■ 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 : 2.97V~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 and 1/4
- 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 －W 1

- IPV: Series Name For VCXO
- 005: Product Series
- x: Frequency Range
- H: V_{DD}
- z: Divide Function
  - 0: 1/1
  - 1: 1/2 Divide
  - 2: 1/4 Divide
- －W: IC Form
- 1: Thickness

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

Recommended V_{DD}	
H	3.3V

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 3 H 0	30.00	50.00	1/1	30.00	50.00	
IPV005 3 H 2			1/4	7.50	12.50	
IPV005 4 H 0	50.00	80.00	1/1	50.00	80.00	
IPV005 5 H 0	80.00	126.00	1/1	80.00	126.00	

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	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}		2.97	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, 54H0

Unless otherwise stated, V_{DD}=2.97V~3.63V, V_{SS}=0V, Ta=-40℃~125℃

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}	$V_{IN}=V_{SS}$			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	V_{DD}=3.3V, CL=15pF, 10~90% V_{DD}					ns
		IPV0052Hz	-40℃~85℃		3.0	4.5	
			85℃~125℃			6.0	
		IPV0053Hz	-40℃~85℃		2.5	3.5	
			85℃~125℃			4.7	
		IPV0054H0	-40℃~85℃		2.0	3.0	
			85℃~125℃			4.0	
Fall time	Tf	V_{DD}=3.3V, CL=15pF, 90~10% V_{DD}					ns
		IPV0052Hz	-40℃~85℃		3.0	4.5	
			85℃~125℃			6.0	
		IPV0053Hz	-40℃~85℃		2.5	3.5	
			85℃~125℃			4.7	
		IPV0054H0	-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 IPV0055H0

Unless otherwise stated, V_{DD}=2.97V~3.63V, V_{SS}=0V, Ta=-40℃~85℃

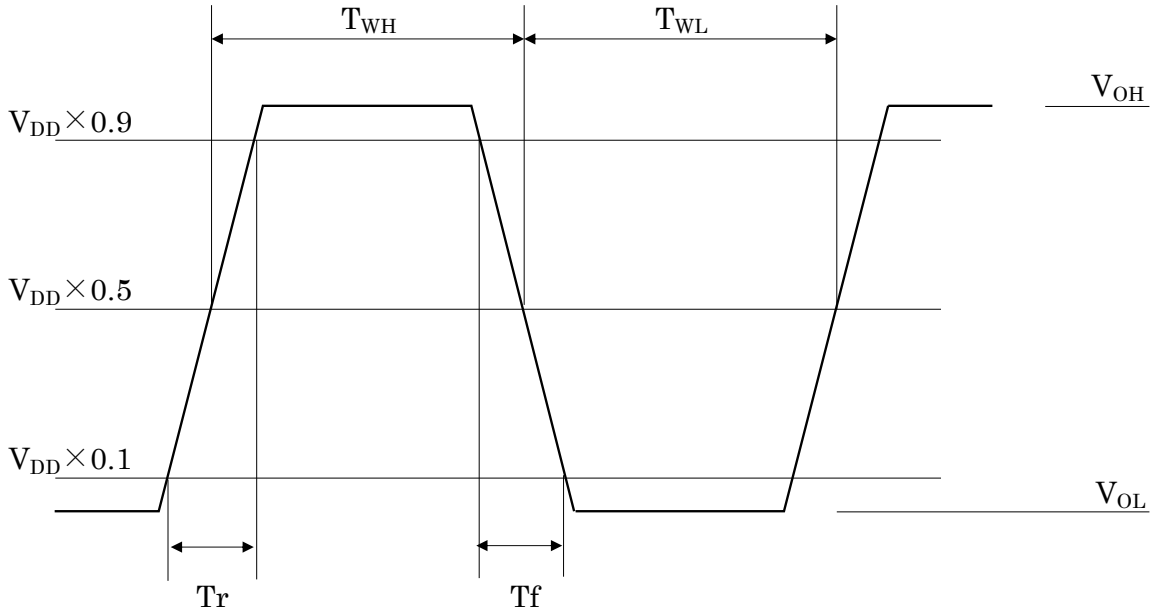
Parameter	Symbol	Condition		Specification			Unit
				Min	Typ	Max	
"H" input current	I_{IH}	$V_{IN}=V_{DD}$				1.0	μA
"L" input current	I_{IL}	$V_{IN}=V_{SS}$				100	μA
"H" output voltage	V_{OH}	I_{OH}=-5mA		V_{DD}-0.4			V
"L" output voltage	V_{OL}	I_{OL}=5mA				0.4	V
Current consumption	I_{DD}	CL=15pF, 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

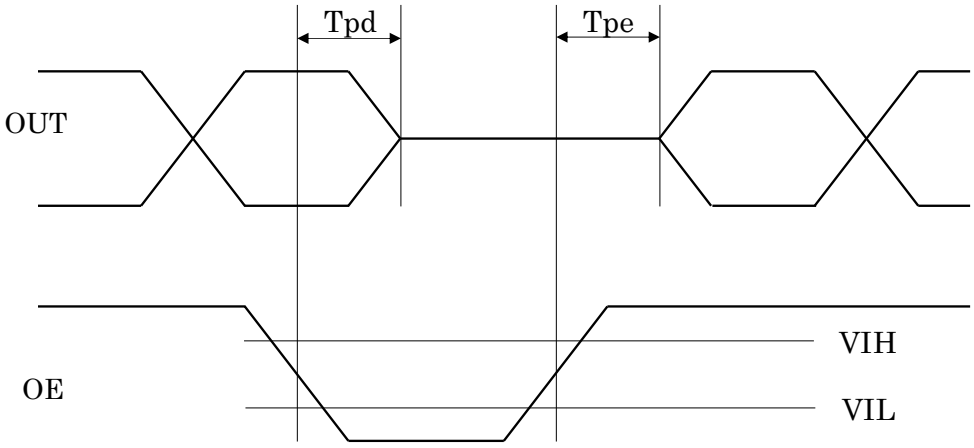
Phase Noise comparison

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

Offset	IPV0055H0	
10Hz	-69 dBc/Hz	
100Hz	-101 dBc/Hz	
1kHz	-126 dBc/Hz	
10kHz	-140 dBc/Hz	
100kHz	-154 dBc/Hz	
1MHz	-160 dBc/Hz	
10MHz	-162 dBc/Hz	
Phase Jitter 12kHz~20MHz	71 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	IPV0052Hz	Rd		0.95	1.20	1.45	kΩ
	IPV0053Hz			0.50	0.60	0.70	
	IPV0054H0			0.08	0.10	0.12	
	IPV0055H0			0.40	0.50	0.60	
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	IPV0052Hz f=27MHz	CLxtal	Vc=0V		10.7		pF
			Vc=1.65V, 1.4V		6.0		
			Vc=3.3V, 3.0V		3.7		
	IPV0053Hz f=47MHz		Vc=0V		10.7		
			Vc=1.65V, 1.4V		6.0		
			Vc=3.3V, 3.0V		3.7		
	IPV0054H0 f=60MHz		Vc=0V		7.5		
			Vc=1.65V		3.0		
			Vc=3.3V		2.3		
	IPV0055H0 f=120MHz		Vc=0V		4.5		
			Vc=1.65V		2.2		
			Vc=3.3V		1.5		
Drive Level	IPV0055H0	DL	Vc=0V		410		μW
			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	Cpg		10	12	14	
		Cpd		38	48	58	

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

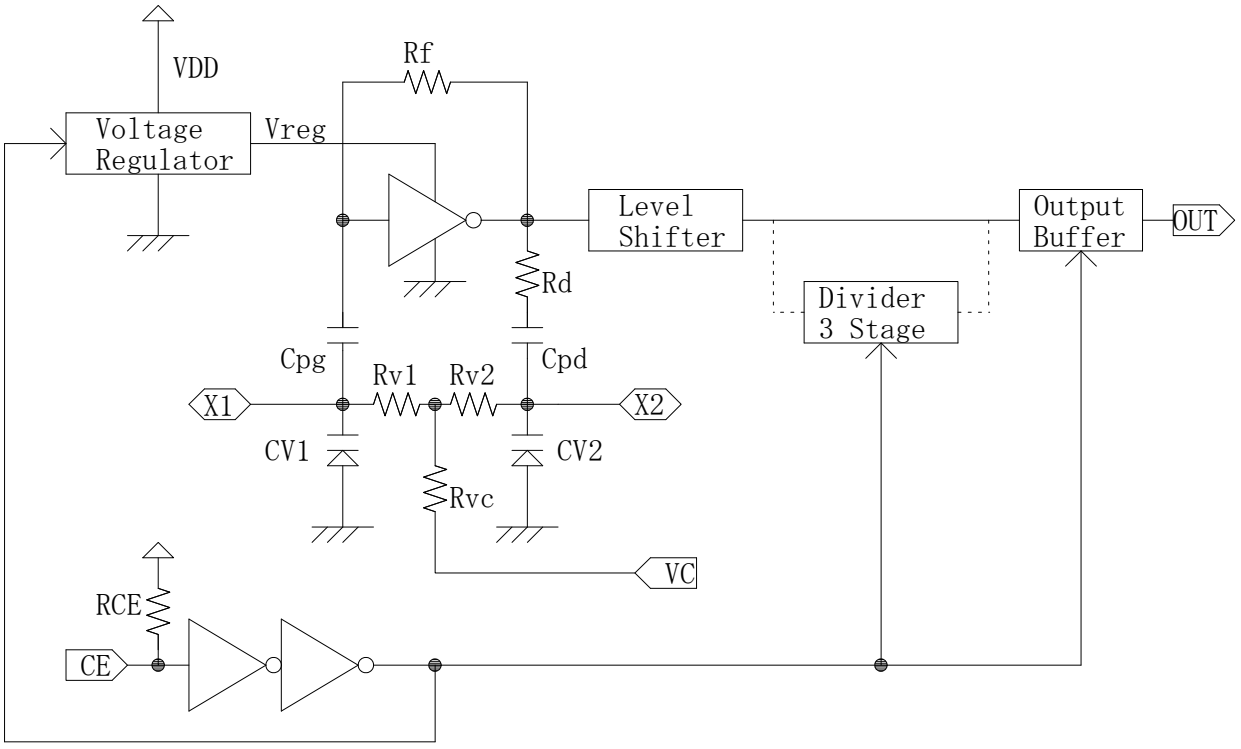
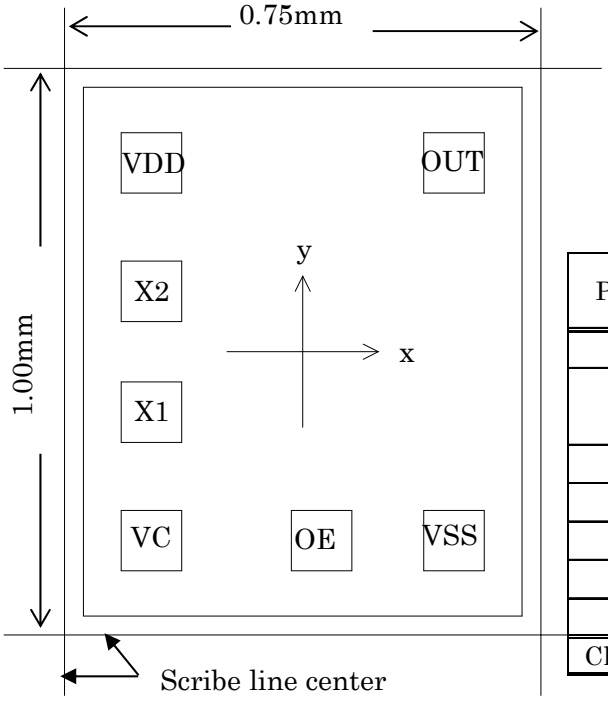


Fig. 6-1 Block Diagram

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.