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## Low phase noise Fundamental Quartz Crystal Oscillator IC

### ■ GENERAL DESCRIPTION

The NJU6222 series is a C-MOS quartz crystal oscillator IC (20MHz to 50MHz) realized very low phase noise. It is consisted of an oscillation amplifier, divider ( $f_0$ ,  $f_0/2$ ), and 3-state output buffer.

There are 2-type of pad location for Flip chip and Wire bonding that apply SMD's 2016-package and more miniature. The NJU6222 in low voltage operation features low phase noise, it is suitable for high quality Hi-Fi sound device, Communication device, and others by battery drive.

### ■ PACKAGE OUTLINE

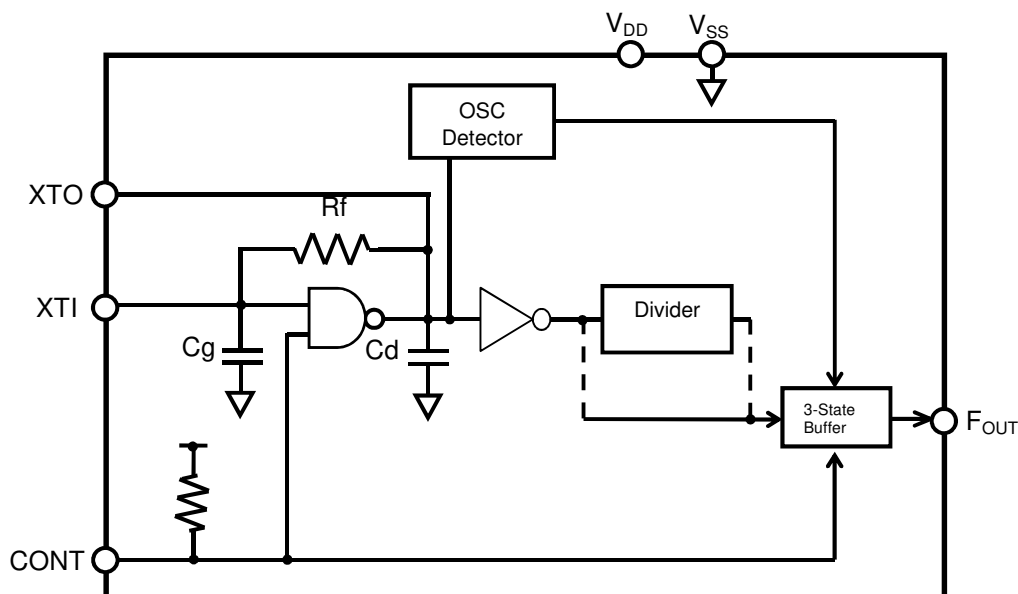


NJU6222XxC-V

### ■ FEATURES

- Oscillation Frequency 20~50MHz(Fundamental)
- Frequency Stability  $\pm 1\text{ppm}@V_{DD}=1.8\text{V}\pm 10\%$ ,  $V_{DD}=3.3\text{V}\pm 10\%$
- Wide Operating Voltage 1.62 to 3.63V
- Very Low Phase Noise
  - 103dBc/Hz(Typ.) @49.152MHz, 10Hz offset,  $V_{DD}=1.8\text{V}$
  - 158dBc/Hz (Typ.) @49.152MHz, 1kHz offset,  $V_{DD}=1.8\text{V}$
  - 103dBc/Hz(Typ.) @49.152MHz, 10Hz offset,  $V_{DD}=3.3\text{V}$
  - 163dBc/Hz(Typ.) @49.152MHz, 1kHz offset,  $V_{DD}=3.3\text{V}$
- RMS Jitter
  - 0.10psec(Typ.) 12kHz~20MHz,  $V_{DD}=1.8\text{V}$
  - 0.05psec(Typ.) 12kHz~20MHz,  $V_{DD}=3.3\text{V}$
- Low Operating Current 3.1mA (Typ.) @49.152MHz,  $V_{DD}=1.8\text{V}$ ,  $CL=15\text{pF}$
- Built-in Divider  $f_0$ ,  $f_0/2$  ( Factory set )
- Stand-by Function Oscillation Stop and High Impedance Output "F<sub>OUT</sub>" terminal (CONT terminal: L)
- 3-State Output Buffer
- Built-in Variable Pull-up Resistance (CONT: Pull-up Resistance large at the Stand-by mode.)
- Built-in Oscillation Capacitors  $C_g$  and  $C_d$
- C-MOS Technology
- Package Outline Die / 8-inch Wafer / 1/4 cut wafer

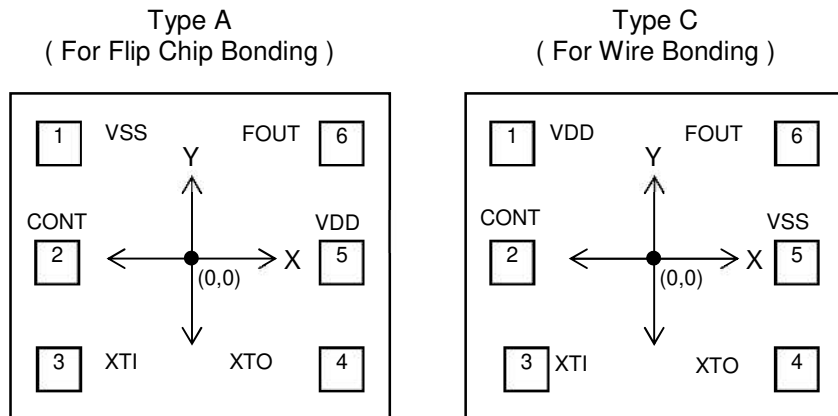
### ■ BLOCK DIAGRAM



■ LINE-UP TABLE

Type No.	F <sub>OUT</sub>	Version	
		Type A	Type C
NJU6222	f <sub>0</sub>	A1	C1
	f <sub>0</sub> /2	A2	C2

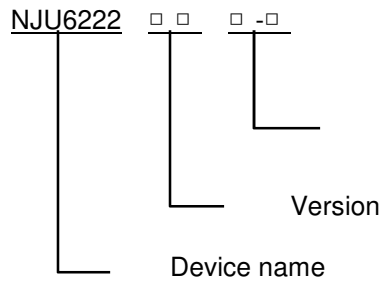
■ PAD LOCATION



■ COORDINATES

Pad No.	X	Y
1	-174	190
2	-186	0
3	-174	-190
4	174	-190
5	186	0
6	174	190

■ PART NUMBER



W-V: Wafer (130μm)  
C-V: Die (130μm)

Starting Point: Die Center Unit[μm]  
Die Size: 0.580x0.588mm  
Die Thickness (C-V): 130±15μm  
Wafer Thickness (W-V): 130±20μm  
Pad size: 80x80μm  
Die Substrate: V<sub>SS</sub> level

## ■ VIRSION DISCRIMINATION INTERNAL COMPONENTS

PAD layout version of the NJU6222 series is determined by the version name in chip. Divide version of the NJU6222 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)

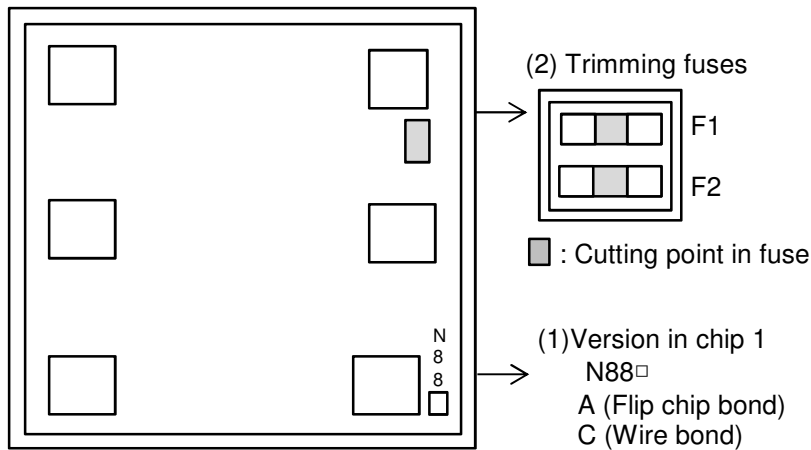


Table 1: Frequency version and Cutting point in fuse.

Version name	Mask / Version set by trimming fuses		
	Mask	Trimming fuses	
	Version	F1	F2
NJU6222A1	A	-	-
NJU6222A2	A	*	-
NJU6222C1	C	-	-
NJU6222C2	C	*	-

Note 1) "-": Uncut, "\*": Cutting

## ■ TERMINAL DESCRIPTION

SYMBOL	FUNCTION
CONT	Oscillation and 3-state Output Buffer Control
	CONT      F <sub>OUT</sub>
	H or OPEN      Output one frequency selected out of f <sub>0</sub> and f <sub>0</sub> /2 (Note1)
	L      Oscillation Stop and High impedance Output
XTI XTO	Quartz Crystal Connection terminals
V <sub>SS</sub>	GND terminal (V <sub>SS</sub> =0V)
F <sub>OUT</sub>	Frequency Output terminal (3-State Output Buffer)
V <sub>DD</sub>	Power Supply terminal V <sub>DD</sub> =1.62 to 3.63V

Note1) Refer to the line-up table.

## ■ FUNCTIONAL DESCRIPTION

### ● Standby Function

When CONT Terminal is “Low”, the F<sub>OUT</sub> Terminal output is High impedance.

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

When not using Stand-by function, CONT terminal is recommended to connect to V<sub>DD</sub>.

### ● Built-in Variable Pull-up Resistance of CONT terminal

The built-in pull-up resistance value of CONT Terminal changes in response to the input level. When CONT is “LOW” level, the pull-up resistance value is large to reduce the current consumption by the resistance. When CONT is open or connected to V<sub>DD</sub>, the pull-up resistance value is small to decrease the input susceptibility to external noise. It works to prevent an unexpectedly stopping of the output by external noise.

## ■ ABSOLUTE MAXIMUM RATINGS

(V<sub>SS</sub>=0V, Ta=25°C)

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V <sub>DD</sub>	-0.6 to +6.0	V
Input Voltage	V <sub>IN</sub>	-0.6 to +V <sub>DD</sub> +0.6 and ≤ 6.0V	V
Output Voltage	V <sub>O</sub>	-0.6 to V <sub>DD</sub> +0.6	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 +125	°C
Storage Temperature Range	T <sub>stg</sub>	-55 to +150	°C

Note2) If the LSI used condition above the absolute maximum ratings, the LSI may be destroyed.

Use beyond the electric characteristics conditions will cause mal-function and poor reliability.

## ■ ELECTRICAL CHARACTERISTICS

(Ta=25°C)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Operating Voltage	V <sub>DD</sub>	fosc=50MHz	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

( $V_{DD}=1.62$  to  $3.63V$ ,  $V_{SS}=0V$ ,  $T_a=25^{\circ}C$ )

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	
Operating Current	$I_{DD}$	x1 version ( $f_0$ ) No load MEASUREMENT CIRCUIT(1) $f_0=49.152MHz$ $F_{out}=49.152MHz$	$V_{DD}=1.8V$	-	1.8	2.9	mA
			$V_{DD}=2.5V$	-	3.3	4.8	
			$V_{DD}=3.3V$	-	5.5	7.7	
		x2 version ( $f_0/2$ ) No load MEASUREMENT CIRCUIT(1) $f_0=49.152MHz$ $F_{out}=24.576MHz$	$V_{DD}=1.8V$	-	1.4	2.4	
			$V_{DD}=2.5V$	-	2.7	4.1	
			$V_{DD}=3.3V$	-	4.8	6.6	
		x1 version ( $f_0$ ) $CL=15pF$ MEASUREMENT CIRCUIT(1) $f_0=49.152MHz$ $F_{out}=49.152MHz$	$V_{DD}=1.8V$	-	3.1	4.1	
			$V_{DD}=2.5V$	-	5.1	6.6	
			$V_{DD}=3.3V$	-	7.9	9.9	
		x2 version ( $f_0/2$ ) $CL=15pF$ MEASUREMENT CIRCUIT(1) $f_0=49.152MHz$ $F_{out}=24.576MHz$	$V_{DD}=1.8V$	-	2.0	3.0	
			$V_{DD}=2.5V$	-	3.6	4.9	
			$V_{DD}=3.3V$	-	5.9	7.7	
Stand-by Current	$I_{STB}$	MEASUREMENT CIRCUIT(1) $CONT=V_{SS}$	$V_{DD}=1.8V$	-	3.0	25.0	$\mu A$
			$V_{DD}=2.5V$	-	5.0	30.0	
			$V_{DD}=3.3V$	-	9.0	35.0	
Output Voltage	$V_{OH}$	MEASUREMENT CIRCUIT(2)	$V_{DD}-0.4$	-	-	V	
	$V_{OL}$		-	-	0.4	V	
Input Voltage	$V_{IH}$	MEASUREMENT CIRCUIT(3)	$0.7V_{DD}$	-	-	V	
	$V_{IL}$		-	-	$0.3V_{DD}$	V	
Input Current	$I_{IN}$	MEASUREMENT CIRCUIT(4) $V_{DD}=1.62V$ , $CONT=V_{DD}$	-	-	0.065	$\mu A$	
		MEASUREMENT CIRCUIT(4) $V_{DD}=1.62V$ , $CONT=V_{SS}$	-	-	-0.5		
		MEASUREMENT CIRCUIT(4) $V_{DD}=3.63V$ , $CONT=V_{SS}$	-	-	0.150		
		MEASUREMENT CIRCUIT(4) $V_{DD}=3.63V$ , $CONT=V_{SS}$	-10	-	-		
3-state Off Leakage Current	$I_{OZ}$	MEASUREMENT CIRCUIT(5) $CONT=V_{SS}$ , $F_{OUT}=V_{DD}$ or $V_{SS}$	-	-	$\pm 0.1$	$\mu A$	

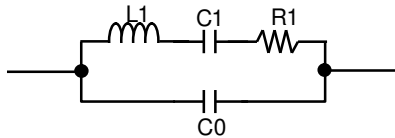
( $V_{DD}=1.62$  to  $3.63V$ ,  $V_{SS}=0V$ ,  $T_a=25^{\circ}C$ )

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	
Feedback Resistance	Rf		-	50	-	k $\Omega$	
Built-in Oscillation Capacitor	Cg	fosc=50MHz	-	8	-	pF	
	Cd	fosc=50MHz	-	17	-	pF	
Oscillation Frequency	fosc	Recommendation	-	-	50	MHz	
Output Signal Symmetry	SYM	MEASURMENT CIRCUIT(1),@ $V_{DD}/2$	45	50	55	%	
Phase Noise	SSB	$f_{OSC}=49.152MHz$ . $V_{DD}=1.8V$	10Hz offset	-	-103	-	dBc/ Hz
			1kHz offset	-	-158	-	
			Floor	-	-166	-	
		$f_{OSC}=49.152MHz$ . $V_{DD}=3.3V$	10Hz offset	-	-103	-	
			1kHz offset	-	-163	-	
			Floor	-	-172	-	
Output Signal Rise Time	Tr	$C_L=15pF$ $0.1V_{DD}$ to $0.9V_{DD}$	$V_{DD}=1.8V$	-	3.1	4.7	ns
			$V_{DD}=2.5V$	-	1.8	2.7	ns
			$V_{DD}=3.3V$	-	1.3	2.0	ns
Output Signal Fall Time	Tf	$C_L=15pF$ $0.9V_{DD}$ to $0.1V_{DD}$	$V_{DD}=1.8V$	-	2.8	4.2	ns
			$V_{DD}=2.5V$	-	1.8	2.7	ns
			$V_{DD}=3.3V$	-	1.4	2.1	ns
Output Disable time	t <sub>POZ</sub>	MEASURMENT CIRCUIT(6)	-	-	200	ns	
Output Enable time	t <sub>PZO</sub>	MEASURMENT CIRCUIT(6)	-	-	1.0	ms	
Oscillation Start time	t <sub>OSC</sub>	MEASURMENT CIRCUIT(1)	-	-	1.0	ms	

Note3) Decoupling capacitor ( $\geq 0.01\mu F$ ) should be connected between  $V_{DD}$  and  $V_{SS}$  due to the stabilized operation the circuit.

Note4) 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

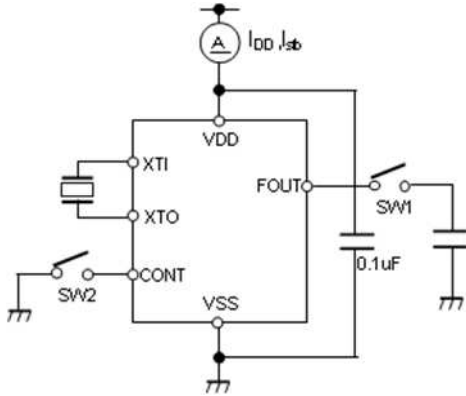


f[MHz]	R1[ $\Omega$ ]	L1[mH]	C1[fF]	C0[pF]
49.152	17.7	3.83	2.74	1.23



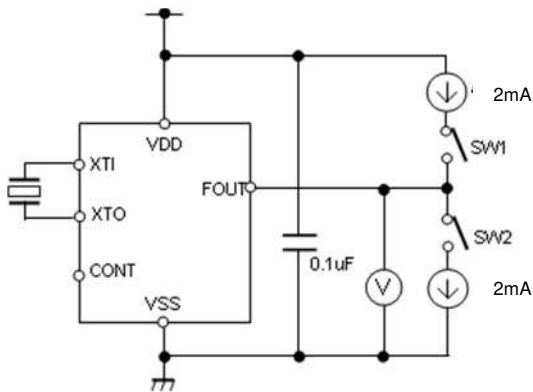
■ MEASUREMENT CIRCUITS

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



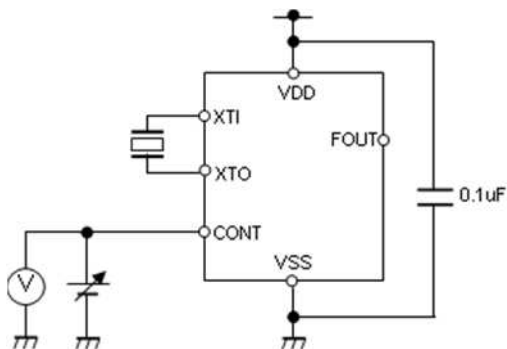
ITEM	SW1	SW2
$I_{DD}(C_L=0pF)$	OFF	OFF
$I_{DD}(C_L=15pF)$	ON	OFF
$I_{stb}$	ON or OFF	ON
SYM, tr, tf	ON	OFF
$t_{osc}$	ON	OFF

(2) H Level, L Level Output Voltage



ITEM	SW1	SW2
$V_{OH}$	OFF	ON
$V_{OL}$	ON	OFF

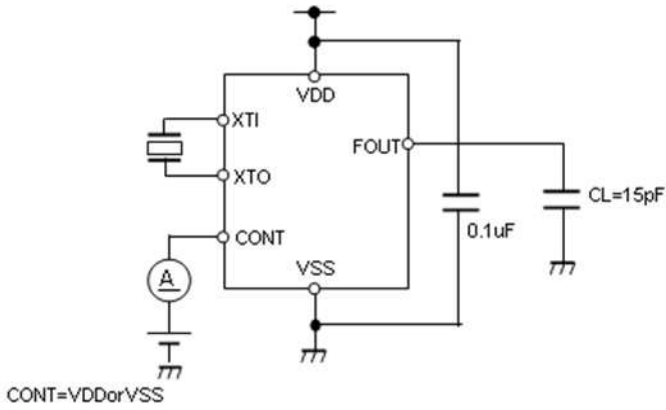
(3) H Level, L Level Input Voltage



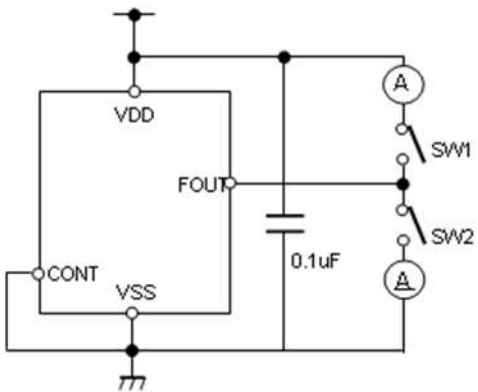
ITEM	$F_{OUT}$
$CONT \geq 0.7V_{DD}$	Oscillation
$CONT \leq 0.3V_{DD}$	Stop



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

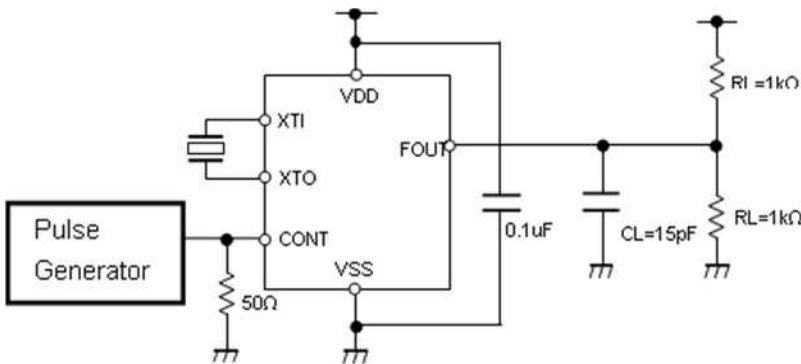


(5) 3-state Leakage Current



ITEM	SW1	SW2
$I_{ozH}$	ON	OFF
$I_{ozL}$	OFF	ON

(6) Output Disable Time ( $C_L=15\text{pF}$ ,  $R_L=1\text{k}\Omega$ )



■ TIMING CHART

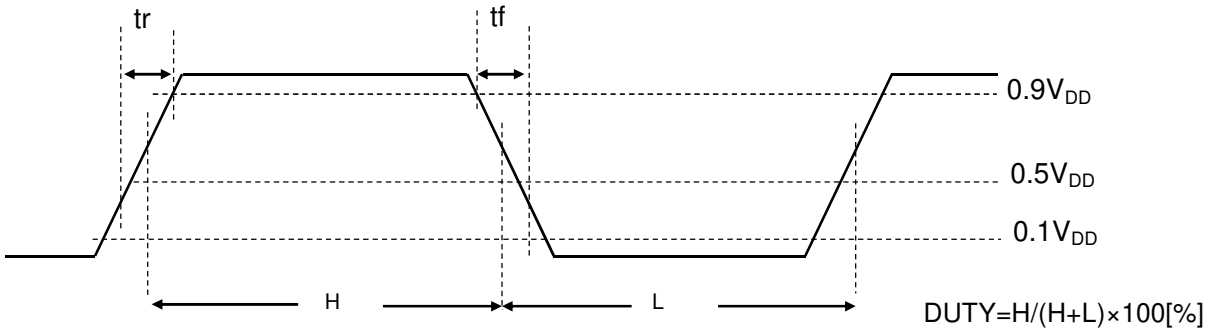


Fig.1 Output Signal Rise Time, Output Signal Fall Time, Output Symmetry

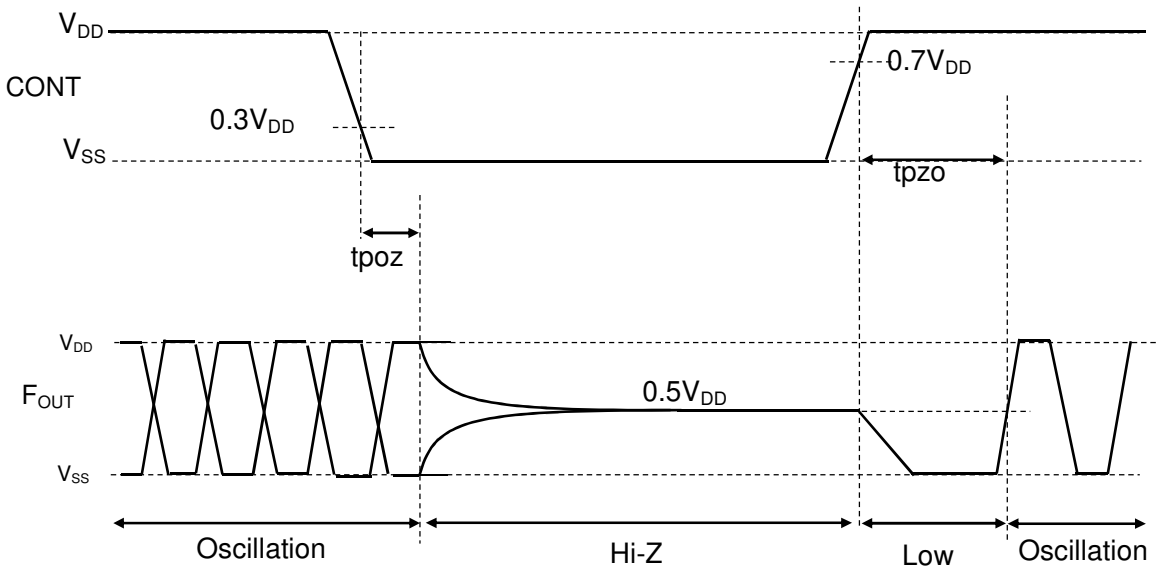


Fig.2 Output Disable time: tpoz, Output Enable time: tpzo, Timing Chart

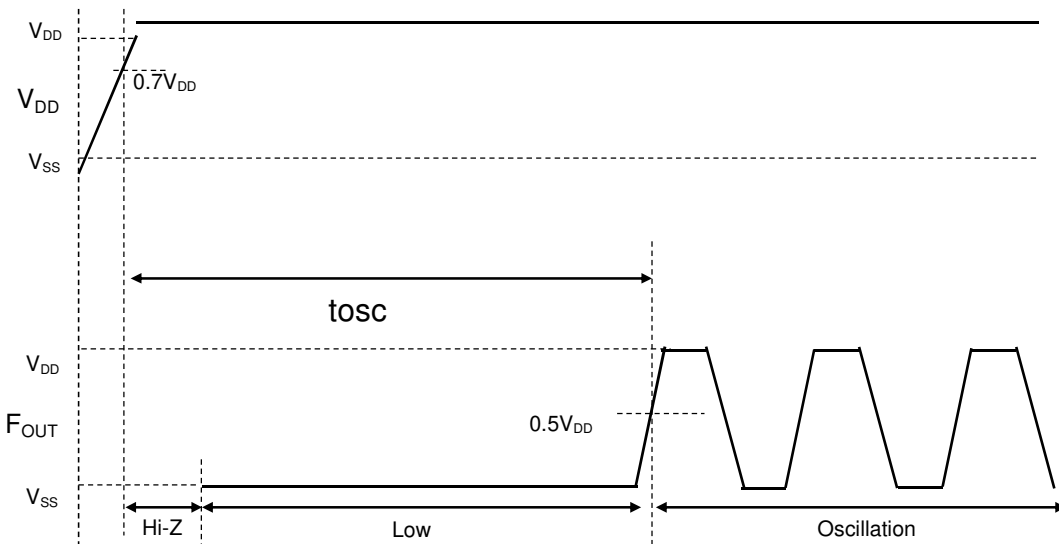
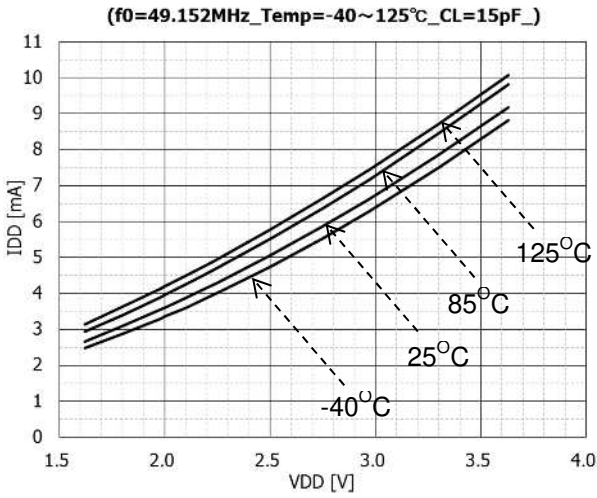


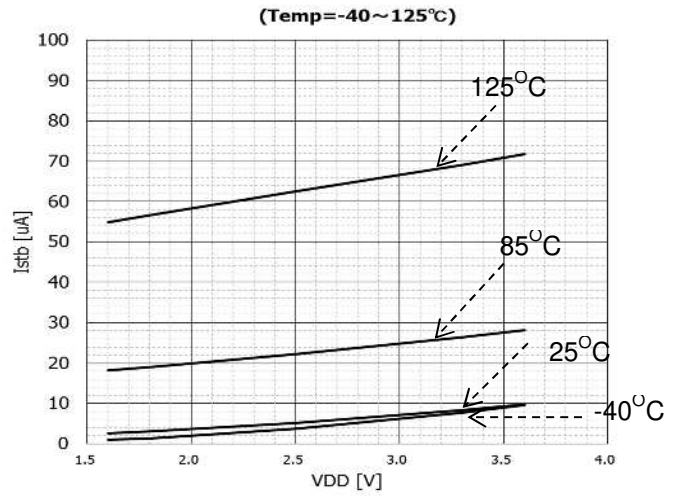
Fig.3 Oscillation Start time: t<sub>osc</sub>

■ TYPICAL CHARACTERISTICS

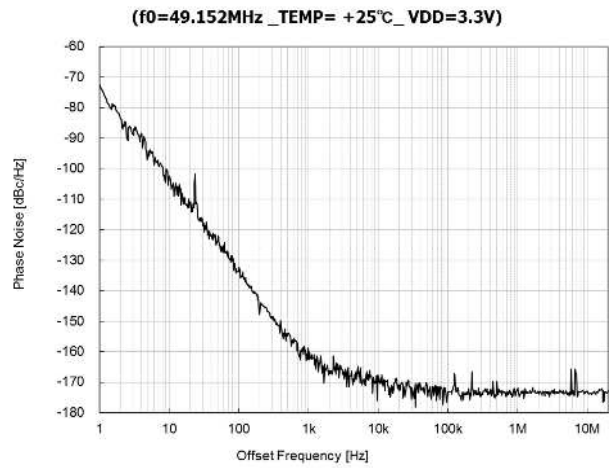
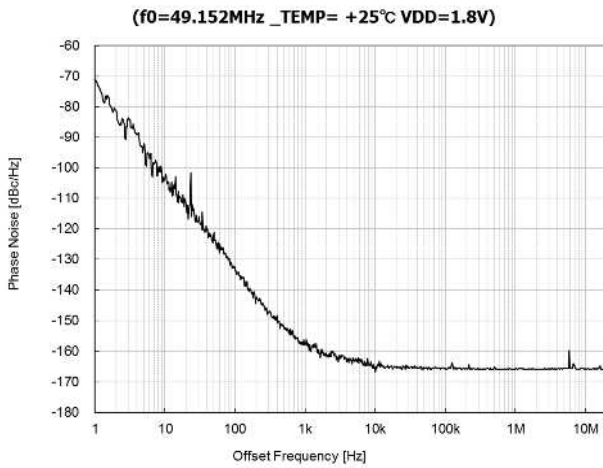
$I_{DD}(CL=15pF)$



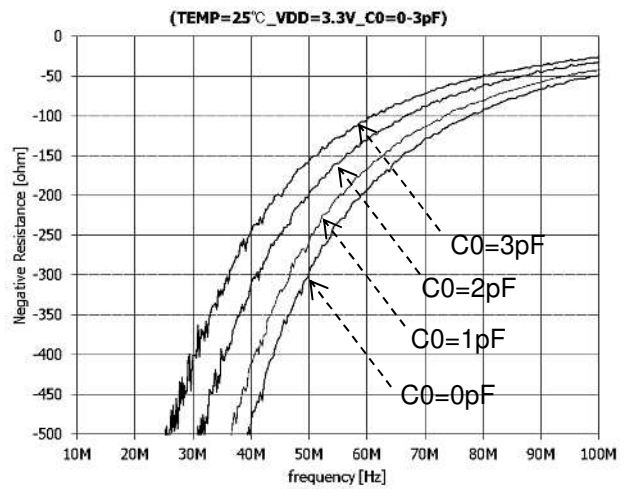
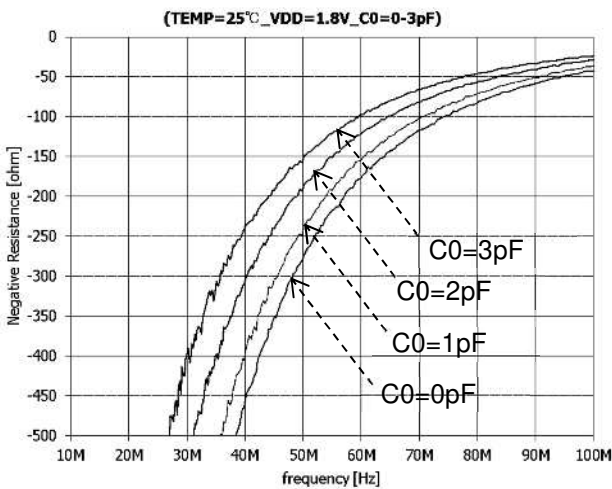
$I_{stb}$

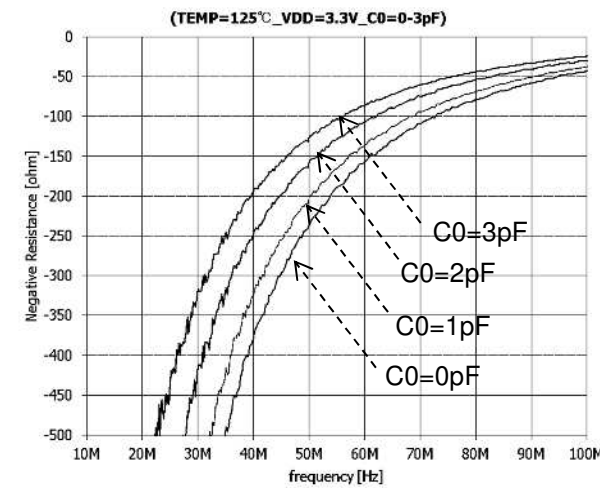
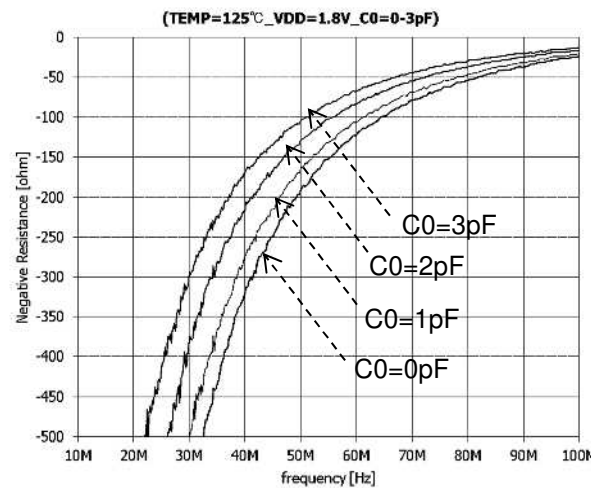
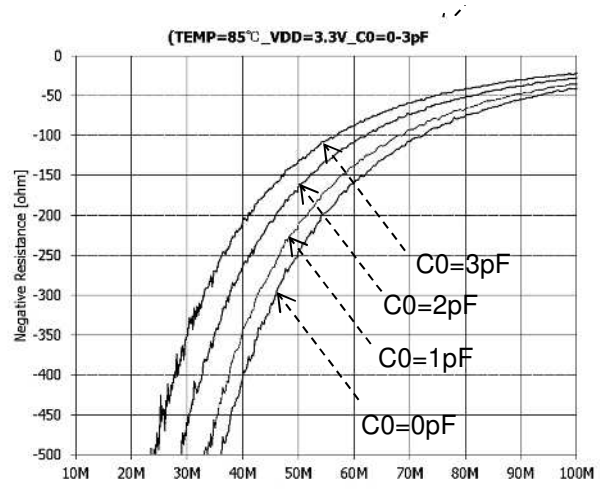
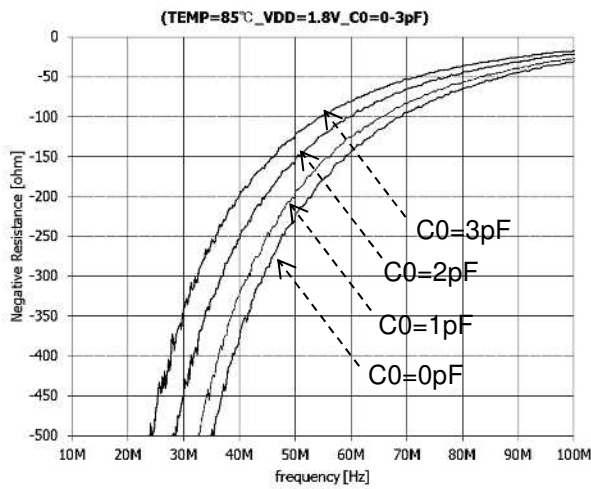
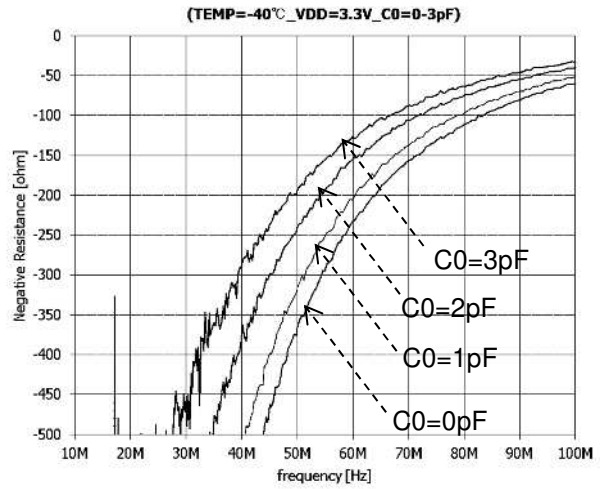
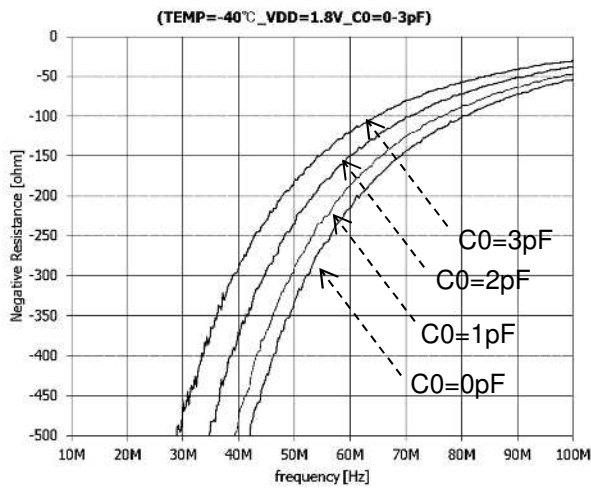


Phase Noise



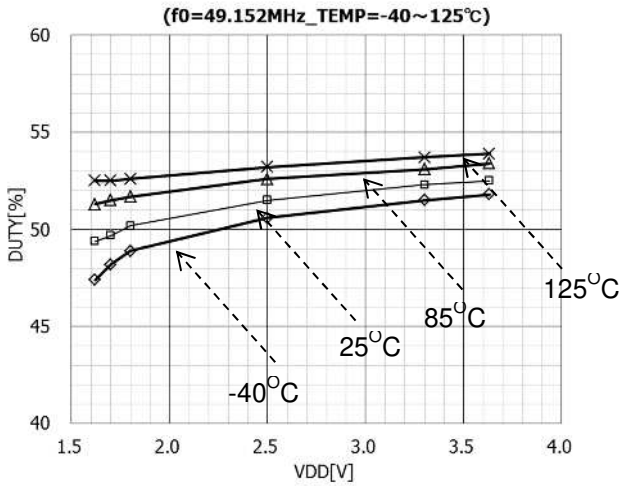
Negative Resistance



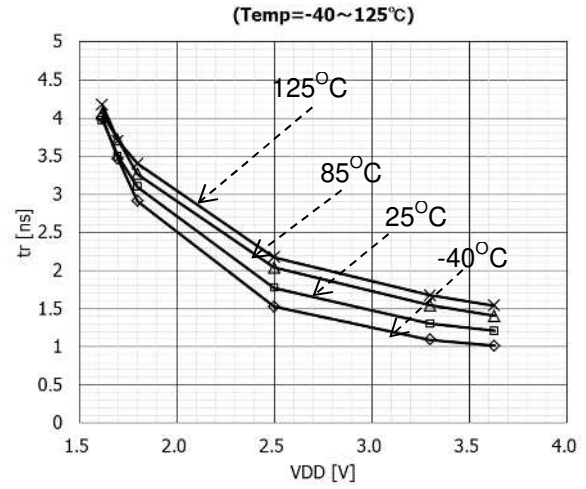


Note; A negative resistance 3 to 5 times the equivalent series resistance is said to be required for sufficient oscillation margin.

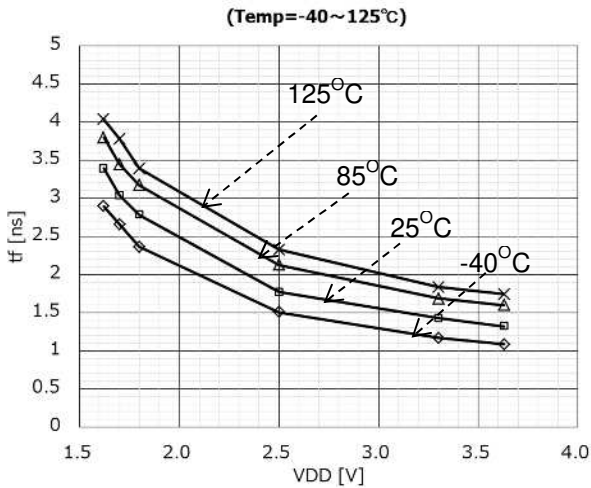
• SYM



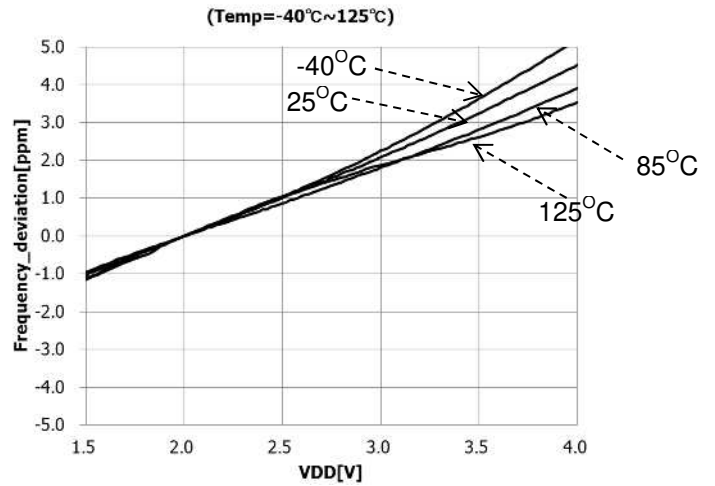
• tr



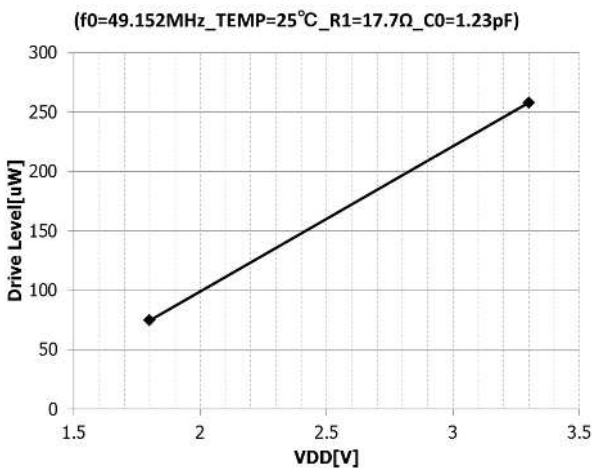
• tf



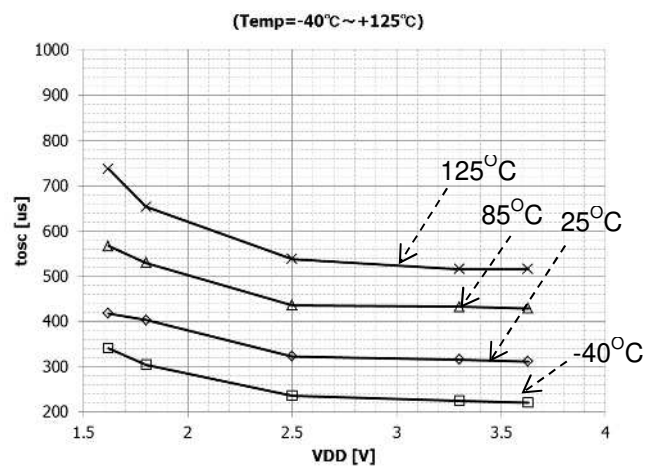
• df/f



• Drive Level



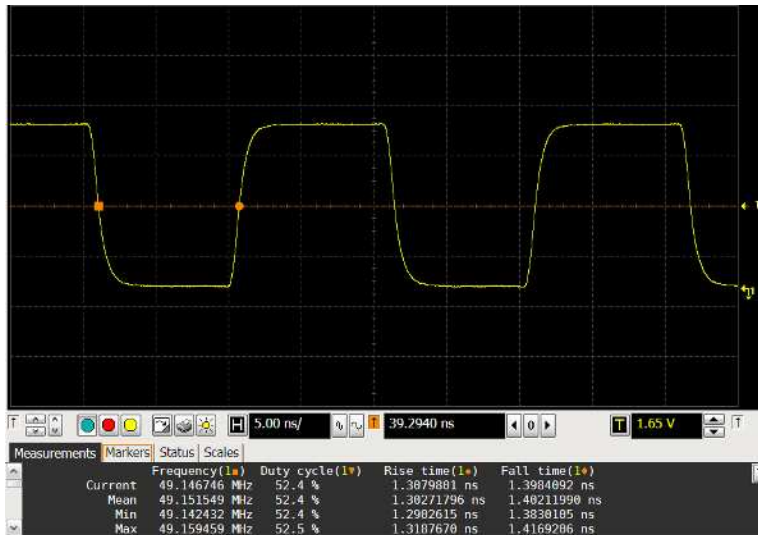
• tosc



• Waveform



Fosc=49.152MHz、V<sub>DD</sub>=1.8V、CL=15pF、Temp=25°C



Fosc=49.152MHz、V<sub>DD</sub>=3.3V、CL=15pF、Temp=25°C

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