NIPPON PRECISION CIRCUITS INC.

CF5005B series

High-frequency Crystal Oscillator Module ICs

OVERVIEW

The CF5005B series are high-frequency crystal oscillator module ICs. They are comprised of an oscillator circuit and output buffer optimized for operation at 125 to 165MHz. 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

- 3.0 to 3.6V operating supply voltage range
- 125 to 165MHz recommended operating frequency range
- Inverter amplifier feedback resistor built-in
- Oscillator capacitors C_G , C_D built-in
- Output three-state function (high impedance in standby mode, oscillator stops)
- f_O output frequency (oscillator frequency)
- 8mA output drive capability (V_{DD} = 3.0V)
- CMOS output duty level
- Chip form (CF5005B××)

SERIES CONFIGURATION

Version	Recommended operating frequency[1] [MHz]	gm ratio	Built-in capacitance [pF]		R_f [kΩ]
			C_G	C_D	
CF5005BLA	125 to 150	1.0	1	6	2.2
CF5005BLB	140 to 165	1.0	1	3	2.2

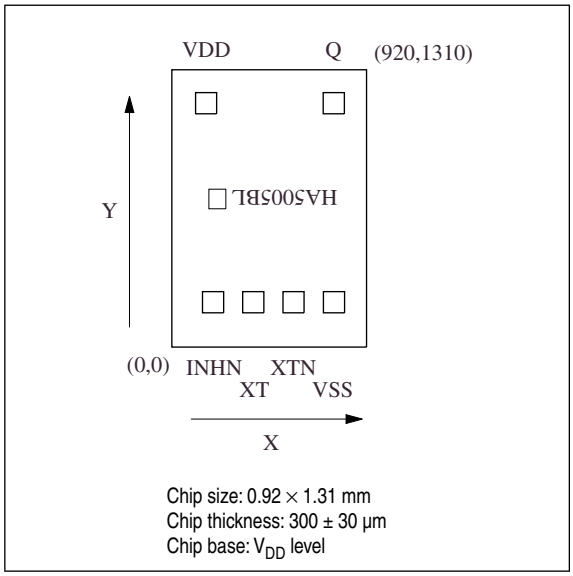
1. The recommended operating frequency is a yardstick value derived from the crystal used for NPC characteristics authentication. However, the oscillator frequency band is not guaranteed. Specifically, when used at high frequencies, the characteristics can vary greatly due to crystal characteristics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

ORDERING INFORMATION

Device	Package
CF5005B××–1	Chip form

PAD LAYOUT

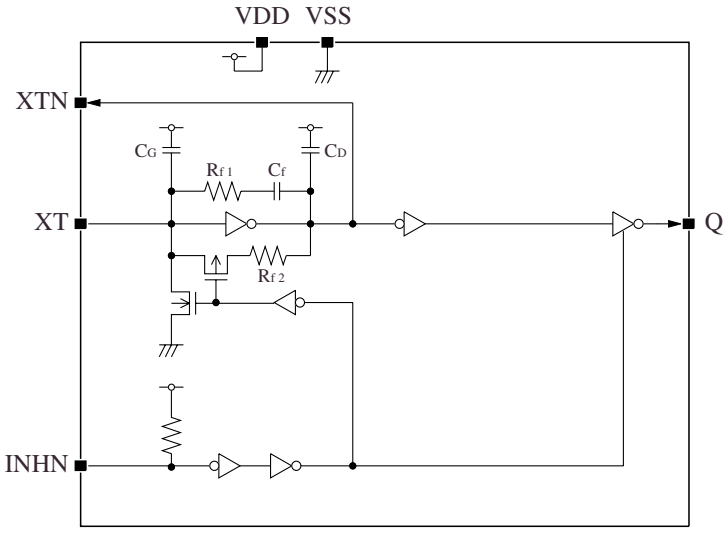
(Unit:µm)



PIN DESCRIPTION and PAD DIMENSIONS

Name	I/O	Description		Pad dimensions [µm]	
				X	Y
INHN	I	Output state control input. Oscillator stops 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 in standby mode		765	1152
VDD	–	Supply voltage		162	1152

BLOCK DIAGRAM



Substrate potential: V_{DD}

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}		25	mA

Recommended Operating Conditions

V_{SS} = 0V, f ≤ 165MHz, C_L ≤ 15pF unless otherwise noted.

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Operating supply voltage	V_{DD}		3.0	–	3.6	V
Input voltage	V_{IN}		V_{SS}	–	V_{DD}	V
Operating temperature	T_{OPR}		–20	–	80	°C

Electrical Characteristics

V_{DD} = 3.0 to 3.6V, 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} = 3.0V, I_{OH} = 8mA		2.5	2.7	–	V
LOW-level output voltage	V_{OL}	Q: Measurement cct 2, V_{DD} = 3.0V, I_{OL} = 8mA		–	0.3	0.4	V
Output leakage current	I_Z	Q: Measurement cct 2, INHN = LOW, V_{DD} = 3.6V	$V_{OH} = V_{DD}$	–	–	10	µA
			$V_{OL} = V_{SS}$	–	–	10	
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 = 133MHz	–	30	65	mA
			f = 156MHz	–	35	80	
Standby current	I_{ST}	Measurement cct 3, INHN = LOW		–	–	10	µA
INHN pull-up resistance	R_{UP1}	Measurement cct 4	INHN = V_{SS}	0.4	–	4	MΩ
	R_{UP2}		INHN = 0.7V_{DD}	50	–	150	kΩ
AC feedback resistance	R_{f1}	Design value, determined by the internal wafer pattern		1.76	2.2	2.64	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	CF5005BLA	0.93	1	1.07	pF
			CF5005BLB	0.93	1	1.07	
	C_D	Design value, determined by the internal wafer pattern	CF5005BLA	5.58	6	6.42	pF
			CF5005BLB	2.79	3	3.21	

Switching Characteristics

V_{DD} = 3.0 to 3.6V, 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, $0.1V_{DD}$ to $0.9V_{DD}$, C_L = 15pF	–	1.5	2.5	ns
Output fall time	t_f	Measurement cct 3, load cct 1, $0.9V_{DD}$ to $0.1V_{DD}$, C_L = 15pF	–	1.5	2.5	ns
Output duty cycle[1]	Duty	Measurement cct 3, load cct 1, Ta = 25°C, V_{DD} = 3.3V, C_L = 15pF, f ≤ 165MHz	40	–	60	%
Output disable delay time[2]	t_{PLZ}	Measurement cct 6, load cct 1, Ta = 25°C, V_{DD} = 3.0V, C_L ≤ 15pF	–	–	100	ns
Output enable delay time[2]	t_{PZL}	Measurement cct 6, load cct 1, Ta = 25°C, V_{DD} = 3.0V, C_L ≤ 15pF	–	–	100	ns

1. Monitored in sample lots.
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.

FUNCTIONAL DESCRIPTION

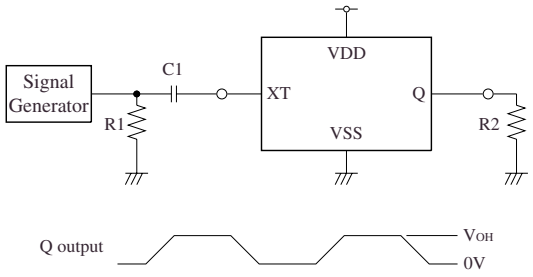
Standby Function

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

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

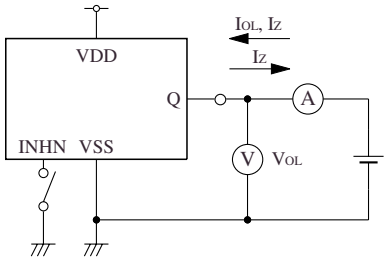
MEASUREMENT CIRCUITS

Measurement cct 1

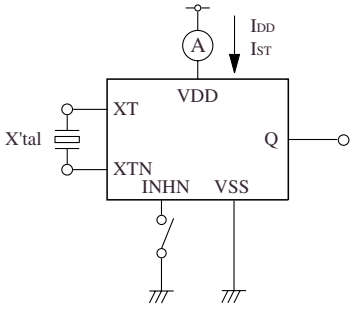


$2.5V_{P-P}$, 10MHz sine wave input signal
C1 : 0.001µF
R1 : 50Ω
R2 : 312.5Ω

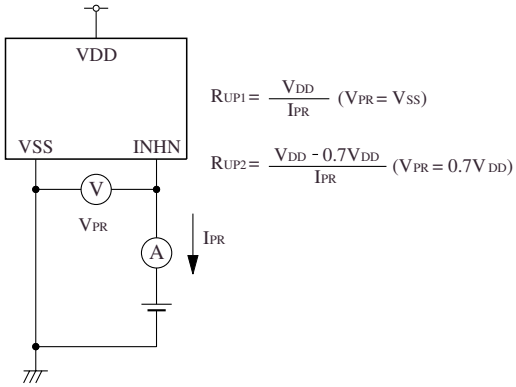
Measurement cct 2



Measurement cct 3



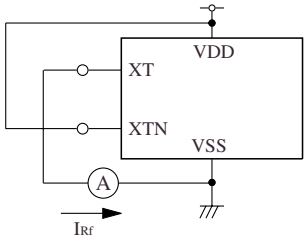
Measurement cct 4



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

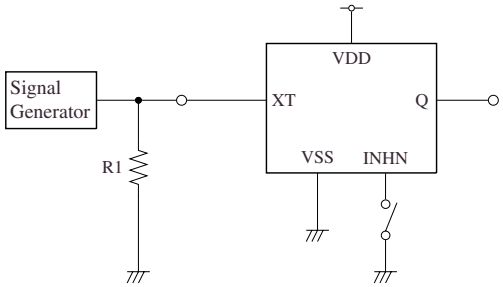
$$R_{UP2} = \frac{V_{DD} - 0.7V_{DD}}{I_{PR}} \quad (V_{PR} = 0.7V_{DD})$$

Measurement cct 5



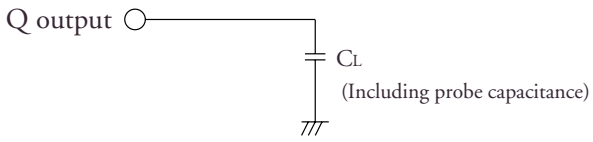
$$R_{f2} = \frac{V_{DD}}{I_{Rf}}$$

Measurement cct 6



R1 : 50Ω

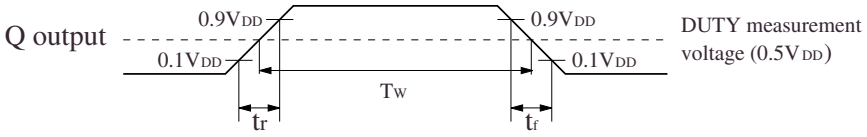
Load cct 1



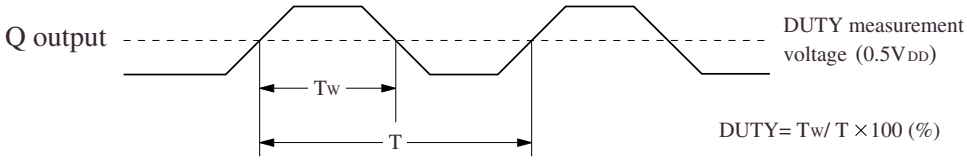
C_L = 15pF

Switching Time Measurement Waveform

Tr, Tf, DUTY

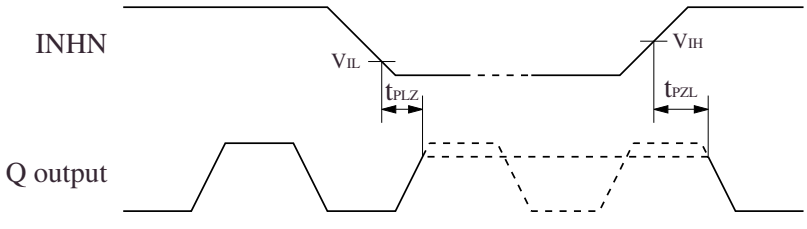


Output duty cycle



Output Enable/Disable Delay

The following figure shows the oscillator timing during normal operation. Note that 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 tr = tf ≤ 10ns

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