

### OVERVIEW

The CF5018 series are crystal oscillator ICs that operate from 2.5V. Devices are available that provide 3rd overtone oscillation in the range 30MHz to 80MHz. They are optimized for 2.5V operation, resulting in stable oscillator startup characteristics and output duty stability. They feature a large reduction in chip surface area compared to existing devices, making possible the construction of small-sized crystal oscillator.

### FEATURES

- 2.25 to 2.75V operating supply voltage range
- 30MHz to 80MHz oscillation frequency range (varies with version)
- -40 to 85°C operating temperature range
- Oscillation capacitors  $C_G$ ,  $C_D$  built-in
- Inverter amplifier feedback resistor built-in
- Standby function
  - High impedance in standby mode, oscillator stops
- Low standby current
  - Power-saving pull-up resistor built-in
- $f_O$  output frequency (oscillation frequency)
- 8mA output drive capability ( $V_{DD} = 2.25V$ )
- CMOS output duty level ( $1/2V_{DD}$ )
- $50 \pm 5\%$  output duty (at  $1/2V_{DD}$ )
- 30pF output load
- Molybdenum-gate CMOS process
- Chip form (CF5018AL $\times$ )

### SERIES CONFIGURATION

Version	Operating supply voltage range [V]	Recommended operating frequency range <sup>1</sup> [MHz]	gm ratio	Built-in capacitance [pF]		Rf [k $\Omega$ ]
				$C_G$	$C_D$	
CF5018ALA	2.25 to 2.75	30 to 36	0.25	8	15	4.7
CF5018ALB		36 to 40	0.50			3.5
CF5018ALC		40 to 50	0.75			3.5
CF5018ALD		50 to 60	1.00			3.0
CF5018ALE		60 to 80	1.50	10	3.5	

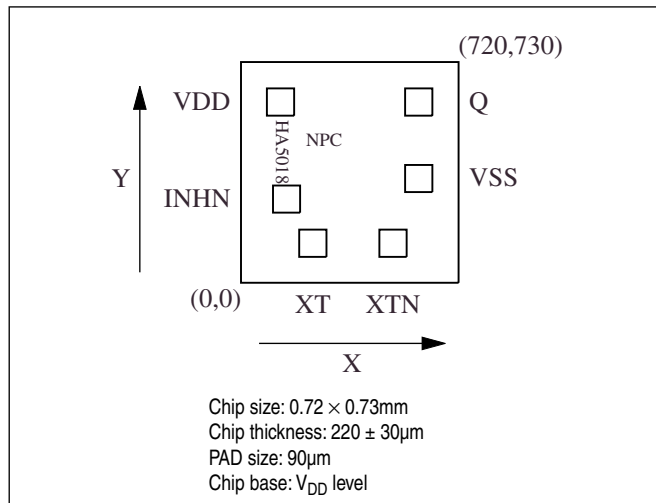
1. The recommended operating frequency is a yardstick value derived from the crystal used for NPC characteristics authentication. However, the oscillator frequency band is not guaranteed. Specifically, the characteristics can vary greatly due to crystal characteristics and mounting conditions, so the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

### ORDERING INFORMATION

Device	Package
CF5018AL $\times$ -2	Chip form

### PAD LAYOUT

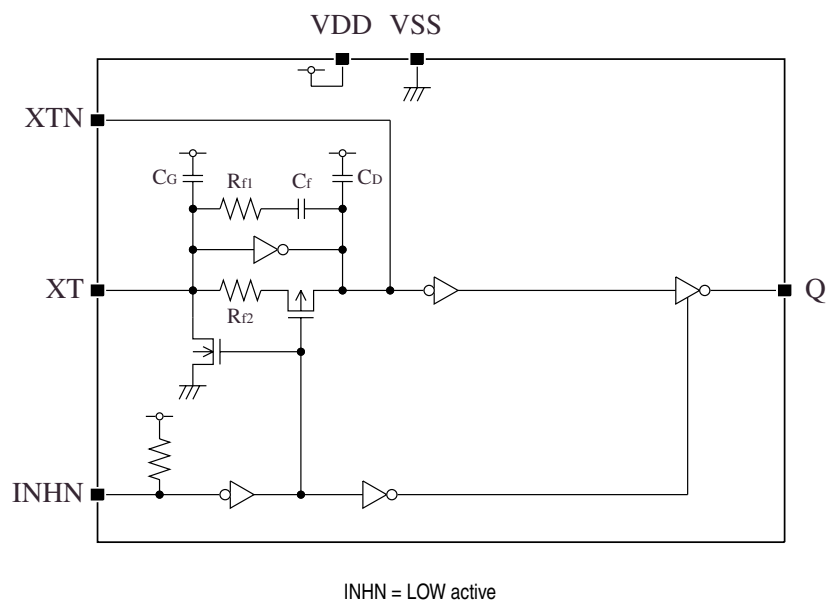
(Unit:  $\mu\text{m}$ )



### PIN DESCRIPTION and PAD DIMENSIONS

Name	I/O	Description	Pad dimensions [ $\mu\text{m}$ ]	
			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	503	131
VSS	-	Ground	588	345
Q	O	Output. Output frequency. High impedance in standby mode	588	598
VDD	-	Supply voltage	131	598

### 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	$I_{OUT}$		20	mA

**Recommended Operating Conditions**

$V_{SS} = 0V, f \leq 80MHz, C_L \leq 30pF$

Parameter	Symbol	Condition	Rating	Unit
Supply voltage range	$V_{DD}$		2.25 to 2.75	V
Input voltage range	$V_{IN}$		$V_{SS}$ to $V_{DD}$	V
Operating temperature range	$T_{OPR}$		-40 to +85	°C

CF5018 series

**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, $V_{DD} = 2.25V$ , $I_{OH} = 8mA$	1.65	1.95	–	V	
LOW-level output voltage	$V_{OL}$	Q: Measurement cct 2, $V_{DD} = 2.25V$ , $I_{OL} = 8mA$	–	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	$\mu A$
			$V_{OL} = V_{SS}$	–	–	10	$\mu A$
Current consumption	$I_{DD}$	Measurement cct 3, load cct 1, INHN = open, $C_L = 30pF$	CF5018ALA $f = 30MHz$	–	6	12	mA
			CF5018ALB $f = 40MHz$	–	8	16	mA
			CF5018ALC $f = 50MHz$	–	10	20	mA
			CF5018ALD $f = 60MHz$	–	11	22	mA
			CF5018ALE $f = 80MHz$	–	15	30	mA
Standby current	$I_{ST}$	Measurement cct 3, INHN = LOW	–	–	3	$\mu A$	
INH N pull-up resistance	$R_{UP1}$	Measurement cct 4	2	6	12	$M\Omega$	
	$R_{UP2}$		20	100	200	$k\Omega$	
AC feedback resistance	$R_{f1}$	Design value. A monitor pattern on a wafer is tested.	CF5018ALA	3.99	4.7	5.41	$k\Omega$
			CF5018ALB	2.97	3.5	4.03	$k\Omega$
			CF5018ALC	2.97	3.5	4.03	$k\Omega$
			CF5018ALD	2.55	3.0	3.45	$k\Omega$
			CF5018ALE	2.97	3.5	4.03	$k\Omega$
DC feedback resistance	$R_{f2}$	Measurement cct 5	50	–	150	$k\Omega$	
AC feedback capacitance	$C_f$	Design value. A monitor pattern on a wafer is tested.	8.5	10	11.5	pF	
Built-in capacitance	$C_G$	Design value. A monitor pattern on a wafer is tested.	6.8	8	9.2	pF	
	$C_D$	Design value. A monitor pattern on a wafer is tested.	CF5018ALA CF5018ALB CF5018ALC CF5018ALD	12.7	15	17.3	pF
			CF5018ALE	8.5	10	11.5	pF

## Switching Characteristics

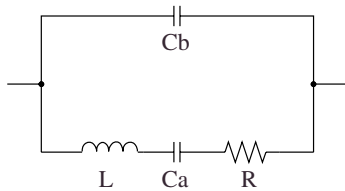
$V_{DD} = 2.25$  to  $2.75V$ ,  $V_{SS} = 0V$ ,  $T_a = -40$  to  $+85^{\circ}C$  unless otherwise noted.

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Output rise time	$t_r$	Measurement cct 3, load cct 1, $0.1V_{DD}$ to $0.9V_{DD}$ , $C_L = 30pF$	–	3	6	ns
Output fall time	$t_f$	Measurement cct 3, load cct 1, $0.9V_{DD}$ to $0.1V_{DD}$ , $C_L = 30pF$	–	3	6	ns
Output duty cycle <sup>1</sup>	Duty	Measurement cct 3, load cct 1, $V_{DD} = 2.5V$ , $T_a = 25^{\circ}C$ , $f = 80MHz$ , $C_L = 30pF$	45	–	55	%
Output disable delay time <sup>2</sup>	$t_{PLZ}$	Measurement cct 6, load cct 1, $V_{DD} = 2.5V$ , $T_a = 25^{\circ}C$ , $C_L = 15pF$	–	–	100	ns
Output enable delay time <sup>2</sup>	$t_{PZL}$		–	–	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 [ $\Omega$ ]	L [mH]	Ca [fF]	Cb [pF]
30	18.62	16.24	1.733	5.337
40	20.53	11.34	1.396	3.989
50	22.17	7.40	1.370	4.105
60	15.37	3.83	1.836	5.191
70	25.42	4.18	1.254	5.170
85	20.58	5.22	0.671	4.965

## FUNCTIONAL DESCRIPTION

### Standby Function

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

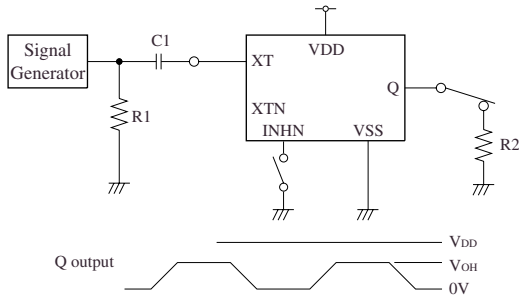
INHN	Q	Oscillator
HIGH (or open)	$f_O$ output frequency	Normal operation
LOW	High impedance	Stopped

### Power-saving Pull-up Resistor

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.

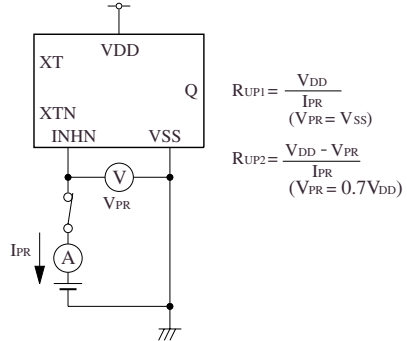
## MEASUREMENT CIRCUITS

### Measurement cct 1



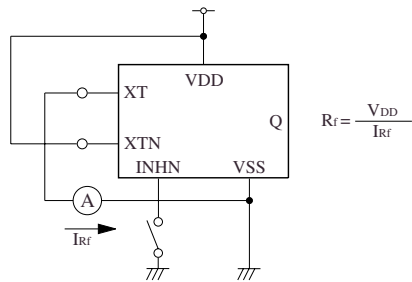
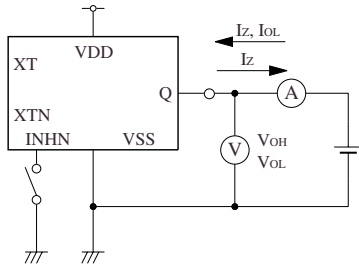
2Vp-p, 10MHz sine wave input signal  
 C1: 0.001 $\mu$ F  
 R1: 50 $\Omega$   
 R2: 206 $\Omega$

### Measurement cct 4



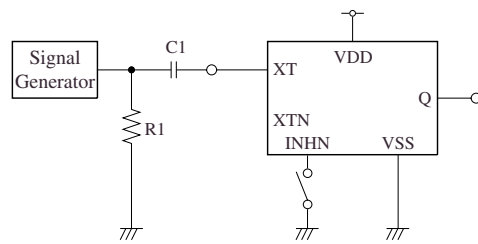
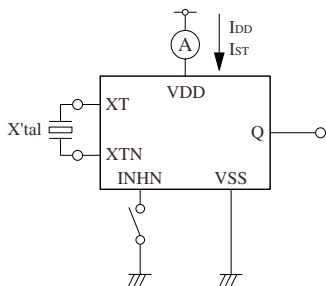
### Measurement cct 5

### Measurement cct 2



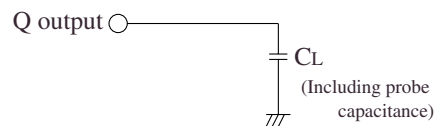
### Measurement cct 6

### Measurement cct 3



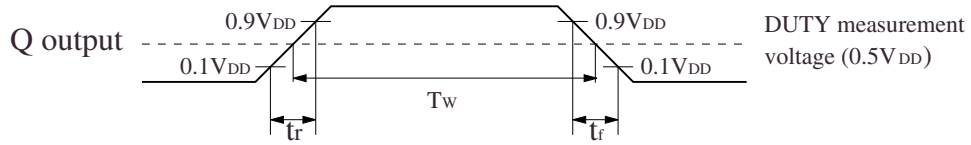
2Vp-p, 10MHz sine wave input signal  
 C1: 0.001 $\mu$ F  
 R1: 50 $\Omega$

### Load cct 1

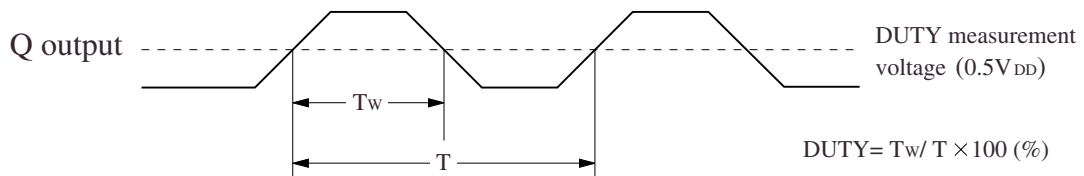


### Switching Time Measurement Waveform

#### Output duty level, $t_r$ , $t_f$

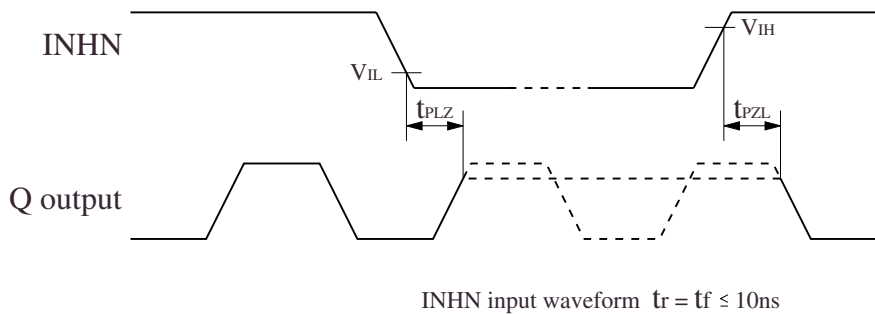


#### Output duty cycle



#### 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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