

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 |

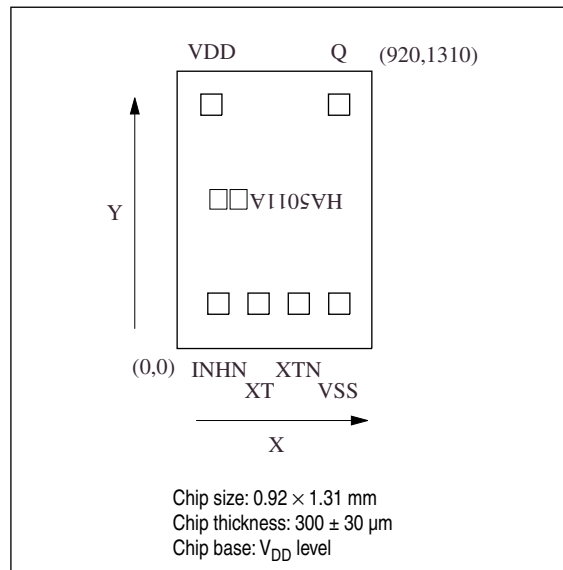
1. Under development

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 |

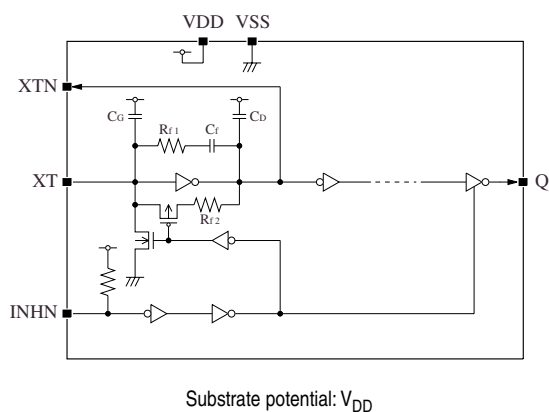
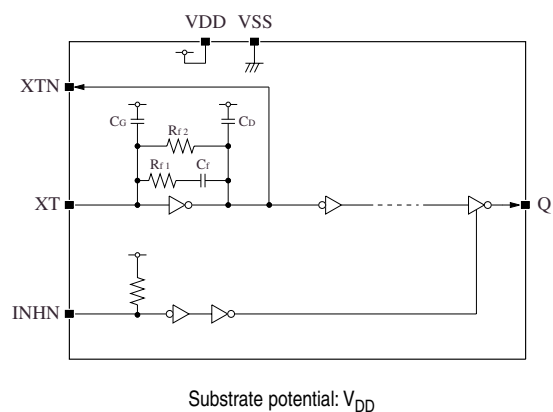
PAD LAYOUT

(Unit: μm)

PIN DESCRIPTION and PAD DIMENSIONS

| Name | I/O | Description | | Pad dimensions [μm] | |
|------|-----|---|--|----------------------------------|------|
| | | | | X | Y |
| 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_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 | 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

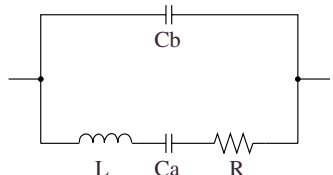
$V_{DD} = 1.6$ to $2.0V$, $V_{SS} = 0V$, $T_a = -20$ to $+80^\circ C$ unless otherwise noted.

| 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×, 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.

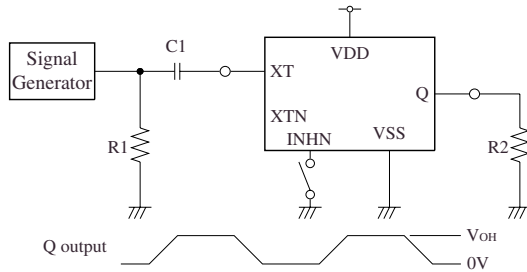
Oscillator stop function (CF5011AL×)

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 |

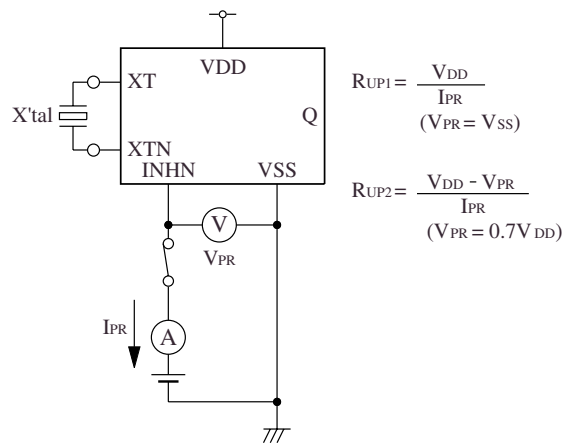
MEASUREMENT CIRCUITS

Measurement cct 1

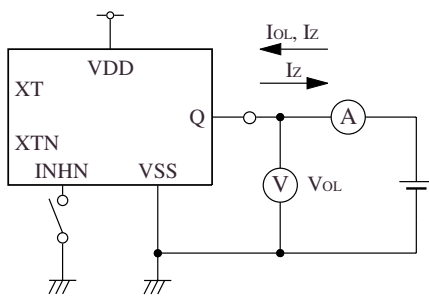


1.0V_{P-P}, 10MHz sine wave input signal
 C1 : 0.001μF
 R1 : 50Ω
 R2 : 137.5Ω

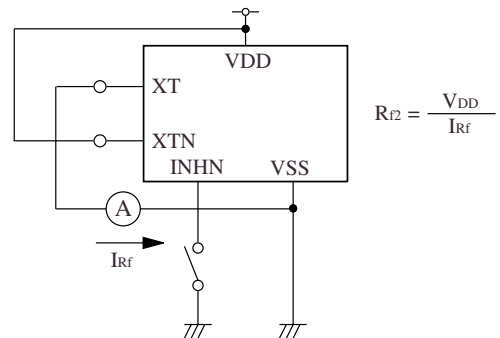
Measurement cct 4



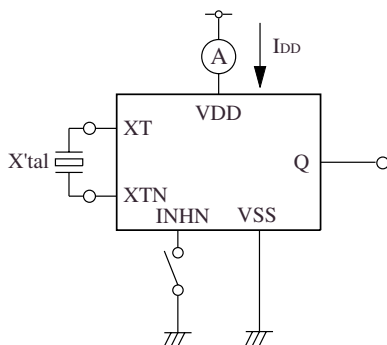
Measurement cct 2



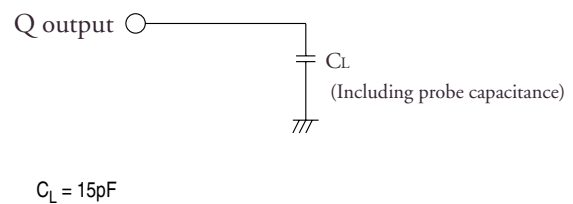
Measurement cct 5



Measurement cct 3

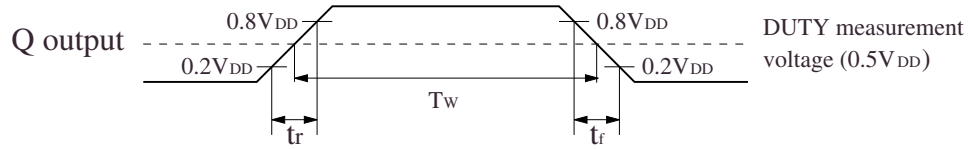


Load cct 1

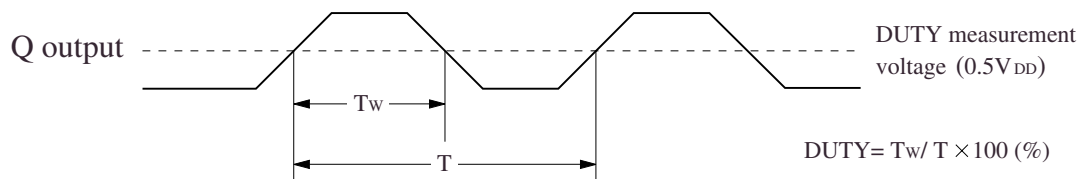


Switching Time Measurement Waveform

T_r , T_f , Duty



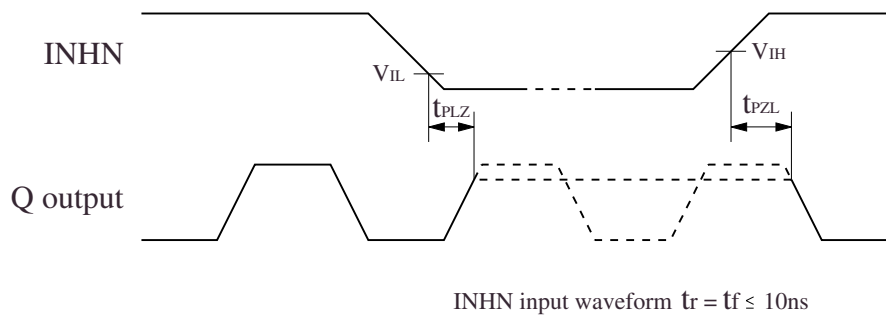
Output duty cycle



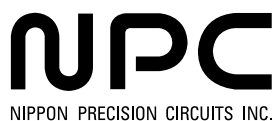
Output Enable/Disable Delay

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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