CF5017 series

3rd Overtone Crystal Oscillator Module ICs

OVERVIEW

The CF5017 series are 3rd overtone crystal oscillator ICs. Devices are available that provide 3rd overtone oscillation in the range 30MHz to 80MHz. The oscillator circuit is comprised of feedback resistors with good temperature characteristics and oscillation capacitors with excellent frequency response for stable 3rd overtone oscillation. Also, the chip layout is optimized, resulting in a large reduction in chip surface area compared to existing devices.

FEATURES

- 2.7 to 5.5V operating supply voltage range
- 30MHz to 80MHz oscillation frequency range (varies with version)
- – 40 to 85°C operating temperature range
- Oscillation capacitors built-in
  - C_G = 8pF, C_D = 15pF
- 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 output frequency (oscillation frequency)
- Output drive capability
  - 8mA (V_{DD} = 2.7V)
  - 16mA (V_{DD} = 4.5V)
- CMOS output duty level (1/2VDD)
- 50 ± 5% output duty (at 1/2VDD)
- 30pF output load
- Molybdenum-gate CMOS process
- Chip form (CF5017AL×)

SERIES CONFIGURATION

Version	Operating supply voltage range [V]	Recommended operating frequency range[1] [MHz]		gm ratio	Built-in capacitance [pF]		Rf [kΩ]
		3V operation	5V operation		C_G	C_D	
CF5017ALA	2.7 to 5.5	30 to 36	30 to 44	0.25	8	15	3.5
CF5017ALB	2.7 to 5.5	36 to 50	40 to 60	0.50			3.5
CF5017ALC	2.7 to 5.5	44 to 60	60 to 80	0.75			3.5
CF5017ALD	2.7 to 3.6	53 to 80	–	1.00			3.0

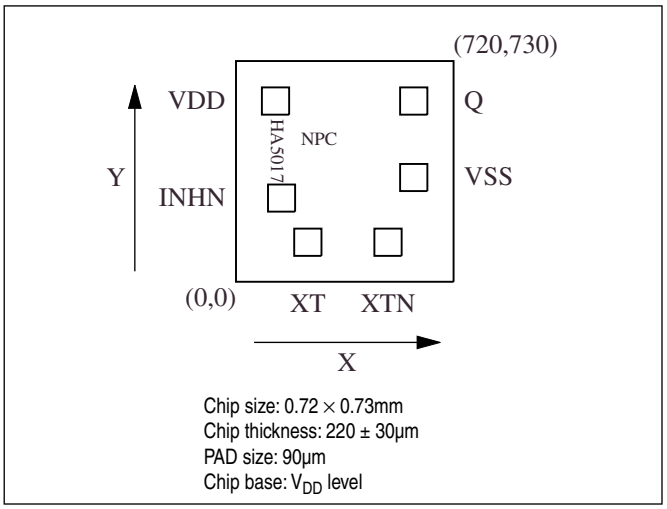
1. The recommended operating frequency is a yardstick value derived from the crystal used for NPC characteristics authentication. However, the oscillator frequency band is not guaranteed. Specifically, the characteristics can vary greatly due to crystal characteristics and mounting conditions, so the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

ORDERING INFORMATION

Device	Package
CF5017AL×–2	Chip form

PAD LAYOUT

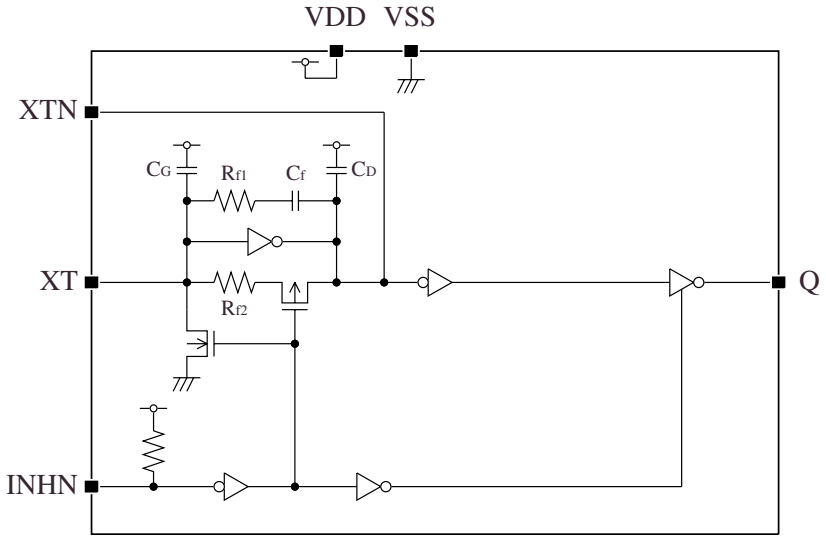
(Unit: µm)



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	Crystal connection pins. Crystal is connected between XT and XTN.	238	131
XTN	O	Amplifier output		503	131
VSS	–	Ground		588	345
Q	O	Output. Output frequency. High impedance in standby mode		588	598
VDD	–	Supply voltage		131	598

BLOCK DIAGRAM



INHN = LOW active

SPECIFICATIONS

Absolute Maximum Ratings

V_{SS} = 0V

Parameter	Symbol	Condition	Rating	Unit
Supply voltage range	V_{DD}		–0.5 to +7.0	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}		20	mA

Recommended Operating Conditions

3V operation (CF5017ALA, ALB, ALC, ALD)

V_{SS} = 0V, f ≤ 80MHz, C_L ≤ 30pF

Parameter	Symbol	Condition	Rating	Unit
Supply voltage range	V_{DD}		2.7 to 3.6	V
Input voltage range	V_{IN}		V_{SS} to V_{DD}	V
Operating temperature range	T_{OPR}		–40 to +85	°C

5V operation (CF5017ALA, ALB, ALC)

V_{SS} = 0V, f ≤ 80MHz, C_L ≤ 30pF

Parameter	Symbol	Condition	Rating	Unit
Supply voltage range	V_{DD}		4.5 to 5.5	V
Input voltage range	V_{IN}		V_{SS} to V_{DD}	V
Operating temperature range	T_{OPR}		–40 to +85	°C

Electrical Characteristics

3V operation (CF5017ALA, ALB, ALC, ALD)

V_{DD} = 2.7 to 3.6V, V_{SS} = 0V, Ta = –40 to +85°C unless otherwise noted.

Parameter	Symbol	Condition		Rating			Unit
				min	typ	max	
HIGH-level output voltage	V_{OH}	Q: Measurement cct 1, V_{DD} = 2.7V, I_{OH} = 8mA		2.2	2.4	–	V
LOW-level output voltage	V_{OL}	Q: Measurement cct 2, V_{DD} = 2.7V, I_{OL} = 8mA		–	0.3	0.4	V
HIGH-level input voltage	V_{IH}	INHN		0.7V_{DD}	–	–	V
LOW-level input voltage	V_{IL}	INHN		–	–	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, INHN = open, C_L = 30pF	CF5017ALA f = 30MHz	–	7	14	mA
			CF5017ALB f = 40MHz	–	10	20	mA
			CF5017ALC f = 60MHz	–	14	28	mA
			CF5017ALD f = 80MHz	–	19	38	mA
Standby current	I_{ST}	Measurement cct 3, INHN = LOW		–	–	5	µA
INHN pull-up resistance	R_{UP1}	Measurement cct 4		2	4	8	MΩ
	R_{UP2}			30	150	300	kΩ
AC feedback resistance	R_{f1}	Design value. A monitor pattern on a wafer is tested.	CF5017ALA	2.97	3.5	4.03	kΩ
			CF5017ALB	2.97	3.5	4.03	kΩ
			CF5017ALC	2.97	3.5	4.03	kΩ
			CF5017ALD	2.55	3.0	3.45	kΩ
DC feedback resistance	R_{f2}	Measurement cct 5		50	–	150	kΩ
AC feedback capacitance	C_f	Design value. A monitor pattern on a wafer is tested.		8.5	10	11.5	pF
Built-in capacitance	C_G	Design value. A monitor pattern on a wafer is tested.		6.8	8	9.2	pF
	C_D			12.7	15	17.3	pF

5V operation (CF5017ALA, ALB, ALC)

V_{DD} = 4.5 to 5.5V, V_{SS} = 0V, Ta = –40 to +85°C unless otherwise noted.

Parameter	Symbol	Condition		Rating			Unit
				min	typ	max	
HIGH-level output voltage	V_{OH}	Q: Measurement cct 1, V_{DD} = 4.5V, I_{OH} = 16mA		3.9	4.2	–	V
LOW-level output voltage	V_{OL}	Q: Measurement cct 2, V_{DD} = 4.5V, I_{OL} = 16mA		–	0.3	0.4	V
HIGH-level input voltage	V_{IH}	INHN		0.7V_{DD}	–	–	V
LOW-level input voltage	V_{IL}	INHN		–	–	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, INHN = open, C_L = 30pF	CF5017ALA f = 40MHz	–	16	32	mA
			CF5017ALB f = 60MHz	–	26	52	mA
			CF5017ALC f = 80MHz	–	35	70	mA
Standby current	I_{ST}	Measurement cct 3, INHN = LOW		–	–	10	µA
INHN pull-up resistance	R_{UP1}	Measurement cct 4		1	2	4	MΩ
	R_{UP2}			20	100	200	kΩ
AC feedback resistance	R_{f1}	Design value. A monitor pattern on a wafer is tested.	CF5017ALA	2.97	3.5	4.03	kΩ
			CF5017ALB	2.97	3.5	4.03	kΩ
			CF5017ALC	2.97	3.5	4.03	kΩ
DC feedback resistance	R_{f2}	Measurement cct 5		50	–	150	kΩ
AC feedback capacitance	C_f	Design value. A monitor pattern on a wafer is tested.		8.5	10	11.5	pF
Built-in capacitance	C_G	Design value. A monitor pattern on a wafer is tested.		6.8	8	9.2	pF
	C_D			12.7	15	17.3	pF

Switching Characteristics

3V operation (CF5017ALA, ALB, ALC, ALD)

V_{DD} = 2.7 to 3.6V, V_{SS} = 0V, Ta = –40 to +85°C unless otherwise noted.

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Output rise time	t_r	Measurement cct 3, load cct 1, 0.1V_{DD} to 0.9V_{DD} , C_L = 30pF	–	2.5	5	ns
Output fall time	t_f	Measurement cct 3, load cct 1, 0.9V_{DD} to 0.1V_{DD} , C_L = 30pF	–	2.5	5	ns
Output duty cycle[1]	Duty	Measurement cct 3, load cct 1, V_{DD} = 3.0V, Ta = 25°C, f = 80MHz, C_L = 30pF	45	–	55	%
Output disable delay time[2]	t_{PLZ}	Measurement cct 6, load cct 1, V_{DD} = 3.0V, Ta = 25°C, C_L = 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. 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.

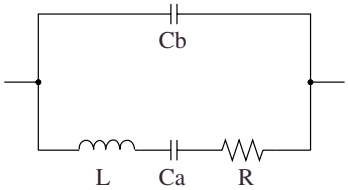
5V operation (CF5017ALA, ALB, ALC)

V_{DD} = 4.5 to 5.5V, V_{SS} = 0V, Ta = –40 to +85°C unless otherwise noted.

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Output rise time	t_r	Measurement cct 3, load cct 1, 0.1V_{DD} to 0.9V_{DD} , C_L = 30pF	–	2	4	ns
Output fall time	t_f	Measurement cct 3, load cct 1, 0.9V_{DD} to 0.1V_{DD} , C_L = 30pF	–	2	4	ns
Output duty cycle[1]	Duty	Measurement cct 3, load cct 1, V_{DD} = 5.0V, Ta = 25°C, f = 80MHz, C_L = 30pF	45	–	55	%
Output disable delay time[2]	t_{PLZ}	Measurement cct 6, load cct 1, V_{DD} = 5.0V, Ta = 25°C, C_L = 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. 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
85	20.58	5.22	0.671	4.965

FUNCTIONAL DESCRIPTION

Standby Function

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

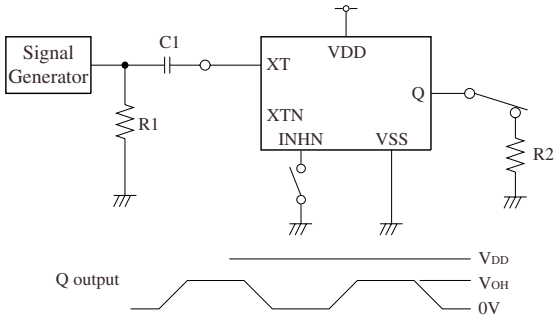
INHN	Q	Oscillator
HIGH (or open)	f_O output frequency	Normal operation
LOW	High impedance	Stopped

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.

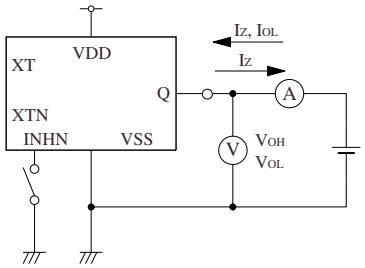
MEASUREMENT CIRCUITS

Measurement cct 1

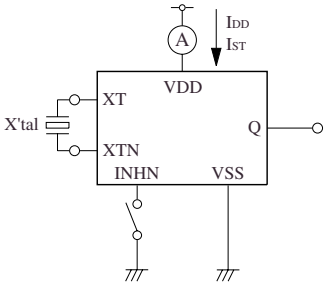


2Vp-p, 10MHz sine wave input signal
C1: 0.001µF
R1: 50Ω
R2: 275Ω (3V operation)
244Ω (5V operation)

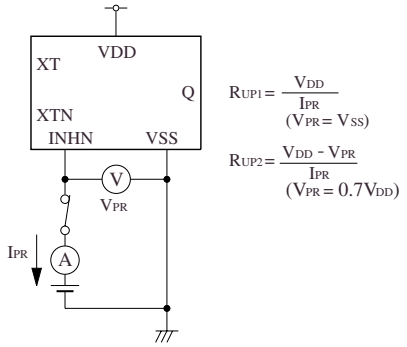
Measurement cct 2



Measurement cct 3



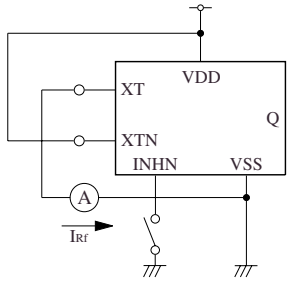
Measurement cct 4



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

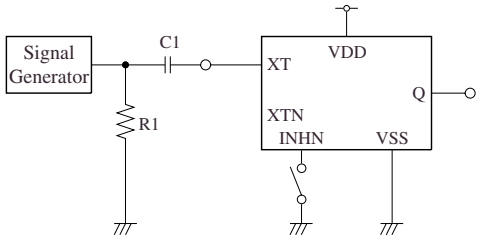
$R_{UP2} = \frac{V_{DD} - V_{PR}}{I_{PR}}$ $(V_{PR} = 0.7V_{DD})$

Measurement cct 5



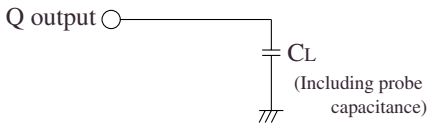
$R_f = \frac{V_{DD}}{I_{Rf}}$

Measurement cct 6



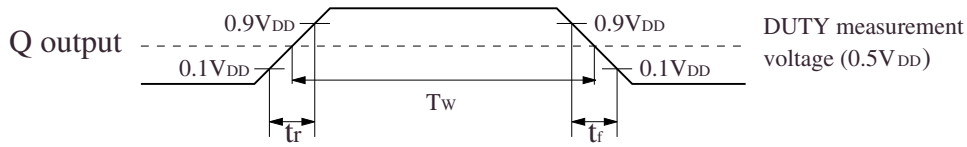
2Vp-p, 10MHz sine wave input signal
C1: 0.001µF
R1: 50Ω

Load cct 1

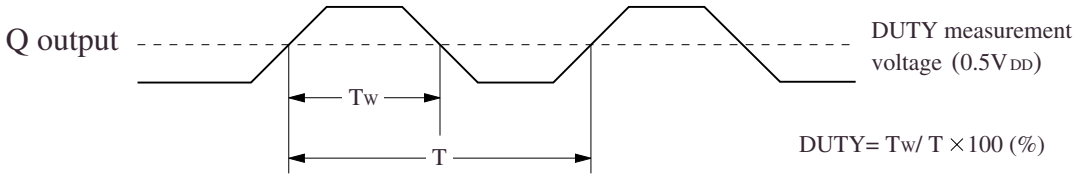


Switching Time Measurement Waveform

Output duty level, t_r, t_f

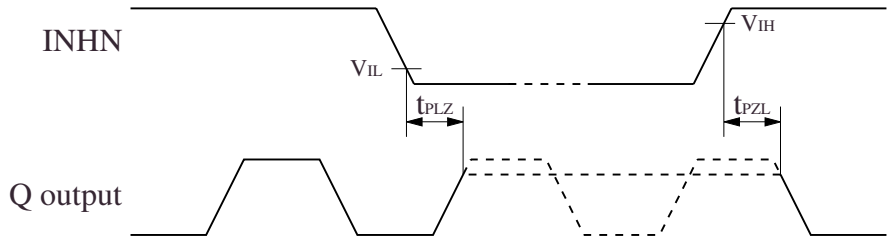


Output duty cycle



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.



INHN input waveform $t_r = t_f \leq 10ns$

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