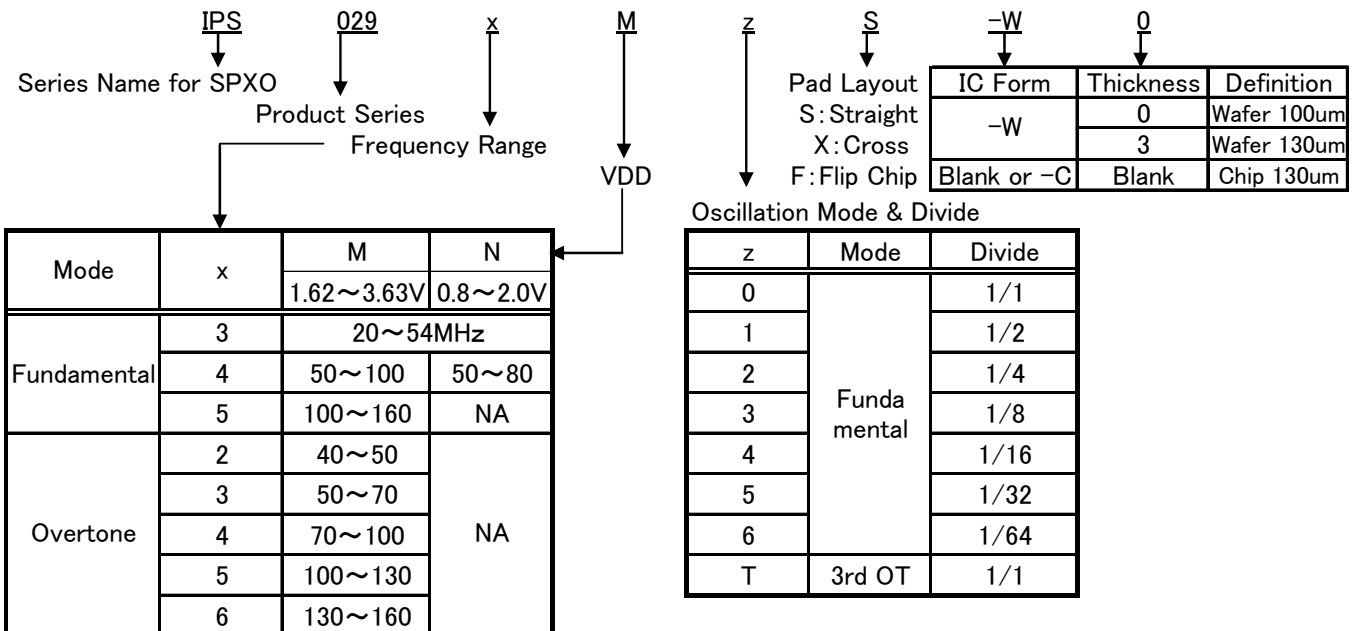


■ Description

IPS029 is the IC for SPXO corresponding to the fundamental or 3rd overtone crystal from 20MHz to 160MHz. Operation voltage is 0.8V minimum and chip size of this product is small enough for 2016 size SMD, so it is suit for hand-held application of a battery drive. In addition, operation temperature is quite high (125°C) with IPS0293M0, 4MT and 5MT, so IPS029 can be used for various applications.

■ Features

- Operation temperature : 85°C
125°C with IPS0293M0, 4MT and 5MT.
105°C with IPS0296MT
Please contact us about 125°C usage with other IC.
- Power supply voltage : 0.8~2.0V / IPS029xN and 1.62~3.63V / IPS029xM
- Small chip size : 0.55mm × 0.56mm
- Oscillation mode : Fundamental or 3rd overtone
- Standby function : Oscillation stop
- Output : CMOS
- Divide function : 1/2, 1/4, 1/8, 1/16, 1/32 and 1/64
- Duty cycle : Within 50±5%

1. Part number rule


2. Series
2-1 Pad Layout : Straight Type

Part Number	Output Frequency (MHz)		Divide	Vdd (V)	Oscillation Mode
	Min.	Max.			
IPS029 3 M 0 S	20.00	54.00	1/1	1.62~3.63	Fundamental
IPS029 3 M 1 S	10.00	27.00	1/2		
IPS029 3 M 2 S	5.00	13.50	1/4		
IPS029 3 M 3 S	2.50	6.75	1/8		
IPS029 3 M 4 S	1.25	3.38	1/16		
IPS029 3 M 5 S	0.63	1.69	1/32		
IPS029 3 M 6 S	0.31	0.84	1/64		
IPS029 4 M 0 S	50.00	100.00	1/1		
IPS029 4 M 1 S	25.00	50.00	1/2		
IPS029 4 M 2 S	12.50	25.00	1/4		
IPS029 5 M 0 S	100.00	160.00	1/1		

2-2 Pad Layout : Cross Type

Part Number	Output Frequency (MHz)		Divide	Vdd (V)	Oscillation Mode etc.
	Min.	Max.			
IPS029 3 M 0 X	20.00	54.00	1/1	1.62~3.63	Fundamental
IPS029 3 M 1 X	10.00	27.00	1/2		
IPS029 3 M 2 X	5.00	13.50	1/4		
IPS029 3 M 3 X	2.50	6.75	1/8		
IPS029 3 M 4 X	1.25	3.38	1/16		
IPS029 4 M 0 X	50.00	100.00	1/1		
IPS029 2 M T X	40.00	50.00	1/1		3rd Overtone
IPS029 3 M T X	50.00	70.00	1/1		
IPS029 4 M T X	70.00	100.00	1/1		
IPS029 5 M T X	100.00	130.00	1/1		-40~85°C
	100.00	120.00			-40~125°C
IPS029 6 M T X	130.00	160.00	1/1		3rd Overtone
IPS029 3 N 0 X	20.00	54.00	1/1		0.8~2.0
IPS029 3 N 1 X	10.00	27.00	1/2		
IPS029 3 N 2 X	5.00	13.50	1/4		
IPS029 3 N 3 X	2.50	6.75	1/8		
IPS029 3 N 4 X	1.25	3.38	1/16		
IPS029 4 N 0 X	50.00	80.00	1/1		

2-3 Pad Layout : Flip Chip Type

Part Number	Output Frequency (MHz)		Divide	Vdd (V)	Oscillation Mode
	Min.	Max.			
IPS029 3 M 0 F	20.00	54.00	1/1	1.62~3.63	Fundamental
IPS029 3 M 1 F	10.00	27.00	1/2		
IPS029 3 M 2 F	5.00	13.50	1/4		
IPS029 3 M 3 F	2.50	6.75	1/8		
IPS029 3 M 4 F	1.25	3.38	1/16		
IPS029 4 M 0 F	50.00	100.00	1/1		
IPS029 4 M 1 F	0.63	1.69	1/2		
IPS029 4 M 2 F	0.16	0.42	1/4		
IPS029 4 M 3 F	0.04	0.11	1/8		
IPS029 4 M 4 F	0.02	0.05	1/16		
IPS029 4 M 5 F	1.56	3.13	1/32		
IPS029 4 M 6 F	0.78	1.56	1/64		
IPS029 5 M 0 F	100.00	160.00	1/1		

3. Absolute Maximum Ratings $V_{SS}=0V$, $T_a=25^{\circ}C \pm 2^{\circ}C$

Parameter	Symbol	Condition	Ratings		
			Min	Max	Unit
Supply Voltage	V_{DD}	IPS029xM	$V_{SS}-0.5$	5.0	V
		IPS029xN	$V_{SS}-0.5$	2.5	
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
Input Current	I_{IN}	CE Pin		50	μA
Output Current	I_{OUT}			25	mA
Junction Temperature	T_j		-55	150	$^{\circ}C$
Storage Temperature	T_{stg}		-55	125	$^{\circ}C$

4. Recommended Operating Condition

Unless otherwise stated, $V_{SS}=0V$, $T_a = -40^{\circ}C \sim +85^{\circ}C$

(125 $^{\circ}C$ with IPS0294MT and 5MT, and 105 $^{\circ}C$ with 6MT. Please contact us about 125 $^{\circ}C$ usage with other IC)

Parameter	Symbol	Condition	Min	Typ	Max	Unit	Note
Supply Voltage	IPS029xM		1.62		3.63	V	V_{DD}
	IPS029xN		0.8		2	V	V_{DD}
“H” Input Voltage	V_{IH}		$V_{DD} \times 0.8$			V	CE
“L” Input Voltage	V_{IL}				$V_{DD} \times 0.2$	V	CE
Input Voltage	V_{IN}		V_{SS}		V_{DD}	V	CE
Output Load Capacitance	CL	CMOS			15	pF	OUT
Ambient Temperature	T_{opt}		-40		85	$^{\circ}C$	



Electrical Specification

5-1 IPS029xM / Fundamental

Unless otherwise stated, $V_{DD}=1.62V\sim 3.63V$, $V_{SS}=0V$, $T_a = -40^{\circ}C\sim +85^{\circ}C$ **(125°C with IPS0293M0.** Please contact us about 125°C usage with other IC)

Parameter	Symbol	Condition	Specification			Unit		
			Min	Typ	Max			
Out put Leak current	I _z	CE ≤ 0.3V, X1=VDD, V _{ss} , V _{out} =V _{ss} ~VDD		10		μA		
Oscillation Disable Time	T _{plz}	OUT pad			10	μs		
Oscillation Enable Time	T _{pzl}	OUT pad			2	ms		
Oscillation start up time	T _{start}	f _{xtal} =48MHz, V _{DD} ≥ 1.2V, Funda.			2	ms		
“H” output voltage	V _{OH}	I _{OH} = -4mA	VDD-0.4			V		
“L” output voltage	V _{OL}	I _{OL} = 4mA			0.4	V		
Current consumption	I _{DD}	IPS0293M, 54MHz, CL=0pF			2.4	mA		
		IPS0294M, 100MHz, CL=0pF			5.0			
		IPS0295M, 150MHz, CL=0pF			8.0			
Current consumption at oscillation disable	I _{DDD}	CL=0pF, CE ≤ 0.3V, T _a ≤ 85°C			3	μA		
		CL=0pF, CE ≤ 0.3V, T _a > 85°C			5			
Frequency V _{DD} deviation	F _{vst}	V _{DD} =3.3V ± 10%			±1	ppm		
Output Duty Ratio	Duty	CL=15pF, 0.5V _{DD} , T _a ≤ 105°C	45		55	%		
		CL=15pF, 0.5V _{DD} , T _a > 105°C	40		60			
Rise time/Fall time	T _r /T _f	VDD=2.52~3.63V, CL=15pF, 10~90%VDD					ns	
		IPS0293M			4			
		IPS0294M			3			
		IPS0295M			2			
		VDD=1.62~2.52V, CL=15pF, 10~90%VDD						
		IPS0293M			5			
		IPS0294M			4			
IPS0295M			3					

5-2 IPS029xM / 3rd Overtone

 Unless otherwise stated, $V_{DD}=1.62V\sim 3.63V$, $V_{SS}=0V$, $T_a = -40^{\circ}C \sim +85^{\circ}C$

(125°C with IPS0294MT and 5MT, and 105°C with 6MT. Please contact us about 125°C usage with other IC)

Parameter	Symbol	Condition	Specification			Unit	
			Min	Typ	Max		
Out put Leak current	I_z	$CE \leq 0.3V$, $X1=V_{DD}$, V_{SS} , $V_{out}=V_{SS} \sim V_{DD}$		10		μA	
Oscillation Disable Time	T_{plz}	OUT pad			10	μs	
Oscillation Enable Time	T_{pzl}	OUT pad			10	ms	
Oscillation start up time	T_{start}	Overtone			10	ms	
“H” output voltage	V_{OH}	IPS0292MT~4MT, $I_{OH} = -4mA$	VDD-0.4			V	
		IPS0295MT/6MT, $I_{OH} = -8mA$					
“L” output voltage	V_{OL}	IPS0292MT~4MT, $I_{OL} = 4mA$			0.4	V	
		IPS0295MT/6MT, $I_{OL} = 8mA$					
Current consumption	I_{DD}	IPS0292MT, 40MHz, $CL=15pF$		5		mA	
		IPS0293MT, 66MHz, $CL=15pF$		11			
		IPS0294MT, 100MHz, $CL=15pF$		11			
		IPS0295MT, 120MHz, $CL=15pF$		17			
		IPS0296MT, 140MHz, $CL=15pF$		17			
Current consumption at oscillation disable	I_{DDD}	$CL=0pF$, $CE \leq 0.3V$		3.0	10.0	μA	
Frequency V_{DD} deviation	F_{vst}	$V_{DD}=3.3V \pm 10\%$			± 1.0	ppm	
		$V_{DD}=1.8V \pm 10\%$			± 2.0		
Output Duty Ratio	Duty	CL=15pF, 0.5V _{DD}					%
		IPS0292MT~6MT, -40~85°C	45		55		
		IPS0294MT/5MT, 85~125°C	40		60		
		IPS0296MT, 85~105°C	40		60		
Rise time/Fall time	T_r/T_f	VDD=2.52~3.63V, CL=15pF, 10~90%VDD					ns
		IPS0292MT~4MT			3		
		IPS0295MT/6MT			2		
		VDD=1.62~2.52V, CL=15pF, 10~90%VDD					
		IPS0292MT~4MT			4		
		IPS0295MT/6MT			3		



5-3 IPS029xN

Unless otherwise stated, $V_{DD}=0.8V\sim 2.0V$, $V_{SS}=0V$, $T_a = -40^{\circ}C\sim +85^{\circ}C$, $f_{xtal}=20\sim 54MHz$

Parameter	Symbol	Condition	Specification			Unit
			Min	Typ	Max	
Out put Leak current	I_z	$CE \leq 0.3V$, $X1=V_{DD}$, V_{SS} , $V_{out}=V_{SS}\sim V_{DD}$			10	μA
Oscillation Disable Time	T_{plz}	OUT pad			10	μs
Oscillation Enable Time	T_{pzl}	OUT pad			2	ms
Oscillation start up time	T_{start}	$f_{xtal}=48MHz$, $V_{DD} \geq 1.2V$			2	ms
“H” output voltage	V_{OH}	$V_{DD}=1.2\sim 2.0V$, $I_{OH}=-3.0mA$	$0.9V_{DD}$			V
		$V_{DD}=0.8\sim 1.2V$, $I_{OH}=-0.7mA$	$0.9V_{DD}$			
“L” output voltage	V_{OL}	$V_{DD}=1.2\sim 2.0V$, $I_{OH}=3.0mA$			$0.1V_{DD}$	V
		$V_{DD}=0.8\sim 1.2V$, $I_{OH}=0.7mA$			$0.1V_{DD}$	
Current consumption	I_{DD}	$CL=0pF$, $V_{DD}=2.0V$, $CE \geq V_{DD}-0.3V$, $F_0=54MHz$		1.6	2.0	mA
		$CL=15pF$, $V_{DD}=2.0V$, $CE \geq V_{DD}-0.3V$, $F_0=54MHz$		3.2	4.0	
Current consumption at oscillation disable	I_{DDD}	$CL=0pF$, $CE \leq 0.3V$		2	6	μA
Frequency V_{DD} deviation	F_{vst}	$V_{DD}=1.0\sim 2.0V$			± 5	ppm
Output Duty Ratio	Duty	$CL=15pF$, $0.5V_{DD}$	45		55	%
Rise time/Fall time	T_r/T_f	$CL=15pF$, $10\sim 90\%V_{DD}$, $V_{DD}=0.8\sim 1.2V$		4.0	8.0	ns
		$CL=15pF$, $10\sim 90\%V_{DD}$, $V_{DD}=1.2\sim 2.0V$		2.0	4.0	

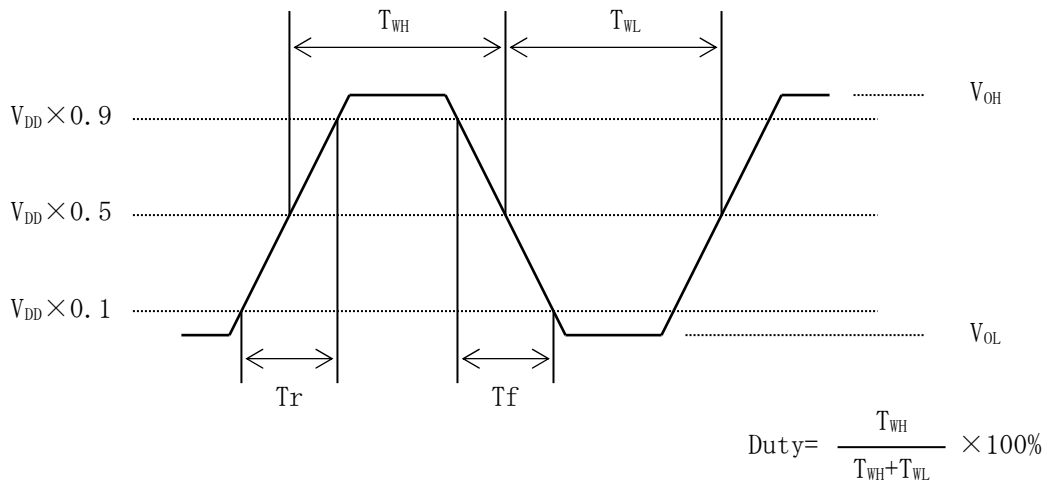
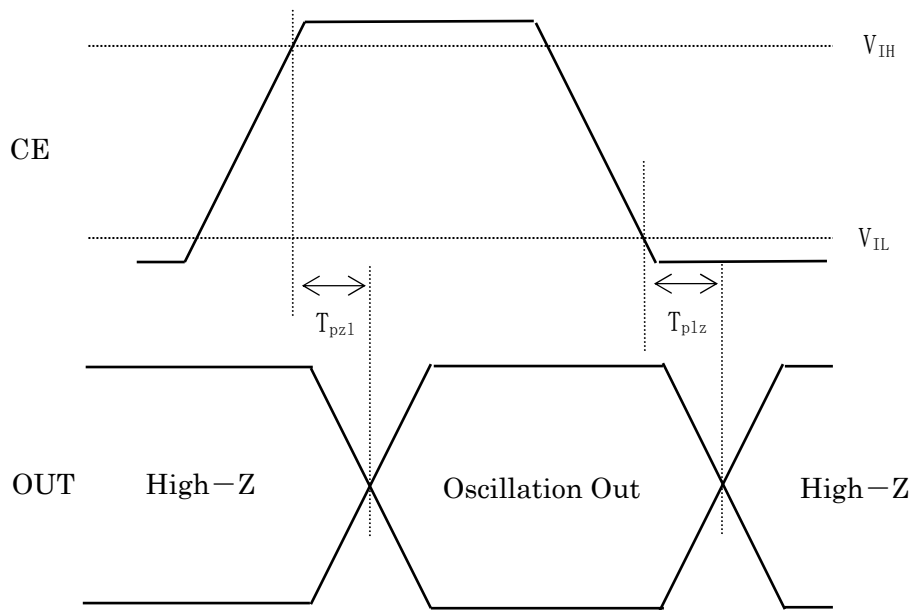


Fig. 5-1 Output wave form (Duty, T_r , T_f , V_{OH} , V_{OL})



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

Fig. 5-2 Input output signal timing



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

6-1 IPS029xM / Fundamental

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Equivalent series (Loading) Capacitance	CLxtal	IPS0293M, V _{DD} =2.7V, f _{xtal} =54MHz		6		pF
		IPS0294M, V _{DD} =2.7V, f _{xtal} =100MHz		4.5		
		IPS0295M, V _{DD} =2.7V, f _{xtal} =150MHz		2.5		

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

6-2 IPS029xM / 3rd Overtone

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Equivalent series (Loading) Capacitance	CLxtal	IPS0295M, V _{DD} =2.7V, f _{xtal} =120MHz		6.5		pF
Drive Level	DL	IPS0295M, V _{DD} =2.7V, T _a =25°C, f _{xtal} =120MHz			60	μ W

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

6-3 IPS029xN

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Equivalent series (Loading) Capacitance	CLxtal	V _{DD} =2.0V, f _{xtal} =54MHz		4		pF
Drive Level	DL	V _{DD} =0.8~1.8V, T _a =25°C, f _{xtal} =27~48MHz	10		20	μ W

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

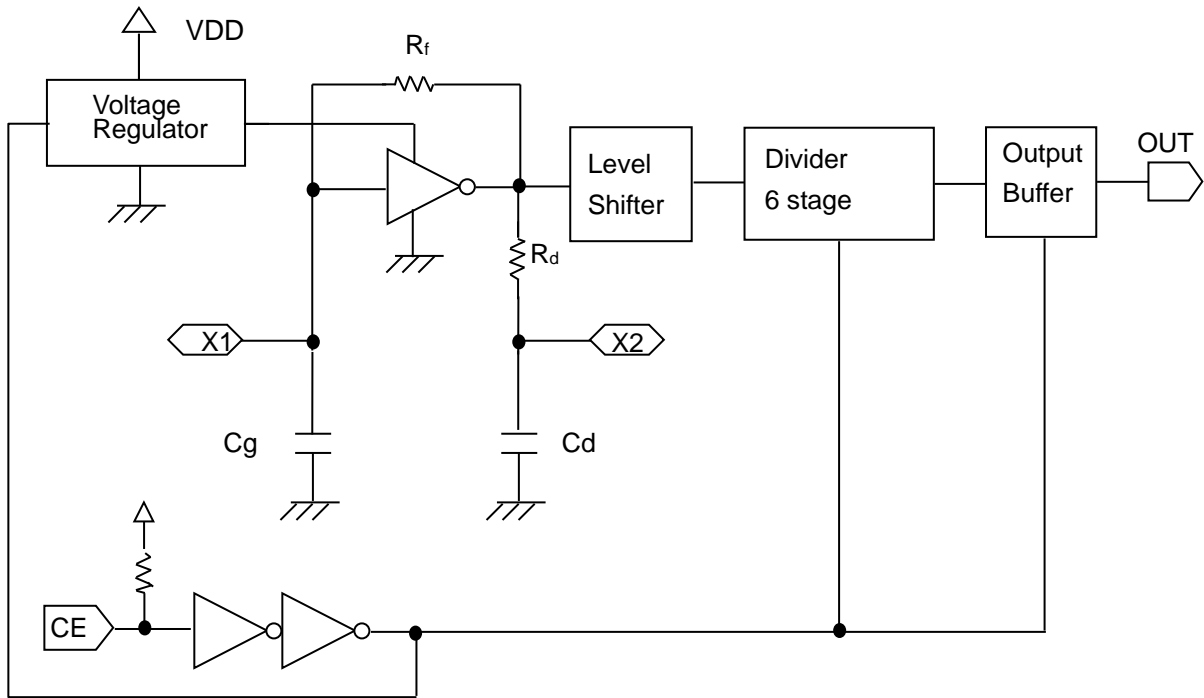
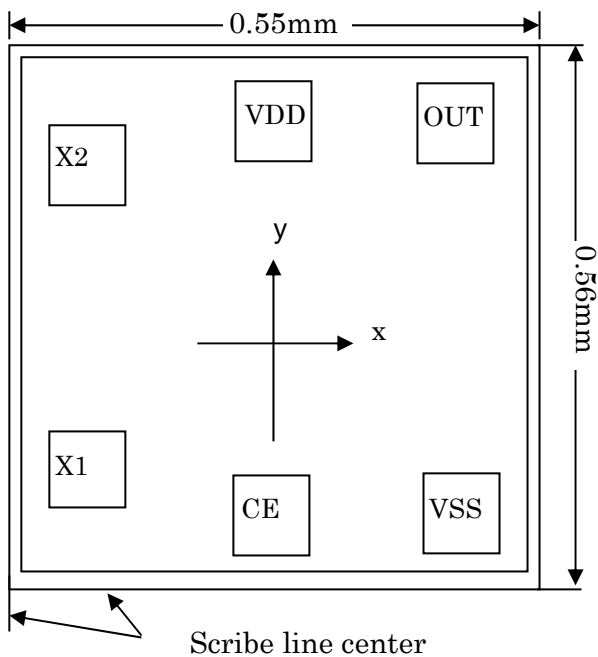


Fig. 6-1 Block Diagram

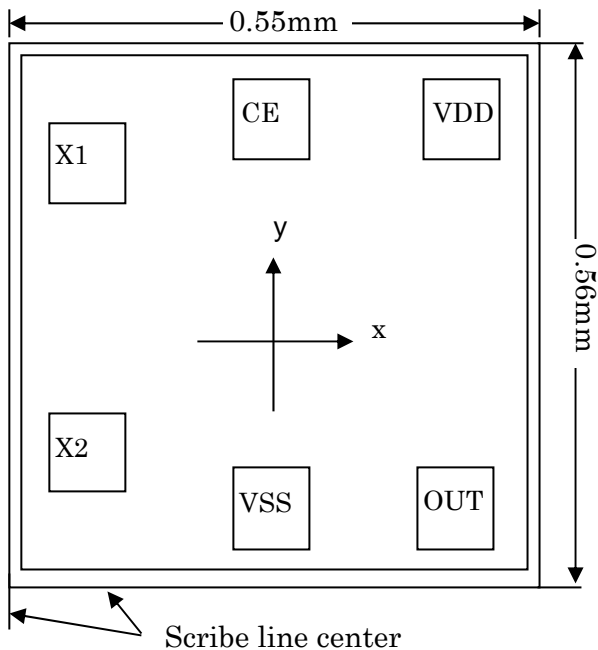
6. Pad Layout



- Die Size: 0.55mm × 0.56mm
- Pad Size: 80um □
- Thickness: 130±10um
- IC Backside: Gnd or Open

Pad Name	Function	Location (μm)	
		x	y
X1	Crystal Feedback	-175.55	-143.15
CE	Oscillation stop, "L": High-Impedance	0	-180.55
VSS	(-)Ground	175.55	-180.55
OUT(Q)	Frequency Output	175.55	180.55
VDD	(+)Power Supply	0	180.55
X2	Crystal Drive	-175.55	143.15
Chip Center		0	0

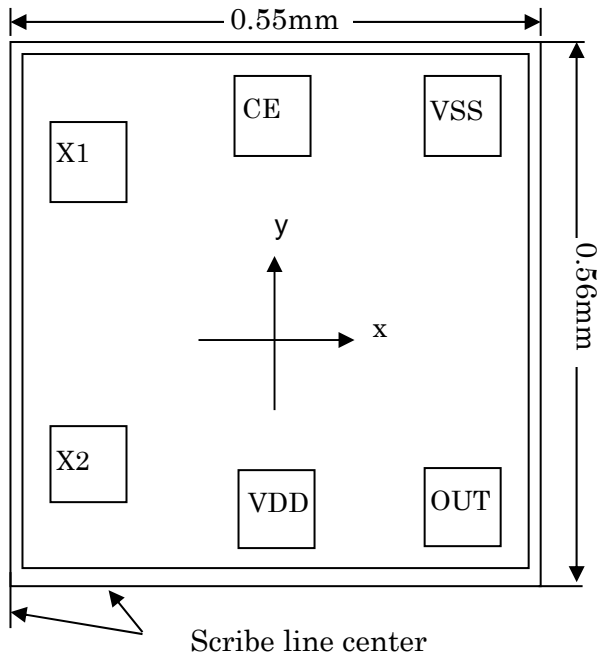
Fig. 7-1 Straight Type



- Die Size: 0.55mm × 0.56mm
- Pad Size: 80um □
- Thickness: 130±10um
- IC Backside: Gnd or Open

Pad Name	Function	Location (μm)	
		x	y
X2	Crystal Drive	-175.55	-143.15
VSS	(-)Ground	0	-180.55
OUT(Q)	Frequency Output	175.55	-180.55
VDD	(+)Power Supply	175.55	180.55
CE	Oscillation stop, "L": High-Impedance	0	180.55
X1	Crystal Feedback	-175.55	143.15
Chip Center		0	0

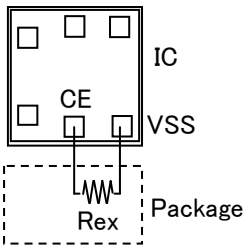
Fig. 7-2 Cross Type



- Die Size: 0.55mm × 0.56mm
- Pad Size: 80um □
- Thickness: 100 or 130±10um / Wafer
- IC Backside: Gnd or Open

Pad Name	Function	Location (μm)	
		x	y
X2	Crystal Drive	-175.55	-143.15
VDD	(+)Power Supply	0	-180.55
OUT(Q)	Frequency Output	175.55	-180.55
VSS	(-)Ground	175.55	180.55
CE	Oscillation stop, "L": High-Impedance	0	180.55
X1	Crystal Feedback	-175.55	143.15
Chip Center		0	0

Fig. 7-3 Flip Chip Type



IMPORTANT Notice for CE function

- * Rex should be over 10MΩ in case of CE = Open usage.
 - * Oscillation will not be activated when CE = Open after CE = Low if Rex is below 10MΩ.
 - * There is no such issue in case of CE = VDD usage.
- Rex : External resistance value between CE and VSS of package.