

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-harmonic oscillator with only the addition of a crystal element.

FEATURES

- 3rd-harmonic oscillation
- 1.6 to 2.0V operating supply voltage range
- 30 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 [MHz]	gm ratio	Built-in capacitance [pF]		R_f [k Ω]	Standby function
			C_G	C_D		
CF5011ALA	30 to 40	1.0	14	16	4.0	Yes
CF5011ALB ¹	40 to 50	1.0	8	16	3.9	Yes
CF5011ALC ¹	50 to 60	1.0	8	16	2.2	Yes
CF5011ALD ¹	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. Under development

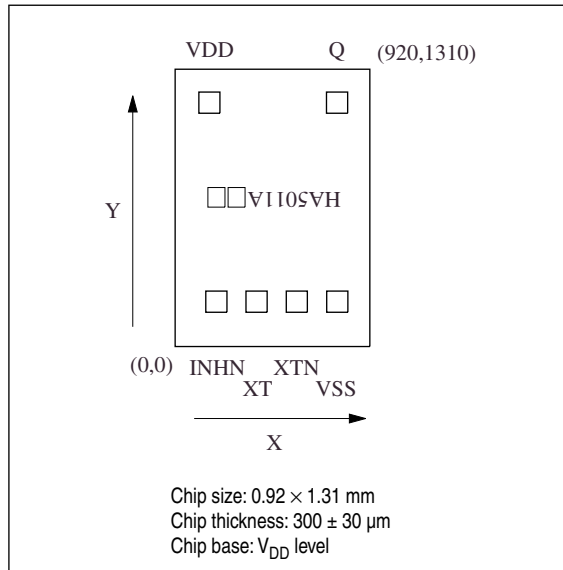
Note: Recommended operating frequency is not the guaranteed value but is measured using NPC's standard crystal.

ORDERING INFORMATION

Device	Package
CF5011xxx-1	Chip form

PAD LAYOUT

(Unit: μm)

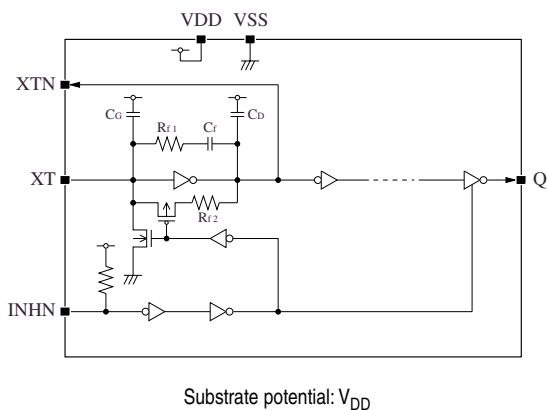


PIN DESCRIPTION and PAD DIMENSIONS

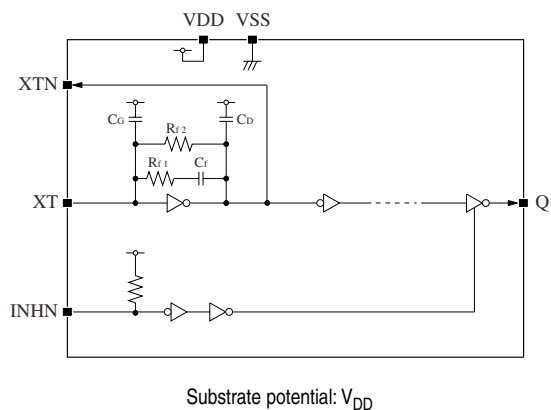
Name	I/O	Description	Pad dimensions [μm]	
			X	Y
INH N	I	Operation mode control input. <CF5011AL> The oscillator stops and Q becomes high impedance when LOW. Power saving pull-up resistor built in <CF5011AN> Q becomes high impedance when LOW. Pull-up resistor built in	195	212
XT	I	Amplifier input	385	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

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

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

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

Parameter	Symbol	Condition	Rating			Unit	
			min	typ	max		
HIGH-level output voltage	V_{OH}	Q: Measurement cct 1, $V_{DD} = 1.6V, I_{OH} = 8\text{mA}$	1.1	1.3	-	V	
LOW-level output voltage	V_{OL}	Q: Measurement cct 2, $V_{DD} = 1.6V, I_{OL} = 8\text{mA}$	-	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, $C_L = 15\text{pF}$, $f = 70\text{MHz}$	-	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	$\text{M}\Omega$
	R_{UP2}	Measurement cct 4, INHN = $0.7V_{DD}$	CF5011AL \times CF5011AN \times	50	-	150	$\text{k}\Omega$
AC feedback resistance	R_{f1}	Design value, determined by the internal wafer pattern	CF5011ALA, ANA	3.20	4.0	4.80	$\text{k}\Omega$
			CF5011ALB, ANB	3.12	3.9	4.68	$\text{k}\Omega$
			CF5011ALC, ANC	1.76	2.2	2.64	$\text{k}\Omega$
			CF5011ALD, AND	2.16	2.7	3.24	$\text{k}\Omega$
DC feedback resistance	R_{f2}	Measurement cct 5	50	-	150	$\text{k}\Omega$	
AC feedback capacitance	C_f	Design value, determined by the internal wafer pattern	9.3	10	10.7	pF	
Built-in capacitance	C_G	Design value, determined by the internal wafer pattern	CF5011ALA, ANA	13.02	14	14.98	pF
			CF5011ALB, ALC, ALD CF5011ANB, ANC, AND	7.44	8	8.56	pF
	C_D	Design value, determined by the internal wafer pattern	CF5011ALA, ANA	14.88	16	17.12	pF
			CF5011ALB, ALC, ALD CF5011ANB, ANC, AND	14.88	16	17.12	pF

Switching Characteristics

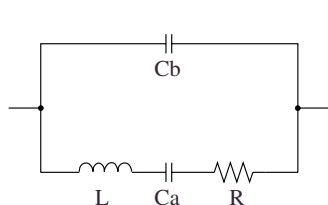
$V_{DD} = 1.6$ to $2.0V$, $V_{SS} = 0V$, $T_a = -20$ to $+80^\circ C$ unless otherwise noted.

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. Monitored in sample lots.

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.

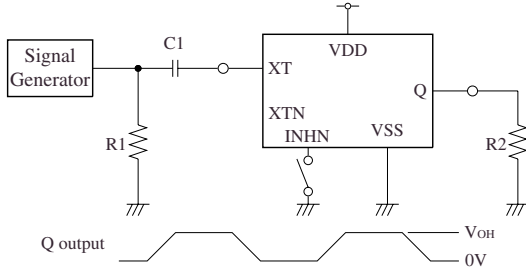
Oscillator stop function (CF5011AL \times)

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

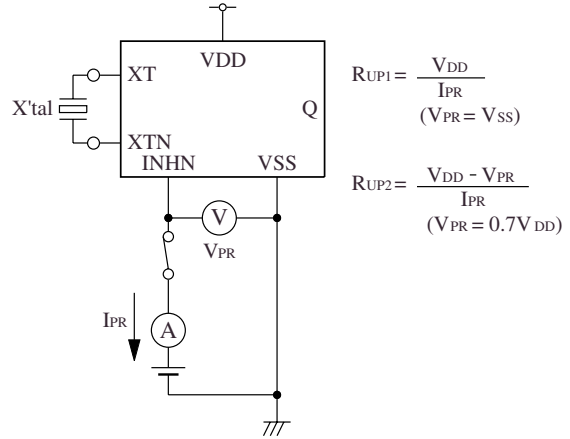
MEASUREMENT CIRCUITS

Measurement cct 1



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

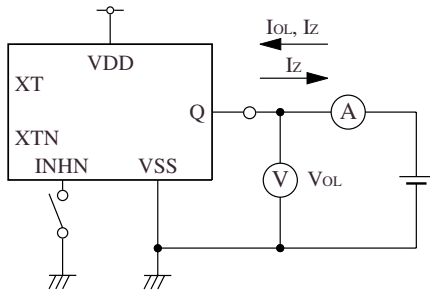
Measurement cct 4



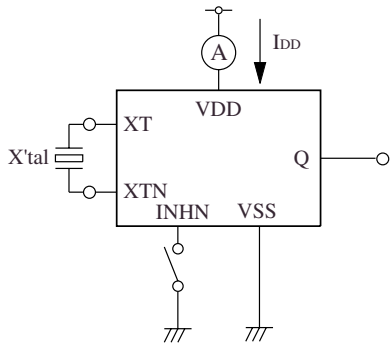
$$R_{UP1} = \frac{V_{DD}}{I_{PR}} \quad (V_{PR} = V_{SS})$$

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

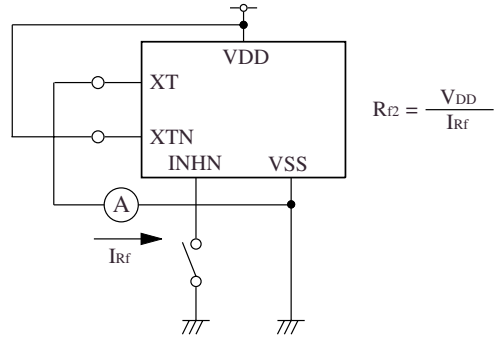
Measurement cct 2



Measurement cct 3

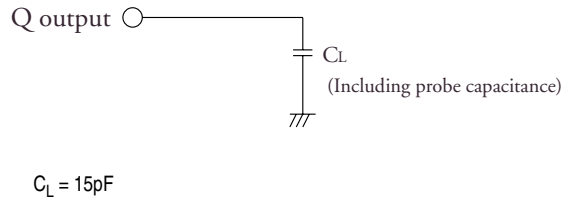


Measurement cct 5



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

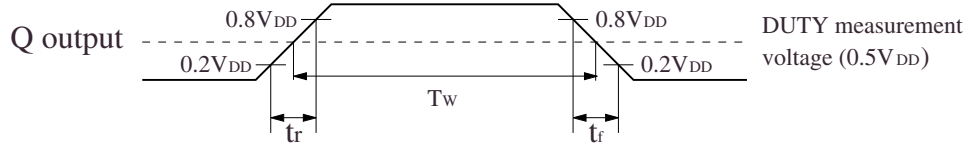
Load cct 1



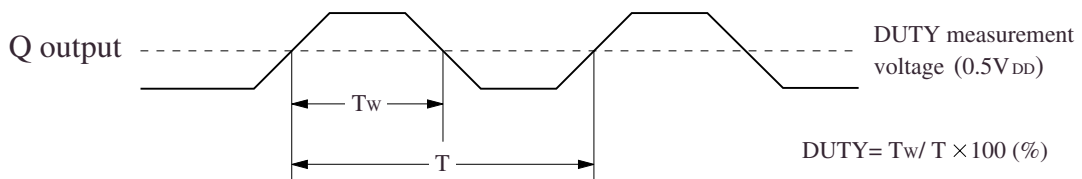
C_L = 15pF

Switching Time Measurement Waveform

T_r , T_f , Duty



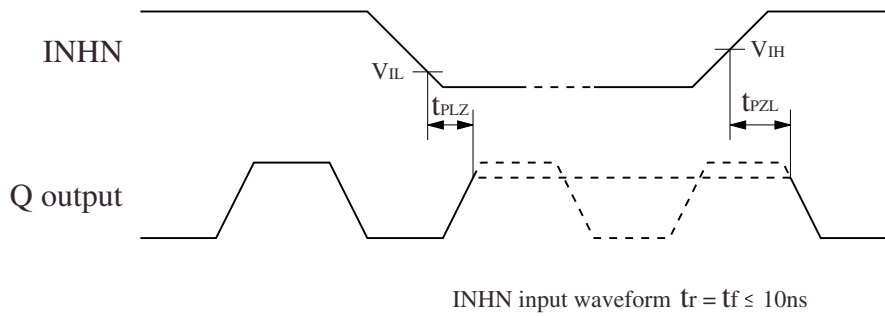
Output duty cycle



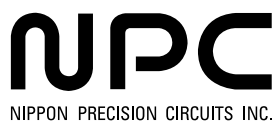
Output Enable/Disable Delay

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.



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