

OVERVIEW

The CF5016 series are 1.8V operation crystal oscillator ICs. They are available for frequencies up to 50MHz. They employ a recently developed low-voltage process optimized for operation at 1.8V, resulting in stable operation at low voltages while maintaining the same output duty stability of existing devices. They are ideally suited for battery-operated electronic equipment applications where small size, low-voltage operation, and low power dissipation are essential.

FEATURES

- 1.6 to 2.0V operating supply voltage range
- Up to 50MHz 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-saving 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 (CF5016AL×)

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		
CF5016AL1	4 to 50	4 to 30	18	18	f_O	Yes
CF5016AL2					$f_O/2$	Yes
CF5016AL3					$f_O/4$	Yes
CF5016AL4					$f_O/8$	Yes
CF5016AL5					$f_O/16$	Yes

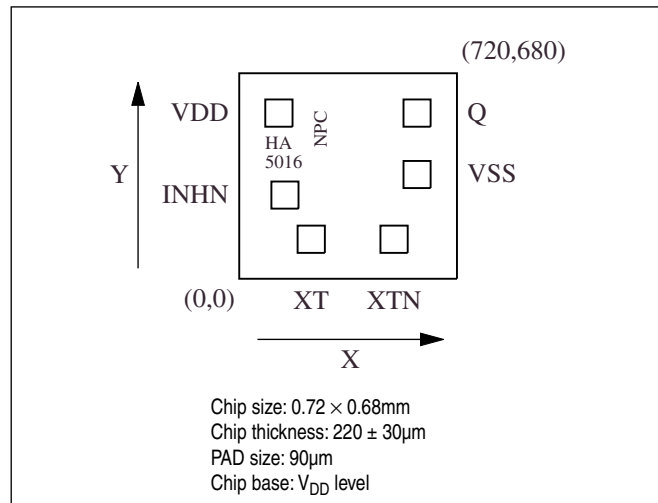
1. The recommended operating frequency is a yardstick value derived from the crystal used for NPC characteristics authentication. However, the oscillator frequency band is not guaranteed. Specifically, the characteristics can vary greatly due to crystal characteristics and mounting conditions, so the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

ORDERING INFORMATION

Device	Package
CF5016AL×-2	Chip form

PAD LAYOUT

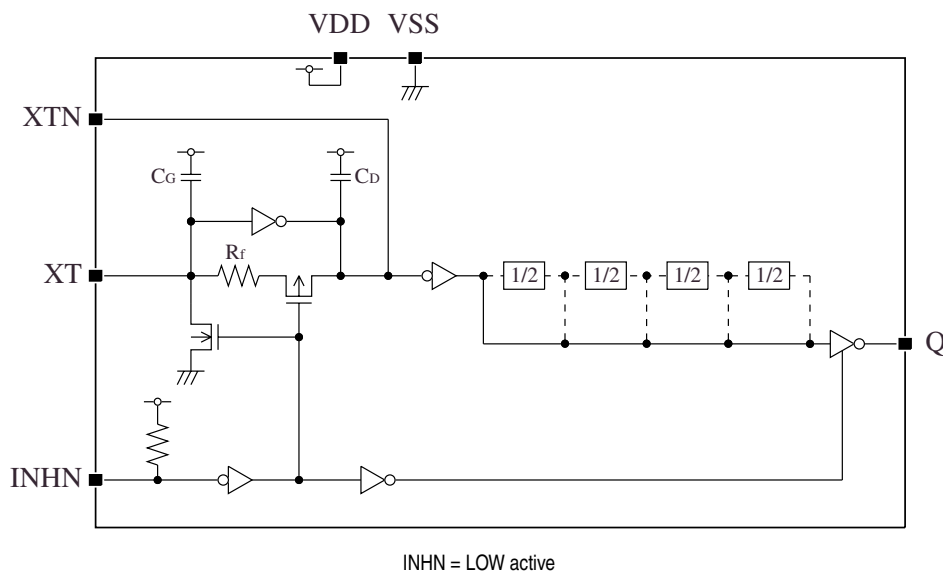
(Unit: μm)



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		
Crystal connection pins. Crystal is connected between XT and XTN.			512	131
VSS	-	Ground	588	345
Q	O	Output. Output frequency ($f_0, f_0/2, f_0/4, f_0/8, f_0/16$) 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 +3.6	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 range	V_{DD}		1.6 to 2.0	V
Input voltage range	V_{IN}		V_{SS} to V_{DD}	V
Operating temperature range	T_{OPR}		-40 to +85	°C
Operating frequency range	f_{OSC}	$C_L \leq 15pF$	4 to 50 ^{*1}	MHz
		$C_L \leq 30pF$	4 to 30	MHz

*1. When the operating frequency is over 45MHz, the duty variation tends to increase.

CF5016 series

Electrical Characteristics

$V_{DD} = 1.6$ to $2.0V$, $V_{SS} = 0V$, $T_a = -40$ 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, $V_{DD} = 1.6V$, $I_{OH} = 2.8mA$	1.1	1.4	–	V	
LOW-level output voltage	V_{OL}	Q: Measurement cct 1, $V_{DD} = 1.6V$, $I_{OL} = 2.8mA$	–	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	μA
			$V_{OL} = V_{SS}$	–	–	10	μA
Current consumption	I_{DD}	Measurement cct 3, load cct 1, INH N = open, $C_L = 15pF$, $f = 50MHz$	CF5016AL1	–	3.5	7	mA
			CF5016AL2	–	2.5	5	mA
			CF5016AL3	–	2	4	mA
			CF5016AL4	–	1.5	3	mA
			CF5016AL5	–	1	2	mA
Standby current	I_{ST}	Measurement cct 3, INHN = LOW	–	–	10	μA	
INH N pull-up resistance	R_{UP1}	Measurement cct 4	2	6	12	$M\Omega$	
	R_{UP2}		30	150	300	$k\Omega$	
Feedback resistance	R_f	Measurement cct 5	100	300	600	$k\Omega$	
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	

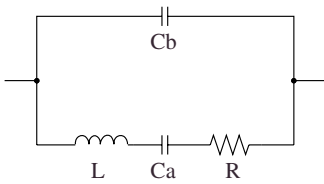
Switching Characteristics

$V_{DD} = 1.6$ to $2.0V$, $V_{SS} = 0V$, $T_a = -40$ 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, $0.2V_{DD}$ to $0.8V_{DD}$	$C_L = 15pF$	–	2.5	5.0	ns
	t_{r2}		$C_L = 30pF$	–	4.0	8.0	
Output fall time	t_{f1}	Measurement cct 3, load cct 1, $0.8V_{DD}$ to $0.2V_{DD}$	$C_L = 15pF$	–	2.5	5.0	ns
	t_{f2}		$C_L = 30pF$	–	4.0	8.0	
Output duty cycle ¹	Duty1	Measurement cct 3, load cct 1, $V_{DD} = 1.8V$, $T_a = 25^\circ C$	$C_L = 15pF$ $f = 45MHz$	45	–	55	%
	Duty2		$C_L = 15pF$ $f = 50MHz$	40	–	60	%
	Duty3		$C_L = 30pF$ $f = 30MHz$	45	–	55	%
Output disable delay time ²	t_{PLZ}	Measurement cct 6, load cct 1, $V_{DD} = 1.8V$, $T_a = 25^\circ C$, $C_L = 15pF$		–	–	200	ns
Output enable delay time ²	t_{PZL}			–	–	200	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]
30	5.26	2.82	9.99	2.68
40	8.24	5.72	2.77	2.22
50	16.12	6.88	1.43	1.18

FUNCTIONAL DESCRIPTION

Standby Function

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

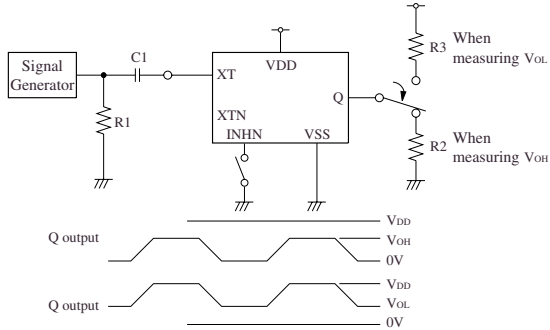
INHN	Q	Oscillator
HIGH (or open)	Any f_O , $f_O/2$, $f_O/4$, $f_O/8$ or $f_O/16$ output frequency	Normal operation
LOW	High impedance	Stopped

Power-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.

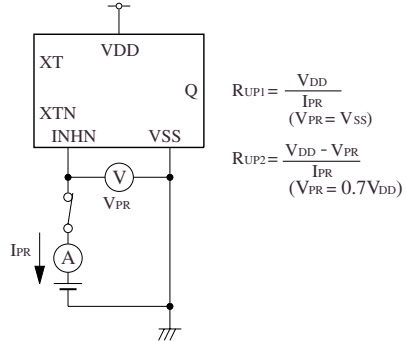
MEASUREMENT CIRCUITS

Measurement cct 1



1Vp-p, 10MHz sine wave input signal
 C1: 0.001μF
 R1: 50Ω
 R2: 393Ω
 R3: 429Ω

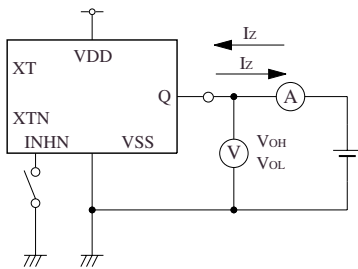
Measurement cct 4



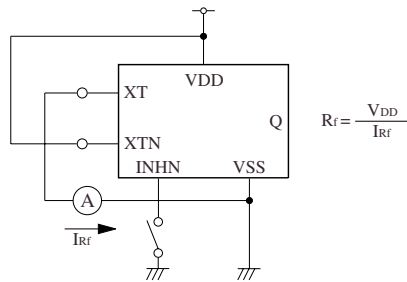
$$R_{UP1} = \frac{V_{DD}}{I_{PR}} \quad (V_{PR} = V_{SS})$$

$$R_{UP2} = \frac{V_{DD} - V_{PR}}{I_{PR}} \quad (V_{PR} = 0.7V_{DD})$$

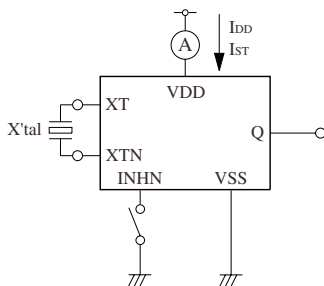
Measurement cct 2



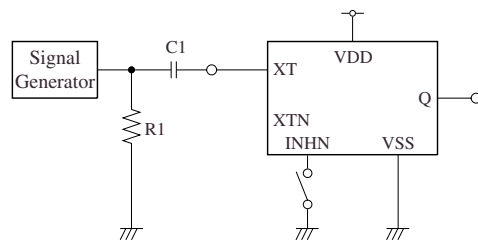
Measurement cct 5



Measurement cct 3

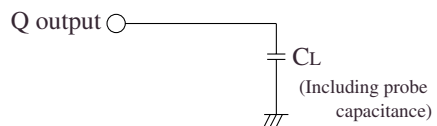


Measurement cct 6



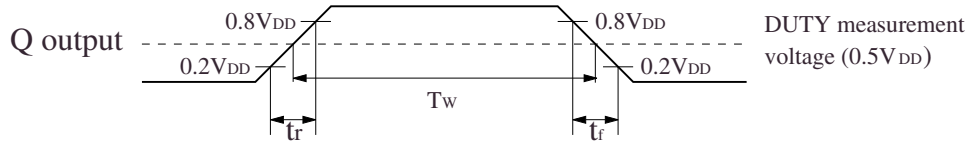
1Vp-p, 10MHz sine wave input signal
 C1: 0.001μF
 R1: 50Ω

Load cct 1

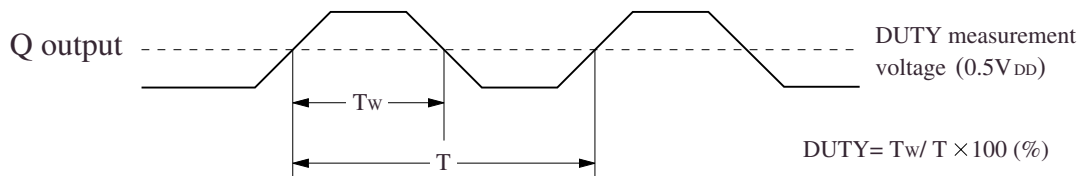


Switching Time Measurement Waveform

Output duty level

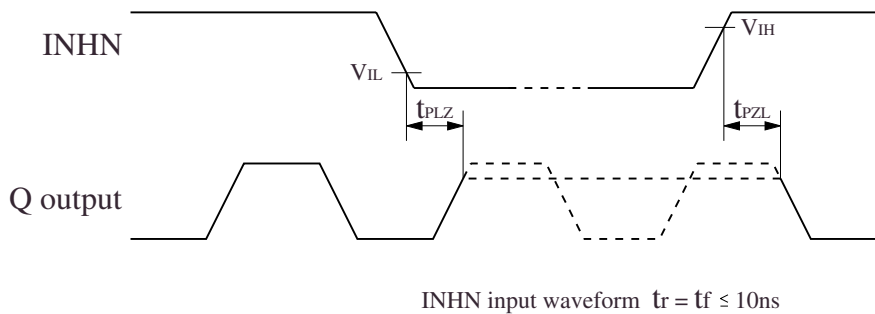


Output duty cycle



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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