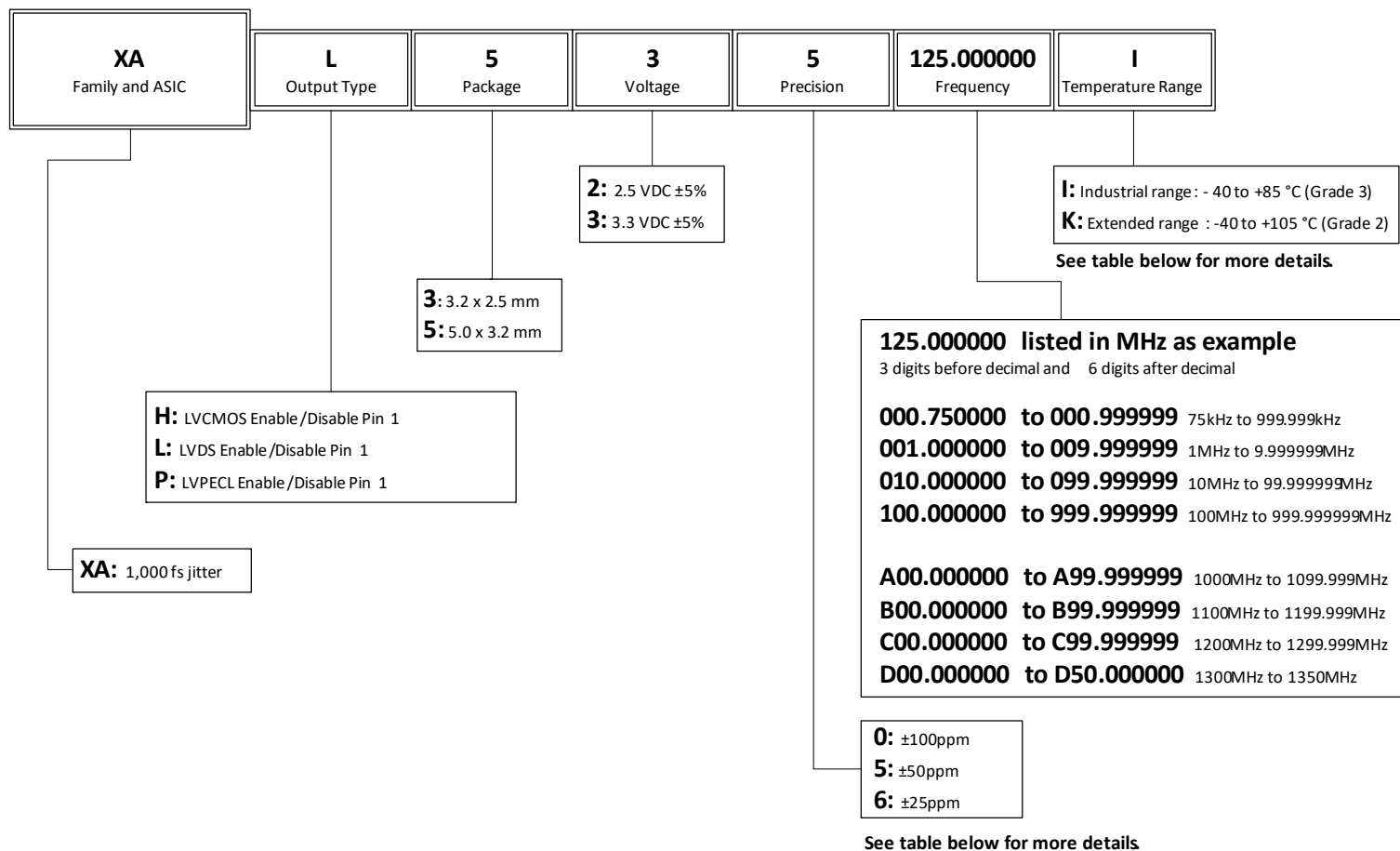
[c] Do not connect for LVCMOS. For XLVCMOS both OUT and OUT2 are ON and in opposite phase.

See [Ordering Information](#) for more details.

## Features

- **Conforms to AEC-Q200**
- Frequency range: 0.750MHz to 1350MHz
- Output types: LVDS, LVPECL, LVCMOS
- Frequency stability:  $\pm 25$ ,  $\pm 50$ , or  $\pm 100$  ppm
- Supply voltage: 2.5V or 3.3V
- Phase jitter (12kHz to 20MHz): 750fs to 890fs typical
- Package options:
  - 3.2 × 2.5 × 1.0 mm
  - 5.0 × 3.2 × 1.2 mm
- Operating temperature: -40°C to +85°C (Grade 3)
  - Frequency stability options:  $\pm 25$ ,  $\pm 50$ , or  $\pm 100$  ppm
- Operating temperature: -40°C to +105°C (Grade 2)
  - Frequency stability options:  $\pm 50$  or  $\pm 100$  ppm

## Ordering Information



**Table 2. Frequency Stability and Operating Temperature Decoder**

"Precision" and "Temperature Range" Codes	Operating Temperature	Frequency Stability		
		Minimum	Maximum	Units
"6" and "I"	-40°C to +85°C	-25	+25	ppm
"5" and "I"	-40°C to +85°C	-50	+50	ppm
"0" and "I"	-40°C to +85°C	-100	+100	ppm
"5" and "K"	-40° to +105°C	-50	+50	ppm
"0" and "K"	-40° to +105°C	-100	+100	ppm

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## Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the device. These ratings, which are standard values for Renesas commercially rated parts, are stress ratings only. Functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods can affect product reliability. Electrical parameters are guaranteed only over the recommended operating temperature range.

**Table 3. Absolute Maximum Ratings**

Item	Rating			
V <sub>DD</sub>	-0.5 to +5.0V			
E/D	-0.5V to V <sub>DD</sub> + 0.5V			
OUT	-0.5V to V <sub>DD</sub> + 0.5V			
Storage Temperature	-55°C to 125°C			
Maximum Junction Temperature	125°C			
Core Current	65mA maximum			
Theta J <sub>A</sub>	JS6	89.6 °C/W	JX6	94.7 °C/W
Theta J <sub>B</sub>	5.0 × 3.2 × 1.2 mm	54.3 °C/W	3.2 × 2.5 × 1.0 mm	66.8 °C/W

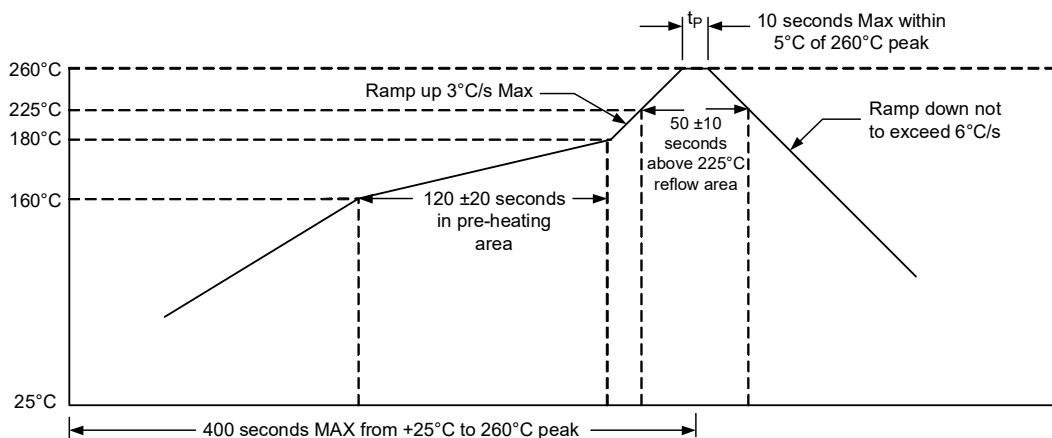
## ESD Compliance

Human Body Model (HBM)	1000V
Machine Model (MM)	150V

## Mechanical Testing

Parameter	Test Method
Mechanical Shock	Drop from 75cm to hardwood surface–3 times.
Mechanical Vibration	10–55Hz, 1.5mm amplitude, 1 minute sweep; 2 hours each in 3 directions (X, Y, Z).
High Temperature Burn-in	Under power at 125°C for 2000 hours.
Hermetic Seal	He pressure: 4 ±1kgf/cm <sup>2</sup> 2 hour soak.

## Solder Reflow Profile



## DC Electrical Characteristics

**Table 4. 3.3V IDD DC Electrical Characteristics**

$V_{DD} = 3.3V \pm 5\%$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ ,  $-40^\circ C$  to  $+105^\circ C$ .

Symbol	Parameter	Output Type	Conditions	Minimum	Typical	Maximum	Units
$I_{DD}$	Power Supply Current	LVDS	—	—	—	100	mA
		LVPECL	—	—	—	120	
		LVCMOS	0.75MHz to 20MHz.	—	—	32	
			20+MHz to 50MHz.	—	—	35	
			50+MHz to 130MHz.	—	—	47	
			130+MHz to 200MHz.	—	—	55	
200+MHz to 250MHz.	—	—	60				

**Table 5. 2.5V IDD DC Electrical Characteristics**

$V_{DD} = 2.5V \pm 5\%$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ ,  $-40^\circ C$  to  $+105^\circ C$ .

Symbol	Parameter	Output Type	Conditions	Minimum	Typical	Maximum	Units
$I_{DD}$	Power Supply Current	LVDS	0.75MHz to 20MHz.	—	—	26	mA
			20+MHz to 220MHz.	—	—	34	
			220+MHz to 630MHz.	—	—	44	
			630+MHz to 1000MHz.	—	—	65	
		LVPECL	0.75MHz to 20MHz.	—	—	33	
			20+MHz to 220MHz.	—	—	41	
			220+MHz to 630MHz.	—	—	63	
			630+MHz to 1000MHz.	—	—	72	
		LVCMOS	0.75MHz to 20MHz.	—	—	22	
			20+MHz to 50MHz.	—	—	25	
			50+MHz to 100MHz.	—	—	29	
			100+MHz to 130MHz.	—	—	32	
			130+MHz to 160MHz.	—	—	35	
			160+MHz to 180MHz.	—	—	37	

**Table 6. LVDS DC Electrical Characteristics**

$V_{DD} = 3.3V, 2.5V \pm 5\%$ ,  $T_A = -40^\circ C$  to  $+85^\circ C, -40^\circ C$  to  $+105^\circ C$ . Below are guaranteed for listed standard frequencies.

Symbol	Parameter	Conditions	Minimum	Typical	Maximum	Units
$V_{OD}$	Differential Output Voltage	$V_{DD} = 3.3V \pm 5\%$ .	—	—	0.6	V
		$V_{DD} = 2.5V \pm 5\%$ .	—	—	0.4	
$V_{OS}$	Output Offset Voltage	$V_{DD} = 3.3V \pm 5\%$ .	—	—	1.3	
		$V_{DD} = 2.5V \pm 5\%$ .	—	—	1.25	
$V_{IH}$	Enable/Disable Input High Voltage (Output enabled)	—	$70\% V_{DD}$	—	—	
$V_{IL}$	Enable/Disable Input Low Voltage (Output disabled)	—	—	—	$30\% V_{DD}$	

**Table 7. LVPECL DC Electrical Characteristics**

$V_{DD} = 3.3V, 2.5V \pm 5\%$ ,  $T_A = -40^\circ C$  to  $+85^\circ C, -40^\circ C$  to  $+105^\circ C$ . Below are guaranteed for listed standard frequencies.

Symbol	Parameter	Conditions	Minimum	Typical	Maximum	Units
$V_{OD}$	Differential Output Voltage	$V_{DD} = 3.3V \pm 5\%$ .	2.055	—	2.405	V
		$V_{DD} = 2.5V \pm 5\%$ .	—	1.4	—	
$V_{OS}$	Output Offset Voltage	$V_{DD} = 3.3V \pm 5\%$ .	1.305	—	1.65	
		$V_{DD} = 2.5V \pm 5\%$ .	—	0.68	—	
$V_{IH}$	Enable/Disable Input High Voltage (Output enabled)	—	$70\% V_{DD}$	—	—	
$V_{IL}$	Enable/Disable Input Low Voltage (Output disabled)	—	—	—	$30\% V_{DD}$	

**Table 8. LVCMOS DC Electrical Characteristics**

$V_{DD} = 3.3V, 2.5V \pm 5\%$ ,  $T_A = -40^\circ C$  to  $+85^\circ C, -40^\circ C$  to  $+105^\circ C$ . Below are guaranteed for listed standard frequencies.

Symbol	Parameter	Conditions		Minimum	Typical	Maximum	Units
$V_{OH}$	Output High Voltage	$V_{DD} = 3.3V \pm 5\%$ .	0.75MHz to 150MHz.	$90\% V_{DD}$	—	—	V
			150+MHz to 250MHz.	$80\% V_{DD}$	—	—	
		$V_{DD} = 2.5V \pm 5\%$ .	0.75MHz to 160MHz.	$90\% V_{DD}$	—	—	
			160+MHz to 180MHz.	$80\% V_{DD}$	—	—	
$V_{OL}$	Output Low Voltage	$V_{DD} = 3.3V \pm 5\%$ .	0.75MHz to 150MHz.	—	—	$10\% V_{DD}$	
			150+MHz to 250MHz.	—	—	$20\% V_{DD}$	
		$V_{DD} = 2.5V \pm 5\%$ .	0.75MHz to 160MHz.	—	—	$10\% V_{DD}$	
			160+MHz to 180MHz.	—	—	$20\% V_{DD}$	
$V_{IH}$	Enable/Disable Input High Voltage (Output enabled)	—	—	$70\% V_{DD}$	—	—	
$V_{IL}$	Enable/Disable Input Low Voltage (Output disabled)	—	—	—	—	$30\% V_{DD}$	

## AC Electrical Characteristics

**Table 9. 3.3V AC Electrical Characteristics**

$V_{DD} = 3.3V \pm 5\%$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ ,  $-40^\circ C$  to  $+105^\circ C$ .

Symbol	Parameter	Test Condition	Minimum	Typical	Maximum	Units	
F	Output Frequency Range	LVDS.	0.75	—	1350	MHz	
		LVPECL.	0.75	—	1350		
		LVC MOS.	0.75	—	250		
	Frequency Stability	Temperature = $-40^\circ C$ to $+85^\circ C$ .	-25 -50 -100	—	+25 +50 +100	ppm	
		Temperature = $-40^\circ C$ to $+105^\circ C$ .	-50 -100	—	+50 +100	ppm	
	Output Load	LVDS. Differential.	—	100	—	$\Omega$	
		LVPECL. $V_{DD} - 2.0V$ .	—	50	—		
		LVC MOS. To GND.	—	15	—	pF	
$T_{ST}$	Start-up Time	Output valid time after $V_{DD}$ meets minimum specified level.	—	—	10	ms	
$t_R$	Output Rise Time	LVDS. 20% to 80% $V_{pp}$ .	—	—	400	ps	
		LVPECL. 20% to 80% $V_{pp}$ .	—	—	400		
		LVC MOS. 10% to 90% $V_{DD}$ .	—	—	3	ns	
$t_F$	Output Fall Time	LVDS. 80% to 20% $V_{pp}$ .	—	—	400	ps	
		LVPECL. 80% to 20% $V_{pp}$ .	—	—	400		
		LVC MOS. 90% to 10% $V_{DD}$ .	—	—	3	ns	
$O_{DC}$	Output Clock Duty Cycle	LVDS.	45	—	55	%	
		LVPECL.	45	—	55		
		LVC MOS.	$F_{OUT} \leq 62.5MHz$ .	45	—		55
			$F_{OUT} \geq 62.5MHz$ .	40	—		60
$T_{OE}$	Output Enable/ Disable Time	—	—	100	ns		
$J_{PER}$	Period Jitter, RMS	LVDS.	—	3	—	ps	
		LVPECL.	—	5.8	—		
		LVC MOS. $F_{OUT} = 125MHz$ .	—	5	—		
$R_J$	Random Jitter	LVDS.	—	1.3	—	ps	
		LVPECL.	—	1.29	—		
		LVC MOS. $F_{OUT} = 125MHz$ .	—	0.6	—		
$D_J$	Deterministic Jitter	LVDS.	—	5.8	—	ps	
		LVPECL.	—	9.3	—		
		LVC MOS. $F_{OUT} = 125MHz$ .	—	10	—		

**Table 9. 3.3V AC Electrical Characteristics (Cont.)**

$V_{DD} = 3.3V \pm 5\%$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ ,  $-40^\circ C$  to  $+105^\circ C$ .

Symbol	Parameter	Test Condition	Minimum	Typical	Maximum	Units
$T_J$	Total Jitter	LVDS.	—	23.6	—	ps
		LVPECL.	—	27.7	—	
		LVC MOS.	$F_{OUT} = 125MHz.$	—	19	
$f_{JITTER}$	Phase Jitter (12kHz–20MHz)	LVDS.	—	890	—	fs
		LVPECL.	—	860	—	
		LVC MOS.	$F_{OUT} = 125MHz.$	—	750	

**Table 10. 2.5V AC Electrical Characteristics**

$V_{DD} = 2.5V \pm 5\%$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ ,  $-40^\circ C$  to  $+105^\circ C$ .

Symbol	Parameter	Test Condition	Minimum	Typical	Maximum	Units	
F	Output Frequency Range	LVDS.	0.75	—	1000	MHz	
		LVPECL.	0.75	—	1000		
		LVC MOS.	0.75	—	180		
	Frequency Stability	Temperature = $-40^\circ C$ to $+85^\circ C$ .	-25 -50 -100	—	+25 +50 +100	ppm	
		Temperature = $-40^\circ C$ to $+105^\circ C$ .	-50 -100	—	+50 +100	ppm	
	Output Load	LVDS.	Differential.	—	100	—	$\Omega$
		LVPECL.	$V_{DD} - 2.0V.$	—	50	—	
		LVC MOS.	To GND.	—	15	—	pF
$T_{ST}$	Start-up Time	Output valid time after $V_{DD}$ meets minimum specified level.	—	—	10	ms	
$t_R$	Output Rise Time	LVDS.	20% to 80% $V_{pp}$ .	—	—	400	ps
		LVPECL.		—	—	400	
		LVC MOS.	10% to 90% $V_{DD}$ .	—	—	3.5	ns
$t_F$	Output Fall Time	LVDS.	80% to 20% $V_{pp}$ .	—	—	400	ps
		LVPECL.		—	—	400	
		LVC MOS.	90% to 10% $V_{DD}$ .	—	—	3	ns
$O_{DC}$	Output Clock Duty Cycle	LVDS.	45	—	55	%	
		LVPECL.	45	—	55		
		LVC MOS.	45	—	55		
$T_{OE}$	Output Enable/ Disable Time	—	—	—	100	ns	



**Table 10. 2.5V AC Electrical Characteristics (Cont.)**

$V_{DD} = 2.5V \pm 5\%$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ ,  $-40^\circ C$  to  $+105^\circ C$ .

Symbol	Parameter	Test Condition	Minimum	Typical	Maximum	Units
$J_{PER}$	Period Jitter, RMS	LVDS.	—	4	—	ps
		LVPECL.	—	5.12	—	
		LVC MOS.	$F_{OUT} = 125MHz.$	—	3.3	
$R_J$	Random Jitter	LVDS.	—	1.4	—	ps
		LVPECL.	—	1.36	—	
		LVC MOS.	$F_{OUT} = 125MHz.$	—	1.3	
$D_J$	Deterministic Jitter	LVDS.	—	9.2	—	ps
		LVPECL.	—	10	—	
		LVC MOS.	$F_{OUT} = 125MHz.$	—	6.7	
$T_J$	Total Jitter	LVDS.	—	29.2	—	ps
		LVPECL.	—	29.3	—	
		LVC MOS.	$F_{OUT} = 125MHz.$	—	25.6	
$f_{JITTER}$	Phase Jitter (12kHz–20MHz)	LVDS.	—	1040	—	fs
		LVPECL.	—	1200	—	
		LVC MOS.	$F_{OUT} = 125MHz.$	—	850	

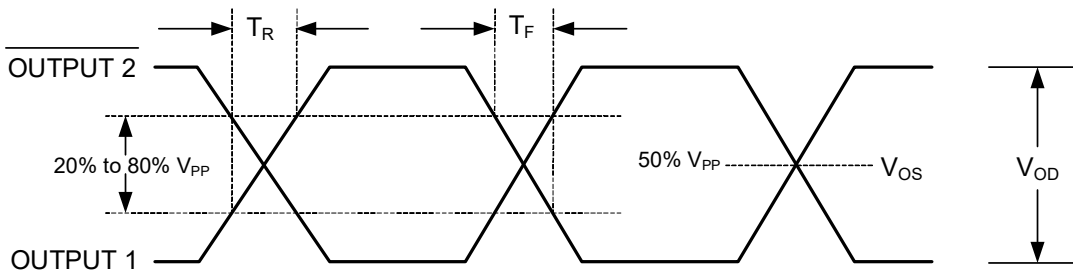
Notes for all AC Electrical Characteristics tables:

<sup>1</sup> All jitter values provided at 156.25MHz, unless noted otherwise.

<sup>2</sup> Stability is inclusive of 25°C tolerance, operating temperature range, input voltage change, load change, aging, shock and vibration.

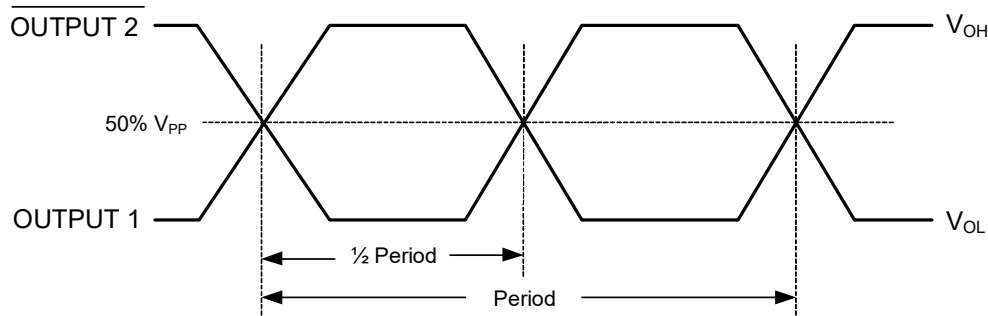
## Output Waveforms – LVDS

Output Levels/Rise Time/Fall Time Measurements



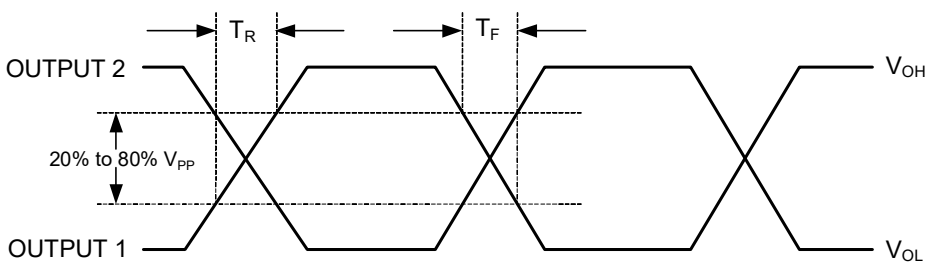
Oscillator Symmetry

Ideally, Symmetry should be 50/50 for  $\frac{1}{2}$  period –Other expressions are 45/55 or 55/45

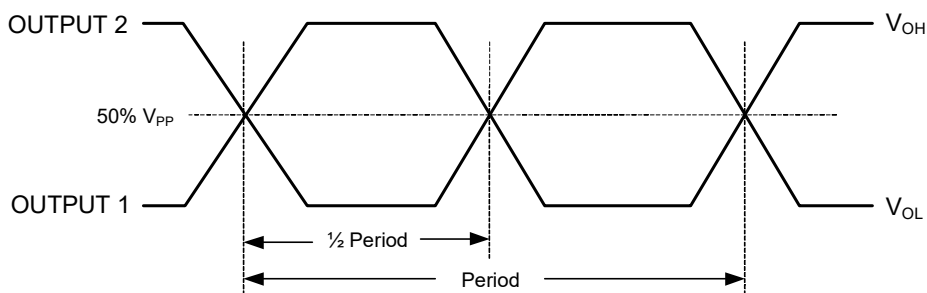


## Output Waveforms – LVPECL

Rise Time/Fall Time Measurements

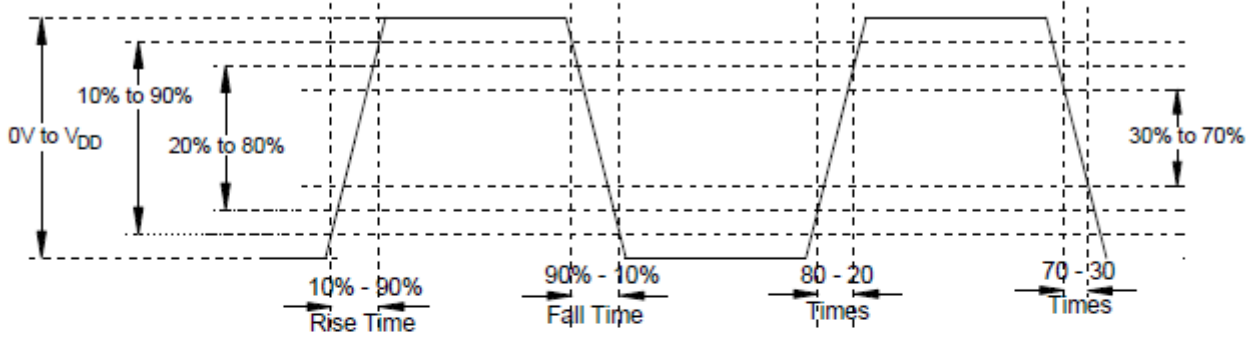


Oscillator Symmetry

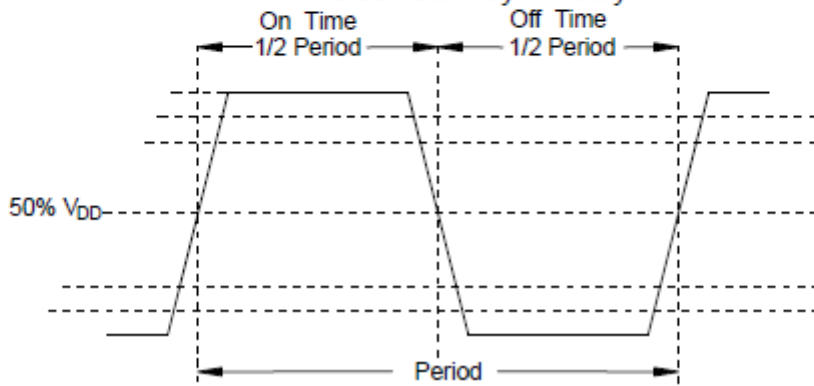


## Output Waveforms – LVCMOS

Rise Time / Fall Time Measurements



Oscillator Symmetry

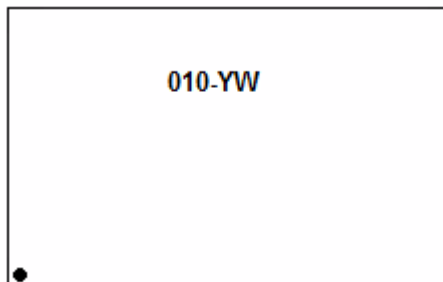


## Package Outline Drawings

The package outline drawings (JS6, JX6) are appended at the end of this document. The package information is the most current data available.

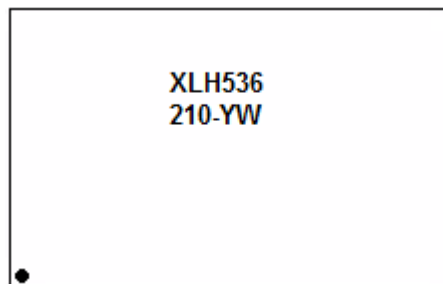
## Marking Diagrams

JX6 3.2 × 2.5 mm Package Option (example based on XLH320010.000000I)



- Line 1:
  - “010” denotes last three digits to the left of the decimal point as shown in the above example. This number will vary depending upon the frequency value selected in the orderable part number.
  - “YW” denotes the last digit of the year and work week the part was assembled.

JS6 5.0 × 3.2 mm Package Option (example based on XLH536210.380000I)

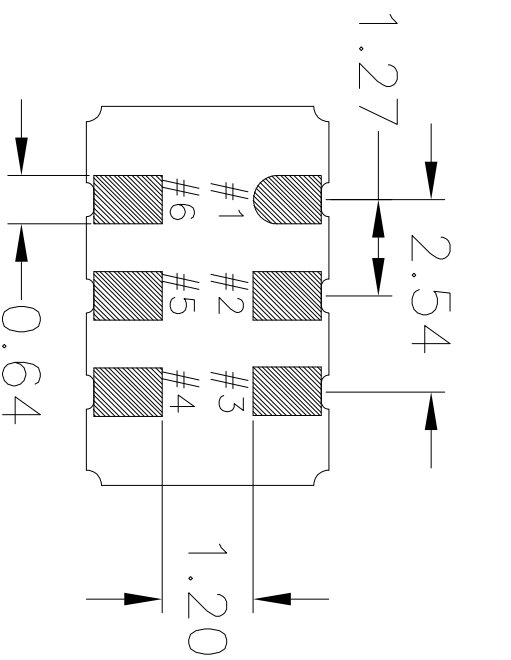


- Line 1:
  - “XL” = family; “H” = output type; “5” = package size; “3” = voltage; “6” = precision level. This number will vary depending upon the output type, voltage, and precision values selected in the orderable part number.
- Line 2:
  - “210” denotes last three digits to the left of the decimal point as shown in the above example. This number will vary depending upon the frequency value selected in the orderable part number.
  - “YW” denotes the last digit of the year and work week the part was assembled.

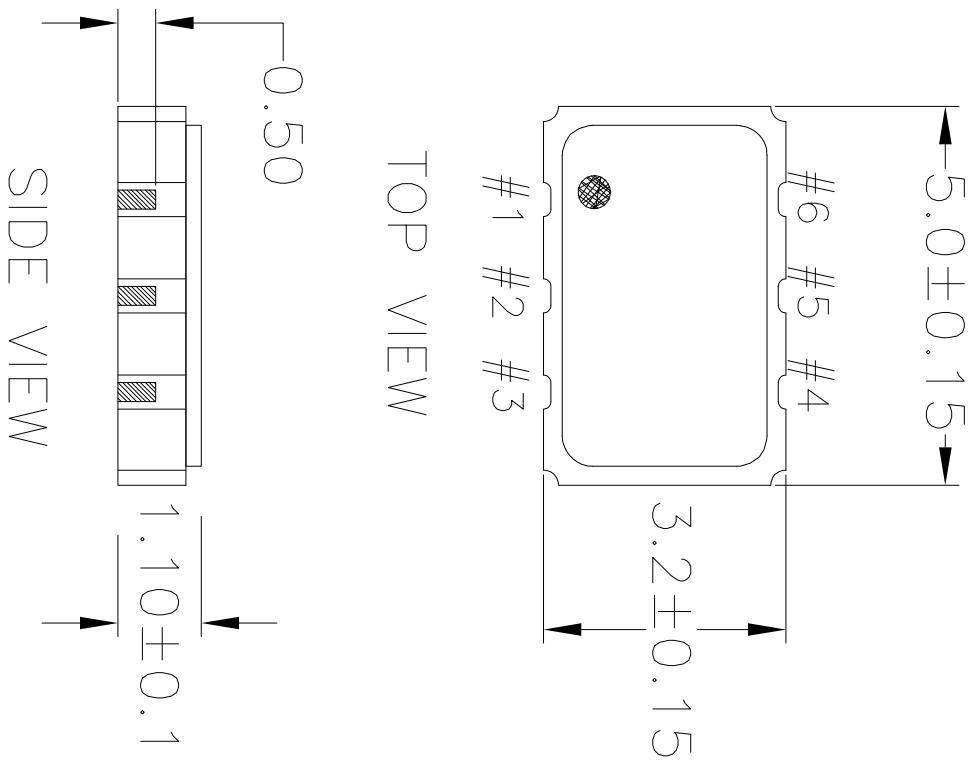
## Revision History

Revision Date	Description of Change
January 11, 2022	<ul style="list-style-type: none"> <li>▪ Removed Aging parameters in <a href="#">Table 9</a> and <a href="#">Table 10</a>.</li> <li>▪ Added footnote 2 after <a href="#">Table 10</a>.</li> </ul>
December 1, 2021	Updated Frequency Stability values in <a href="#">Table 9</a> and <a href="#">Table 10</a> .
November 23, 2021	Added <a href="#">Frequency Stability and Operating Temperature Decoder</a> table after Ordering Information.
August 18, 2021	Moved Ordering Information table to just after Pin Descriptions.
January 15, 2021	<ul style="list-style-type: none"> <li>▪ Removed 4-pin package description table, figure, and package drawing references.</li> <li>▪ Added footnote for pin 5 in <a href="#">Table 1</a>.</li> <li>▪ Updated “H:” description under “Output Type” in Ordering Information.</li> </ul>
January 13, 2021	Added Marking Diagrams section and updated Package Outline Drawings links.
May 24, 2018	Updated LVCMOS Output Clock Duty Cycle, FOVT test condition.
April 27, 2018	Initial release.

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
00	INITIAL RELEASE	04/2/12	DP
01	ADDED LID IN TOP VIEW	07/12/12	KS
02	UPDATED LID TOLERANCES	12/03/12	KS
03	UPDATE PACKAGE DRAWING	8/8/14	JHUA



BOTTOM VIEW



TOP VIEW

SIDE VIEW

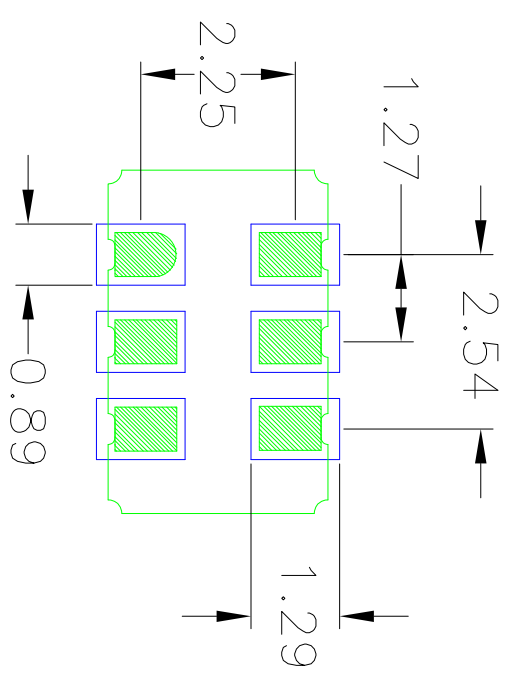
NOTES:  
1. ALL DIMENSIONS IN MM.

TOLERANCES UNLESS SPECIFIED		6024 Silver Creek Valley Rd Sonoma, CA 95138	
DECIMAL	ANGULAR	PHONE: (408) 727-6116	
XXX±	±	FAX: (408) 492-8874	
XXXX±			
XXXX±			
APPROVALS	DATE	TITLE	SIZE
DRAWN <i>QAC</i>	04/2/12	JS6 PACKAGE OUTLINE	DRAWING No.
CHECKED		5.0 x 3.2 mm BODY	PSC-4411
		1.1 mm Thick	
			REV
			03
DO NOT SCALE DRAWING			SHEET 1 OF 2



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REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
00	INITIAL RELEASE	04/2/12	DP
01	ADDED LID IN TOP VIEW	07/12/12	KS
02	UPDATED LID TOLERANCES	12/03/12	KS
03	UPDATE PACKAGE DRAWING	8/8/14	JHUA

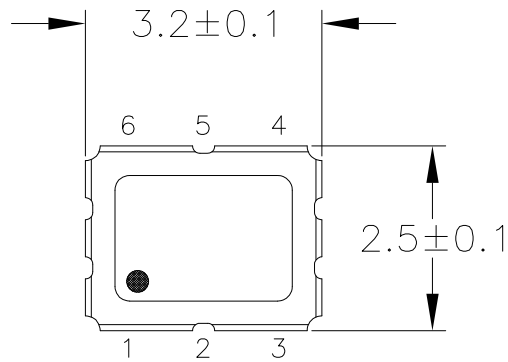


RECOMMENDED LAND PATTERN

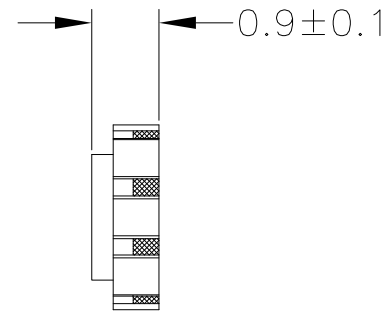
- NOTES:
1. ALL DIMENSION ARE IN mm. ANGLES IN DEGREES.
  2. TOP DOWN VIEW. AS VIEWED ON PCB.
  3. COMPONENT OUTLINE SHOW FOR REFERENCE IN GREEN.
  4. LAND PATTERN IN BLUE. NSMD PATTERN ASSUMED.
  5. LAND PATTERN RECOMMENDATION PER IPC-7351B GENERIC REQUIREMENT FOR SURFACE MOUNT DESIGN AND LAND PATTERN.

TOLERANCES UNLESS SPECIFIED		6024 Silver Creek Valley Rd	
DECIMAL	ANGULAR	San Jose, CA 95138	
XXX±	±	PHONE: (408) 727-6176	
XXXX±		FAX: (408) 492-8674	
APPROVALS		www.IDT.com	
DRAWN	DATE	TITLE	
04/2/12		J56 PACKAGE OUTLINE	
CHECKED		5.0 x 3.2 mm BODY	
		1.1 mm Thick	
SIZE	DRAWING No.	REV	
C	PSC-4411	03	
DO NOT SCALE DRAWING			SHEET 2 OF 2

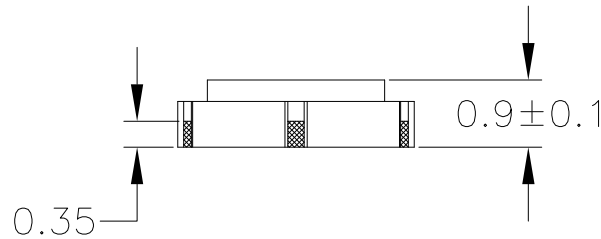
REVISIONS			
REV	DESCRIPTION	DATE CREATED	AUTHOR
00	INITIAL RELEASE	8/11/14	J.HUA
01	ADD PITCH	11/17/16	J.HUA
REFER TO DCP FOR OFFICIAL RELEASE DATE			



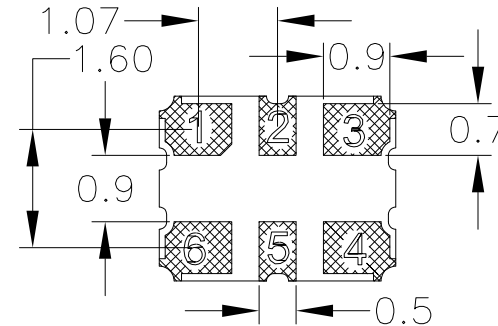
TOP VIEW



END VIEW




SIDE VIEW



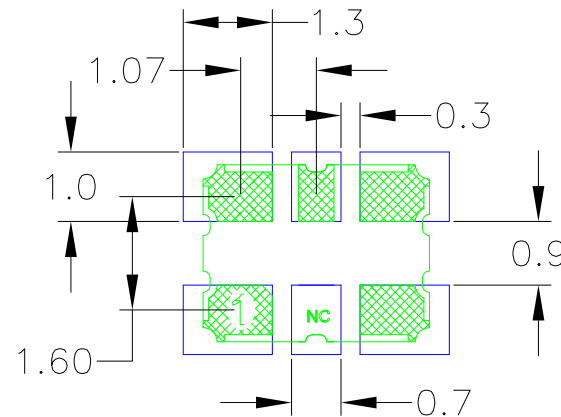
BOTTOM VIEW

NOTES:

1. ALL DIMENSIONS IN MM.

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DECIMAL	ANGULAR	
XX±	±	
XXX±		
XXXX±		
TITLE		JX6 PACKAGE OUTLINE
		3.2 x 2.5 mm BODY
		0.9 mm Thick
SIZE	DRAWING No.	REV
C	PSC-4412	01
DO NOT SCALE DRAWING		SHEET 1 OF 2


REVISIONS			
REV	DESCRIPTION	DATE CREATED	AUTHOR
00	INITIAL RELEASE	8/11/14	J.HUA
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### RECOMMENDED LAND PATTERN DIMENSION

#### NOTES:

1. ALL DIMENSIONS ARE IN MM. ANGLES IN DEGREES.
2. TOP DOWN VIEW. AS VIEWED ON PCB.
3. COMPONENT OUTLINE SHOWS FOR REFERENCE IN GREEN.
4. LAND PATTERN IN BLUE. NSMD PATTERN ASSUMED.
5. LAND PATTERN RECOMMENDATION PER IPC-7351B GENERIC REQUIREMENT FOR SURFACE MOUNT DESIGN AND LAND PATTERN.

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DECIMAL	ANGULAR	
XX±	±	
XXX±		
XXXX±		
TITLE		JX6 PACKAGE OUTLINE 3.2 x 2.5 mm BODY 0.9 mm Thick
SIZE	DRAWING No.	REV
C	PSC-4412	01
DO NOT SCALE DRAWING		SHEET 2 OF 2



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