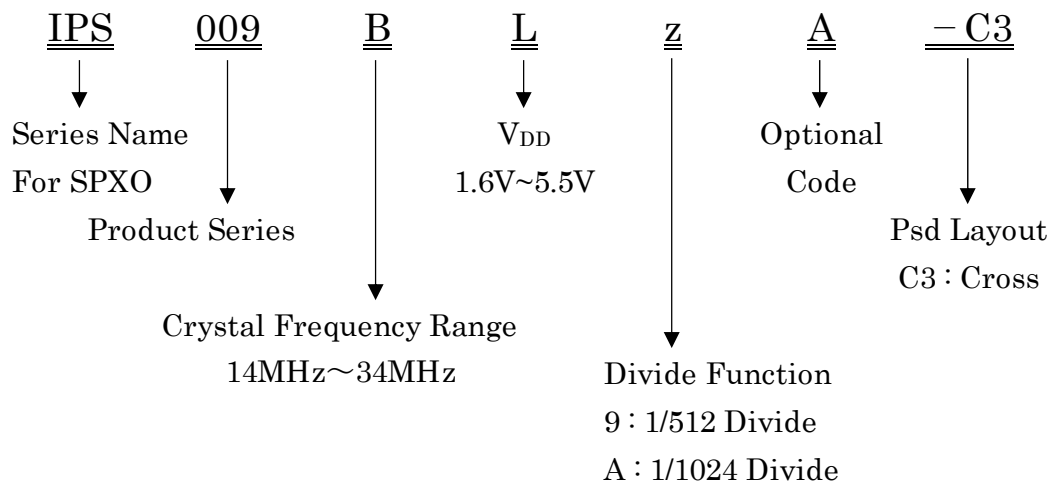■Description

　　IPS009BL9, IPS009BL9A and IPS009BLAA is the specific SPXO IC for achieving 32.768kHz output by divide, corresponding to the fundamental crystal from 14MHz to 34MHz corresponding to each IC.

　　The power consumption of these IC is quite low, so IPS009BL9, IPS009BL9A and IPS009BLAA suit for mobile application.

■　Features

- Divide function 　　　　　　　：1/512 or 1/1024
- Crystal frequency 　　　　　　：14MHz to 34MHz
- Operation temperature 　　　　：-40℃~125℃
- Power supply voltage 　　　　　：1.6V~5.5V
- Standby function 　　　　　　　：Oscillation stop
- Output 　　　　　　　　　　　　：CMOS
- Small chip size 　　　　　　　　：0.70mm × 0.75mm
- Frequency stability to Vdd 　　：Within ±1ppm
- Duty cycle 　　　　　　　　　　：Within 50%±5%

1. Part number rule

$$\underline{\text{IPS}} \quad \underline{009} \quad \underline{\text{B}} \quad \underline{\text{L}} \quad \underline{\text{z}} \quad \underline{\text{A}} \quad \underline{-\text{C3}}$$

Series Name
For SPXO

Product Series

Crystal Frequency Range
14MHz～34MHz

V_{DD}
1.6V~5.5V

Divide Function
9：1/512 Divide
A：1/1024 Divide

Optional
Code

Psd Layout
C3：Cross

2. Series

Part Number	Crystal Frequency f (MHz)		Divide	Output Frequency F0 (kHz)		Pad Layout	V_{DD} (V)	Remarks
	Min.	Max.		Min.	Max.			
IPS009 BL 9 -C3	16.777		1/512	32.768		Cross	1.62 ~5.5	・Low Power Consumption ・AT-cut Crystal
IPS009 BL 9 A -C3	14.000	27.000		27.3	52.7			
IPS009 BL A A -C3	14.000	34.000	1/1024	13.6	33.2			

3. Absolute Maximum Ratings

Vss=0V, Ta=25℃±2℃

Parameter	Symbol	Condition	Ratings		Unit
			Min	Max	
Supply Voltage	V_{DD}		V_{SS}-0.5	7.0	V
Input Voltage	V_{IN}	All Input Pin	V_{SS}-0.5	V_{DD}+0.5	V
Output Voltage	V_{OUT}		V_{SS}-0.5	V_{DD}+0.5	V
Output Current	I_{OUT}			25	mA
Junction Temperature	Tj		-55	150	℃
Storage Temperature	Tstg		-55	125	℃

4. Recommended Operating Condition

Vss=0V, Ta=-40℃~125℃

Parameter	Symbol	Condition		Min	Typ	Max	Unit	Note
Supply Voltage	V_{DD}			1.6	3.3	5.5	V	V_{DD}
"H" Input Voltage	V_{IH}			V_{DD}×0.7			V	CE
"L" Input Voltage	V_{IL}					V_{DD}×0.3	V	CE
Input Voltage	V_{IN}			V_{SS}		V_{DD}	V	CE
Output Load Capacitance	CL	CMOS	IPS009BL9			30	pF	OUT
			IPS009BL9A			15		
			IPS009BLAA					
Ambient Temperature	Topt			-40		125	℃	

This IC has enough immunity against ESD and Latch-up, but handle with care.

5. Electrical Specification

5-1 IPS009BL9

Unless otherwise stated, V_{DD}=1.6V~5.5V, V_{SS}=0V, Ta=-40℃~125℃

Parameter	Symbol	Condition	Specification			Unit
			Min	Typ	Max	
Out put Leak current	Iz	CE=0V, X1=V_{DD}, Vss Vout=Vss~V_{DD}			20	μA
"H" input current	I_{IH}	CE pad, V_{IH}=V_{DD}		0.01	0.15	μA
"L" input current	I_{IL}	CE pad, V_{IL}=0V	-1.45	-1.25		
Output Disable Time	Tplz	OUT pad			0.1	μs
Output Enable Time	Tpzl	OUT pad			2.0	ms
Osc. start up time	Tstart	V_{DD}>1.6V			2.0	ms
"H" output voltage	V_{OH}	OUT pad, I_{OH}=-1.0mA	0.9V_{DD}			V
"L" output voltage	V_{OL}	OUT pad, I_{OL}=1.0mA			0.1V_{DD}	V
Current consumption※	I_{DD}	CL=15pF, V_{DD}=3.63V		56	115	μA
		CL=15pF, V_{DD}=5.5V		64	130	
		CL=30pF, V_{DD}=1.8V		52	110	
		CL=30pF, V_{DD}=3.63V		58	120	
		CL=30pF, V_{DD}=5.5V		67	140	
Current consumption at oscillation disable	I_{DDD}	CL=15pF, V_{DD}=3.3V CE≦0.3V		1.0	3.0	μA
Freq. V_{DD} deviation	Fvst	V_{DD}=3.3±10%			±1.0	ppm
Output Duty Ratio	Duty	1/2V_{DD} point	45		55	%
Rise/Fall time	Tr/Tf	10%~90%V_{DD}, CL=15pF V_{DD}=1.62V~2.5V		5.5	14.0	ns
		10%~90%V_{DD}, CL=15pF V_{DD}=2.5V~5.5V		3.0	10.0	
		10%~90%V_{DD}, CL=30pF V_{DD}=1.62V~2.5V		8.0	18.0	
		10%~90%V_{DD}, CL=30pF V_{DD}=2.5V~5.5V		5.0	13.0	

※Condition ： CE≧V_{DD}-0.3V, f=16.777MHz

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5-2 IPS009BL9A

Unless otherwise stated, V_{DD}=1.6V~5.5V, V_{SS}=0V, Ta=-40℃~125℃

Parameter	Symbol	Condition	Specification			Unit
			Min	Typ	Max	
Out put Leak current	Iz	CE=0V, X1=V_{DD}, Vss Vout=Vss~V_{DD}			20	µA
"H" input current	I_{IH}	CE pad, V_{IH}=V_{DD}		0.01	0.15	µA
"L" input current	I_{IL}	CE pad, V_{IL}=0V	-1.45	-1.25		
Output Disable Time	Tplz	OUT pad			0.1	µs
Output Enable Time	Tpzl	OUT pad			2.0	ms
Osc. start up time	Tstart	V_{DD}>1.6V			2.0	ms
"H" output voltage	V_{OH}	OUT pad, I_{OH}=-0.4mA	0.9V_{DD}			V
"L" output voltage	V_{OL}	OUT pad, I_{OL}=0.4mA			0.1V_{DD}	V
Current consumption※	I_{DD}	No Load, V_{DD}=3.63V f=16.777MHz, CE≧V_{DD}-0.3V		38	58	µA
		No Load, V_{DD}=5.5V f=16.777MHz, CE≧V_{DD}-0.3V		45	80	
		No Load, V_{DD}=3.63V f=27MHz, CE≧V_{DD}-0.3V		64	97	
		No Load, V_{DD}=5.0V f=27MHz, CE≧V_{DD}-0.3V		75	120	
Current consumption at oscillation disable	I_{DDD}	CL=15pF, V_{DD}=3.3V CE≦0.3V		1.0	3.0	µA
Freq. V_{DD} deviation	Fvst	V_{DD}=3.3±10%			±1.0	ppm
Output Duty Ratio	Duty	1/2V_{DD} point	45		55	%
Rise/Fall time	Tr/Tf	10%~90%V_{DD}, CL=15pF V_{DD}=1.62V~2.5V		14.0	21.0	ns
		10%~90%V_{DD}, CL=15pF V_{DD}=2.5V~5.5V		8.0	12.0	

5-3 IPS009BLAA

Unless otherwise stated, V_{DD}=1.6V~5.5V, V_{SS}=0V, Ta=-40℃~125℃

Parameter	Symbol	Condition	Specifivation			Unit
			Min	Typ	Max	
Out put Leak current	Iz	CE=0V, X1=V_{DD}, Vss Vout=Vss~V_{DD}			20	μA
"H" input current	I_{IH}	CE pad, V_{IH}=V_{DD}		0.01	0.15	μA
"L" input current	I_{IL}	CE pad, V_{IL}=0V	-1.45	-1.25		
Output Disable Time	Tplz	OUT pad			0.1	μs
Output Enable Time	Tpzl	OUT pad			2.0	ms
Osc. start up time	Tstart	V_{DD}>1.6V			2.0	ms
"H" output voltage	V_{OH}	OUT pad, I_{OH}=-0.4mA	0.9V_{DD}			V
"L" output voltage	V_{OL}	OUT pad, I_{OL}=0.4mA			0.1V_{DD}	V
Current consumption※	I_{DD}	No Load, V_{DD}=3.63V f=33.554MHz, CE≧V_{DD}-0.3V		75	125	μA
		No Load, V_{DD}=5.5V f=33.554MHz, CE≧V_{DD}-0.3V		80	140	
Current consumption at oscillation disable	I_{DDD}	CL=15pF, V_{DD}=3.3V CE≦0.3V		1.0	3.0	μA
Freq. V_{DD} deviation	Fvst	V_{DD}=3.3±10%			±1.0	ppm
Output Duty Ratio	Duty	1/2V_{DD} point	45		55	%
Rise/Fall time	Tr/Tf	10%~90%V_{DD}, CL=15pF V_{DD}=1.62V~2.5V		14.0	21.0	ns
		10%~90%V_{DD}, CL=15pF V_{DD}=2.5V~5.5V		8.0	12.0	

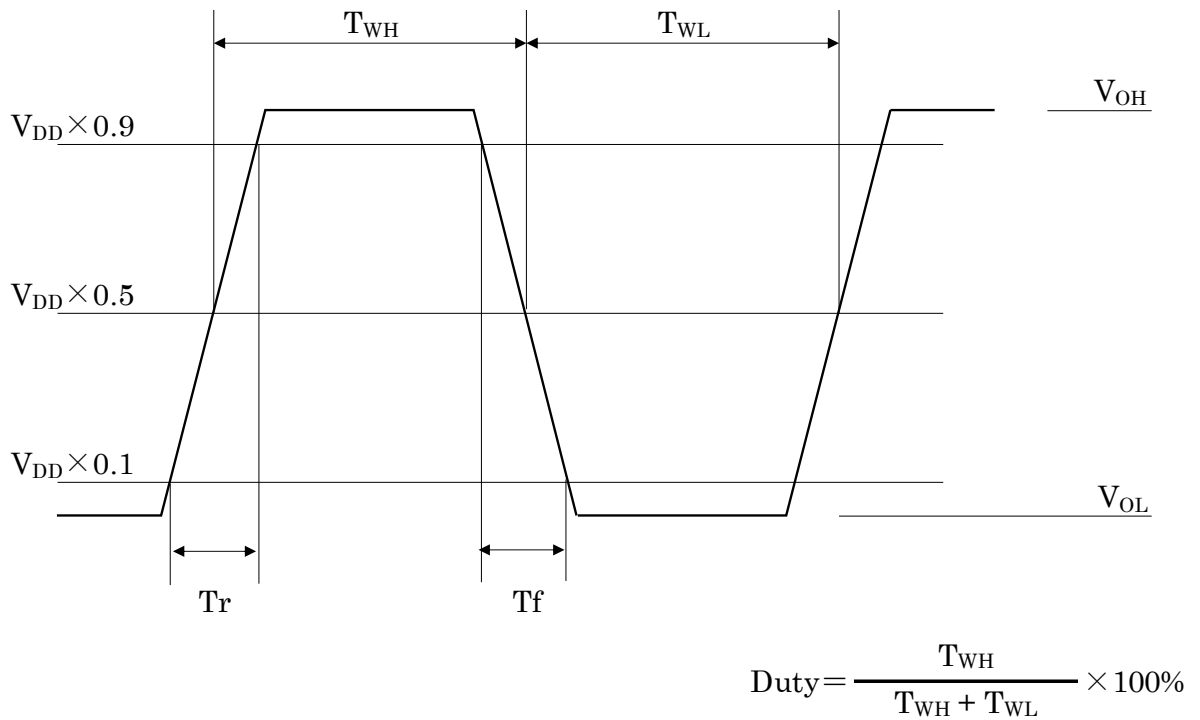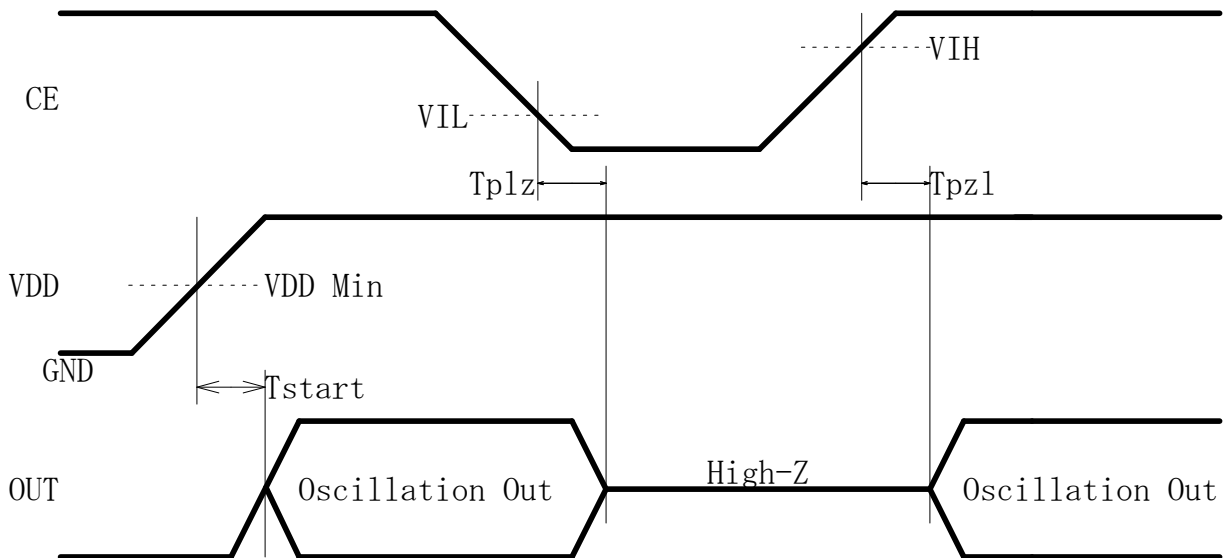$$\text{Duty} = \frac{T_{WH}}{T_{WH} + T_{WL}} \times 100\%$$

Fig. 5-1 Output wave form (Duty, Tr, Tf, V_{OH}, V_{OL})

V_{IH} : Threshold voltage for Oscillation Start
V_{IL} : Threshold voltage for Oscillation Stop

Fig. 5-2 Input output signal timing

6. Circuit Parameters of Oscillator (Reference Data for Circuit Design)

Ta=25℃

Parameter		Symbol	Condition	Min	Typ	Max	Unit
Equivalent series (Loading) Capacitance		CLxtal	V_{DD}=3.3V, f=16MHz		3.3		pF
Drive Level	IPS009BL9	DL	V_{DD}=3.3V, Ta=25℃ f=16MHz		15		μW
	IPS009BL9A IPS009BLAA				1.7		
Feedback Resistor		Rf			300		kΩ
Driving Resistor	IPS009BL9	Rd			600		Ω
	IPS009BL9A IPS009BLAA				1000		
Oscillation Capacitor		Cg			6.0		pF
	IPS009BL9	Cd			8.0		pF
	IPS009BL9A IPS009BLAA				2.0		

*The above values are the design values and are not guaranteed by test.

※Divider
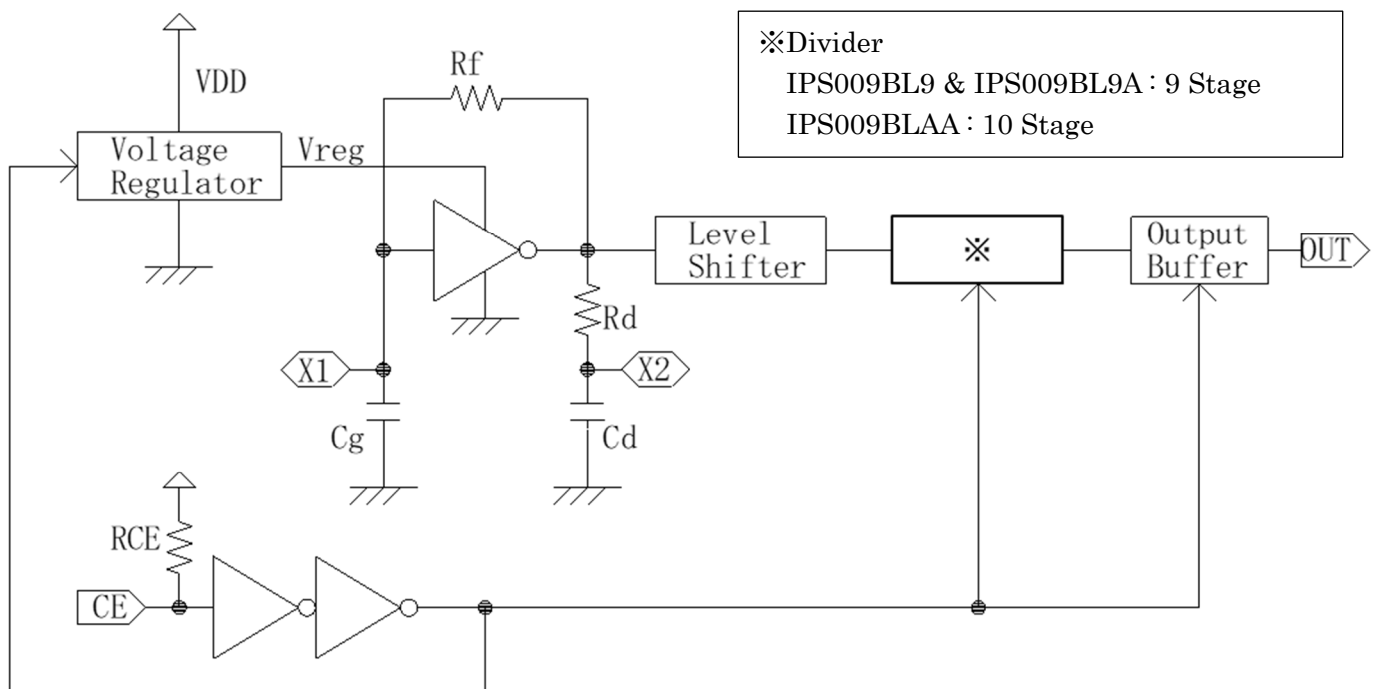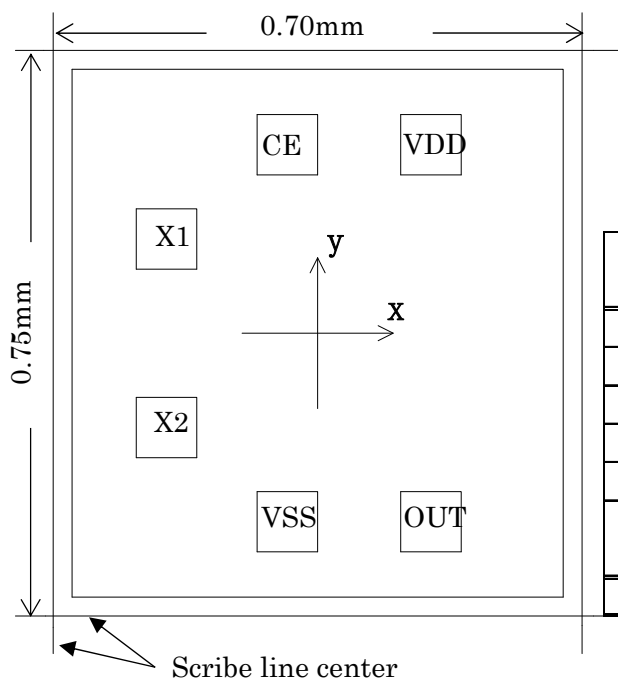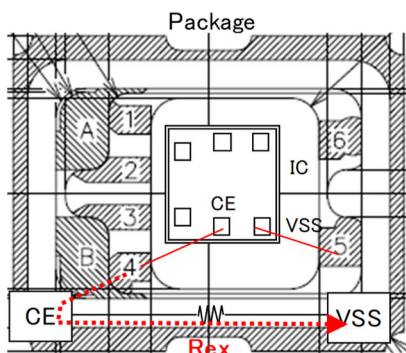　IPS009BL9 & IPS009BL9A : 9 Stage
　IPS009BLAA : 10 Stage

Fig. 6　Block Diagram

7. Pad Layout

・Die Size：0.70mm × 0.75mm

・Pad Size：80um □

・Thickness：150um±20um

・IC Backside：Gnd or Open

Pad Name	Function	Location (μm)	
		x	y
VDD	(＋) Power Supply	152	244
OUT(Q)	Frequency Output	152	-244
VSS	(－) Ground	-39	-244
X2	Crystal Drive	-209	-133
X1	Crystal Feedback	-209	133
CE	Oscillation stop "L": High-Impedance	-39	244
Chip Center		0	0

IMPORTANT Notice for CE function

※ Oscillation will not be activated when CE=Open after CE=Low if Rex is not large.

※ Reference value of Rex is over 10MΩ with CE=Open usage.

※ There is no such issue with CE=VDD usage.

Rex： Resistance value between CE and VSS of package