■ Description

IPS029*B series is the successor IC of IPS009BM series and IPS029xM series, for SPXO corresponding to the fundamental or 3rd overtone crystal from 20MHz to 160MHz. Chip size of this IC is small enough for 2016 size SMD. In addition, operation temperature is quite high (125℃) so IPS029xB can be used for various applications.

■ Features

- Operation temperature : -40℃~125℃
- Power supply voltage : 1.62V~3.63V
- Standby function : Oscillation stop
- Frequency range : 20MHz~160MHz
- Output : CMOS
- Crystal mode : Fundamental & 3rd overtone
- Small chip size : 0.56mm × 0.56mm
- Divider function : 1/2, 1/4, 1/8 and 1/16
- Duty cycle : Within 50%±5% (Except IPS0295MTBq & IPS0296MTBq)

1. Part number rule

IPS 029 x M z B q −C 3 −3

- IPS: Series Name For SPXO
- 029: Product Series
- x: Frequency Range
- M: V_{DD} 1.62V ~3.63V
- z: X'tal Mode & Divide Function
  - 0 : Fund. & 1/1
  - 1 : Fund. & 1/2
  - 2 : Fund. & 1/4
  - 3 : Fund. & 1/8
  - 4 : Fund. & 1/16
  - T : 3rd & 1/1
- B: Optional code
  - B : IPS029 successor
- q: Pad Layout
  - S : Straight
  - X : Cross
  - F : Flip

x	X'tal Frequency Range	
	Fund.	3rd
3	20~54MHz	50~70MHz
4	50~100MHz	70~100MHz
5	100~160MHz	100~130MHz
6		130~160MHz

Delivery Form	IC Thickness	Tray Size
W : Wafer	0 : 100um	Blank
	3 : 130um	
C : Chip	3 : 130um	2 : 2 inch Tray
		3 : 3 inch Tray

2. Series

Part Number	Crystal Frequency f (MHz)		Crystal Mode	Divide	Output Frequency F0 (MHz)		Remarks
	Min.	Max.			Min.	Max.	
IPS029 3 M 0 B q	20.00	54.00	Fund.	1/1	20.00	54.00	Pad layout q= S : Straight X : Cross F : Flip
IPS029 3 M 1 B q				1/2	10.00	27.00	
IPS029 3 M 2 B q				1/4	5.00	13.50	
IPS029 3 M 3 B q				1/8	2.50	6.75	
IPS029 3 M 4 B q				1/16	1.25	3.38	
IPS029 4 M 0 B q	50.00	100.00	Fund.	1/1	50.00	100.00	
IPS029 4 M 1 B q				1/2	25.00	50.00	
IPS029 4 M 2 B q				1/4	12.50	25.00	
IPS029 4 M 3 B q				1/8	6.25	12.50	
IPS029 4 M 4 B q				1/16	3.13	6.25	
IPS029 5 M 0 B q	100.00	160.00	Fund.	1/1	100.00	160.00	
IPS029 3 M T B q	50.00	70.00	3rd	1/1	50.00	70.00	
IPS029 4 M T B q	70.00	100.00		1/1	70.00	100.00	
IPS029 5 M T B q	100.00	130.00		1/1	100.00	130.00	
IPS029 6 M T B q	130.00	160.00		1/1	130.00	160.00	

3. Absolute Maximum Ratings

V_{SS}=0V, Ta=25℃± 2℃

Parameter	Symbol	Condition	Ratings		
			Min	Max	Unit
Supply Voltage	V_{DD}		V_{SS}-0.5	5.0	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

V_{SS}=0V, Ta=-40℃~125℃

Parameter	Symbol	Condition	Min	Typ	Max	Unit	Note
Supply Voltage	V_{DD}		1.62		3.63	V	V_{DD}
“H” Input Voltage	V_{IH}		V_{DD}×0.8			V	CE
“L” Input Voltage	V_{IL}				V_{DD}×0.2	V	CE
Input Voltage	V_{IN}		V_{SS}		V_{DD}	V	CE
Output Load Capacitance	CL	CMOS			15	pF	OUT
Ambient Temperature	Topt		-40		125	℃	

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

5. Electrical Specification

5-1 Fundamental

Unless otherwise stated, V_{DD}=1.62V~3.63V, V_{SS}=0V, Ta=-40℃~125℃

Parameter	Symbol	Condition		Specification			Unit
				Min	Typ	Max	
Output leak current	I_Z	CE=0V, X1=V_{DD} or V_{SS} Vout=V_{SS}~V_{DD}				10	μA
"H" output voltage	V_{OH}	I_{OH}=-1.0mA		0.9V_{DD}			V
"L" output voltage	V_{OL}	I_{OL}=1.0mA				0.1V_{DD}	V
Output Disable Time	Tplz					100	ns
Output Enable Time	Tpzl					2.0	ms
Oscillation start up time	Tstart	V_{DD}≧1.62V				2.0	ms
Current consumption	I_{DD}	CL=15pF IPS0293M0B, f=27MHz	V_{DD}=1.8V			2.3	mA
			V_{DD}=3.3V			4.2	
		CL=15pF IPS0294M0B, f=100MHz	V_{DD}=1.8V			6.0	
			V_{DD}=3.3V			12.0	
		CL=15pF IPS0295M0B, f=160MHz	V_{DD}=1.8V			14.0	
			V_{DD}=3.3V			20.0	
Current consumption at oscillation stop	I_{DDD}	V_{DD}=3.3V, CE≦0.3V				5.0	uA
Freq. V_{DD} deviation	Fvst	V_{DD}=1.8V±10%	IPS0293M0B IPS0294M0B			±1.0	ppm
			IPS0295M0B			±3.0	
		V_{DD}=3.3V±10%	IPS0293M0B IPS0294M0B			±1.0	
			IPS0295M0B			±2.0	
Output Duty Ratio	DUTY	1/2V_{DD} point		45		55	%
Rise time / Fall time	Tr / Tf	V_{DD}=1.62V~2.25V CL=15pF 10%~90%V_{DD}	IPS0293M0B			6.5	ns
			IPS0294M0B			5.0	
			IPS0295M0B			3.5	
		V_{DD}=2.25V~3.63V CL=15pF 10%~90%V_{DD}	IPS0293M0B			4.0	
			IPS0294M0B			3.0	
			IPS0295M0B			2.0	

5-2 3rd Overtone

Unless otherwise stated, V_{DD}=1.62V~3.63V, V_{SS}=0V, Ta=-40℃~125℃

Parameter	Symbol	Condition		Specification			Unit
				Min	Typ	Max	
Output leak current	IZ	CE=0V, X1=V_{DD} or V_{SS} Vout=V_{SS}~V_{DD}				10	μA
"H" output voltage	V_{OH}	I_{OH}=-1.0mA		0.9V_{DD}			V
"L" output voltage	V_{OL}	I_{OL}=1.0mA				0.1V_{DD}	V
Output Disable Time	Tplz					100	ns
Output Enable Time	Tpzl					10.0	ms
Oscillation start up time	Tstart	V_{DD}≧1.62V				10.0	ms
Current consumption	I_{DD}	CL=15pF IPS0293MTB, f=65MHz	V_{DD}=1.8V			13.5	mA
			V_{DD}=3.3V			30.0	
		CL=15pF IPS0294MTB, f=100MHz	V_{DD}=1.8V			15.0	
			V_{DD}=3.3V			32.5	
		CL=15pF IPS0295MTB, f=130MHz	V_{DD}=1.8V			19.0	
			V_{DD}=3.3V			40.0	
		CL=15pF IPS0296MTB, f=160MHz	V_{DD}=1.8V			24.5	
			V_{DD}=3.3V			47.0	
Current consumption at oscillation stop	I_{DDD}	V_{DD}=3.3V, CE≦0.3V				5.0	uA
Freq. V_{DD} deviation	Fvst	V_{DD}=1.8V±10%	IPS0293MTB IPS0294MTB			±1.0	ppm
			IPS0295MTB IPS0296MTB			±2.0	
		V_{DD}=3.3V±10%	All Models			±1.0	
Output Duty Ratio	DUTY	1/2V_{DD} point -40℃~125℃	IPS0293MTB IPS0294MTB	45		55	%
		1/2VDD point -40℃~85℃	IPS0295MTB IPS0296MTB	45		55	
		1/2VDD point 85℃~125℃	IPS0295MTB IPS0296MTB	40		60	
Rise time / Fall time	Tr / Tf	V_{DD}=1.62V~2.25V CL=15pF 10%~90%V_{DD}	IPS0293MTB			6.5	ns
			IPS0294MTB			5.0	
			IPS0295MTB			3.5	
			IPS0296MTB			3.5	
		V_{DD}=2.25V~3.63V CL=15pF 10%~90%V_{DD}	IPS0293MTB			4.0	
			IPS0294MTB			3.0	
			IPS0295MTB			2.0	
			IPS0296MTB			2.0	

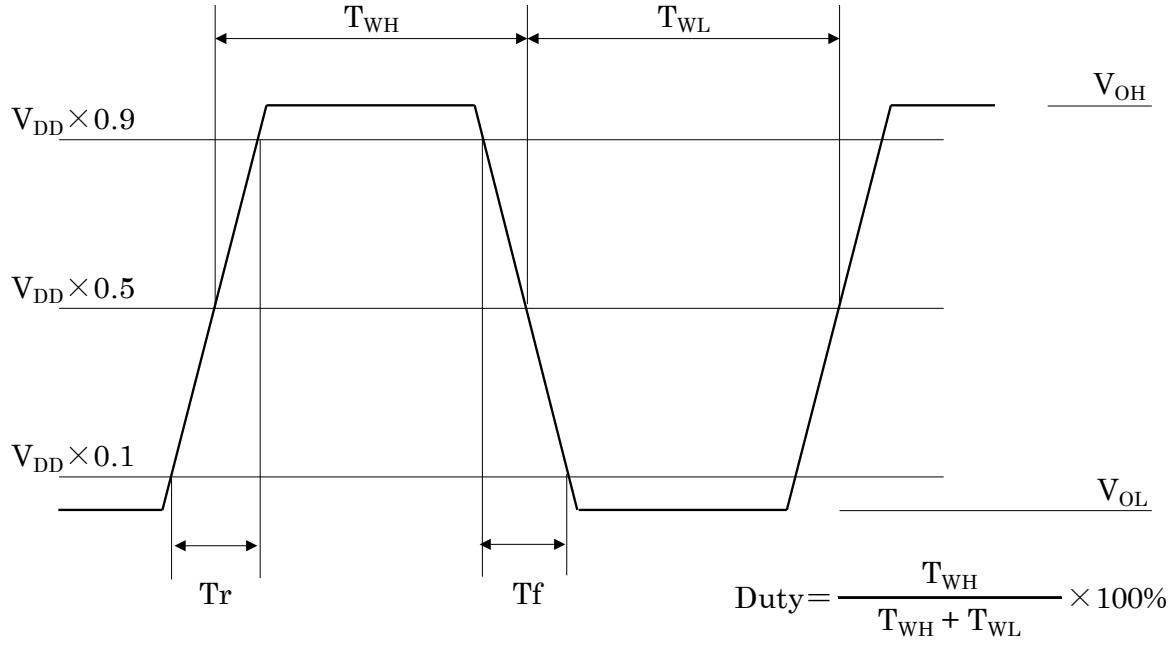
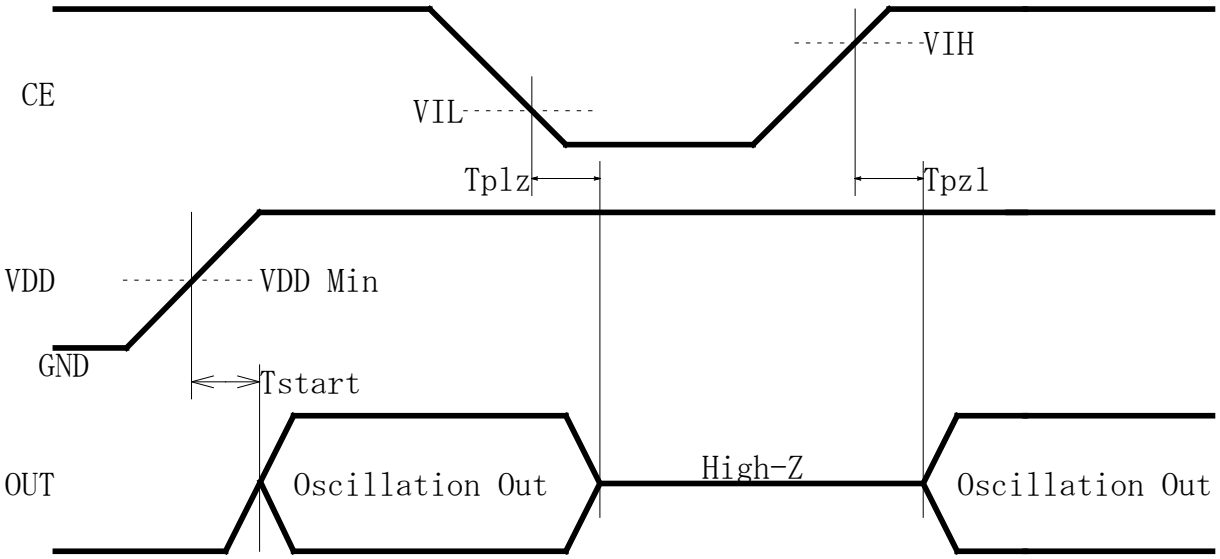


Fig. 5-1　Output Wave Form (Duty, Tr, Tf, V_{OH}, V_{OL})



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
Feedback Resistor	IPS029xMzB (z=0, 1, 2, 3, 4)	Rf	Refer to Fig. 6-1		300		kΩ
	IPS0293MTB				4.0		
	IPS0294MTB				3.0		
	IPS0295MTB				2.5		
	IPS0296MTB				1.96		
Driving Resistor	IPS0293MzB (z=0, 1, 2, 3, 4)	Rd	Refer to Fig. 6-1		1000		Ω
	IPS0294MzB (z=0, 1, 2, 3, 4)				750		
	IPS0295M0B				250		
	IPS0293MTB				500		
	IPS0294MTB				250		
	IPS0295MTB				250		
	IPS0296MTB				125		
Oscillation Capacitor	IPS0293MzB (z=0, 1, 2, 3, 4)	Cg	Refer to Fig. 6-1		5.0		pF
		Cd			12.0		
	IPS0294MzB (z=0, 1, 2, 3, 4)	Cg			4.0		
		Cd			7.0		
	IPS0295M0B	Cg			4.0		
		Cd			6.0		
	IPS0293MTB	Cg			8.0		
		Cd			10.0		
	IPS0294MTB	Cg			5.0		
		Cd			9.0		
	IPS0295MTB	Cg			4.0		
		Cd			8.0		
	IPS0296MTB	Cg			3.0		
		Cd			8.0		

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

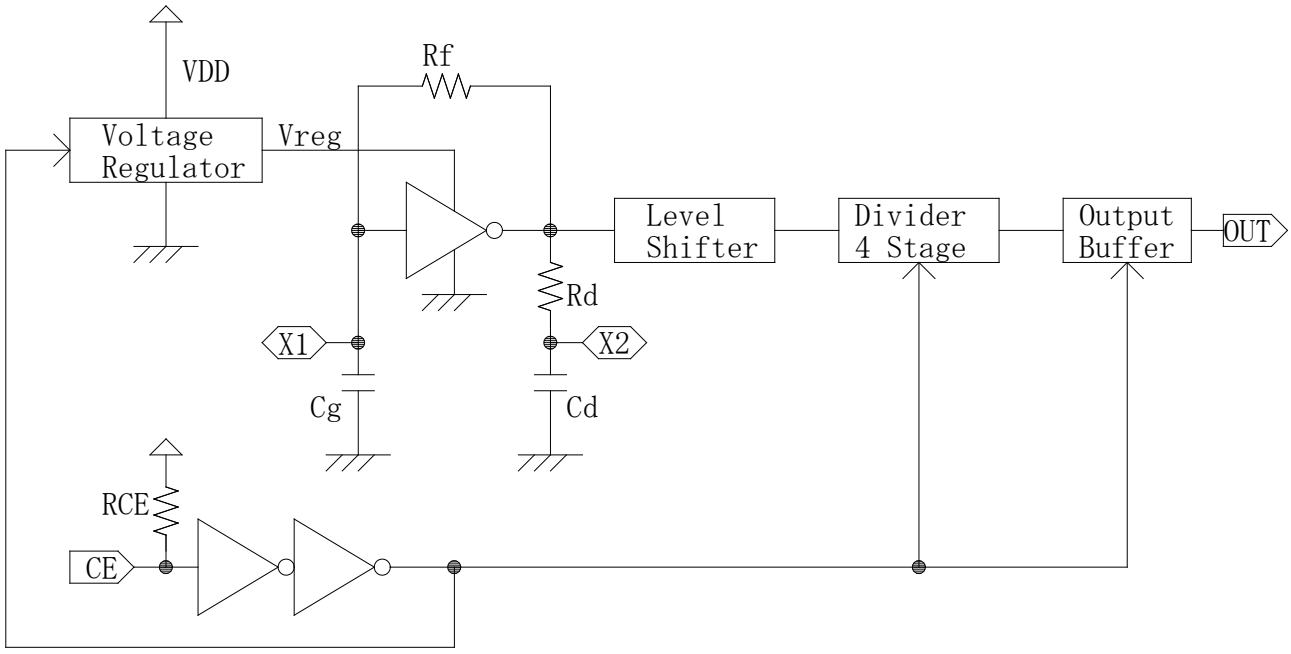
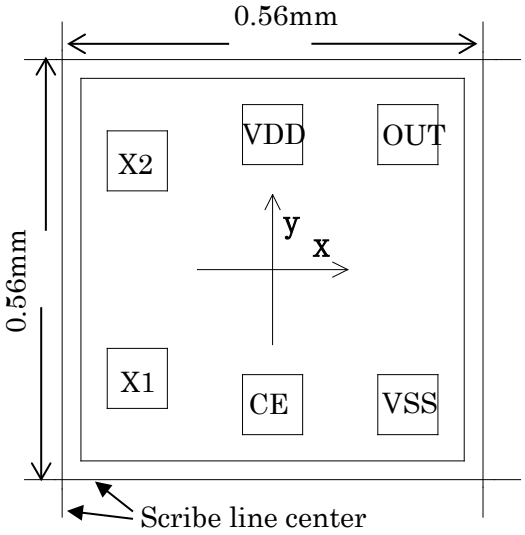


Fig. 6-1 Block Diagram

7. Pad Layout

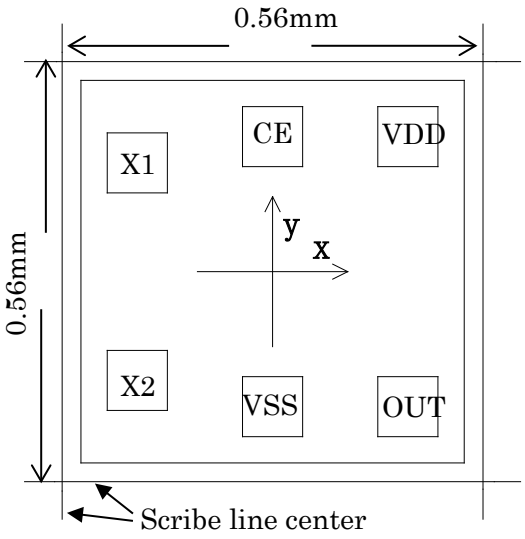
7-1 Straight Type



- Die Size: 0.56mm × 0.56mm
- Pad Size: 80um □
- Thickness: 100um or 130um±10um
- IC Backside: Gnd or Open

Pad Name	Function	Location (μm)	
		x	y
X1	Crystal Feedback	-181.00	-143.15
CE	Oscillation stop "L": High-Impedance	0.00	-180.55
VSS	(−) Ground	181.00	-180.55
OUT(Q)	Frequency Output	181.00	180.55
VDD	(+) Power Supply	0.00	180.55
X2	Crystal Drive	-181.00	143.15
Chip Center		0	0

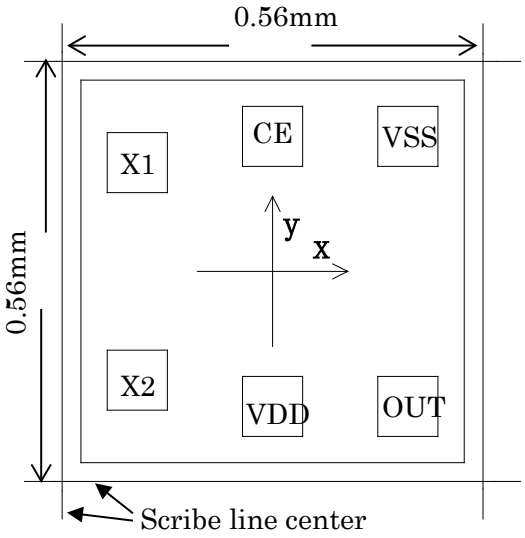
7-2 Cross Type



・Die Size：0.56mm × 0.56mm
・Pad Size：80um □
・Thickness：100um or 130um±10um
・IC Backside：Gnd or Open

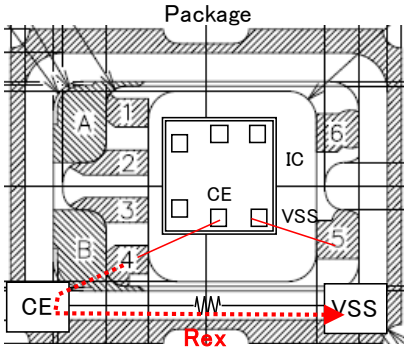
Pad Name	Function	Location (μm)	
		x	y
X2	Crystal Drive	-181.00	-143.15
VSS	(−) Ground	0.00	-180.55
OUT(Q)	Frequency Output	181.00	-180.55
VDD	(+) Power Supply	181.00	180.55
CE	Oscillation stop "L": High-Impedance	0.00	180.55
X1	Crystal Feedback	-181.00	143.15
Chip Center		0	0

7-3 Flip Type



・Die Size：0.56mm × 0.56mm
・Pad Size：80um □
・Thickness：100um or 130um±10um
・IC Backside：Gnd or Open

Pad Name	Function	Location (μm)	
		x	y
X2	Crystal Drive	-181.00	-143.15
VDD	(+) Power Supply	0.00	-180.55
OUT(Q)	Frequency Output	181.00	-180.55
VSS	(−) Ground	181.00	180.55
CE	Oscillation stop "L": High-Impedance	0.00	180.55
X1	Crystal Feedback	-181.00	143.15
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