

OVERVIEW

The CF5015 series are 2.5V operation crystal oscillator ICs. They are available for frequencies up to 60MHz. They employ a process optimized for 2.5V operation, resulting in both improved operating frequency and stable operation. They feature a large reduction in chip size, when compared to existing devices, making possible the construction of small-sized crystal oscillators.

FEATURES

- 2.25 to 2.75V operating supply voltage range
- Up to 60MHz oscillation frequency range
- – 40 to 85°C operating temperature range
- Oscillation capacitors built-in
 - $C_G = 18\text{pF}$, $C_D = 18\text{pF}$
- Inverter amplifier feedback resistor built-in
- Standby function
 - High impedance in standby mode, oscillator stops
- Low standby current
 - Power-save pull-up resistor built-in
- f_O , $f_O/2$, $f_O/4$, $f_O/8$, or $f_O/16$ output frequency, determined by internal connection
- CMOS output duty level (1/2VDD)
- Molybdenum-gate CMOS process
- Chip form (CF5015AL×)

SERIES CONFIGURATION

Version	Recommended operating frequency range ¹ [MHz]		Built-in capacitance [pF]		Output frequency	Standby function
	$C_L = 15\text{pF}$	$C_L = 30\text{pF}$	C_G	C_D		
CF5015AL1	4 to 60	4 to 50	18	18	f_O	Yes
CF5015AL2					$f_O/2$	Yes
CF5015AL3					$f_O/4$	Yes
CF5015AL4					$f_O/8$	Yes
CF5015AL5					$f_O/16$	Yes

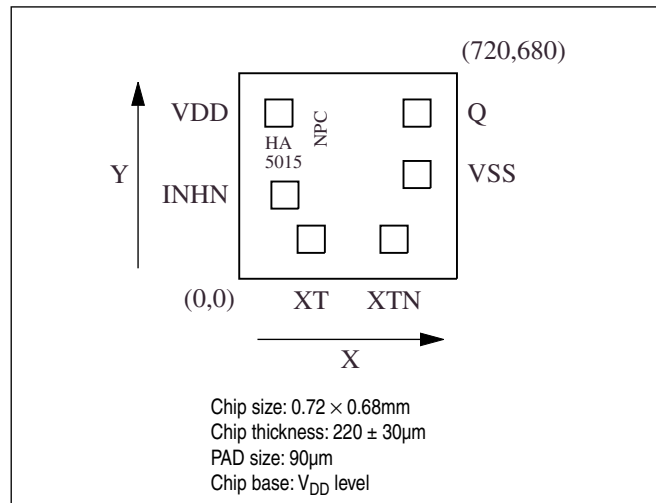
1. The recommended operating frequency is a yardstick value derived from the crystal used for NPC characteristics authentication. However, the oscillator frequency band is not guaranteed. Specifically, the characteristics can vary greatly due to crystal characteristics and mounting conditions, so the oscillation characteristics of components must be carefully evaluated.

ORDERING INFORMATION

Device	Package
CF5015AL×–2	Chip form

PAD LAYOUT

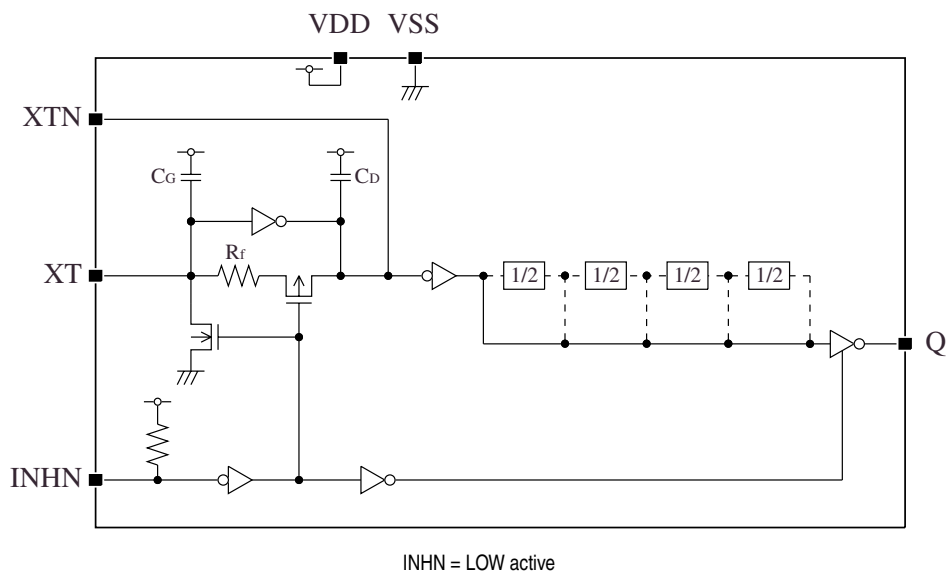
(Unit: μm)



PIN DESCRIPTION and PAD DIMENSIONS

Name	I/O	Description	Pad dimensions [μm]	
			X	Y
INHN	I	Output state control input. High impedance when LOW (oscillator stops). Power-saving pull-up resistor built-in.	151	277
XT	I	Amplifier input	238	131
XTN	O	Amplifier output	512	131
VSS	–	Ground	588	345
Q	O	Output. Output frequency (f_O , $f_O/2$, $f_O/4$, $f_O/8$, $f_O/16$) determined by internal connection	588	548
VDD	–	Supply voltage	131	548

BLOCK DIAGRAM



SPECIFICATIONS

Absolute Maximum Ratings

$V_{SS} = 0V$

Parameter	Symbol	Condition	Rating	Unit
Supply voltage range	V_{DD}		−0.5 to +7.0	V
Input voltage range	V_{IN}		−0.5 to $V_{DD} + 0.5$	V
Output voltage range	V_{OUT}		−0.5 to $V_{DD} + 0.5$	V
Operating temperature range	T_{opr}		−40 to +85	°C
Storage temperature range	T_{STG}		−65 to +150	°C
Output current	I_{OUT}		12	mA

Recommended Operating Conditions

$V_{SS} = 0V$

Parameter	Symbol	Condition	Rating	Unit
Supply voltage	V_{DD}		2.25 to 2.75	V
Input voltage	V_{IN}		V_{SS} to V_{DD}	V
Operating temperature	T_{OPR}		−40 to +85	°C
Operating frequency	f_{OSC}	$C_L \leq 15pF$	4 to 60	MHz
		$C_L \leq 30pF$	4 to 50	MHz

Electrical Characteristics

$V_{DD} = 2.25$ to $2.75V$, $V_{SS} = 0V$, $T_a = -40$ to $+85^{\circ}C$ unless otherwise noted.

Parameter	Symbol	Condition		Rating			Unit
				min	typ	max	
HIGH-level output voltage	V _{OH}	Q: Measurement cct 1, V _{DD} = 2.25V, I _{OH} = 4mA		1.65	1.95	–	V
LOW-level output voltage	V _{OL}	Q: Measurement cct 1, V _{DD} = 2.25V, I _{OL} = 4mA		–	0.3	0.4	V
HIGH-level input voltage	V _{IH}	INH N		0.7V _{DD}	–	–	V
LOW-level input voltage	V _{IL}	INH N		–	–	0.3V _{DD}	V
Output leakage current	I _Z	Q: Measurement cct 2, INHN = LOW	V _{OH} = V _{DD}	–	–	10	μA
			V _{OL} = V _{SS}	–	–	10	μA
Current consumption	I _{DD}	Measurement cct 3, load cct 1, INHN = open, C _L = 15pF, f = 60MHz	CF5015AL1	–	5.5	11	mA
			CF5015AL2	–	4	8	mA
			CF5015AL3	–	3	6	mA
			CF5015AL4	–	2.5	5	mA
			CF5015AL5	–	2	4	mA
Standby current	I _{ST}	Measurement cct 3, INHN = LOW		–	–	3	μA
INH N pull-up resistance	R _{UP1}	Measurement cct 4		2	6	12	MΩ
	R _{UP2}			20	100	200	kΩ
Feedback resistance	R _f	Measurement cct 5		100	300	600	kΩ
Built-in capacitance	C _G	Design value. A monitor pattern on a wafer is tested.		15.3	18	20.7	pF
	C _D			15.3	18	20.7	pF

Switching Characteristics

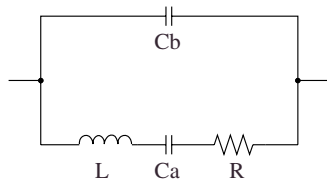
$V_{DD} = 2.25$ to $2.75V$, $V_{SS} = 0V$, $T_a = -40$ to $+85^{\circ}C$ unless otherwise noted.

Parameter	Symbol	Condition		Rating			Unit
				min	typ	max	
Output rise time	t _{r1}	Measurement cct 3, load cct 1, 0.1V _{DD} to 0.9V _{DD}	C _L = 15pF	–	3	6	ns
	t _{r2}		C _L = 30pF	–	5	10	
Output fall time	t _{f1}	Measurement cct 3, load cct 1, 0.9V _{DD} to 0.1V _{DD}	C _L = 15pF	–	3	6	ns
	t _{f2}		C _L = 30pF	–	5	10	
Output duty cycle ¹	Duty1	Measurement cct 3, load cct 1, V _{DD} = 2.5V, Ta = 25°C	C _L = 15pF f = 60MHz	45	–	55	%
	Duty2		C _L = 30pF f = 50MHz	45	–	55	%
Output disable delay time ²	t _{PLZ}	Measurement cct 6, load cct 1, V _{DD} = 2.5V, Ta = 25°C, C _L = 15pF		–	–	100	ns
Output enable delay time ²	t _{PZL}			–	–	100	ns

1. The duty cycle characteristic is checked the sample chips of each production lot.

2. Oscillator stop function is built-in. When INHN goes LOW, normal output stops. When INHN goes HIGH, normal output is not resumed until after the oscillator start-up time has elapsed.

Current consumption and Output waveform with NPC's standard crystal



f [MHz]	R [Ω]	L [mH]	Ca [fF]	Cb [pF]
50	16.12	6.88	1.48	1.18
60*	–	–	–	–

* The 60MHz crystal data is confidential.

FUNCTIONAL DESCRIPTION

Standby Function

When INHN goes LOW, the oscillator stops and the oscillator output on Q becomes high impedance.

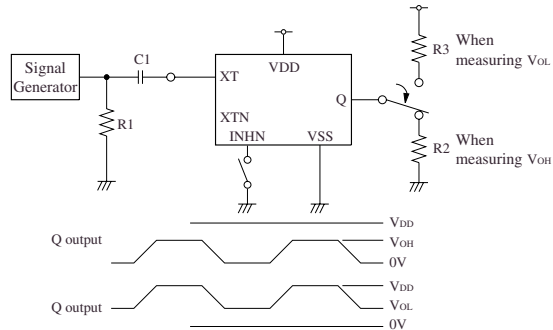
INHN	Q	Oscillator
HIGH (or open)	Any f_O , $f_O/2$, $f_O/4$, $f_O/8$ or $f_O/16$ output frequency	Normal operation
LOW	High impedance	Stopped

Power-save Pull-up Resistance

The INHN pull-up resistance changes in response to the input level (HIGH or LOW). When INHN goes LOW (standby state), the pull-up resistance becomes large to reduce the current consumption during standby.

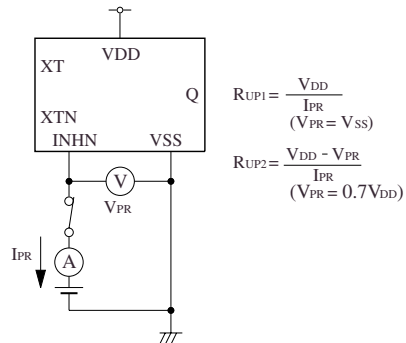
MEASUREMENT CIRCUITS

Measurement cct 1

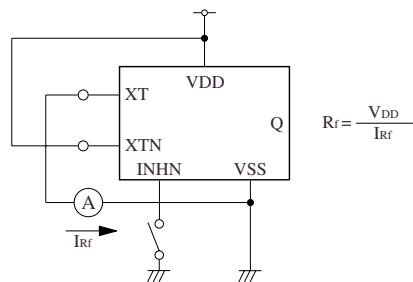


2Vp-p, 10MHz sine wave input signal
 $C1: 0.001\mu F$
 $R1: 50\Omega$
 $R2: 413\Omega$
 $R3: 462\Omega$

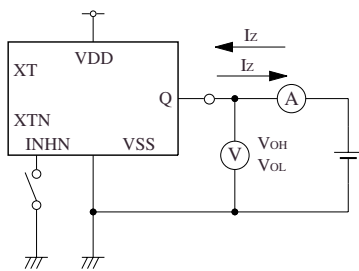
Measurement cct 4



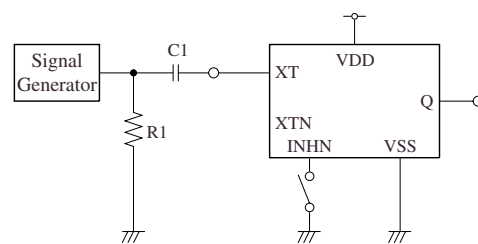
Measurement cct 5



Measurement cct 2

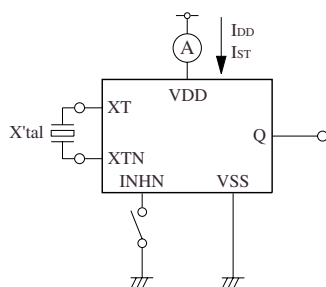


Measurement cct 6

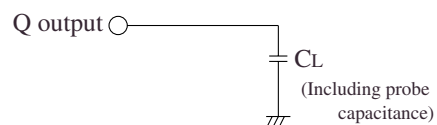


2Vp-p, 10MHz sine wave input signal
 $C1: 0.001\mu F$
 $R1: 50\Omega$

Measurement cct 3

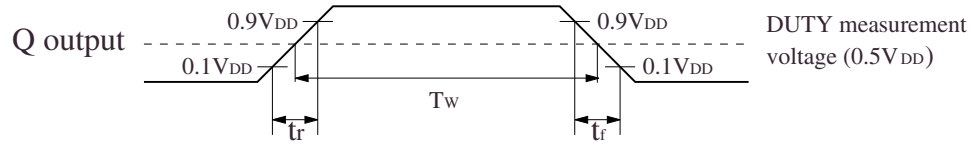


Load cct 1

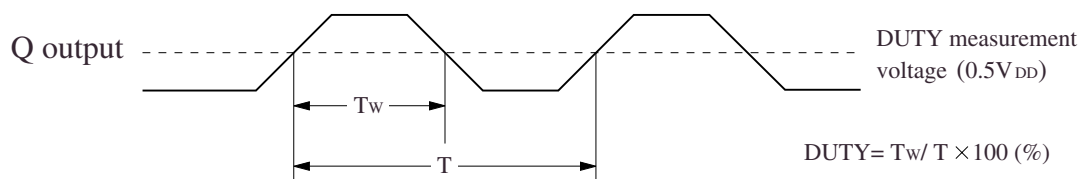


Switching Time Measurement Waveform

Output duty level

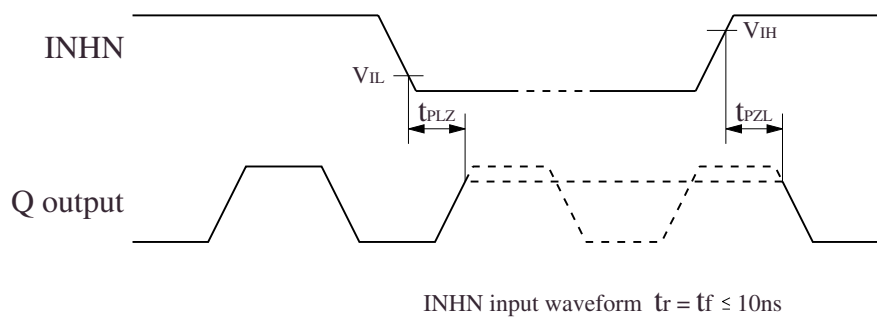


Output duty cycle



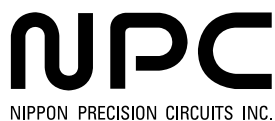
Output Enable/Disable Delay

when the device is in standby, the oscillator stops. When standby is released, the oscillator starts and stable oscillator output occurs after a short delay.



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NIPPON PRECISION CIRCUITS INC.

4-3, Fukuzumi 2-chome, Koto-ku,
Tokyo 135-8430, Japan
Telephone: +81-3-3642-6661
Facsimile: +81-3-3642-6698
<http://www.npc.co.jp/>
Email: sales@npc.co.jp

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