

OVERVIEW

The CF5011 series are low-voltage crystal oscillator module ICs that operate at 1.8V. The crystal oscillator circuit and output buffer employ a low-voltage CMOS process operating at 1.8V. The crystal oscillator circuit has a built-in thin-film feedback resistor with good temperature characteristics and built-in capacitors with excellent frequency response, making possible a stable 3rd overtone oscillator with only the addition of a crystal element.

FEATURES

- 3rd overtone oscillation
- 1.6 to 2.0V operating supply voltage range
- 30MHz to 70MHz recommended operating frequency range
- Inverter amplifier feedback resistor built-in
- Oscillator capacitors C_G , C_D built-in
- Standby function
- f_O output frequency (oscillator frequency)
- 8mA output drive capability ($V_{DD} = 1.6V$)
- CMOS output duty level
- Chip form (CF5011xxx)

SERIES CONFIGURATION

Version	Recommended operating frequency range ¹ [MHz]	gm ratio	Built-in capacitance [pF]		R_f [kΩ]	Standby function
			C_G	C_D		
CF5011ALA	30 to 40	1.0	14	16	4.0	Yes
CF5011ALB	40 to 50	1.0	8	16	3.9	Yes
CF5011ALC	50 to 60	1.0	8	16	2.2	Yes
CF5011ALD	60 to 70	1.5	8	16	2.7	Yes
CF5011ANA	30 to 40	1.0	14	16	4.0	No
CF5011ANB	40 to 50	1.0	8	16	3.9	No
CF5011ANC	50 to 60	1.0	8	16	2.2	No
CF5011AND	60 to 70	1.5	8	16	2.7	No

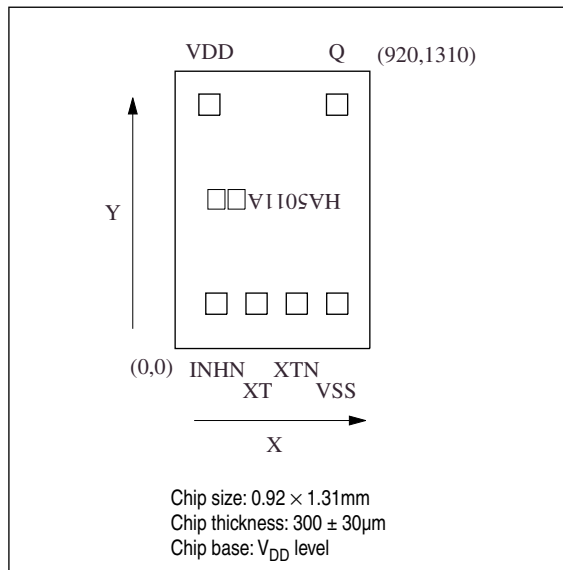
1. The recommended operating frequency is a yardstick value derived from the crystal used for NPC characteristics authentication. However, the oscillator frequency band is not guaranteed. Specifically, the characteristics can vary greatly due to crystal characteristics and mounting conditions, so the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

ORDERING INFORMATION

Device	Package
CF5011xxx-1	Chip form

PAD LAYOUT

(Unit: μm)

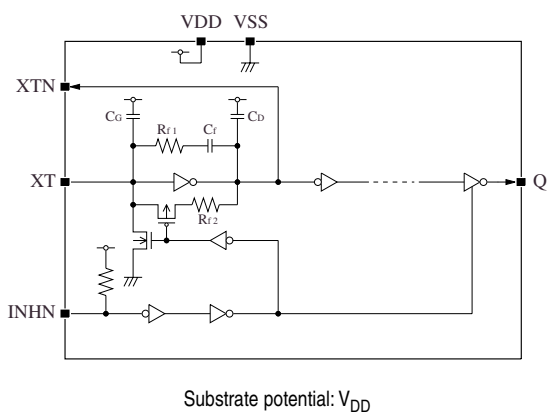


PIN DESCRIPTION and PAD DIMENSIONS

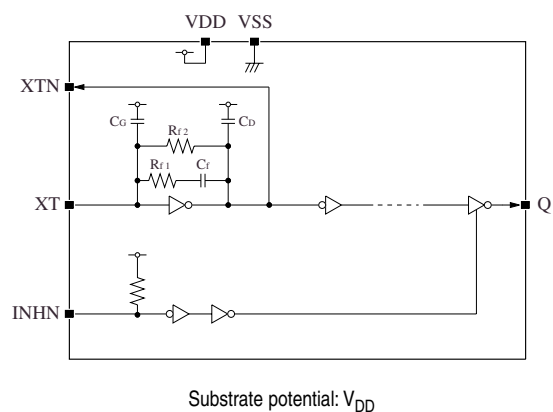
Name	I/O	Description	Pad dimensions [μm]	
			X	Y
INH N	I	Operation mode control input. <CF5011AL> The oscillator stops and Q becomes high impedance when LOW. Power-saving pull-up resistor built in <CF5011AN> Q becomes high impedance when LOW. Pull-up resistor built in	195	212
XT	I	Amplifier input	385	212
XTN	O	Amplifier output	575	212
VSS	-	Ground	766	212
Q	O	Output. Output frequency (f_0). High impedance when INHN is LOW	765	1152
VDD	-	Supply voltage	162	1152

BLOCK DIAGRAM

CF5011AL \times



CF5011AN \times



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}		25	mA

Recommended Operating Conditions

 $V_{SS} = 0V$, $f \leq 70MHz$, $C_L = 15pF$ unless otherwise noted.

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Supply voltage	V_{DD}		1.6	-	2.0	V
Input voltage	V_{IN}		V_{SS}	-	V_{DD}	V
Operating temperature	T_{OPR}		-20	-	+80	°C

Electrical Characteristics

 $V_{DD} = 1.6$ to $2.0V$, $V_{SS} = 0V$, $T_a = -20$ to $+80^\circ C$ unless otherwise noted.

Parameter	Symbol	Condition	Rating			Unit	
			min	typ	max		
HIGH-level output voltage	V_{OH}	Q: Measurement cct 1, $V_{DD} = 1.6V$, $I_{OH} = 8mA$	1.1	1.3	-	V	
LOW-level output voltage	V_{OL}	Q: Measurement cct 2, $V_{DD} = 1.6V$, $I_{OL} = 8mA$	-	0.3	0.4	V	
Output leakage current	I_z	Q: Measurement cct 2, INHN = LOW, $V_{DD} = 2.0V$	$V_{OH} = V_{DD}$	-	-	10	μA
			$V_{OL} = V_{SS}$	-	-	10	μA
HIGH-level input voltage	V_{IH}	INHN	$0.7V_{DD}$	-	-	V	
LOW-level input voltage	V_{IL}	INHN	-	-	$0.3V_{DD}$	V	
Current consumption	I_{DD}	Measurement cct 3, load cct 1, INHN = open, $C_L = 15pF$, $f = 70MHz$	-	9	18	mA	
Standby current	I_{ST}	Measurement cct 3, INHN = LOW	-	-	100	μA	
INHN pull-up resistance	R_{UP1}	Measurement cct 4, INHN = LOW	CF5011AL \times	0.4	-	8	$M\Omega$
	R_{UP2}	Measurement cct 4, INHN = $0.7V_{DD}$	CF5011AL \times CF5011AN \times	50	-	150	$k\Omega$
AC feedback resistance	R_{f1}	Design value. A monitor pattern on a wafer is tested.	CF5011ALA, ANA	3.20	4.0	4.80	$k\Omega$
			CF5011ALB, ANB	3.12	3.9	4.68	$k\Omega$
			CF5011ALC, ANC	1.76	2.2	2.64	$k\Omega$
			CF5011ALD, AND	2.16	2.7	3.24	$k\Omega$
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.	9.3	10	10.7	pF	
Built-in capacitance	C_G	Design value. A monitor pattern on a wafer is tested.	CF5011ALA, ANA	13.02	14	14.98	pF
			CF5011ALB, ALC, ALD CF5011ANB, ANC, AND	7.44	8	8.56	pF
	C_D	Design value. A monitor pattern on a wafer is tested.	CF5011ALA, ANA	14.88	16	17.12	pF
			CF5011ALB, ALC, ALD CF5011ANB, ANC, AND	14.88	16	17.12	pF

Switching Characteristics

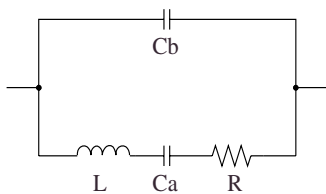
$V_{DD} = 1.6$ to $2.0V$, $V_{SS} = 0V$, $T_a = -20$ to $+80^\circ C$ unless otherwise noted.

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Output rise time	t_r	Measurement cct 3, load cct 1, $0.2V_{DD}$ to $0.8V_{DD}$, $C_L = 15pF$	–	1	3.5	ns
Output fall time	t_f	Measurement cct 3, load cct 1, $0.8V_{DD}$ to $0.2V_{DD}$, $C_L = 15pF$	–	1	3.5	ns
Output duty cycle ¹	Duty	Measurement cct 3, load cct 1, $T_a = 25^\circ C$, $V_{DD} = 1.8V$, $C_L = 15pF$, $f \leq 70MHz$	40	–	60	%
Output disable delay time ²	t_{PLZ}	Measurement cct 3, load cct 1, $T_a = 25^\circ C$, $V_{DD} = 1.6V$, $C_L \leq 15pF$	–	–	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. In the case of the CF5011AL \times , 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	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

FUNCTIONAL DESCRIPTION

Standby Function

Output three-state function (CF5011AL \times , CF5011AN \times)

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

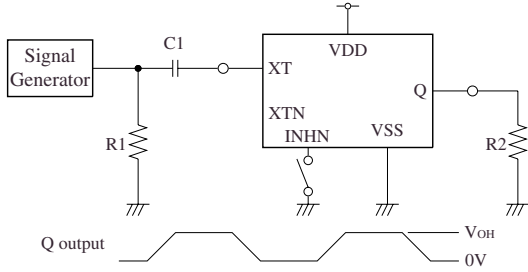
Oscillator stop function (CF5011AL \times)

When INHN goes LOW, the oscillator stops.

Version	INHN	Q	Oscillator
CF5011AL \times	HIGH (or open)	f_O output frequency	Normal operation
	LOW	High impedance	Stop
CF5011AN \times	HIGH (or open)	f_O output frequency	Normal operation
	LOW	High impedance	Normal operation

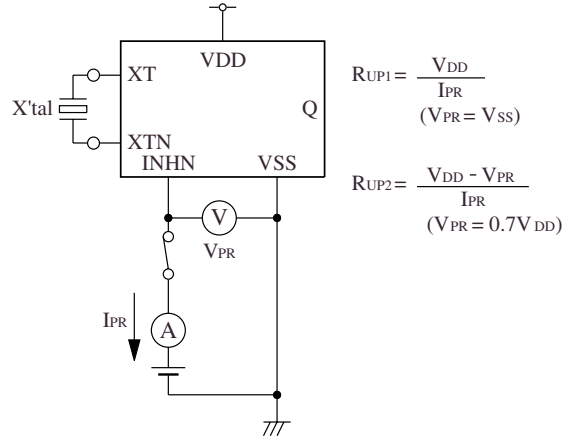
MEASUREMENT CIRCUITS

Measurement cct 1



1.0V_{p-p}, 10MHz sine wave input signal
 C1 : 0.001μF
 R1 : 50Ω
 R2 : 137.5Ω

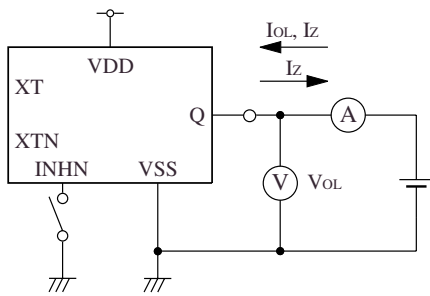
Measurement cct 4



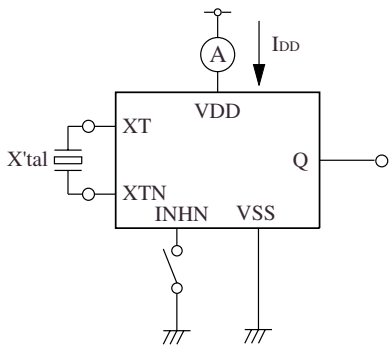
$$R_{UP1} = \frac{V_{DD}}{I_{PR}} \quad (V_{PR} = V_{SS})$$

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

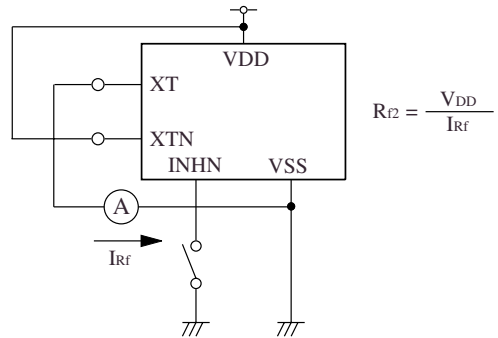
Measurement cct 2



Measurement cct 3

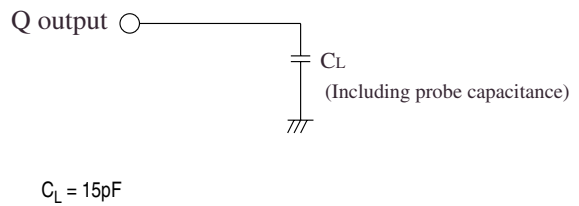


Measurement cct 5



$$R_{f2} = \frac{V_{DD}}{I_{rf}}$$

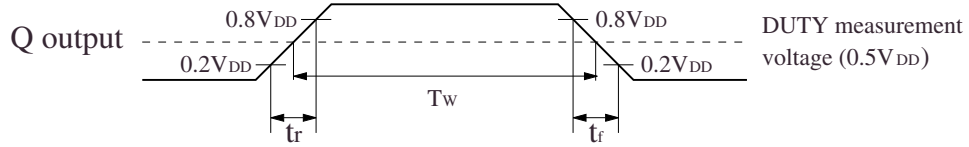
Load cct 1



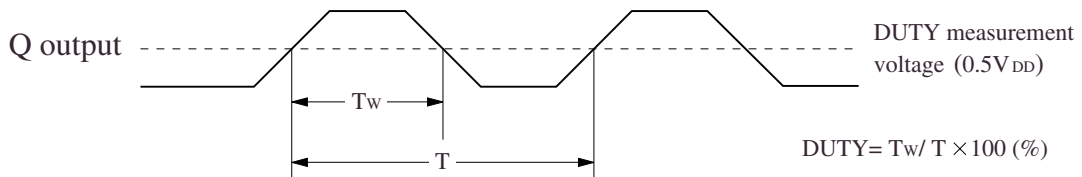
C_L = 15pF

Switching Time Measurement Waveform

t_r , t_f , Duty



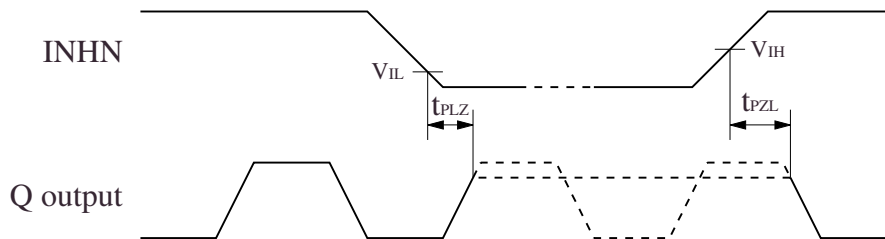
Output duty cycle



Output Enable/Disable Delay

The following figure shows the oscillator timing during normal operation (CF5011AN× only).

In case of CF5011AL×, the oscillator stops when the device is in standby. When standby is released, the oscillator starts and stable oscillator output occurs after a short delay.



INHN input waveform $t_r = t_f \leq 10\text{ns}$

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