■ 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. IPS029B series is the basic series, IPS029BA series features low power consumption, IPS029BB series includes OE functionality, and IPS029BE series offers high-speed tr/tf.

■ Features

- Operation temperature : -40℃~125℃
- Power supply voltage : 1.62V~3.63V
- Standby function : Oscillation stop / Output disable
- 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, 1/16, 1/32 and 1/64

1. Part number rule

IPS 029 x M z B B q －C 3 －3

- IPS: Series Name For SPXO
- 029: Product Series
- M: V_{DD} 1.62V ~3.63V
- q: Pad Layout 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

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
5 : Fund. & 1/32
6 : Fund. & 1/64
T : 3rd & 1/1

B: Optional code
Blank : Basic Model
A : Low Power Consumptiom
B : OE function
E : high tr/tf output

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

2-1 IPS029xMyBz Basic Series

Part Number	Crystal Frequency f (MHz)		Crystal Mode	Divide	Output Frequency F0 (MHz)		Remarks
	Min.	Max.			Min.	Max.	
IPS029 3 M 0 B X	20.00	54.00	Fund	1/1	20.00	54.00	Basic series Fundamental
IPS029 3 M 0 B F							
IPS029 3 M 1 B X				1/2	10.00	27.00	
IPS029 3 M 1 B F							
IPS029 3 M 2 B X				1/4	5.00	13.50	
IPS029 3 M 2 B F							
IPS029 3 M 3 B X				1/8	2.50	6.75	
IPS029 3 M 3 B F							
IPS029 3 M 4 B X				1/16	1.25	3.38	
IPS029 3 M 4 B F							
IPS029 4 M 0 B X	50.00	100.00		1/1	50.00	100.00	
IPS029 4 M 0 B F							
IPS029 5 M 0 B X	100.00	160.00		1/1	100.00	160.00	
IPS029 5 M 0 B F							
IPS029 3 M T B X	50.00	70.00	3rd	1/1	50.00	70.00	Basic series 3rd Overtone
IPS029 3 M T B F							
IPS029 4 M T B X	70.00	100.00		1/1	70.00	100.00	
IPS029 4 M T B F							
IPS029 5 M T B X	100.00	130.00		1/1	100.00	130.00	
IPS029 5 M T B F							
IPS029 6 M T B X	130.00	160.00		1/1	130.00	160.00	
IPS029 6 M T B F							

Please contact us for gray color models.

2-2 IPS029xMyBAz Low Power Consumption Series

Part Number	Crystal Frequency f (MHz)		Crystal Mode	Divide	Output Frequency F0 (MHz)		Remarks
	Min.	Max.			Min.	Max.	
IPS029 3 M 0 B A X	20.00	54.00	Fund	1/1	20.00	54.00	Low Power Consumption
IPS029 3 M 0 B A F							
IPS029 3 M 1 B A X				1/2	10.00	27.00	
IPS029 3 M 1 B A F							
IPS029 3 M 2 B A X				1/4	5.00	13.50	
IPS029 3 M 2 B A F							
IPS029 3 M 3 B A X				1/8	2.50	6.75	
IPS029 3 M 3 B A F							
IPS029 3 M 4 B A X				1/16	1.25	3.38	
IPS029 3 M 4 B A F							
IPS029 3 M 5 B A X				1/32	0.62	1.69	
IPS029 3 M 5 B A F							
IPS029 3 M 6 B A X				1/64	0.31	0.84	
IPS029 3 M 6 B A F							
IPS029 5 M 0 B A X	100.00	150.00		1/1	100.00	150.00	
IPS029 5 M 0 B A F							
IPS029 5 M 1 B A F				1/2	50.00	75.00	
IPS029 5 M 2 B A F				1/4	25.00	37.50	
IPS029 5 M 3 B A F				1/8	12.50	18.75	
IPS029 3 M T B A F	50.00	70.00	3rd	1/1	50.00	70.00	
IPS029 4 M T B A F	70.00	100.00		1/1	70.00	100.00	
IPS029 5 M T B A F	100.00	130.00		1/1	100.00	130.00	
IPS029 6 M T B A F	130.00	160.00		1/1	130.00	160.00	

Please contact us for gray color models.

2-3 IPS029xMyBBz OE Series

Part Number	Crystal Frequency f (MHz)		Crystal Mode	Divide	Output Frequency F0 (MHz)		Remarks
	Min.	Max.			Min.	Max.	
IPS029 3 M 0 B B X	20.00	54.00	Fund	1/1	20.00	54.00	OE function
IPS029 3 M 0 B B F							
IPS029 3 M 1 B B X				1/2	10.00	27.00	
IPS029 3 M 1 B B F							
IPS029 3 M 2 B B X				1/4	5.00	13.50	
IPS029 3 M 2 B B F							
IPS029 4 M 0 B B X	50.00	100.00		1/1	50.00	100.00	
IPS029 4 M 0 B B F							
IPS029 4 M 1 B B X				1/2	25	50	
IPS029 4 M 1 B B F							
IPS029 4 M 2 B B X				1/4	12.5	25	
IPS029 4 M 2 B B F							
IPS029 5 M 0 B B X	100.00	160.00		1/1	100.00	160.00	
IPS029 5 M 0 B B F							

Please contact us for gray color models.

2-4 IPS0293MTBEX high tr/tf Series

Part Number	Crystal Frequency f (MHz)		Crystal Mode	Divide	Output Frequency F0 (MHz)		Remarks
	Min.	Max.			Min.	Max.	
IPS029 3 M T B E X	50.00	70.00	3rd	1/1	50.00	70.00	high tr/tf output

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(OE)
“L” Input Voltage	V_{IL}				V_{DD}×0.2	V	CE(OE)
Input Voltage	V_{IN}		V_{SS}		V_{DD}	V	CE(OE)
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 IPS029xM0By / IPS029xM0BAy

Unless otherwise stated, CL=15pF, 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 * CL=15pF i=2,3,4 j=2,3,4,5,6	I_{DD}	IPS0293M0B, f=27MHz, V_{DD}=1.8V				2.3	mA
		IPS0293M0B, f=27MHz, V_{DD}=3.3V				4.2	
		IPS0293M0BA, f=27MHz, V_{DD}=1.8V				2.0	
		IPS0293M0BA, f=27MHz, V_{DD}=3.3V				3.5	
		IPS0293M1B, f=27MHz, V_{DD}=1.8V				2.0	
		IPS0293M1B, f=27MHz, V_{DD}=3.3V				3.5	
		IPS0293M1BA, f=27MHz, V_{DD}=1.8V				1.5	
		IPS0293M1BA, f=27MHz, V_{DD}=3.3V				2.5	
		IPS0293MiB, f=27MHz, V_{DD}=1.8V				1.5	
		IPS0293MiB, f=27MHz, V_{DD}=3.3V				3.0	
		IPS0293MjBA, f=27MHz, V_{DD}=1.8V				1.0	
		IPS0293MjBA, f=27MHz, V_{DD}=3.3V				1.5	
		IPS0294M0B, f=100MHz, V_{DD}=1.8V				6.0	
		IPS0294M0B, f=100MHz, V_{DD}=3.3V				12.0	
		IPS0295M0B, f=150MHz, V_{DD}=1.8V				14.0	
		IPS0295M0B, f=150MHz, V_{DD}=3.3V				20.0	
		IPS0295M0BA, f=150MHz, V_{DD}=1.8V				12.0	
		IPS0295M0BA, f=150MHz, V_{DD}=3.3V				17.0	
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%	IPS0293MyB(A) IPS0294M0B			±1.0	ppm
			IPS0295M0B(A)			±3.0	
		V_{DD}=3.3V±10%	IPS0293MyB(A) IPS0294M0B			±1.0	
			IPS0295M0B(A)			±2.0	

Output Duty Ratio	DUTY	1/2V_{DD} point		45		55	%
Rise time / Fall time *CL=15pF	Tr / Tf	V_{DD}=1.62V~2.25V 10%~90%V_{DD}	IPS0293MyB(A)			6.5	ns
			IPS0294M0B			5.0	
			IPS0295M0B(A)			3.5	
		V_{DD}=2.25V~3.63V 10%~90%V_{DD}	IPS0293MyB(A)			4.0	
			IPS0294M0B			3.0	
			IPS0295M0B(A)			2.0	

5-2 IPS029xMyBB

Unless otherwise stated, CL=15pF, 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	OE=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					200	ns
Oscillation start up time	Tstart	V_{DD}≧1.62V				2.0	ms
Current consumption *CL=15pF	I_{DD}	IPS0293MyBB, f=27MHz,V_{DD}=1.8V				2.3	mA
		IPS0293MyBB, f=27MHz,V_{DD}=3.3V				4.2	
		IPS0294MyBB, f=100MHz,V_{DD}=1.8V				6.0	
		IPS0294MyBB, f=100MHz,V_{DD}=3.3V				12.0	
		IPS0295M0BB, f=150MHz,V_{DD}=1.8V				TBD	
		IPS0295M0BB, f=150MHz,V_{DD}=3.3V				TBD	
Current consumption at oscillation stop	I_{DDD}	f=54MHz, OE=Low				3.8	mA
		f=100MHz, OE=Low				5.0	
		f=150MHz, OE=Low				TBD	
Freq. V_{DD} deviation	Fvst	V_{DD}=1.8V±10%	IPS0293MyBB IPS0294MyBB			±1.0	ppm
			IPS0295M0BB			TBD	
		V_{DD}=3.3V±10%	IPS0293MyBB IPS0294MyBB			±1.0	
			IPS0295M0BB			TBD	
Output Duty Ratio	DUTY	1/2V_{DD} point		45		55	%
Rise time / Fall time * CL=15pF	Tr / Tf	V_{DD}=1.62V~2.25V 10%~90%V_{DD}	IPS0293MyBB			6.5	ns
			IPS0294MyBB			5.0	
			IPS0295M0BB			TBD	
		V_{DD}=2.25V~3.63V 10%~90%V_{DD}	IPS0293MyBB			4.0	
			IPS0294MyBB			3.0	
			IPS0295M0BB			TBD	

5-3 IPS029xMTB / IPS0293MTBE

Unless otherwise stated, CL=15pF, 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					10.0	ms
Oscillation start up time	Tstart	V_{DD}≧1.62V				10.0	ms
Current consumption * CL=15pF	I_{DD}	IPS0293MTB, f=65MHz, V_{DD}=1.8V				13.5	mA
		IPS0293MTB, f=65MHz, V_{DD}=3.3V				30.0	
		IPS0293MTBE, f=65MHz, V_{DD}=1.8V				15.0	
		IPS0293MTBE, f=65MHz, V_{DD}=3.3V				30.0	
		IPS0294MTB, f=100MHz, V_{DD}=1.8V				15.0	
		IPS0294MTB, f=100MHz, V_{DD}=3.3V				32.5	
		IPS0295MTB, f=130MHz, V_{DD}=1.8V				19.0	
		IPS0295MTB, f=130MHz, V_{DD}=3.3V				40.0	
		IPS0296MTB, f=160MHz, V_{DD}=1.8V				24.5	
		IPS0296MTB, f=160MHz, 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(E) 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(E) 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 * CL=15pF	Tr / Tf	V_{DD}=1.62V~2.25V 10%~90%V_{DD}	IPS0293MTB			6.5	ns
			IPS0293MTBE			3.5	
			IPS0294MTB			5.0	
			IPS0295MTB			3.5	
			IPS0296MTB			3.5	
		V_{DD}=2.25V~3.63V 10%~90%V_{DD}	IPS0293MTB			4.0	
			IPS0293MTBE			2.0	
			IPS0294MTB			3.0	
			IPS0295MTB			2.0	
			IPS0296MTB			2.0	

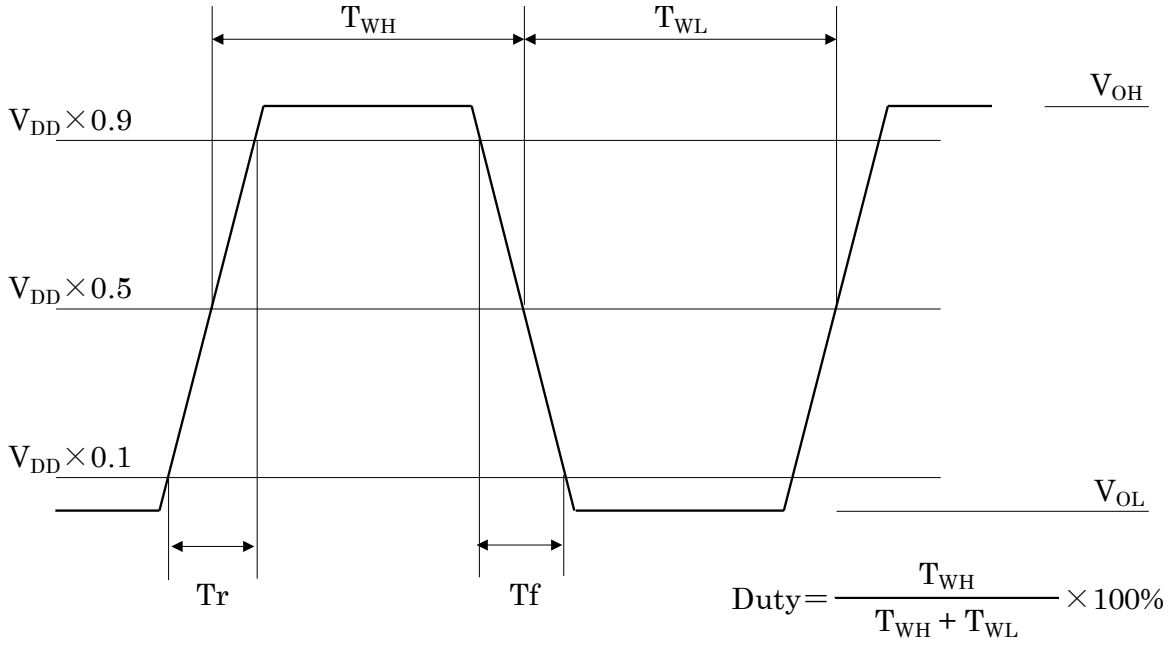
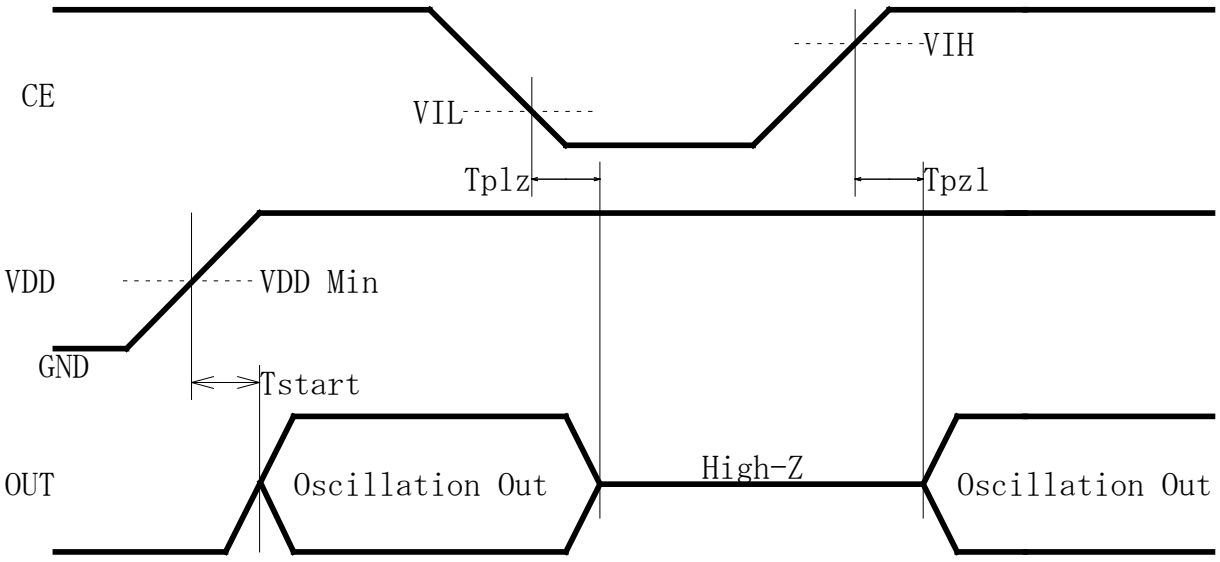


Fig. 5-1 Output Wave Form (Duty, Tr, Tf, V_{OH}, V_{OL})



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

Fig. 5-2 Input output signal timing

* IPS029xBBy series are OE pins instead of CE pins.

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

6-1 IPS029xMyB Series

Ta=25℃

Parameter		Symbol	Condition	Min	Typ	Max	Unit
Feedback Resistor	All Models	Rf	Refer to Fig. 6-1		300		kΩ
Driving Resistor	IPS0293MyB (y=0, 1, 2, 3, 4)	Rd	Refer to Fig. 6-1		1000		Ω
	IPS0294M0B				750		
	IPS0295M0B				250		
Oscillation Capacitor	IPS0293MyB (y=0, 1, 2, 3, 4)	Cg	Refer to Fig. 6-1		5.0		pF
		Cd			12.0		
	IPS0294M0B	Cg			4.0		
		Cd			7.0		
	IPS0295M0B	Cg			4.0		
		Cd			6.0		

6-2 IPS029xMyBA Series

Ta=25℃

Parameter		Symbol	Condition	Min	Typ	Max	Unit
Feedback Resistor	All Models	Rf	Refer to Fig. 6-1		200		kΩ
Driving Resistor	IPS0293MyBA (y=0,1,2,3,4,5,6)	Rd	Refer to Fig. 6-1		1000		Ω
	IPS0295M0BA				300		
Oscillation Capacitor	IPS0293MyBA (y=0,1,2,3,4,5,6)	Cg	Refer to Fig. 6-1		4.8		pF
		Cd			12.0		
	IPS0295M0BA	Cg			4.8		
		Cd			4.8		

6-3 IPS029xMyBB Series

Ta=25℃

Parameter		Symbol	Condition	Min	Typ	Max	Unit
Feedback Resistor	All Models	Rf	Refer to Fig. 6-1		300		kΩ
Driving Resistor	IPS0293MyBB (y=0, 1, 2)	Rd	Refer to Fig. 6-1		1000		Ω
	IPS0294MyBB (y=0, 1, 2)				750		
	IPS0295M0BB				250		
Oscillation Capacitor	IPS0293MyBB (y=0, 1, 2)	Cg	Refer to Fig. 6-1		5.0		pF
		Cd			12.0		
	IPS0294MyBB (y=0, 1, 2)	Cg			4.0		
		Cd			7.0		
	IPS0295M0BB	Cg			4.0		
		Cd			6.0		

6-4 IPS029xMTB Series / IPS0293MTBE

Ta=25℃

Parameter		Symbol	Condition	Min	Typ	Max	Unit
Feedback Resistor	IPS0293MTB	Rf	Refer to Fig. 6-1		4.0		kΩ
	IPS0293MTBE				3.25		
	IPS0294MTB				3.0		
	IPS0295MTB				2.5		
	IPS0296MTB				1.96		
Driving Resistor	IPS0293MTB	Rd	Refer to Fig. 6-1		500		Ω
	IPS0293MTBE				500		
	IPS0294MTB				250		
	IPS0295MTB				250		
	IPS0296MTB				125		
Oscillation Capacitor	IPS0293MTB	Cg	Refer to Fig. 6-1		10.0		pF
		Cd			5.0		
	IPS0293MTBE	Cg			8.0		
		Cd			10.0		
	IPS0294MTB	Cg			9.0		
		Cd			4.0		
	IPS0295MTB	Cg			8.0		
		Cd			3.0		
	IPS0296MTB	Cg			8.0		
		Cd			6.0		

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

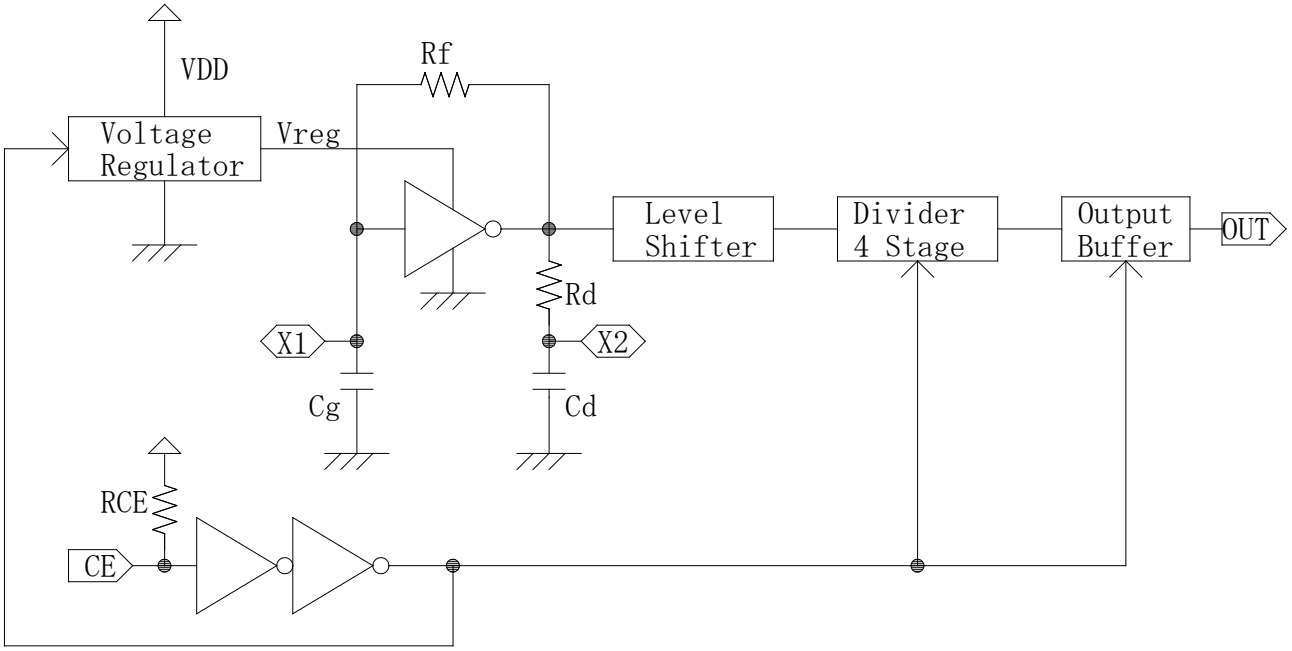
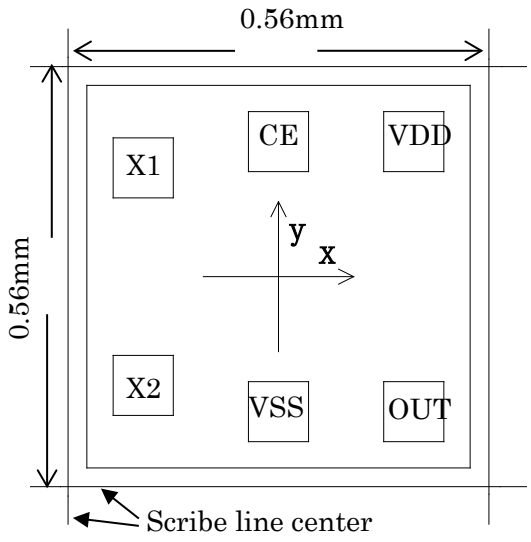


Fig. 6-1 Block Diagram

7. Pad Layout

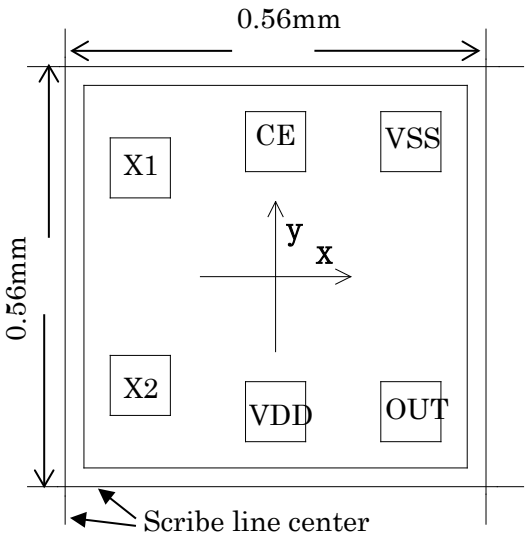
7-1 Cross Type



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

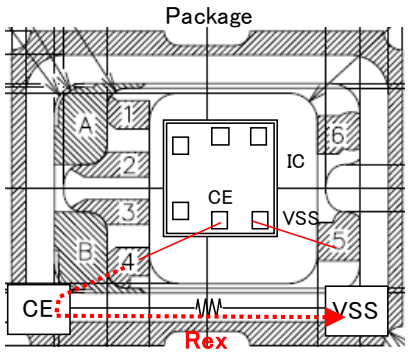
Pad Name	Function	Location (μm)	
		x	y
X2	Crystal Drive	-181.00	-143.15
VSS	(−) Ground	0.00	-180.55
OUT(Q)	Frequency Output	181.00	-180.55
VDD	(+) Power Supply	181.00	180.55
CE	Oscillation stop "L": High-Impedance	0.00	180.55
X1	Crystal Feedback	-181.00	143.15
Chip Center		0	0

7-2 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

* IPS029xBBy series are OE pins instead of CE pins.