■ Description

IPV005xH Series IC is a single chip VCXO IC with built-in Variable Capacitor. This product has the features of the wide pulling range, the low power consumption and a stable output against voltage fluctuation by the built-in the original voltage variable capacitor and high precision constant voltage circuit. Also the small chip size of this product enables a smaller VCXO having output frequency from 1MHz to 126MHz.

■ Features

- Operation temperature : -40℃~125℃ (Except IPV0055)
- Power supply voltage : 2.52V~3.63V
- Vc Input impedance : 5MΩ
- Standby function : Output disable
- Crystal frequency : 16MHz~126MHz
- Low power consumption : 3mA (IPV0052H)
- Output : CMOS
- Divide function : 1/2, 1/4, 1/8 and 1/16
- Small chip size : 0.75mm × 1.00mm
- Frequency stability to V_{DD} : Within ±1ppm
- Wide pulling range : ±100ppm minimum / Vc=1.65V±1.35V
- Duty cycle : Within 50%±5%

1. Part number rule

IPV 005 x H z A －W 1

- IPV: Series Name For VCXO
- 005: Product Series
- x: Frequency Range

x	Frequency Range
2	16~36MHz
3	30~50MHz
4	50~80MHz
5	80~126MHz

- H: V_{DD}

Recommended V_{DD}	
H	3.3V

- z: Divide Function
  - 0: 1/1
  - 1: 1/2 Divide
  - 2: 1/4 Divide
  - 3: 1/8 Divide
  - 4: 1/16 Divide
- A: Optional code

Code	Definition
A	Lower Phase Noise
M	Better Pull balance / Slower Tr, Tf
Blank	Standard Product

- －W / 1

IC Form	Thickness	Definition
－W	1	Wafer 150um
Blank or －C	Blank	Chip 150um

2. Series

Part Number	Crystal Frequency f (MHz)		Divide	Output Frequency F0 (MHz)		Remarks
	Min.	Max.		Min.	Max.	
IPV005 2 H 0	16.00	36.00	1/1	16.00	36.00	
IPV005 2 H 1			1/2	8.00	18.00	
IPV005 2 H 2			1/4	4.00	9.00	
IPV005 2 H 3			1/8	2.00	4.50	
IPV005 2 H 4			1/16	1.00	2.25	
IPV005 3 H 0	30.00	50.00	1/1	30.00	50.00	
IPV005 3 H 1			1/2	15.00	25.00	
IPV005 3 H 2			1/4	7.50	12.50	
IPV005 4 H 0	50.00	80.00	1/1	50.00	80.00	Wider Frequency range than 54H0M
IPV005 4 H 1			1/2	25.00	40.00	
IPV005 4 H 0 M	45.00	60.00	1/1	45.00	60.00	Better Pull balance than 54H0
IPV005 5 H 0	80.00	126.00	1/1	80.00	126.00	
IPV005 5 H 0 M	80.00	126.00	1/1	80.00	126.00	Tr, Tf is Slower than 55H0
IPV005 5 H 0 A	80.00	126.00	1/1	80.00	126.00	Lower Phase Noise

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	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}			30	mA
Junction Temperature	Tj		-55	150	℃
Storage Temperature	Tstg		-55	125	℃

4. Recommended Operating Condition

V_{SS}=0V, Ta=-40℃~125℃ (85℃ with IPV0055)

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Note
Supply Voltage		V_{DD}		2.52	3.30	3.63	V	V_{DD}
"H" Input Voltage		V_{IH}		V_{DD}×0.7			V	OE
"L" Input Voltage		V_{IL}				V_{DD}×0.3	V	OE
Input Voltage		V_{IN}		V_{SS}		V_{DD}	V	OE
Control Voltage		V_C		0		V_{DD} +1.0	V	VC
Output Load Capacitance	IPV0052H	CL	CMOS		15	30	pF	OUT
	Others					15		
Ambient Temperature 1		Topt	Except IPV0055	-40		125	℃	
Ambient Temperature 2		Topt	IPV0055	-40		85	℃	

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

5. Electrical Specification

5-1 IPV0052Hz, 53Hz, 54Hz

Unless otherwise stated, V_{DD}=2.52V~3.63V, V_{SS}=0V, Ta=-40℃~125℃

Parameter	Symbol	Condition		Specification Min	Specification Typ	Specification Max	Unit
"H" input current	I_{IH}	$V_{IN}=V_{DD}$				1.0	μA
"L" input current	I_{IL}	$V_{IN}=V_{SS}$			1.3	10	μA
"H" output voltage	V_{OH}	I_{OH}=-5mA, -40℃~85℃ I_{OH}=-3mA, 85℃~125℃		V_{DD} -0.4			V
"L" output voltage	V_{OL}	I_{OL}=5mA, -40℃~85℃ I_{OL}=3mA, 85℃~125℃				0.4	V
Current consumption	I_{DD}	CL=15pF, V_{DD}=3.63V OE≧V_{DD}-0.3V, f=27MHz			3.0	5.0	mA
Current consumption at output disable	I_{DDD}	CL=15pF, V_{DD}=3.63V OE≦0.3V, f=27MHz			1.0	2.0	mA
Output off leak at output disable	I_O	OE≦0.3V				10	μA
Output Duty Ratio	Duty	CL=15pF f=27MHz Vc=1/2V_{DD}	-40℃~85℃	45		55	%
			85℃~125℃	43		57	
Pull Range	Fcntr	Vc=+1.65±1.35V, 27MHz Crystal *1		±110			ppm
Rise time	Tr	CL=15pF, 10~90% V_{DD}					ns
		IPV0052H	-40℃~85℃		3.0	4.5	
			85℃~125℃			6.0	
		IPV0053H	-40℃~85℃		2.5	3.5	
			85℃~125℃			4.7	
		IPV0054H	-40℃~85℃		2.0	3.0	
			85℃~125℃			4.0	
Fall time	Tf	CL=15pF, 90~10% V_{DD}					ns
		IPV0052H	-40℃~85℃		3.0	4.5	
			85℃~125℃			6.0	
		IPV0053H	-40℃~85℃		2.5	3.5	
			85℃~125℃			4.7	
		IPV0054H	-40℃~85℃		2.0	3.0	
			85℃~125℃			4.0	
Output Enable Time	Tpe					100	ns
Output Disable Time	Tpd					100	ns
Modulation Band Width	Fc	Vc=1.35sinωt+1.65V		15	20		kHz

Crystal *1 ; Equivalent Parameter of Crystal is γ=C0/C1<300

5-2 IPV0054H0M

Unless otherwise stated, V_{DD}=2.52V~3.63V, V_{SS}=0V, Ta=-40℃~85℃

Parameter	Symbol	Condition	Specification			Unit
			Min	Typ	Max	
"H" input current	I_{IH}	$V_{IN}=V_{DD}$			1.0	μA
"L" input current	I_{IL}	$V_{IN}=V_{SS}$			10	μA
"H" output voltage	V_{OH}	I_{OH}=-5mA	V_{DD}-0.4			V
"L" output voltage	V_{OL}	I_{OL}=5mA			0.4	V
Current consumption	I_{DD}	CL=15pF, V_{DD}=3.63V OE≧V_{DD}-0.3V, f=54MHz		6.0	10.0	mA
Current consumption at output disable	I_{DDD}	CL=15pF, V_{DD}=3.63V OE≦0.3V, f=54MHz		2.0	3.0	mA
Output off leak at output disable	I_O	OE≦0.3V			10	μA
Output Duty Ratio	Duty	CL=15pF, f=54MHz, Vc=1/2V_{DD}	45		55	%
Pull Range	Fcntr	Vc=+1.65±1.35V, 54MHz Crystal *1	±110			ppm
Rise time	Tr	CL=15pF, 10~90% V_{DD}		2.0	3.0	ns
Fall time	Tf	CL=15pF, 90~10% V_{DD}		2.0	3.0	ns
Output Enable Time	Tpe				100	ns
Output Disable Time	Tpd				100	ns
Modulation Band Width	Fc	Vc=1.35sinωt+1.65V	15	20		kHz

Crystal *1 ; Equivalent Parameter of Crystal is γ=C0/C1<300

5-3 IPV0055H0

Unless otherwise stated, V_{DD}=2.52V~3.63V, V_{SS}=0V, Ta=-40℃~85℃

Parameter	Symbol	Condition		Specification			Unit
				Min	Typ	Max	
"H" input current	I_{IH}	$V_{IN}=V_{DD}$				1.0	μA
"L" input current	I_{IL}	$V_{IN}=V_{SS}$				100	μA
"H" output voltage	V_{OH}	I_{OH}=-5mA		V_{DD}-0.4			V
"L" output voltage	V_{OL}	I_{OL}=5mA				0.4	V
Current consumption	I_{DD}	CL=15pF, V_{DD}=3.63V OE≧V_{DD}-0.3V, f=126MHz			16.0	20.0	mA
Current consumption at output disable	I_{DDD}	CL=15pF, V_{DD}=3.63V OE≦0.3V, f=126MHz			8.6	10.0	mA
Output off leak at output disable	I_O	OE≦0.3V				10	μA
Output Duty Ratio	Duty	CL=15pF Vc=1/2V_{DD}	f=80MHz	45		55	%
			f=100MHz	45		55	%
			f=126MHz	40		60	%
Pull Range	Fcntr	Vc=1.65±1.65V Crystal *1	f=80MHz	±110			ppm
			f=100MHz	±100			ppm
			f=126MHz	±90			ppm
Rise time	Tr	CL=15pF, 10~90% V_{DD}			1.5	1.9	ns
Fall time	Tf	CL=15pF, 90~10% V_{DD}			1.4	1.9	ns
Output Enable Time	Tpe					100	ns
Output Disable Time	Tpd					100	ns
Modulation Band Width	Fc	Vc=1.35sinωt+1.65V		15			kHz

Crystal *1 ; Equivalent Parameter of Crystal is γ =C0/C1<300

5-4 IPV0055H0M

Unless otherwise stated, V_{DD}=2.52V~3.63V, V_{SS}=0V, Ta=-40℃~85℃

Parameter	Symbol	Condition		Specification			Unit
				Min	Typ	Max	
"H" input current	I_{IH}	$V_{IN}=V_{DD}$				1.0	μA
"L" input current	I_{IL}	$V_{IN}=V_{SS}$				100	μA
"H" output voltage	V_{OH}	I_{OH}=-5mA		V_{DD}-0.4			V
"L" output voltage	V_{OL}	I_{OL}=5mA				0.4	V
Current consumption	I_{DD}	CL=15pF, V_{DD}=3.63V OE≧V_{DD}-0.3V, f=126MHz			16.0	20.0	mA
Current consumption at output disable	I_{DDD}	CL=15pF, V_{DD}=3.63V OE≦0.3V, f=126MHz			8.6	10.0	mA
Output off leak at output disable	I_O	OE≦0.3V				10	μA
Output Duty Ratio	Duty	CL=15pF Vc=1/2V_{DD}	f=80MHz	45		55	%
			f=100MHz	45		55	%
			f=126MHz	40		60	%
Pull Range	Fcntr	Vc=1.65±1.35V Crystal *1	f=80MHz	±110			ppm
			f=100MHz	±100			ppm
			f=126MHz	±90			ppm
Rise time	Tr	CL=15pF, 10~90% V_{DD}			2.5	4.0	ns
Fall time	Tf	CL=15pF, 90~10% V_{DD}			2.0	3.5	ns
Output Enable Time	Tpe					100	ns
Output Disable Time	Tpd					100	ns
Modulation Band Width	Fc	Vc=1.35sinωt+1.65V		15			kHz

Crystal *1 ; Equivalent Parameter of Crystal is γ =C0/C1<300

5-5 IPV0055H0A

Unless otherwise stated, V_{DD}=2.52V~3.63V, V_{SS}=0V, Ta=-40℃~85℃

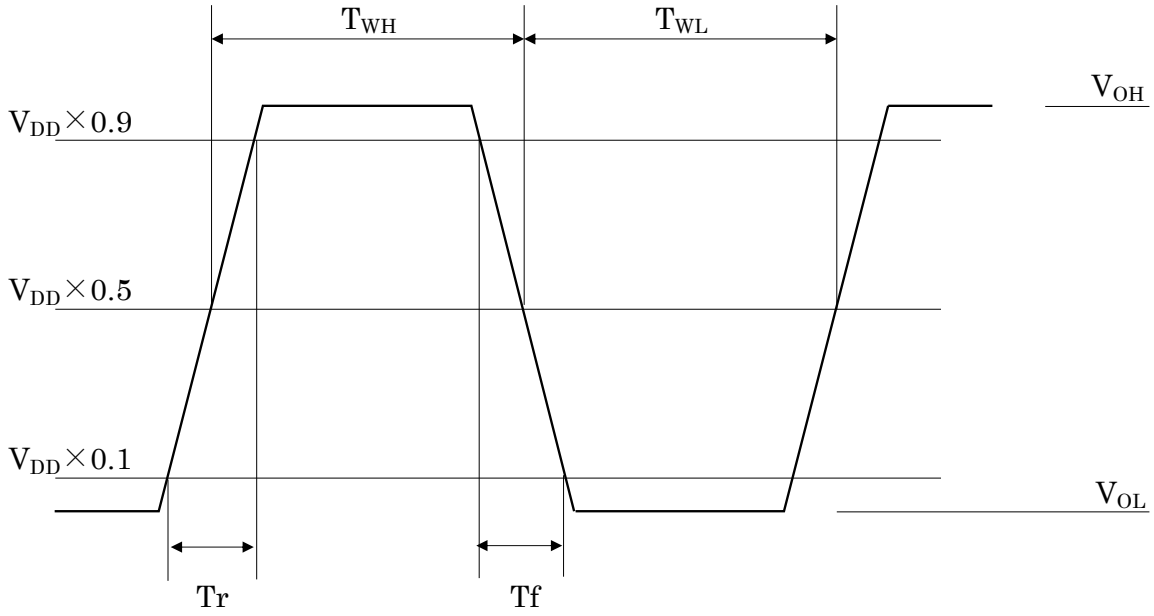
Parameter	Symbol	Condition		Specification			Unit
				Min	Typ	Max	
"H" input current	I_{IH}	$V_{IN}=V_{DD}$				1.0	μA
"L" input current	I_{IL}	$V_{IN}=V_{SS}$				100	μA
"H" output voltage	V_{OH}	I_{OH}=-5mA		V_{DD}-0.4			V
"L" output voltage	V_{OL}	I_{OL}=5mA				0.4	V
Current consumption	I_{DD}	CL=15pF, V_{DD}=3.63V OE≧V_{DD}-0.3V, f=126MHz			16.0	20.0	mA
Current consumption at output disable	I_{DDD}	CL=15pF, V_{DD}=3.63V OE≦0.3V, f=126MHz			8.6	10.0	mA
Output off leak at output disable	I_O	OE≦0.3V				10	μA
Output Duty Ratio	Duty	CL=15pF Vc=1/2V_{DD}	f=80MHz	45		55	%
			f=100MHz	45		55	%
			f=126MHz	40		60	%
Pull Range	Fcntr	Vc=1.65±1.65V Crystal *1	f=80MHz	±110			ppm
			f=100MHz	±100			ppm
			f=126MHz	±90			ppm
Rise time	Tr	CL=15pF, 10~90% V_{DD}			1.5	1.9	ns
Fall time	Tf	CL=15pF, 90~10% V_{DD}			1.4	1.9	ns
Output Enable Time	Tpe					100	ns
Output Disable Time	Tpd					100	ns
Modulation Band Width	Fc	Vc=1.35sinωt+1.65V		15			kHz

Crystal *1 ; Equivalent Parameter of Crystal is γ=C0/C1<300

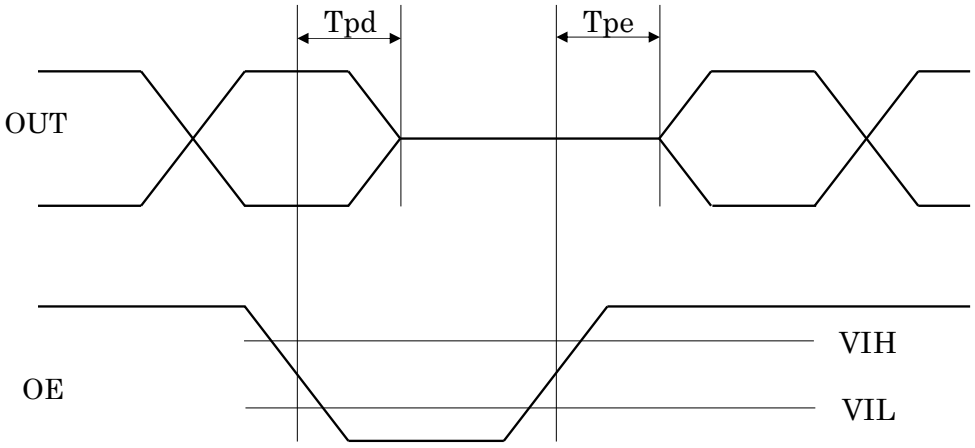
Phase Noise comparison

F0=122MHz, Vc=1.65V, Room Temperature

Offset	IPV0055H0	IPV0055H0A
10Hz	-69 dBc/Hz	-70 dBc/Hz
100Hz	-101 dBc/Hz	-103 dBc/Hz
1kHz	-126 dBc/Hz	-127 dBc/Hz
10kHz	-140 dBc/Hz	-145 dBc/Hz
100kHz	-154 dBc/Hz	-156 dBc/Hz
1MHz	-160 dBc/Hz	-161 dBc/Hz
10MHz	-162 dBc/Hz	-162 dBc/Hz
Phase Jitter 12kHz~20MHz	71 fs	66 fs



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



VIH : Threshold voltage for Output Start
VIL : Threshold voltage for Output Stop

Fig. 5-1 Output Wave Form (Duty, Tr, Tf, Tpd, Tpe)

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

V_{DD}=3.3V, V_{SS}=0V, Ta=25℃, Vc=V_{SS}~V_{DD}

Parameter		Symbol	Condition	Min	Typ	Max	Unit
Feedback Resistor		Rf	Refer to Fig. 6-1	80	100	120	kΩ
Driving Resistor	IPV0052H	Rd		0.95	1.20	1.45	kΩ
	IPV0053H			0.50	0.60	0.70	
	IPV0054H			0.08	0.10	0.12	
	IPV0054H0M			0.24	0.30	0.36	
	IPV0055H0, H0A			0.40	0.50	0.60	
	IPV0055H0M			0.08	0.10	0.12	
Bias Resistor		R_{V1}		200	240	280	kΩ
		R_{V2}		96	120	145	kΩ
Input Resistor		R_{VC}			20		kΩ
VC Input impedance		Zvc	VC terminal to GND	5			MΩ
Equivalent series (Loading) Capacitance	IPV0052H f=27MHz	CLxtal	Vc=0V		10.7		pF
			Vc=1.65V, 1.4V		6.0		
			Vc=3.3V, 3.0V		3.7		
	IPV0053H f=47MHz		Vc=0V		10.7		
			Vc=1.65V, 1.4V		6.0		
			Vc=3.3V, 3.0V		3.7		
	IPV0054H f=60MHz		Vc=0V		7.5		
			Vc=1.65V		3.0		
			Vc=3.3V		2.3		
	IPV0055H0, H0A f=120MHz		Vc=0V		4.5		
			Vc=1.65V		2.2		
			Vc=3.3V		1.5		
Drive Level	IPV0054H0M	DL	Vc=0V		240		μW
			Vc=1.65V		200		
			Vc=3.3V		160		
	IPV0055H		Vc=0V		410		
			Vc=1.65V		390		
			Vc=3.3V		320		
Frequency deviation by IC		⊿fc/fc	Crystal fixed			25	ppm
DC cut Capacitor	All series except below.	Cpg		13	16	19	pF
		Cpd		40	50	60	
	IPV0055H0, H0A	Cpg		10	12	14	
		Cpd		38	48	58	
	IPV0055H0M	Cpg		10	12	14	
		Cpd		40	50	60	

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

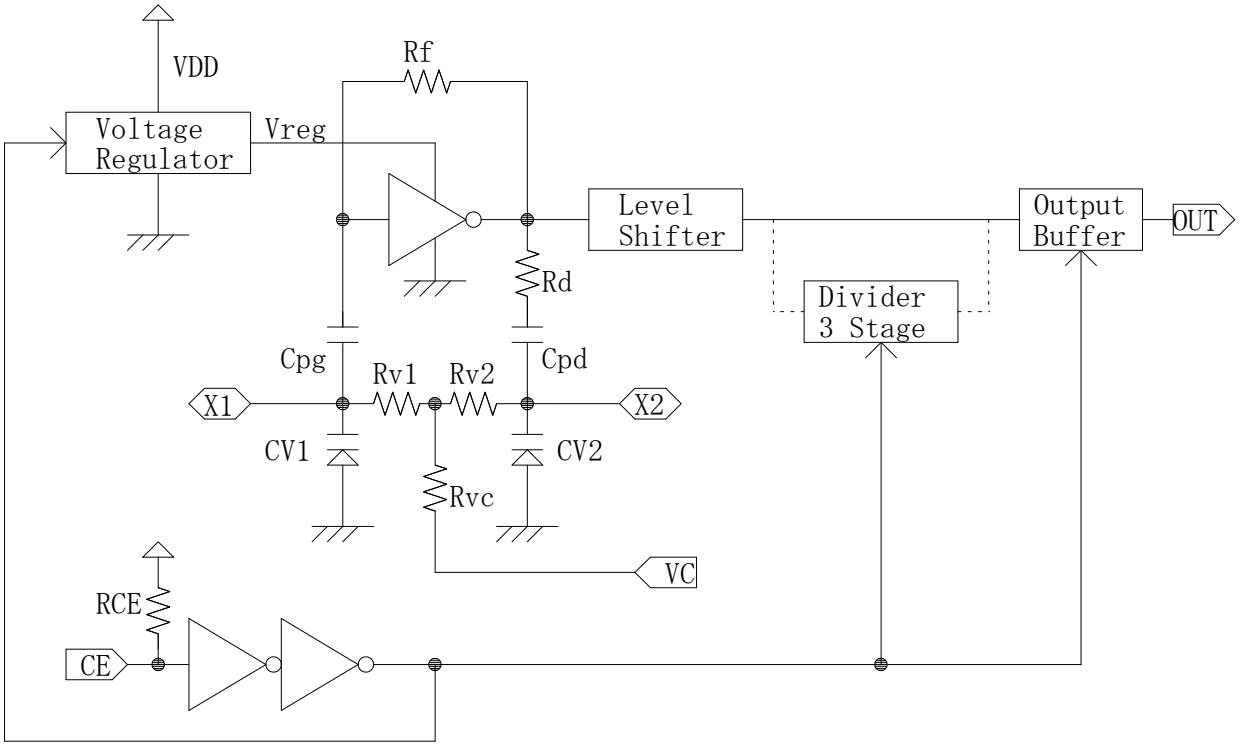
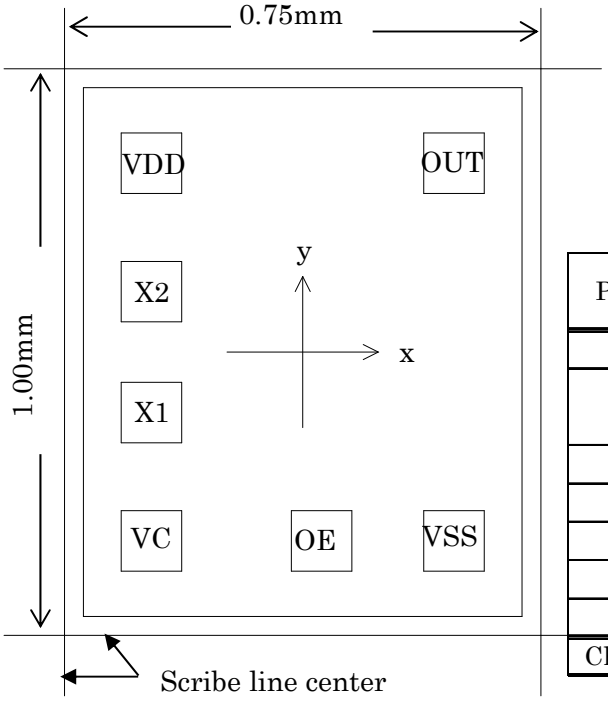


Fig. 6-1 Block Diagram

7. Pad Layout



- Die Size: 0.75mm × 1.00mm
- Pad Size: 80um □
- Thickness: 150um±20um
- IC Backside: Gnd or Open

Pad Name	Function	Location (μm)	
		x	y
VC	Frequency Control Input	-244	-359
OE	Output Enable, "L": High-Impedance *1)	44	-359
VSS	(−) Ground	244	-359
OUT(Q)	Frequency Output	179	359
VDD	(+) Power Supply	-244	359
X2	Crystal Drive	-244	132
X1	Crystal Feedback	-244	-132
Chip Center		0	0

*1) : 2.5MΩ Typ.