NIPPON PRECISION CIRCUITS INC.

CF5011 series

1.8V Crystal Oscillator Module ICs

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 (CF5011×××)

SERIES CONFIGURATION

Version	Recommended operating frequency [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[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

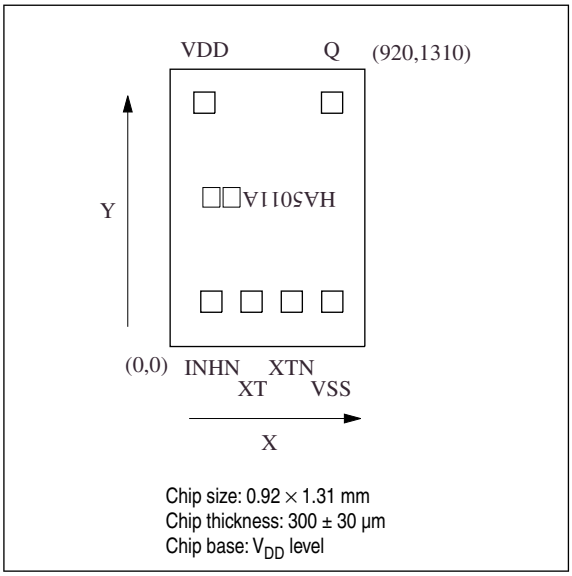
Note: Recommended operating frequency is not the guaranteed value but is measured using NPC's standard crystal.

ORDERING INFORMATION

Device	Package
CF5011×××–1	Chip form

PAD LAYOUT

(Unit:µm)



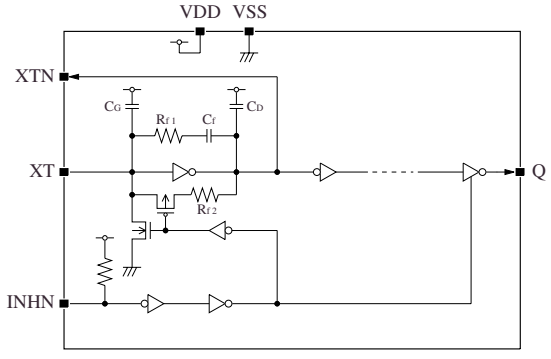
Chip size: 0.92 × 1.31 mm
Chip thickness: 300 ± 30 µm
Chip base: V_{DD} level

PIN DESCRIPTION and PAD DIMENSIONS

Name	I/O	Description		Pad dimensions [µm]	
				X	Y
INHN	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	Crystal oscillator connection pins. Crystal oscillator connected between XT and XTN	385	212
XTN	O	Amplifier output		575	212
VSS	–	Ground		766	212
Q	O	Output. Output frequency (f_O). High impedance when INHN is LOW		765	1152
VDD	–	Supply voltage		162	1152

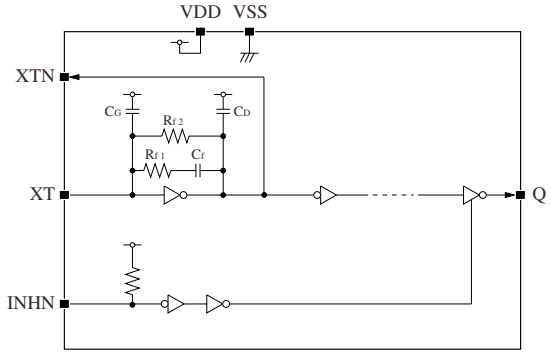
BLOCK DIAGRAM

CF5011AL×



Substrate potential: V_{DD}

CF5011AN×



Substrate potential: V_{DD}

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 ≤ 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, Ta = –20 to +80°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	CF5011AL×	–	–	100	µA
INHN pull-up resistance	R_{UP1}	Measurement cct 4, INHN = LOW	CF5011AL×	0.4	–	8	MΩ
	R_{UP2}	Measurement cct 4, INHN = $0.7V_{DD}$	CF5011AL× CF5011AN×	50	–	150	kΩ
AC feedback resistance	R_{f1}	Design value, determined by the internal wafer pattern	CF5011ALA, ANA	3.20	4.0	4.80	kΩ
			CF5011ALB, ANB	3.12	3.9	4.68	kΩ
			CF5011ALC, ANC	1.76	2.2	2.64	kΩ
			CF5011ALD, AND	2.16	2.7	3.24	kΩ
DC feedback resistance	R_{f2}	Measurement cct 5		50	–	150	kΩ
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

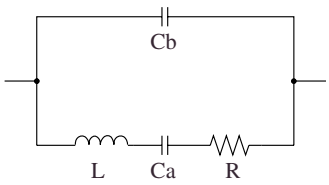
Switching Characteristics

V_{DD} = 1.6 to 2.0V, V_{SS} = 0V, Ta = –20 to +80°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, Ta = 25°C, V_{DD} = 1.8V, C_L = 15pF, f ≤ 70MHz	40	–	60	%
Output disable delay time[2]	t_{PLZ}	Measurement cct 3, load cct 1, Ta = 25°C, V_{DD} = 1.6V, C_L ≤ 15pF	–	–	100	ns
Output enable delay time[2]	t_{PZL}		–	–	100	ns

1. Monitored in sample lots.
2. In the case of the CF5011AL×, 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×, CF5011AN×)

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

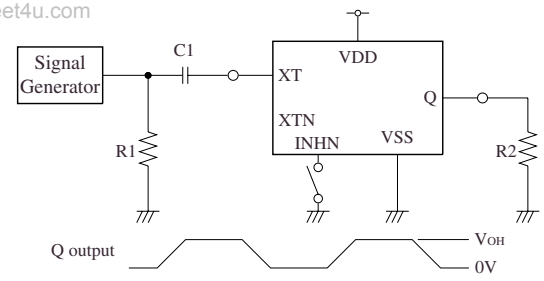
Oscillator stop function (CF5011AL×)

When INHN goes LOW, the oscillator stops.

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

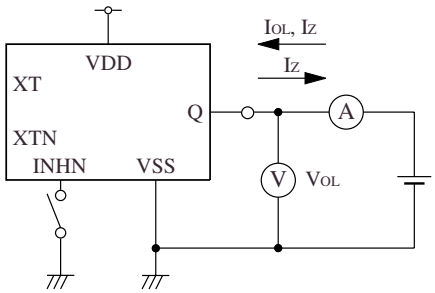
MEASUREMENT CIRCUITS

Measurement cct 1

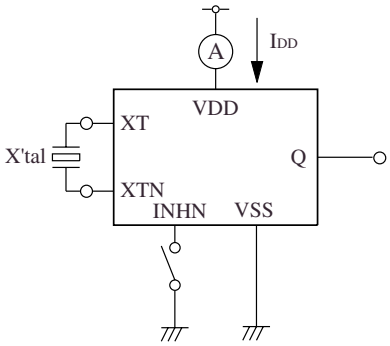


1.0V_{P-P} , 10MHz sine wave input signal
C1 : 0.001µF
R1 : 50Ω
R2 : 137.5Ω

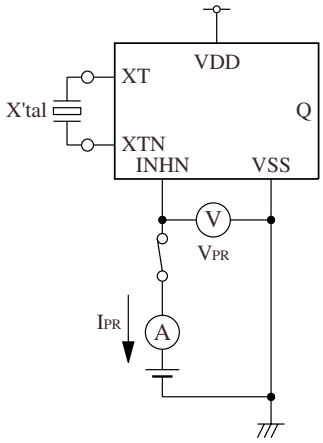
Measurement cct 2



Measurement cct 3



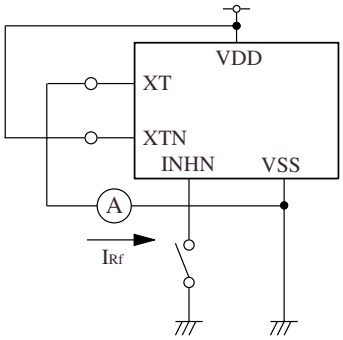
Measurement cct 4



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

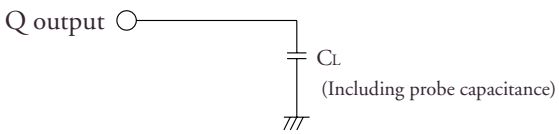
$$R_{UP2} = \frac{V_{DD} - V_{PR}}{I_{PR}} \quad (V_{PR} = 0.7V_{DD})$$

Measurement cct 5



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

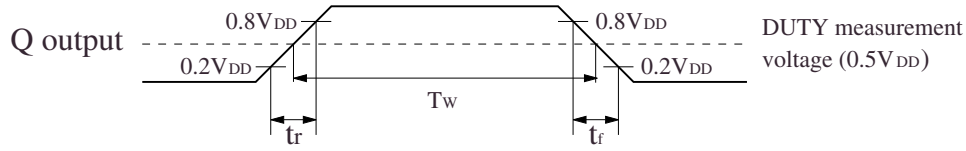
Load cct 1



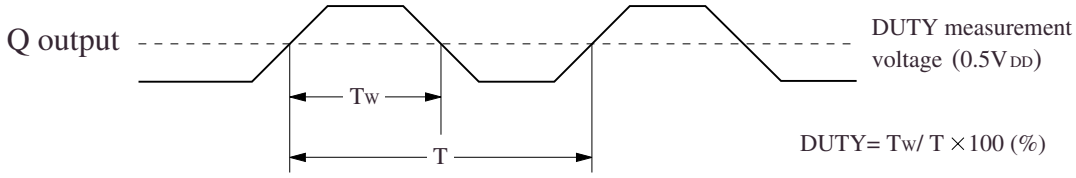
C_L = 15pF

Switching Time Measurement Waveform

T_r , T_f , Duty



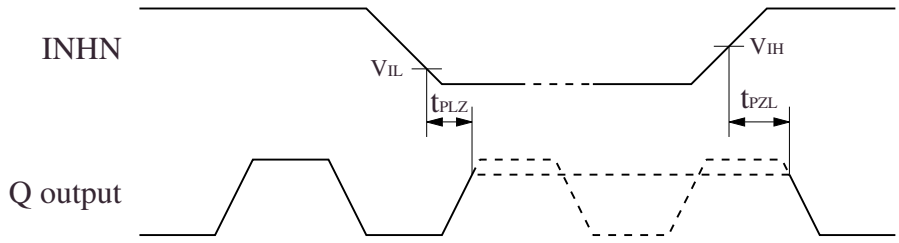
Output duty cycle



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 $t_r = t_f \leq 10$ns

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