■ Description

IPV005xH and IPV005xA 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 : 125℃ (Except IPV0055)
- Power supply voltage : 2.52～3.63V
- Vc Input impedance : 5MΩ
- Standby function : Output disable
- Crystal frequency : 16～126MHz
- 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 Vdd : Within ±1ppm
- Wide pulling range : ±100ppm minimum / Vc=1.65±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
- H: VDD
- z: Divide Function
- A: Optional code
- -W 1:

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

Optional code

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

Divide Function
0:1/1
1:1/2 Divide
2:1/4 Divide
3:1/8 Divide
4:1/16 Divide

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

Recommended VDD	
H	3.3V
A	2.8V

2. Series

Part Number	Output Frequency (MHz)		Divide	Remarks
	Min.	Max.		
IPV005 2 H 0	16.00	36.00	1/1	
IPV005 2 H 1	8.00	18.00	1/2	
IPV005 2 H 2	4.00	9.00	1/4	
IPV005 2 H 3	2.00	4.50	1/8	
IPV005 2 H 4	1.00	2.25	1/16	
IPV005 3 H 0	30.00	50.00	1/1	
IPV005 3 H 1	15.00	25.00	1/2	
IPV005 3 H 2	7.50	12.50	1/4	
IPV005 4 H 0	50.00	80.00	1/1	Wider Frequency range than 54H0M
IPV005 4 H 1	25.00	40.00	1/2	
IPV005 4 H 0 M	45.00	60.00	1/1	Better Pull balance than 54H0
IPV005 5 H 0	80.00	126.00	1/1	
IPV005 5 H 0 M	80.00	126.00	1/1	Tr, Tf is Slower than 55H0
IPV005 5 H 0 A	80.00	126.00	1/1	Lower Phase Noise
IPV005 2 A 0	16.00	36.00	1/1	
IPV005 2 A 1	8.00	18.00	1/2	
IPV005 2 A 2	4.00	9.00	1/4	
IPV005 3 A 0	30.00	54.00	1/1	
IPV005 3 A 1	15.00	27.00	1/2	

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	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	T_{stg}		-55	125	℃

4. Recommended Operating Condition V_{SS}=0V, T a =- 40℃～＋125℃ (85℃ with IPV0055)

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Note
Supply Voltage		V_{DD}		2.52	3.3	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	2.52V≤V_{DD}≤ 3.63V	0		V_{DD} +1.0	V	VC
Output Load Capacitance	IPV0052H IPV005xA	CL	CMOS		15	30	pF	OUT
	IPV0053H IPV0054H IPV0055H					15		
Ambient Temperature 1		T_{opT}	Except IPV0055	-40		125	℃	
Ambient Temperature 2		T_{opT}	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、T a =-40～125℃

Parameter		Symbol	Condition	Specification				Unit
				Min	Typ	Max	125℃	
"H" input current		I_{IH}	V_{IN}=V_{DD}			1	←	μA
"L" input current		I_{IL}	V_{IN}=V_{SS}		1.3	10	←	μA
"H" output voltage		V_{OH}	I_{OH}=-5mA	V_{DD}-0.4			I_{OH}=-3mA	V
"L" output voltage		V_{OL}	I_{OL}=5mA			0.4	I_{OL}=3mA	V
Current consumption		I_{DD}	CL=15pF, VDD=3.63V, OE≧V_{DD}-0.3V, Fo=27MHz		3	5	←	mA
Current consumption at output disable		I_{DDD}	CL=15pF, VDD=3.63V, OE≦0.3V, F0=27MHz		1	2	←	mA
Output off leak at output disable		I_O	OE≦0.3V			10	←	μA
Output Duty Ratio		Duty	CL=15pF, F0=27MHz, Vc=1/2V_{DD}	45		55	43Min 57Max	%
Pull Range		Fcntr	Vc=+1.65±1.35V 27MHz, Crystal *1	±110			←	ppm
Rise time	IPV0052	Tr	CL=15pF, 10～90% VDD		3.0	4.5	6.0Max	ns
	IPV0053				2.5	3.5	4.7Max	
	IPV0054				2.0	3.0	4.0Max	
Fall time	IPV0052	Tf	CL=15pF, 10～90% VDD		3.0	4.5	6.0Max	ns
	IPV0053				2.5	3.5	4.7Max	
	IPV0054				2.0	3.0	4.0Max	
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、
T a ＝-40～85℃

Parameter	Symbol	Condition	Specification			Unit
			Min	Typ	Max	
“H” input current	I_{IH}	$V_{IN}=V_{DD}$			1	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, Fo=54MHz		6	10	mA
Current consumption at output disable	I_{DDD}	CL=15pF, V_{DD}=3.63V, OE≦0.3V,　F0=54MHz		2	3	mA
Output off leak at output disable	I_O	OE≦0.3V			10	μA
Output Duty Ratio	Duty	CL=15pF, F0=54MHz, Vc=1/2V_{DD}	45		55	%
Pull Range	Fcntr	Vc=+1.65±1.35V Crystal *1	±110			ppm
Rise time	Tr	CL=15pF, 10～90% VDD		2.0	3.0	ns
Fall time	Tf	CL=15pF, 10～90% VDD		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, T a =-40～85℃

Parameter	Symbol	Condition		Specification			Unit
				Min	Typ	Max	
“H” input current	I_{IH}	$V_{IN}=V_{DD}$				1	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, VDD=3.63V, OE≧VDD-0.3V, F0=126MHz			16	20	mA
Current consumption at output disable	I_{DDD}	CL=15pF, VDD=3.63V, OE≦0.3V, F0=126MHz			8.6	10	mA
Output off leak at output disable	I_O	OE≦0.3V				10	μA
Output Duty Ratio	Duty	CL=15pF, Vc=1/2V_{DD}	80MHz	45		55	%
			120MHz	45		55	%
			126MHz	40		60	%
Pull Range	Fcntr	Vc=1.65±1.65V Crystal *1	80MHz	±110			ppm
			100MHz	±100			ppm
			126MHz	±90			ppm
Rise time	Tr	CL=15pF, 10～90% VDD			1.5	1.9	ns
Fall time	Tf	CL=15pF, 10～90% VDD			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, T a =-40～85℃

Parameter	Symbol	Condition		Specification			Unit
				Min	Typ	Max	
"H" input current	I_{IH}	$V_{IN}=V_{DD}$				1	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, VDD=3.63V, OE≧VDD-0.3V, F0=126MHz			16	20	mA
Current consumption at output disable	I_{DDD}	CL=15pF, VDD=3.63V, OE≦0.3V, F0=126MHz			8.6	10	mA
Output off leak at output disable	I_O	OE≦0.3V				10	μA
Output Duty Ratio	Duty	CL=15pF, Vc=1/2V_{DD}	80MHz	45		55	%
			120MHz	45		55	%
			126MHz	40		60	%
Pull Range	Fcntr	Vc=1.65±1.35V Crystal *1	80MHz	±110			ppm
			100MHz	±100			ppm
			126MHz	±90			ppm
Rise time	Tr	CL=15pF, 10～90% VDD			2.5	4.0	ns
Fall time	Tf	CL=15pF, 10～90% VDD			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, T a =-40～85℃

Parameter	Symbol	Condition		Specification			Unit
				Min	Typ	Max	
“H” input current	I_{IH}	$V_{IN}=V_{DD}$				1	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, VDD=3.63V, OE≧VDD-0.3V, F0=126MHz			16	20	mA
Current consumption at output disable	I_{DDD}	CL=15pF, VDD=3.63V, OE≦0.3V, F0=126MHz			8.6	10	mA
Output off leak at output disable	I_O	OE≦0.3V				10	μA
Output Duty Ratio	Duty	CL=15pF, Vc=1/2V_{DD}	80MHz	45		55	%
			120MHz	45		55	%
			126MHz	40		60	%
Pull Range	Fcntr	Vc=1.65±1.65V Crystal *1	80MHz	±110			ppm
			100MHz	±100			ppm
			126MHz	±90			ppm
Rise time	Tr	CL=15pF, 10～90% VDD			1.5	1.9	ns
Fall time	Tf	CL=15pF, 10～90% VDD			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
F=122MHz, Vc=1.65V, Room Temperature

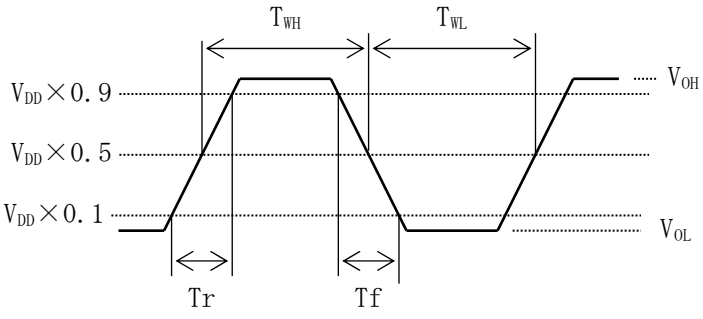
Offset	IPV0055H0	IPV0055H0A
10Hz	-69 dBc	-70 dBc
100Hz	-101 dBc	-103 dBc
1KHz	-126 dBc	-127 dBc
10KHz	-140 dBc	-145 dBc
100KHz	-154 dBc	-156 dBc
1MHz	-160 dBc	-161 dBc
10MHz	-162 dBc	-162 dBc

Phase Jitter	IPV0055H0	IPV0055H0A
12KHz～20MHz	71 fs	66 fs

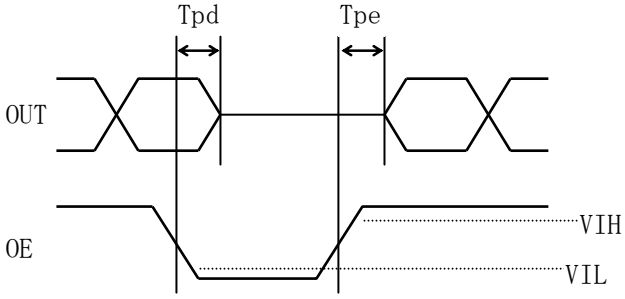
5-6 IPV005xAz　　Unless otherwise stated, V_{DD}=2.52V～3.63V, V_{SS}=0V, T a =-40～125℃

Parameter		Symbol	Condition	Specification				Unit
				Min	Typ	Max	125℃	
"H" input current		I_{IH}	$V_{IN}=V_{DD}$			1	←	μA
"L" input current		I_{IL}	$V_{IN}=V_{SS}$		1.3	10	←	μA
"H" output voltage		V_{OH}	I_{OH}=-5mA	V_{DD}-0.4			I_{OH}=-3mA	V
"L" output voltage		V_{OL}	I_{OL}=5mA			0.4	I_{OL}=3mA	V
Current consumption		I_{DD}	CL=15pF, V_{DD}=3.0V, OE≧VDD-0.3V, Fo=27MHz		2.0	3.3	4.5	mA
Current consumption at output disable		I_{DDD}	CL=15pF, V_{DD}=3.0V, OE≦0.3V, F0=27MHz		0.5	1.0	1.8	mA
Output off leak at output disable		I_O	OE≦0.3V			10	←	μA
Output Duty Ratio	IPV0052Az	Duty	CL=15pF, F0=27MHz, Vc=1/2V_{DD}	45		55	43Min 58Max	%
	IPV0053Az		CL=15pF, F0=54MHz, Vc=1/2V_{DD}	43		58	←	%
Pull Range		Fcntr	V_{DD}=2.8V, Vc=1.40±1.40V 27MHz, Crystal *1	±100			←	ppm
Rise time		Tr	CL=15pF, 10～90% VDD		3.0	4.5	6.0Max	ns
Fall time		Tf	CL=15pF, 10～90% VDD		3.0	4.5	6.0Max	ns
Output Enable Time		Tpe				100	←	ns
Output Disable Time		Tpd				100	←	ns
Modulation Band Width		Fc	Vc=1.40sinωt+1.40V	15	20		←	KHz

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



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



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, A	Rd		0.95	1.20	1.45	KΩ
	IPV0053H, A			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	All series except below.	R_{V1}		200	240	280	KΩ
		R_{V2}		96	120	145	KΩ
	IPV005xA	R_{V1}		150	180	210	KΩ
		R_{V2}		75	90	105	KΩ
Input Resistor		R_{VC1}			20		KΩ
VC Input impedance		Rvc	VC terminal to GND	5			MΩ
Equivalent series (Loading) Capacitance	IPV0052H, A 27MHz	CLxtal	Vc=0V		10.7		pF
			Vc=1.65V, 1.4V		6.0		
			Vc=3.3V, 3.0V		3.7		
	IPV0053H, A 47MHz		Vc=0V		10.7		
			Vc=1.65V, 1.4V		6.0		
			Vc=3.3V, 3.0V		3.7		
	IPV0054H 60MHz		Vc=0V		7.5		
			Vc=1.65V		3.0		
			Vc=3.3V		2.3		
	IPV0055H0, H0A 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.

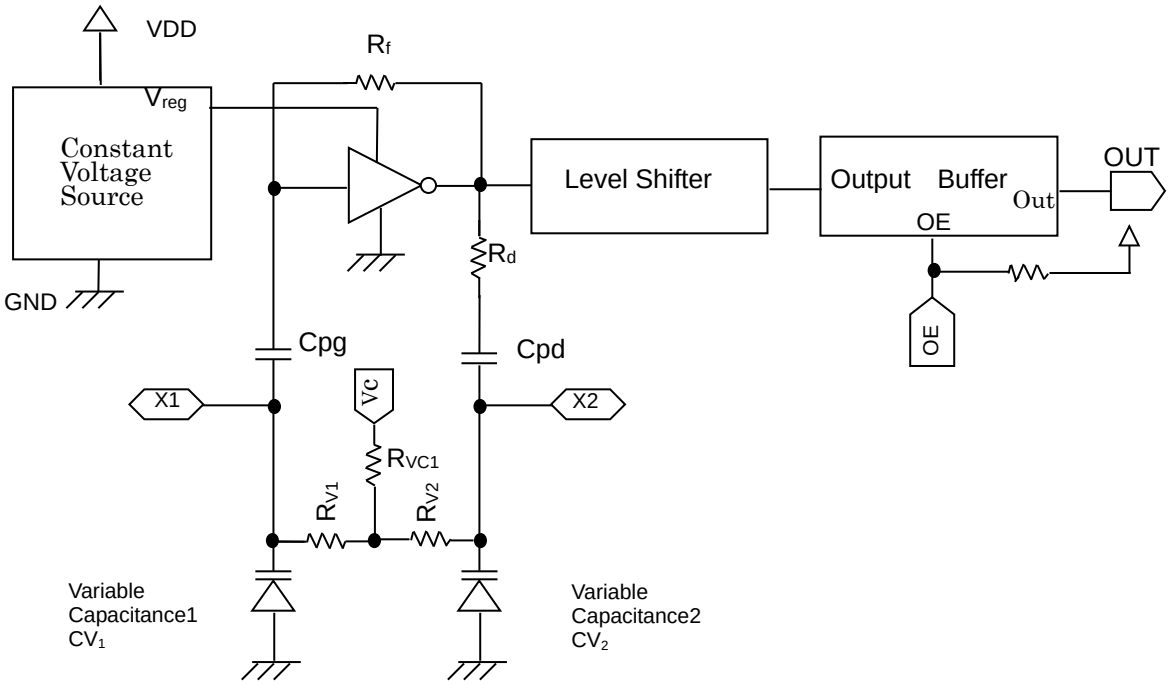
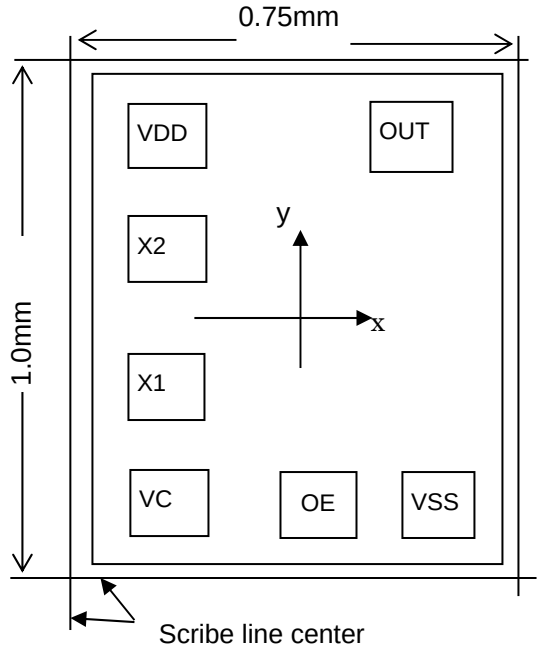


Fig. 6-1 Block Diagram

7. Pad Layout



- Die Size : 0.75mm × 1.0mm
- Pad Size : 80um □
- Thickness : 150±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.

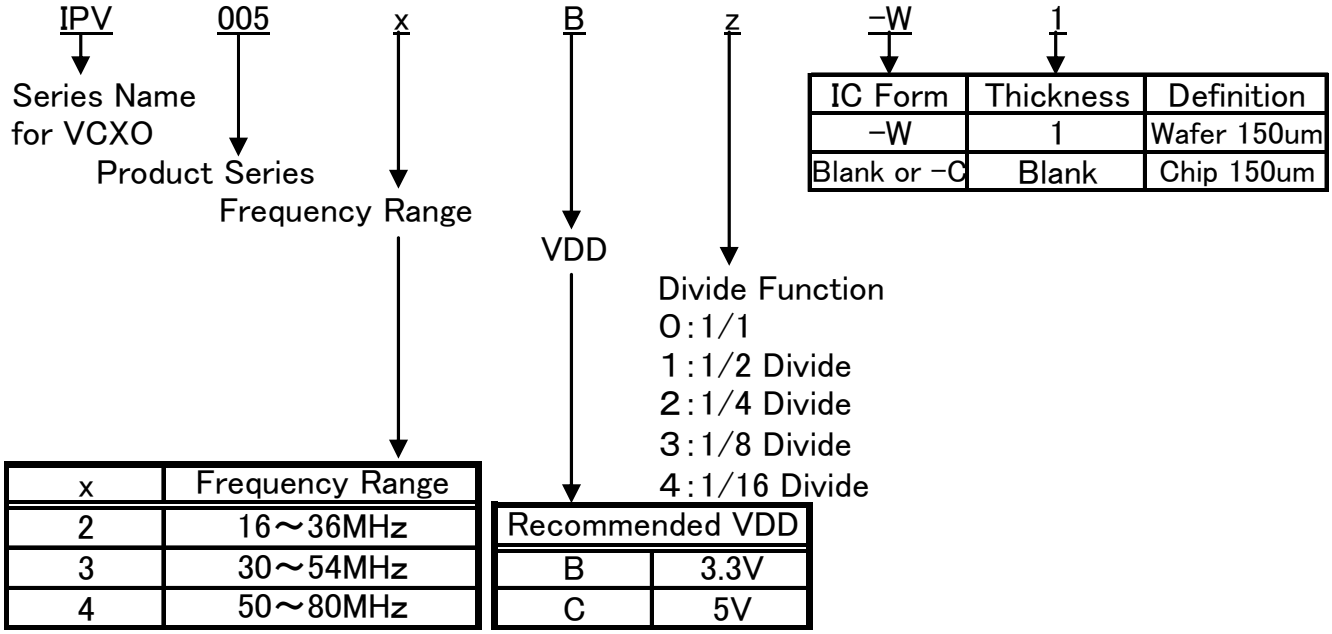
■ Description

IPV005xB and IPV005xC 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 80MHz.

■ Features

- Operation temperature : 125℃
- Power supply voltage : 2.52～3.63V / IPV005xB and 4.5～5.5V / IPV005xC
- Vc Input impedance : 100KΩ
- Standby function : Output disable
- Crystal frequency : 16～80MHz
- Low power consumption : 3mA (IPV0052B)
- Output : CMOS
- Divide function : 1/2, 1/4, 1/8 and 1/16
- Small chip size : 0.75mm × 1.00mm
- Frequency stability to Vdd : Within ±1ppm
- Wide pulling range : ±100ppm minimum / Vc=1.65±1.35V
- Duty cycle : Within 50±5%

1. Part number rule



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

x	Frequency Range
2	16～36MHz
3	30～54MHz
4	50～80MHz

Recommended VDD	
B	3.3V
C	5V

2. Series

Part Number	Output Frequency (MHz)		Divide	Remarks
	Min.	Max.		
IPV005 2 B 0	16.00	36.00	1/1	
IPV005 2 B 1	8.00	18.00	1/2	
IPV005 2 B 2	4.00	9.00	1/4	
IPV005 2 B 3	2.00	4.50	1/8	
IPV005 2 B 4	1.00	2.25	1/16	
IPV005 3 B 0	30.00	54.00	1/1	
IPV005 3 B 1	15.00	27.00	1/2	
IPV005 3 B 2	7.50	13.50	1/4	
IPV005 4 B 0	50.00	80.00	1/1	
IPV005 2 C 0	16.00	36.00	1/1	
IPV005 2 C 1	8.00	18.00	1/2	
IPV005 2 C 2	4.00	9.00	1/4	
IPV005 2 C 3	2.00	4.50	1/8	
IPV005 2 C 4	1.00	2.25	1/16	
IPV005 3 C 0	30.00	54.00	1/1	
IPV005 4 C 0	50.00	80.00	1/1	

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	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, T a =- 40℃～＋125℃

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Note
Supply Voltage	IPV005xB	V_{DD}		2.52	3.3	3.63	V	V_{DD}
	IPV005xC	V_{DD}		4.5	5.0	5.5	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	IPV005xB	V_C	2.52V≤V_{DD}≤3.63V	0		V_{DD} +1.0	V	VC
	IPV005xC	V_C	4.5V≤V_{DD}≤5.5V	0		V_{DD} +0.5	V	VC
Output Load Capacitance	IPV0052C	CL	CMOS		15	30	pF	OUT
	IPV005xB IPV0053C IPV0054C					15		
Ambient Temperature		T_{opT}		-40		125	℃	

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

5. Electrical Specification

5-1 IPV005xB Unless otherwise stated, V_{DD}=2.52V～3.63V, V_{SS}=0V, T a =-40～125℃

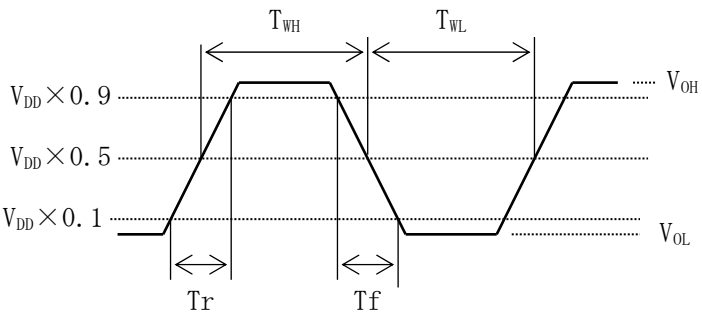
Parameter		Symbol	Condition	Specification				Unit
				Min	Typ	Max	125℃	
"H" input current		I_{IH}	$V_{IN}=V_{DD}$			1	←	μA
"L" input current		I_{IL}	$V_{IN}=V_{SS}$		1.3	10	←	μA
"H" output voltage		V_{OH}	I_{OH}=-5mA	V_{DD}-0.4			I_{OH}=-3mA	V
"L" output voltage		V_{OL}	I_{OL}=5mA			0.4	I_{OL}=3mA	V
Current consumption		I_{DD}	CL=15pF, V_{DD}=3.63V, OE≧VDD-0.3V, Fo=27MHz		3.0	5.0	←	mA
Current consumption at output disable		I_{DDD}	CL=15pF, V_{DD}=3.63V, OE≦0.3V, F0=27MHz		1.0	2.0	←	mA
Output off leak at output disable		I_O	OE≦0.3V			10	←	μA
Output Duty Ratio	IPV0052B	Duty	CL=15pF, F0=27MHz, Vc=1/2V_{DD}	45		55	43Min 57Max	%
	IPV0053B		CL=15pF, F0=47MHz, Vc=1/2V_{DD}	43		58	←	%
	IPV0054B		CL=15pF, F0=77MHz, Vc=1/2V_{DD}	40		60	←	%
Pull Range		Fcntr	Vc=+1.65±1.35V 27MHz, Crystal *1	±110			←	ppm
Rise time	IPV0052B	Tr	CL=15pF, 10～90% VDD		3.0	4.5	6.0Max	ns
	IPV0053B				2.5	3.5	4.7Max	
	IPV0054B				2.0	3.0	4.0Max	
Fall time	IPV0052B	Tf	CL=15pF, 10～90% VDD		3.0	4.5	6.0Max	ns
	IPV0053B				2.5	3.5	4.7Max	
	IPV0054B				2.0	3.0	4.0Max	
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

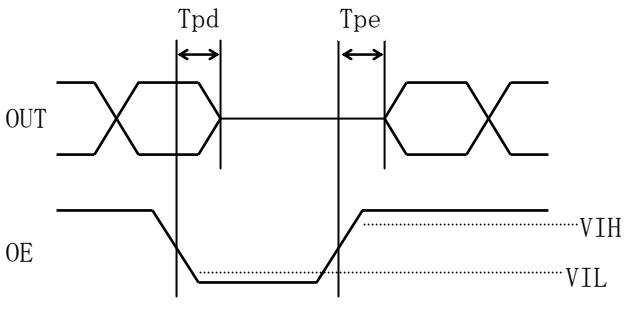
5-2 IPV005xC　　Unless otherwise stated, V_{DD}=4.5V～5.5V, V_{SS}=0V, T a =-40～125℃

Parameter		Symbol	Condition	Specification				Unit
				Min	Typ	Max	125℃	
"H" input current		I_{IH}	$V_{IN}=V_{DD}$			1	←	μA
"L" input current		I_{IL}	$V_{IN}=V_{SS}$		1.3	10	←	μA
"H" output voltage		V_{OH}	I_{OH}=-5mA	V_{DD}-0.4			I_{OH}=-3mA	V
"L" output voltage		V_{OL}	I_{OL}=5mA			0.4	I_{OL}=3mA	V
Current consumption		I_{DD}	CL=15pF, V_{DD}=5.5V, OE≧VDD-0.3V, Fo=27MHz		4.0	6.0	7.0Max	mA
Current consumption at output disable		I_{DDD}	CL=15pF, V_{DD}=5.5V, OE≦0.3V, F0=27MHz		1.0	2.0	←	mA
Output off leak at output disable		I_O	OE≦0.3V			10	←	μA
Output Duty Ratio	IPV0052C	Duty	CL=15pF, F0=27MHz, Vc=1/2V_{DD}	45		55	43Min 57Max	%
	IPV0053C		CL=15pF, F0=47MHz, Vc=1/2V_{DD}	40		60	←	%
	IPV0054C		CL=15pF, F0=77MHz, Vc=1/2V_{DD}	40		60	←	%
Pull Range		Fcntr	Vc=+2.5±2.0V 27MHz, Crystal *1	±110			←	ppm
Rise time	IPV0052C	Tr	CL=15pF, 10～90% VDD		3.0	4.5	←	ns
	IPV0053C				2.5	3.5	←	
	IPV0054C				2.0	3.0	←	
Fall time	IPV0052C	Tf	CL=15pF, 10～90% VDD		3.0	4.5	←	ns
	IPV0053C				2.5	3.5	←	
	IPV0054C				2.0	3.0	←	
Output Enable Time		Tpe				100	←	ns
Output Disable Time		Tpd				100	←	ns
Modulation Band Width		Fc	Vc=2.0sinωt+2.5V	15			←	KHz

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



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



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}=2.52V～3.63V / IPV005xB, 5.0V / IPV005xC, V_{SS}=0V, T a =25℃, Vc= V_{SS} ～V_{DD}

Parameter		Symbol	Condition	Min	Typ	Max	Unit
Input Resistor		R_{VC1}		25	30	35	KΩ
VC Input impedance		Rvc	VC terminal to GND	100			KΩ
Equivalent series (Loading) Capacitance	IPV0052B 27MHz	CLxtal	Vc=0V		10.7		pF
			Vc=1.65V		6.0		
			Vc=3.3V		3.7		
	IPV0053B 47MHz		Vc=0V		10.7		
			Vc=1.65V		6.0		
			Vc=3.3V		3.7		
	IPV0054B 60MHz		Vc=0V		7.5		
			Vc=1.65V		3.0		
			Vc=3.3V		2.3		
	IPV0052C 27MHz		Vc=0V		10.7		
			Vc=2.75V		6.0		
			Vc=5.5V		3.7		
	IPV0053C 47MHz		Vc=0V		10.7		
			Vc=2.75V		6.0		
			Vc=5.5V		3.7		
	IPV0054C 60MHz		Vc=0V		8.5		
			Vc=2.75V		5.0		
			Vc=5.5V		3.3		
Frequency deviation by IC		⊿fc/fc	Crystal fixed			25	ppm

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

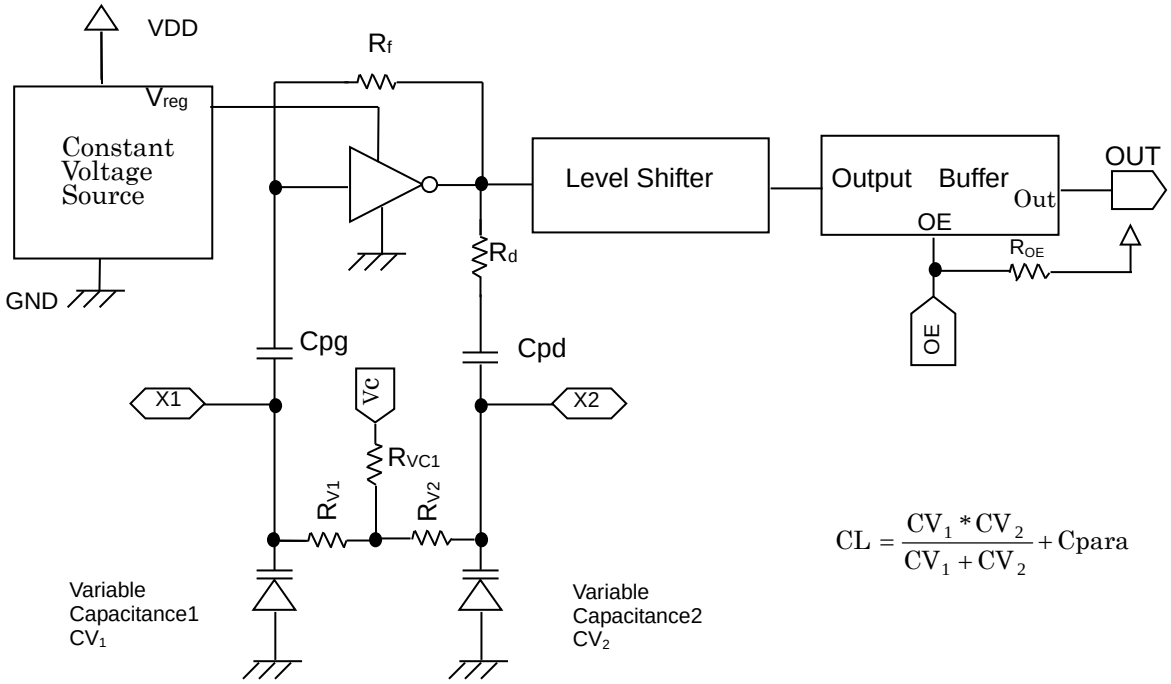
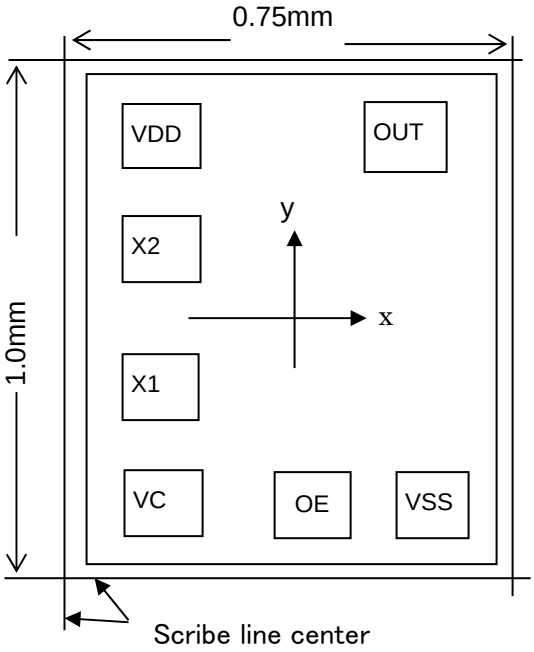


Fig. 6-1 Block Diagram

7. Pad Layout



- Die Size : 0.75mm × 1.0mm
- Pad Size : 80um □
- Thickness : 150±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.

■ Description

IPV005xL 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 operation voltage 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 4MHz to 36MHz.

■ Features

- Operation temperature : 125℃
- Power supply voltage : 1.62～3.0V
- Vc Input impedance : 5MΩ
- Standby function : Oscillation stop
- Crystal frequency : 16～36MHz
- Low power consumption : 1.5mA (IPV0052L)
- Output : CMOS
- Divide function : 1/2 and 1/4
- Small chip size : 0.75mm × 1.00mm
- Frequency stability to Vdd : Within ±1ppm
- Wide pulling range : ±100ppm minimum / Vc=0.9±0.9V
- Duty cycle : Within 50±5%

1. Part number rule

IPV 005 x L z -W 1

Series Name for VCXO

Product Series

Frequency Range

VDD

Divide Function
0:1/1
1:1/2 Divide
2:1/4 Divide

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

x	Frequency Range
2	16～36MHz

Recommended VDD	
L	1.8V

2. Series

Part Number	Output Frequency (MHz)		Divide	Remarks
	Min.	Max.		
IPV005 2 L 0	16.00	36.00	1/1	
IPV005 2 L 1	8.00	18.00	1/2	
IPV005 2 L 2	4.00	9.00	1/4	

3. Absolute Maximum Ratings VSS=0V、 Ta=+ 25℃± 2℃

Parameter	Symbol	Condition	Ratings		
			Min	Max	Unit
Supply Voltage	V_{DD}		V_{SS}-0.5	7	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	T_{stg}		-55	125	℃

4. Recommended Operating Condition V_{SS}=0V, T a =- 40℃～＋125℃

Parameter	Symbol	Condition	Min	Typ	Max	Unit	Note
Supply Voltage	V_{DD}		1.62	1.8	3.0	V	V_{DD}
“H” Input Voltage	V_{IH}		V_{DD}×0.7			V	CE
“L” Input Voltage	V_{IL}				V_{DD}×0.3	V	CE
Input Voltage	V_{IN}		V_{SS}		V_{DD}	V	CE
Control Voltage	V_C	1.62V ≤V_{DD} ≤ 3.0V	0		V_{DD} +1.0	V	VC
Output Load Capacitance	CL	CMOS		15	30	pF	OUT
Ambient Temperature	T_{opT}		-40		125	℃	

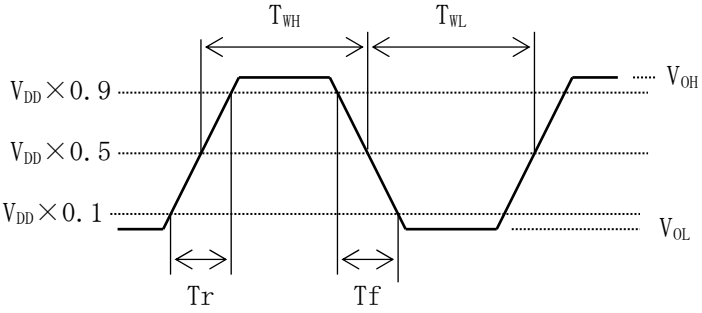
This IC has enough immunity against ESD and Latch-up, but handle with care.

5. Electrical Specification

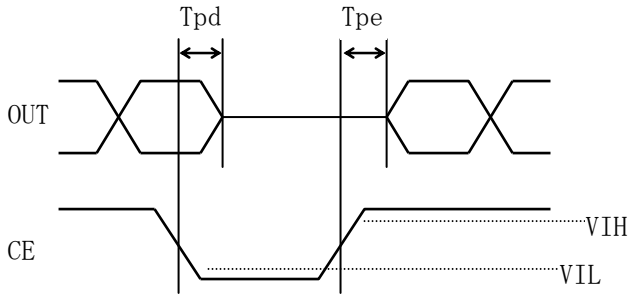
Unless otherwise stated, VDD＝1.62V～3.0V, VSS＝0V, T a ＝-40～125℃

Parameter	Symbol	Condition	Specification				Unit
			Min	Typ	Max	125℃	
“H” input current	I_{IH}	$V_{IN}=V_{DD}$			1	←	μA
“L” input current	I_{IL}	$V_{IN}=V_{SS}$		1.3	10	←	μA
“H” output voltage	V_{OH}	I_{OH}＝-5mA	V_{DD}-0.4			I_{OH}＝-3mA	V
“L” output voltage	V_{OL}	I_{OL}=5mA			0.4	I_{OL}=3mA	V
Current consumption	I_{DD}	CL=15pF, V_{DD}=2.0V, CE≧V_{DD}-0.3V, F0=27MHz		1.5	2.0	2.2Max	mA
Current consumption without output load	I_{DD}	CL=0pF, VDD=1.8V, CE≧VDD-0.3V, F0=27MHz		0.6	1.0	1.2Max	mA
Current consumption at output disable	I_{DDD}	CL=15pF, VDD=1.8V, CE≦0.3V, F0=27MHz		0.5	1.0	←	mA
Output off leak at output disable	I_O	CE≦0.3V			10	←	μA
Output Duty Ratio IPV0052Lz	Duty	CL=15pF, V_{DD}=1.8V, F0=27MHz, Vc=1/2V_{DD}	45		55	43Min 57Max	%
Pull Range	Fcntr	Vc=+0.9±0.9V 27MHz, Crystal *1	±100			←	ppm
Rise time	Tr	CL=15pF, 10～90% V_{DD}		5.0	6.5	9.0Max	ns
Fall time	Tf	CL=15pF, 10～90% V_{DD}		5.0	6.5	9.0Max	ns
Output Enable Time	Tpe				2	←	ns
Output Disable Time	Tpd				100	←	ns
Modulation Band Width	Fc	Vc=0.9sinωt+0.9V	15	20		←	KHz

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



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



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

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

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

V_{DD}=1.62～3.0V, V_{SS}=0V, T a =25℃, Vc= V_{SS} ～V_{DD}

Parameter		Symbol	Condition	Min	Typ	Max	Unit
Input Resistor		R_{VC1}		16	20	25	KΩ
VC Input impedance		Rvc	VC terminal to GND	5			MΩ
Equivalent series (Loading) Capacitance	IPV0052L 27MHz	CLxtal	Vc=0V		10.7		pF
			Vc=0.9V		6.0		
			Vc=1.8V		3.7		
Frequency deviation by IC		⊿fc/fc	Crystal fixed			25	ppm

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

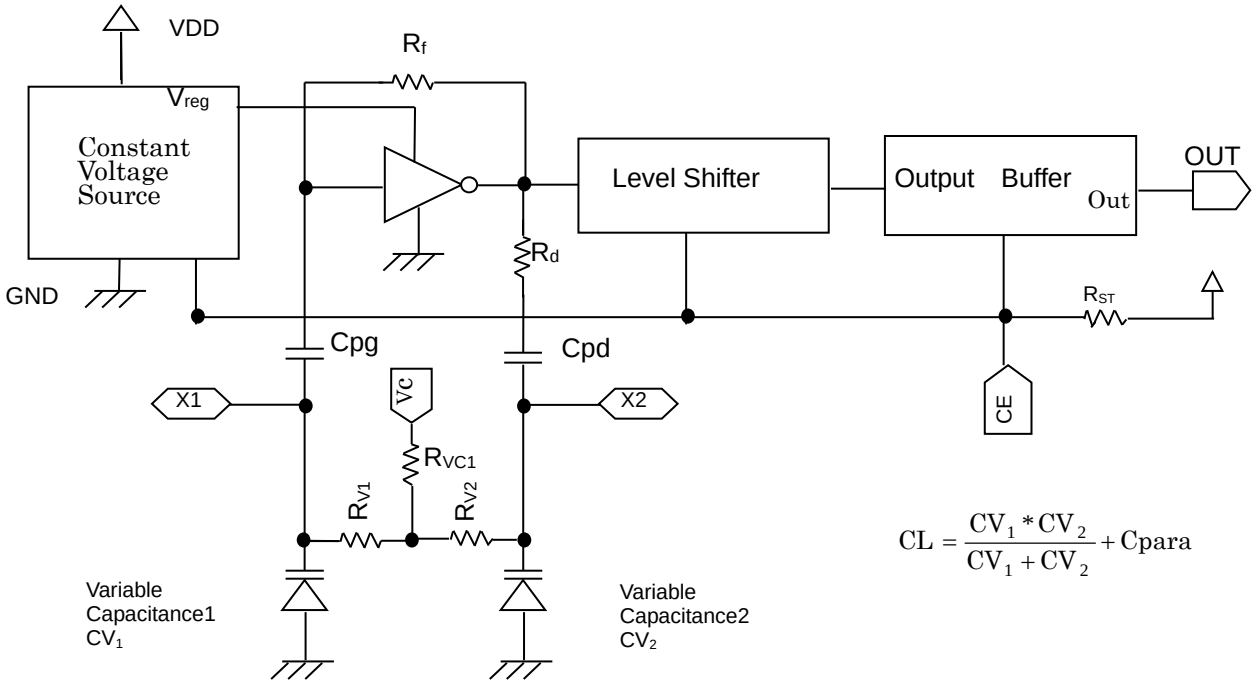
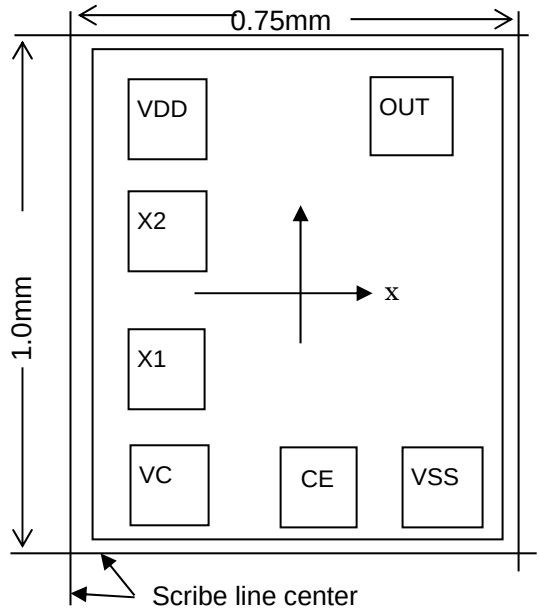


Fig. 6-1 Block Diagram

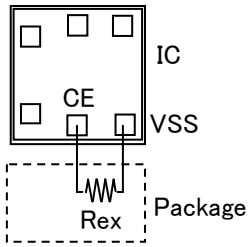
7. Pad Layout



- Die Size : 0.75mm × 1.0mm
- Pad Size : 80um □
- Thickness : 150±20um
- IC Backside : Gnd or Open

Pad Name	Function	Location (μm)	
		x	y
VC	Frequency Control Input	−244	−359
CE	Oscillation stop, "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.



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.

■ Description

IPV0056H Series IC is a single chip VCXO IC that covers high frequency over 80MHz to 170MHz. This product has the features of the wide pulling range 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.

■ Features

- Crystal frequency : 80～170MHz
- Output : CMOS
- Divide function : No divide
- Power supply voltage : 2.97～3.63V
- Vc Input impedance : 5MΩ
- Standby function : Oscillation stop
- Operation temperature : 85℃ (Please contact us about 105℃ usage.)
- Small chip size : 0.70mm × 0.75mm
- Frequency stability to Vdd : Within ±2ppm
- Wide pulling range : ±90ppm minimum / Vc=1.65±1.65V
- Duty cycle : Within 50±5%

1. Part number rule

IPV 005 6 H z B -W 1

- IPV: Series Name for VCXO
- 005: Product Series
- 6: Frequency Range
- H: VDD
- z: Divide Function 0:1/1
- B: Optional code
- -W: IC Form
- 1: Thickness

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

Optional code	
Code	Definition
B	Lower Phase Noise
Blank	Standard product

x	Frequency Range
6	80～170MHz

Recommended VDD	
H	3.3V

2. Series

Part Number	Output Frequency (MHz)		Divide	Remarks
	Min.	Max.		
IPV005 6 H 0	80.00	170.00	1/1	
IPV005 6 H 0 B	80.00	170.00	1/1	Lower Phase Noise

3. Absolute Maximum Ratings VSS=0V、 Ta=+ 25℃± 2℃

Parameter	Symbol	Condition	Ratings		
			Min	Max	Unit
Supply Voltage	V_{DD}		V_{SS}-0.5	5	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}	IPV0056H0		30	mA
		IPV0056H0B		25	mA
Junction Temperature	Tj		-55	150	℃
Storage Temperature	T_{stg}		-55	125	℃

4. Recommended Operating Condition V_{SS} =0V, Ta=-40~85℃

Parameter	Symbol	Condition	Min	Typ	Max	Unit	Note
Supply Voltage	V_{DD}		2.97	3.3	3.63	V	V_{DD}
“H” Input Voltage	V_{IH}		$V_{DD}\times 0.7$			V	CE
“L” Input Voltage	V_{IL}				$V_{DD}\times 0.3$	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	℃	

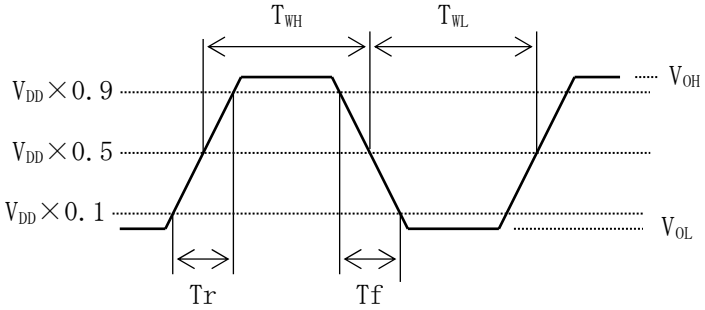
Please contact us about 105℃ usage.

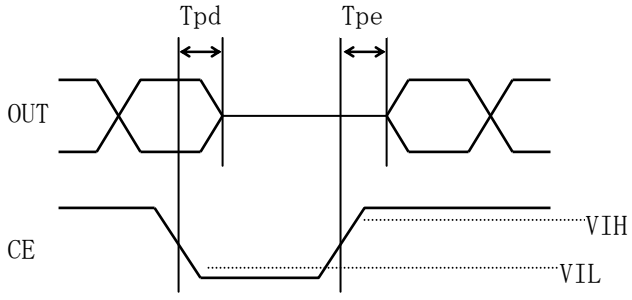
5. Electrical Specification

Unless otherwise stated, V_{DD} =2.97~3.63V, Vss=0V, Ta=-40~85℃
(Please contact us about 105℃ usage.)

Parameter	Symbol	Condition	Specification			Unit
			Min	Typ	Max	
"H" input current	I_{IH}	IPV0056H0 $V_{IN}=V_{DD}$			1	μA
		IPV0056H0B $V_{IN}=V_{DD}$			30	μA
"L" input current	I_{IL}	IPV0056H0 CE≦0.3V	-10			μA
		IPV0056H0B CE≦0.3V	-60			μA
"H" output voltage	V_{OH}	I_{OH}=-5mA	V_{DD}-0.4			V
		CL=15pF	0.9V_{DD}			
"L" output voltage	V_{OL}	I_{OL}=5mA			0.4	V
		CL=15pF			0.1V_{DD}	
Current consumption	I_{DD}	CL=15pF, CE≧VDD-0.3V, F0=170MHz		24	34	mA
Current consumption at oscillation disable	I_{DDD}	IPV0056H0 CL=15pF, VDD=3.63V,CE≦0.3V		10	30	μA
		IPV0056H0B CL=15pF, VDD=3.63V, CE≦0.3V			60	μA
Output off leak at oscillation disable	I_Z	CE≦0.3V			10	μA
Output Duty Ratio	Duty	CL=15pF	45		55	%
Pull Range	Fcntr	Vc=1.65±1.65V, 170MHz*1)				
		IPV0056H0	±100			ppm
		IPV0056H0B	±120			ppm
Rise time	Tr	IPV0056H0 CL=15pF, 10～90% V_{DD}		1.4	2.0	ns
Fall time	Tf			1.2	1.8	ns
Rise time	Tr	IPV0056H0B CL=15pF, 10～90% V_{DD}			2.0	ns
Fall time	Tf				2.0	ns
Output Enable Time	Tpe				2	ms
Output Disable Time	Tpd	IPV0056H0			100	ns
		IPV0056H0B			200	ns
Modulation Band Width	Fc	Vc=1.35sinωt+1.65V, -3dB	15	20		KHz

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





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

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

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

6. Phase noise

F=155MHz, Vc=1.65V, Room temperature

Offset	IPV0056H0	IPV0056H0B
1KHz	−117.6 dBc/Hz	−116.6 dBc/Hz
10KHz	−133.3 dBc/Hz	−137.3 dBc/Hz
100KHz	−145.5 dBc/Hz	−147.2 dBc/Hz
1MHz	−153.8 dBc/Hz	−154.3 dBc/Hz

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

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Bias Resistor	R_{V1}			280		KΩ
	R_{V2}			93		KΩ
Input Resistor	R_{VC1}			20		KΩ
Feedback Resistor	Rf			100		KΩ
Driving Resistor	Rd			400		Ω
VC Input impedance	Rvc	VC terminal to GND	5			MΩ
Equivalent series (Loading) Capacitance	CLxtal	Vc=0V		6.7		pF
		Vc=1.65V		4.2		
		Vc=3.3V		2.9		
Drive Level	DL	Vc=0V, 135MHz		350		μW
		Vc=1.65V, 135MHz		240		
		Vc=3.3V, 135MHz		150		
Frequency deviation by IC	⊿fc/fc	Crystal fixed			25	ppm

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

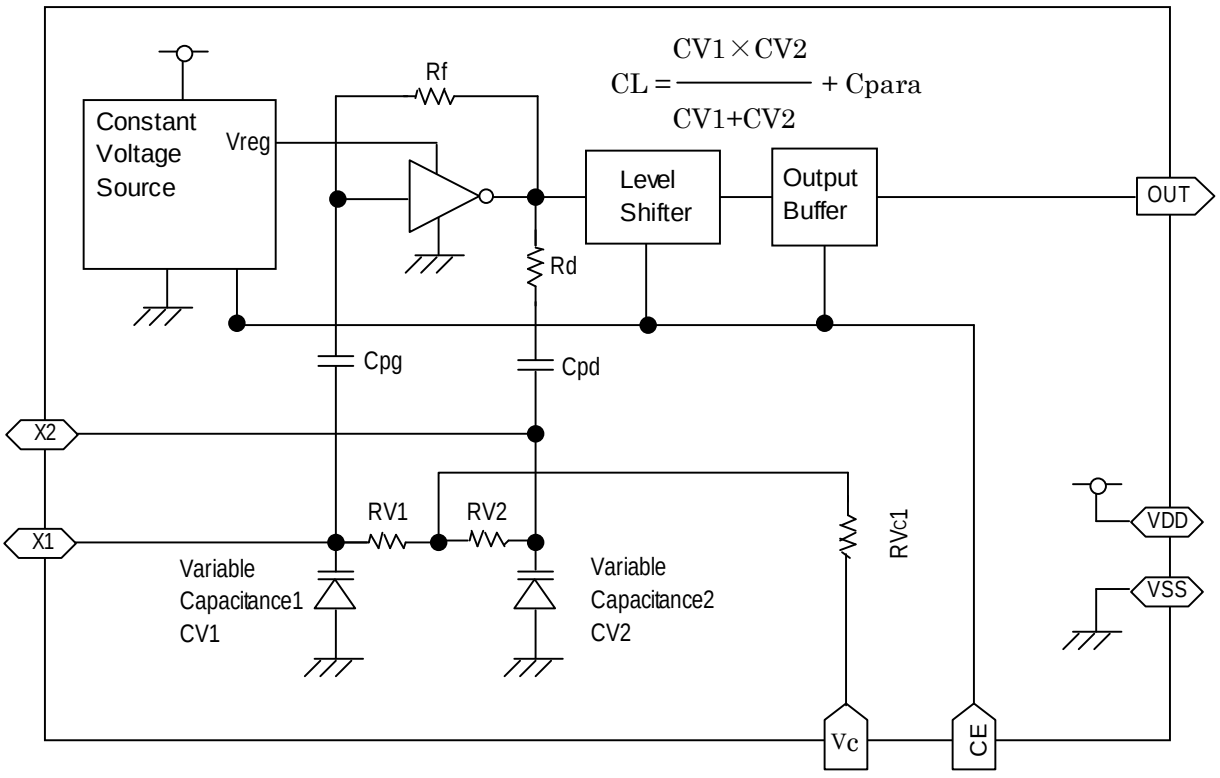
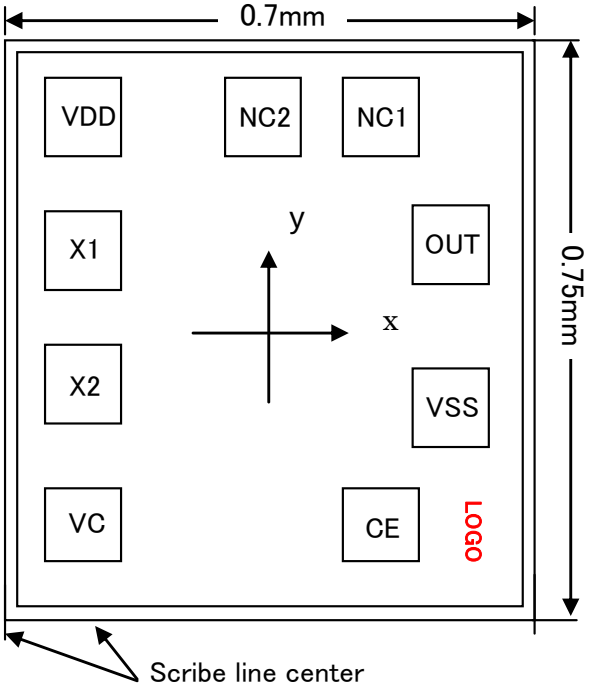


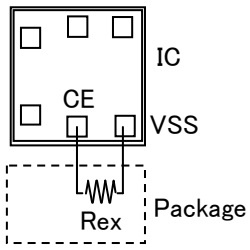
Fig 6-1 Block Diagram

8. Pad Layout



- Die Size : 0.75mm × 0.7mm
- Pad Size : 80um □
- Thickness : 150±20um
- IC Backside : Gnd or Open

Pad Name	Function	Location (μm)	
		x	y
VDD	(+)Power Supply	−250.55	275.55
X1	Crystal Feedback	−250.55	86.35
X2	Crystal Drive	−250.55	−94.35
VC	Frequency Control Input	−250.55	−275.55
CE	Oscillation stop	170.55	−275.55
VSS	(−)Ground	250.55	−80.05
OUT	Output	250.55	94.35
NC1	None Connection	170.55	275.55
NC2	None Connection	−1.2	275.55
Chip Center		0	0



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.

7. IC Part # Identification

Part #	LOGO
IPV0056H0	IPV0056H0
IPV0056H0B	IPV0056H0B