

## 1.8V Operating Voltage 3<sup>rd</sup> Overtone Quartz Crystal Oscillator IC with Input Tolerant Function

### GENERAL DESCRIPTION

The NJU6227 series is a C-MOS quartz crystal oscillator IC realized excellent frequency stability for 3<sup>rd</sup> Overtone (up to 160MHz) oscillation, and consists of an oscillation amplifier, a 3-state output buffer, a built-in LDO and a input tolerant circuit.

The operating voltage is from 1.62V to 3.63V (x3, x4, x5, x6: from 2.25V to 3.63V), and the LDO holds down the characteristic change of the oscillation amplifier for operating voltage variation, and has been stabilized oscillation frequency (Frequency stability  $\pm 1\text{ppm}@V_{DD}\pm 10\%$ ). The 3-state output buffer is C-MOS compatible.

The input tolerant circuit ensures that 0 to 3.63 V can be applied to CONT terminal without regard to the supply voltage.

The oscillation stopping current is very low stand-by mode, therefore, it is suitable for the portable items of the communication equipment and the like.

### PACKAGE OUTLINE

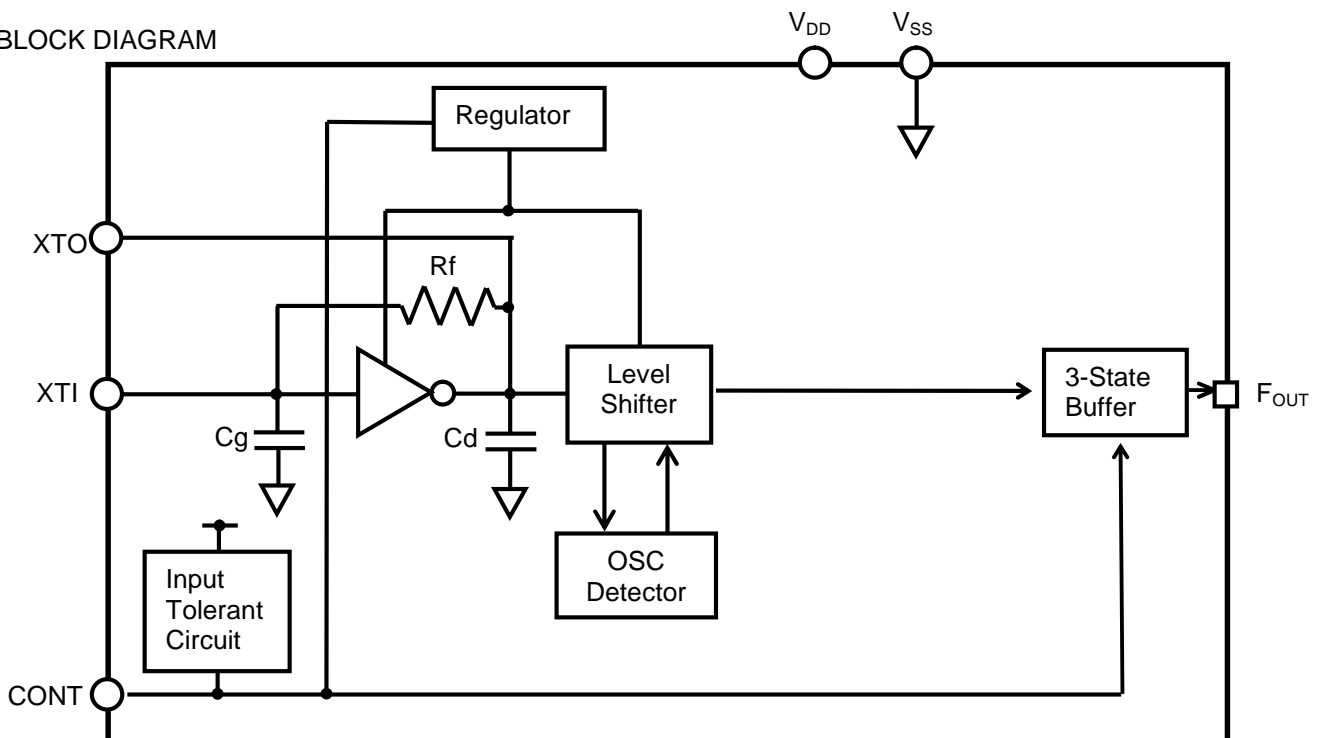


NJU6227xXC-V

### FEATURES

- Maximum Oscillation Frequency      160MHz(3<sup>rd</sup> Overtone)
- Frequency Stability                     $\pm 1\text{ppm}@V_{DD}\pm 10\%$
- Wide Operating Voltage                1.62 to 3.63V(x3, x4, x5, x6 2.25V to 3.63V)
- Built-in LDO
- Input Tolerant Circuit                    0 to 3.63V@CONT Term.
- Stand-by Function ( Oscillation Stop and High-Z )
- 3-State Output Buffer
- Variable Pull-up Resistance on-Die ( CONT Terminal: Pull-up resistance is large at Stand-by Function )
- Oscillation Capacitors Cg and Cd on-Die
- C-MOS Technology
- Package Outline                            Die/Wafer

### BLOCK DIAGRAM

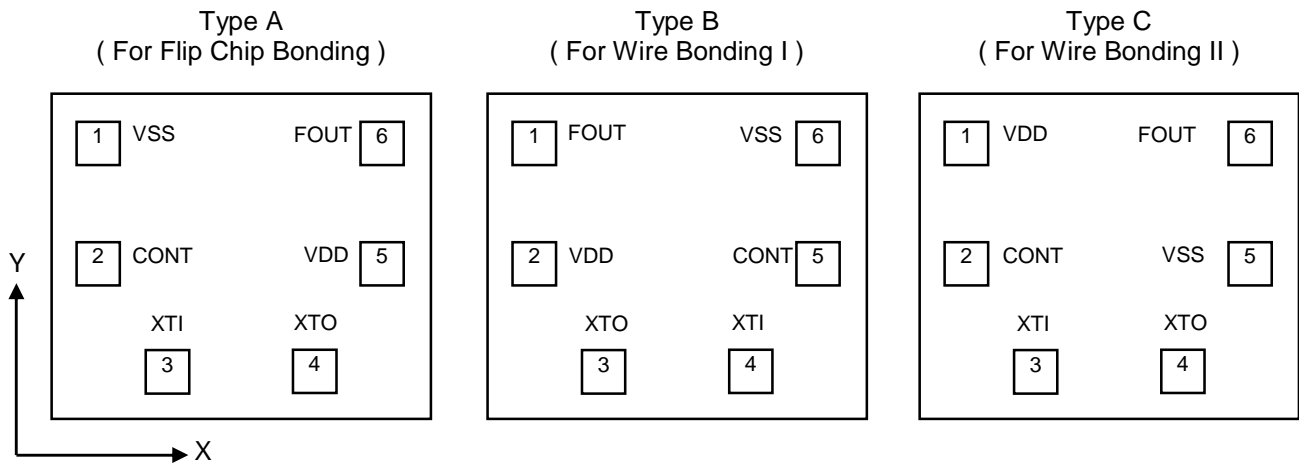


### LINE-UP TABLE

Type No.	Recommended Oscillation Frequency	Version		
		Type A	Type B	Type C
NJU6227	40 to 50MHz	A1*	B1*	C1
	50 to 60MHz	A2*	B2*	C2
	60 to 85MHz	A3*	B3*	C3
	85 to 110MHz	A4*	B4*	C4
	110 to 130MHz	A5*	B5*	C5
	130 to 160MHz	A6*	B6*	C6

\* Under development and tentative value.

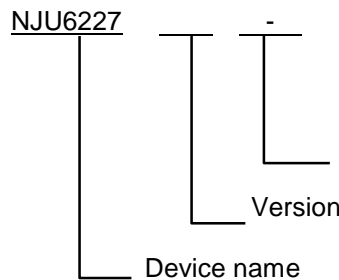
### PAD LOCATION



### COORDINATES

	X	Y
1	-261.5	198.5
2	-261.5	-21.5
3	-146.5	-211.5
4	144.5	-211.5
5	260.5	-21.5
6	260.5	198.5

### PART NUMBER



W-H: Wafer (200μm)  
W-B: Wafer (160μm)  
WS4-V: 1/4Wafer(130μm)  
C-V: Chip(130μm)

Starting Point: Die Center Unit[μm]  
Die Size: 0.73x0.63mm  
Die Thickness (C-V): 130±15μm  
Wafer Thickness(WS4-V): 130±15μm  
Wafer Thickness (W-B): 160±20μm  
Wafer Thickness (W-H): 200±20μm  
Pad size: 80x80μm  
Die Substrate: V<sub>SS</sub> level

### VERSION DISCRIMINATION INTERNAL COMPONENTS

PAD layout version of the NJU6227 series is determined by the mask pattern. Frequency version of the NJU6227 series is determined by the internal fuse trimming.

Laser-trimmed versions are identified externally by the combination of the version name marking (1) and the locations of trimmed fuses (2). (Table 1 shows the chip version identification)

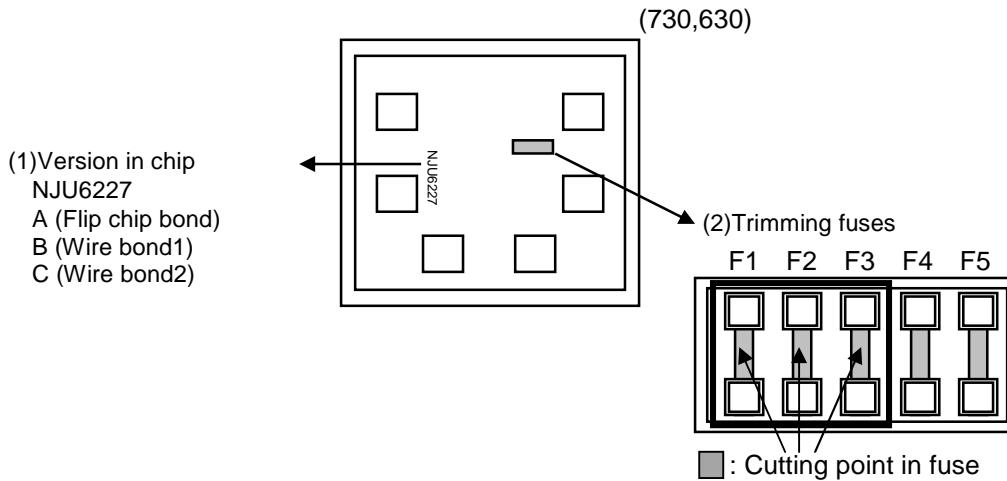


Table1: Frequency version and Cutting point in fuse.

Version name	Mask / Version set by trimming fuses					
	Mask	Trimming fuses				
	Version	F1	F2	F3	F4	F5
NJU6227A1	A	*	-	-	Untrimmed	
NJU6227A2	A	*	-	*		
NJU6227A3	A	-	-	-		
NJU6227A4	A	-	-	*		
NJU6227A5	A	-	*	-		
NJU6227A6	A	-	*	*		
NJU6227B1	B	*	-	-		
NJU6227B2	B	*	-	*		
NJU6227B3	B	-	-	-		
NJU6227B4	B	-	-	*		
NJU6227B5	B	-	*	-		
NJU6227B6	B	-	*	*		
NJU6227C1	C	*	-	-		
NJU6227C2	C	*	-	*		
NJU6227C3	C	-	-	-		
NJU6227C4	C	-	-	*		
NJU6227C5	C	-	*	-		
NJU6227C6	C	-	*	*		

Note1) “-”: Uncut, “\*”: Cutting

## TERMINAL DESCRIPTION

SYMBOL	FUNCTION	
CONT	Oscillation and 3-state Output Buffer Control	
	<b>CONT</b>	<b>F<sub>OUT</sub></b>
	H or OPEN	Output frequency f <sub>0</sub>
	L	Oscillation Stop and High impedance Output
XTI XTO	Quartz Crystal Connecting Terminals	
V <sub>SS</sub>	GND Terminal (V <sub>SS</sub> =0V)	
F <sub>OUT</sub>	Frequency Output	
V <sub>DD</sub>	V <sub>DD</sub> =1.62 to 3.63V (x3, x4, x5, x6 2.25 to 3.63V)	

## FUNCTIONAL DESCRIPTION

### Standby Function

When CONT Terminal goes "Low", the F<sub>OUT</sub> Terminal output becomes High impedance.

CONT	F <sub>OUT</sub>	Oscillator
High(Open)	Frequency output	Normal operation
Low	High impedance	Stopped

### Variable Pull-up Resistance

The CONT Terminal pull-up resistance changes in response to the input level. When CONT is tied "LOW" level, the pull-up resistance is large, reducing the current consumed by the resistance. When CONT is left open circuit, the pull-up resistance is small, which increases the input susceptibility to external noise. However, the pull-up resistance ties the CONT Terminal "High" level to prevent external noise from unexpectedly stopping the output.

## ABSOLUTE MAXIMUM RATINGS

(V<sub>SS</sub>=0V, Ta=25°C)

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V <sub>DD</sub>	-0.5 to +4.0	V
Input Voltage	V <sub>IN</sub>	-0.5 to +4.0	V
Output Voltage	V <sub>O</sub>	-0.5 to V <sub>DD</sub> +0.5	V
Input Current	I <sub>IN</sub>	±10	mA
Output Current	I <sub>O</sub>	±25	mA
Operating Temperature Range	T <sub>opr</sub>	-40 to +85	°C
Storage Temperature Range	T <sub>stg</sub>	-55 to +125	°C

Note1) Decoupling capacitor should be connected between V<sub>DD</sub> and V<sub>SS</sub> due to the stabilized operation for the circuit.

## ELECTRICAL CHARACTERISTICS

(Ta=+25°C)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Operating Voltage	V <sub>DD</sub>	x1,x2, version	1.62		3.63	V
Input Voltage	V <sub>IN</sub>	CONT	0		3.63	V
Output Voltage	V <sub>OUT</sub>	F <sub>OUT</sub>	0		V <sub>DD</sub>	V
Output Frequency Stability	df/f	V <sub>DD</sub> ±10%		±1		ppm

(Ta=+25°C)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Operating Voltage	V <sub>DD</sub>	x3, x4, x5, x6 version	2.25		3.63	V
Input Voltage	V <sub>IN</sub>	CONT	0		3.63	V
Output Voltage	V <sub>OUT</sub>	F <sub>OUT</sub>	0		V <sub>DD</sub>	V
Output Frequency Stability	df/f	V <sub>DD</sub> ±10%		±1		ppm

Note3) C0 minimum requirement

Version: x1, x2, x3, x4, x5     1pF

Version: x6                         1.5pF

( $V_{DD}=1.62$  to  $3.63V$  (x3, x4, x5, x6 2.25 to  $3.63V$ ),  $V_{SS}=0V$ ,  $T_a=+25^{\circ}C$ )

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	
Operating Current	$I_{DD}$	x1 version No load CONT=Open $f_{osc}=50MHz$	$V_{DD}=1.8V$	-	2.0	2.6	mA
			$V_{DD}=2.5V$	-	2.4	3.1	
			$V_{DD}=3.3V$	-	3.1	4.0	
		x2 version No load CONT=Open $f_{osc}=60MHz$	$V_{DD}=1.8V$	-	2.4	3.1	
			$V_{DD}=2.5V$	-	2.8	3.6	
			$V_{DD}=3.3V$	-	3.6	4.7	
		x3 version No load CONT=Open $f_{osc}=85MHz$	$V_{DD}=2.5V$	-	6.0	7.8	
			$V_{DD}=3.3V$	-	7.0	9.1	
		x4 version No load CONT=Open $f_{osc}=110MHz$	$V_{DD}=2.5V$	-	6.6	8.6	
			$V_{DD}=3.3V$	-	7.8	10.1	
		x5 version No load CONT=Open $f_{osc}=130MHz$	$V_{DD}=2.5V$	-	6.8	8.8	
			$V_{DD}=3.3V$	-	8.2	10.7	
		x6 version No load CONT=Open $f_{osc}=160MHz$	$V_{DD}=2.5V$	-	7.5	9.8	
			$V_{DD}=3.3V$	-	9.0	11.7	
Oscillation Stopping Current	$I_{STB}$	CONT= $V_{SS}$ , No load	-	-	10	$\mu A$	
Output Voltage	$V_{OH}$	$I_{OH}=4mA$	$V_{DD}-0.4$	-	-	V	
	$V_{OL}$	$I_{OL}=4mA$	-	-	0.4	V	
Input Voltage	$V_{IH}$	CONT Input Tolerant Function	$0.7V_{DD}$	-	-	V	
	$V_{IL}$	CONT	-	-	$0.3V_{DD}$	V	
Input Current Note1)	$I_{IN}$	CONT= $3.63V$	-	-	1	$\mu A$	
		CONT= $0.8V_{DD}$	-	-	8		
		CONT= $0.2V_{DD}$	-	-	5		
3-state Off Leakage Current	$I_{OZ}$	CONT= $V_{SS}$ , $F_{OUT}=V_{DD}$ or $V_{SS}$	-	-	$\pm 0.1$	$\mu A$	

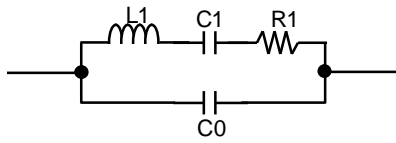
Note1) Absolute value.

( $V_{DD}=1.62$  to  $3.63V$  (x3, x4, x5, x6 2.25 to  $3.63V$ ),  $V_{SS}=0V$ ,  $T_a=+25^{\circ}C$ )

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	
Feedback Resistance	Rf	x1 version	-	12.5	-	kΩ	
		x2 version	-	6.8	-		
		x3 version	-	6.8	-		
		x4 version	-	12.3	-		
		x5 version	--	12.4	-		
		x6 version	-	12.5	-		
Internal Capacitor	Cg/Cd	x1 version	-	7.2/7.2	-	pF	
		x2 version	-	7.2/7.2	-		
		x3 version	-	7.2/7.2	-		
		x4 version	-	5.1/5.4	-		
		x5 version	-	4.2/4.1	-		
		x6 version	-	3.1/3.1	-		
Oscillation Frequency	fosc	Recommendation Note1)	40		50	MHz	
			50		60		
			60		85		
			85		110		
			110		130		
			130		160		
Output Signal Symmetry	SYM	$C_L=15pF$ , @ $V_{DD}/2$	45	50	55	%	
Output Signal Rise Time	tr	$C_L=15pF$ $0.1V_{DD}$ to $0.9V_{DD}$	$V_{DD}=1.8V$	-	2.0	4.0	ns
			$V_{DD}=2.5V$	-	1.1	2.1	
			$V_{DD}=3.3V$	-	0.8	1.7	
Output Signal Fall Time	tf	$C_L=15pF$ $0.9V_{DD}$ to $0.1V_{DD}$	$V_{DD}=1.8V$	-	1.7	3.4	ns
			$V_{DD}=2.5V$	-	1.0	1.9	
			$V_{DD}=3.3V$	-	0.8	1.5	
Output Disable time	$t_{POZ}$	$C_L=15pF$ , $R_L=1k\Omega$	-	-	100	ns	
Output Enable Time	$t_{PZO}$	$C_L=15pF$	-	-	1	ms	

Note1) The oscillation frequency range has used NJRC's standard crystal for measurement. However it is not guaranteed. (Refer to EXAMPLE OF CRYSTAL PARAMETERS FOR MEASUREMENT CIRCUITS)

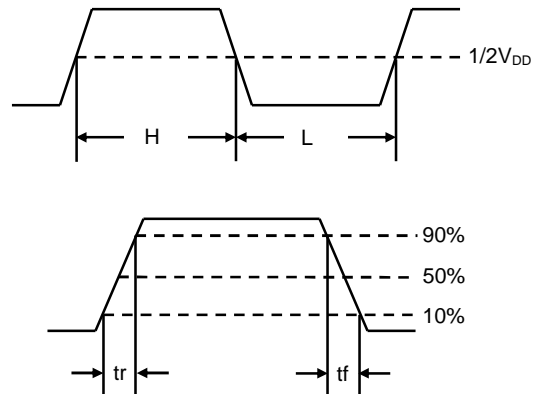
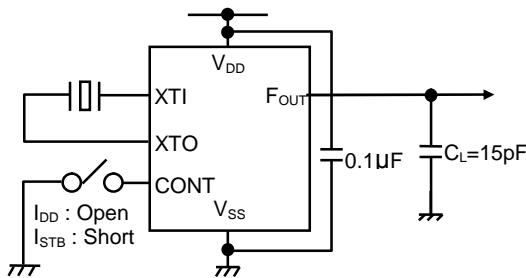
EXAMPLE OF CRYSTAL PARAMETERS FOR MEASUREMENT CIRCUITS



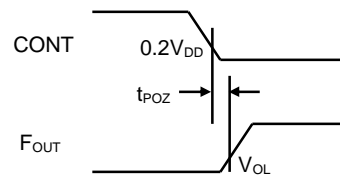
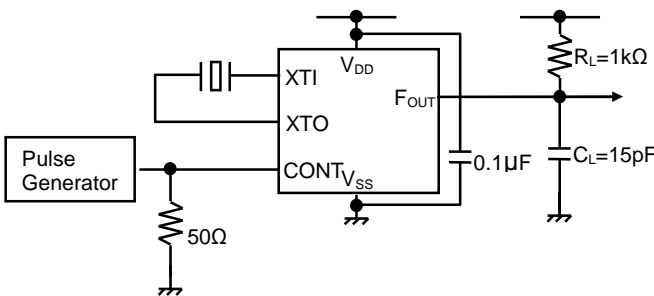
f[MHz]	R1[Ω]	L1[mH]	C1[fF]	C0[pF]	Size
40	34.8	20.8	0.76	2.42	7050
50	67.1	27.5	0.37	1.46	7050
60	33.1	10.7	0.66	2.49	7050
90	42.2	6.68	0.47	2.03	7050
113	30.2	3.52	0.56	3.22	7050
125	30.3	2.61	0.62	3.47	7050
133	24.7	2.11	0.68	3.60	7050
155	38.3	1.55	0.68	3.75	7050

MEASUREMENT CIRCUITS

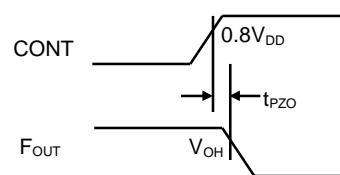
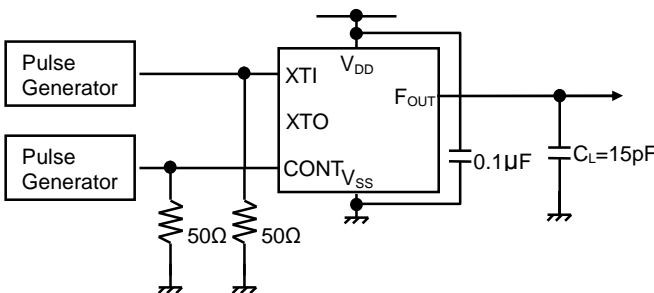
(1) Operating Current ( $C_L=0pF$ ), Output Signal Symmetry ( $C_L=15pF$ ), Output Signal Rise/Fall Time ( $C_L=15pF$ )



(2) Output Disable Time ( $C_L=15pF, R_L=1kΩ$ )

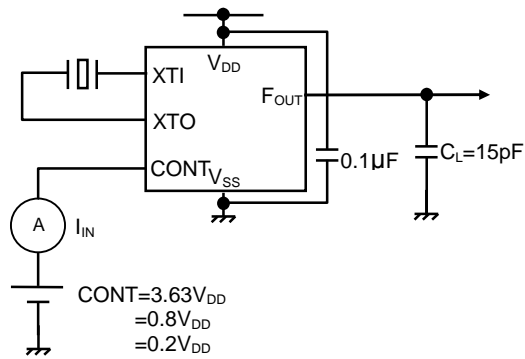


(3) Output Enable Time ( $C_L=15pF$ )





(4) Input Current ( $C_L=15\text{pF}$ )



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