CF5074A

VCXO Module IC with Built-in Varicap

OVERVIEW

The CF5074A is VCXO module IC with built-in varicap diodes. The integrated varicap diode BiCMOS process allows the device to be fabricated on a single chip. A newly developed oscillator circuit features reduced drive level of crystal and wide pullrange. A VCXO module can be constructed with just the connection of a crystal unit, making the devices ideal as surface-mounted, compact VCXO modules.

FEATURES

- 2.25 to 3.6V operating supply voltage range
- 50MHz to 80MHz operating frequency range
- Varicap diode built-in
- Oscillation start-up detector function
- CMOS output duty level
- 4mA (min) output drive capability
- 15pF output load
- Standby function
  - High impedance in standby mode
- BiCMOS process
- Chip form (CF5074A)

APPLICATIONS

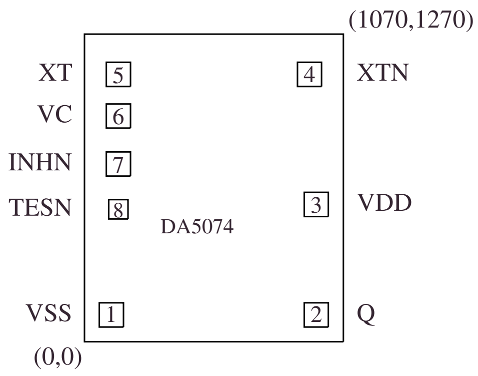
- VCXO modules

ORDERING INFORMATION

Device	Package
CF5074A–1	Chip form
CF5074A–3	

PAD LAYOUT

(Unit: µm)

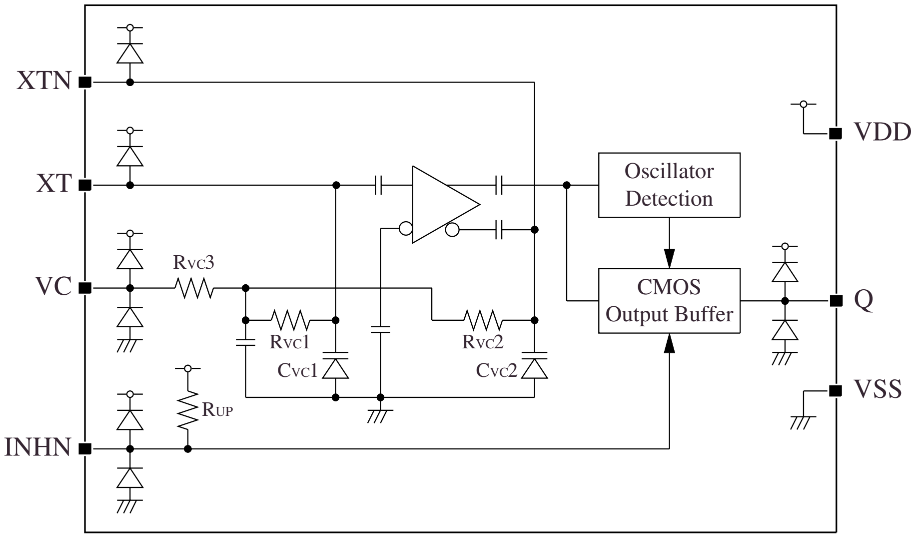


Chip size: 1.07 × 1.27mm
Chip thickness: 300 ± 30µm (CF5074A-1)
180 ± 20µm (CF5074A-3)
PAD size: 100 × 100µm (TESN: 80 × 80µm)
Chip base: V_{SS} potential

PAD DESCRIPTION AND DIMENSIONS

Pad No.	Name	I/O	Description	Pad dimensions [µm]	
				X	Y
1	VSS	–	(–) supply pin	111	111
2	Q	O	Output pin. High-impedance in standby mode	958	111
3	VDD	–	(+) supply pin	958	567
4	XTN	O	Oscillator output. Crystal connection pin	930	1104
5	XT	I	Oscillator input. Crystal connection pin	140	1104
6	VC	I	Oscillation frequency control voltage input pin. Positive polarity (frequency increases with increasing voltage)	140	932
7	INHN	I	Output state control voltage input pin. Standby mode when LOW. Power-saving pull-up resistor built-in	140	734
8	TESN	I	Test pin (leave open)	140	547

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

V_{SS} = 0V unless otherwise noted.

Parameter	Symbol	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
Storage temperature range	T_{STG}	–65 to +150	°C
Output current	I_{OUT}	20	mA

RECOMMENDED OPERATING CONDITIONS

V_{SS} = 0V unless otherwise noted.

Parameter	Symbol	Rating			Unit
		Min	Typ	Max	
Operating supply voltage	V_{DD}	2.25	–	3.6	V
Output frequency	f_{OUT}	50	–	80	MHz
Output load capacitance	C_L	–	–	15	pF
Input voltage	V_{IN}	V_{SS}	–	V_{DD}	V
Operating temperature	T_{OPR}	–40	+25	+85	°C

ELECTRICAL CHARACTERISTICS

V_{DD} = 2.25 to 3.6V, V_C = 0.5V_{DD}, V_{SS} = 0V, Ta = –40 to +85°C unless otherwise noted.

Parameter	Symbol	Conditions		Rating			Unit
				Min	Typ	Max	
Current consumption	I_{DD}	Measurement circuit 2, load circuit 1, INHN = open, C_L = 15pF, f = 80MHz	V_{DD} = 2.25 to 2.75V	–	20	30	mA
			V_{DD} = 3.0 to 3.6V	–	26	36	mA
HIGH-level output voltage	V_{OH}	Q: Measurement circuit 1, I_{OH} = –4mA		V_{DD} – 0.4	V_{DD} – 0.2	–	V
LOW-level output voltage	V_{OL}	Q: Measurement circuit 1, I_{OL} = 4mA		–	0.2	0.4	V
Output leakage current	I_Z	Q: Measurement circuit 6, INHN = LOW	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
INHN pull-up resistance	R_{UP1}	Measurement circuit 3	INHN = V_{SS}	0.4	0.8	1.2	MΩ
	R_{UP2}		INHN = 0.7V_{DD}	15	–	150	kΩ
Oscillator block built-in resistance	R_{VC1}	Measurement circuit 4		75	150	225	kΩ
	R_{VC2}			75	150	225	kΩ
	R_{VC3}			10	30	90	kΩ
Oscillator block built-in capacitance	C_{VC}	Capacitance of C_{VC1} and C_{VC2}	V_C = 0.3V	13	16.3	19.6	pF
			V_C = 1.65V	6.7	8.9	10.9	pF
			V_C = 3.0V	3.3	4.7	6.1	pF
VC input resistance	R_{VIN}	Measurement circuit 7, Ta = 25°C		10	–	–	MΩ
VC input impedance	Z_{VIN}	Measurement circuit 8, V_C = 0V, f = 10kHz, Ta = 25°C		–	250	–	kΩ
VC input capacitance	C_{VIN}	Measurement circuit 8, V_C = 0V, f = 10kHz, Ta = 25°C		–	60	–	pF
Modulation bandwidth	fm	Measurement circuit 9, –3dB frequency, V_{DD} = 3.3V, V_C = 3.3Vp-p, Ta = 25°C, crystal: f = 80MHz, C0 = 4.8pF, $\gamma \leq 440$		–	30	–	kHz

SWITCHING CHARACTERISTICS

V_{DD} = 2.25 to 3.6V, V_C = 0.5V_{DD}, V_{SS} = 0V, Ta = –40 to +85°C unless otherwise noted.

Parameter	Symbol	Conditions		Rating			Unit
				Min	Typ	Max	
Output rise time	t_{r1}	Measurement circuit 2, load circuit 1, 0.2V_{DD} → 0.8V_{DD}, Ta = 25°C, C_L = 15pF		–	2.5	4	ns
Output fall time	t_{f1}	Measurement circuit 2, load circuit 1, 0.8V_{DD} → 0.2V_{DD}, Ta = 25°C, C_L = 15pF		–	2.5	4	ns
Output duty cycle	Duty	Measurement circuit 2, load circuit 1, Ta = 25°C, C_L = 15pF	V_{DD} = 2.5V	40	50	60	%
			V_{DD} = 3.3V	45	50	55	%
Output disable delay time	t_{PLZ}	Measurement circuit 5, load circuit 1, Ta = 25°C, C_L ≤ 15pF		–	–	100	ns
Output enable delay time	t_{PZL}			–	–	100	ns

FUNCTIONAL DESCRIPTION

Standby Function

When INHN goes LOW, the device is in standby mode. The Q output becomes high impedance and the oscillator circuit continues running.

INHN	Q	Oscillator
HIGH (or open)	f_O	Operating
LOW	High impedance	Operating

Power-saving Pull-up Resistor

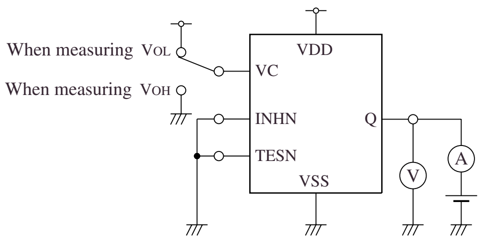
The INHN pin pull-up resistance changes in response to the input level (HIGH or LOW). When INHN is tied LOW, the pull-up resistance becomes large, reducing the current consumed by the resistance. When INHN is left open, the pull-up resistance becomes small, such that even if the input is affected by external noise the outputs are stable due to INHN being tied HIGH by the pull-up resistor.

Oscillation Start-up Detector Function

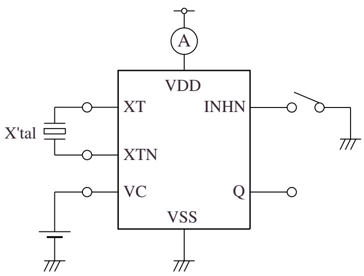
The devices also feature an oscillation start-up detector circuit. This circuit functions to disable the outputs until the oscillation starts. This prevents unstable oscillator output at oscillator start-up when power is applied.

MEASUREMENT CIRCUITS

Measurement Circuit 1

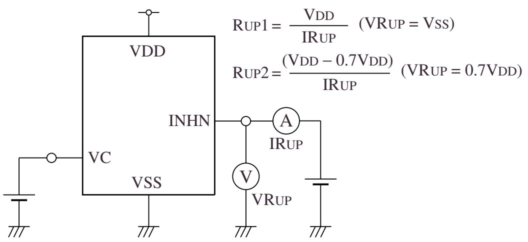


Measurement Circuit 2



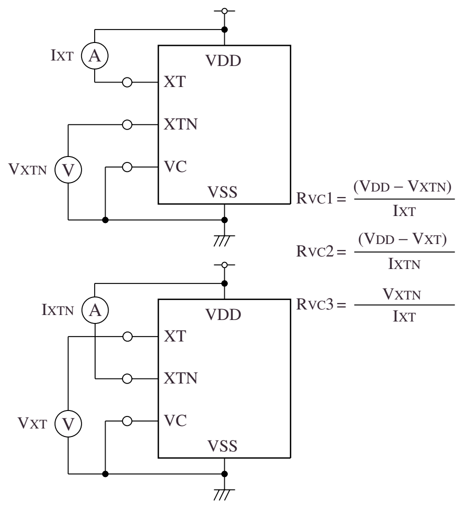
$V_C = 0.5V_{DD}$, INHN = open, crystal oscillation

Measurement Circuit 3

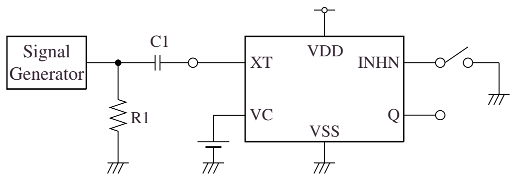


$V_C = 0.5V_{DD}$

Measurement Circuit 4



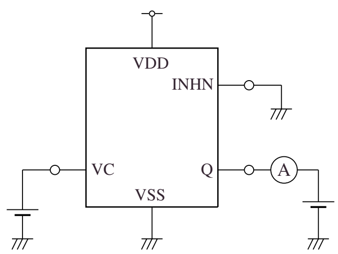
Measurement Circuit 5



XT input signal: 10MHz, 1.0Vp-p

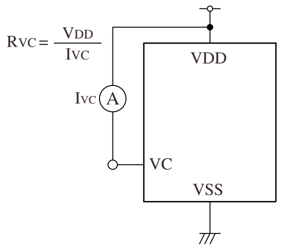
C1 = 0.001μF, R1 = 50Ω, $V_C = 0.5V_{DD}$

Measurement Circuit 6

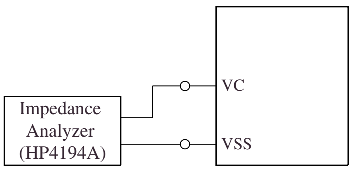


$V_C = 1/2V_{DD}$

Measurement Circuit 7

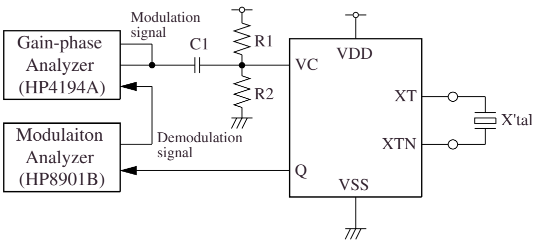


Measurement Circuit 8



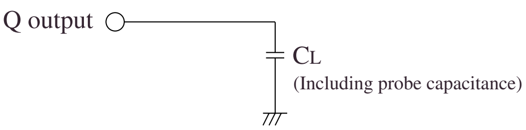
VC input signal: 100Hz to 10kHz, 0.1Vp-p, V_C = 0V

Measurement Circuit 9



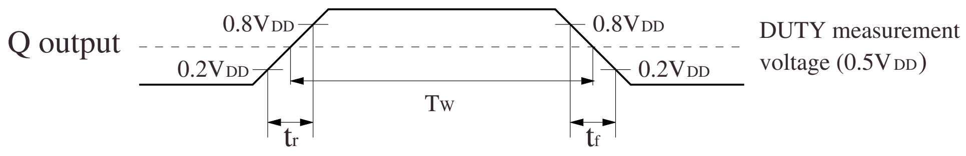
C1 = 20μF, R1 = R2 = 100MΩ, V_{DD} = 3.3V
VC modulation signal: 100Hz to 100kHz, 3.3Vp-p

Load Circuit 1

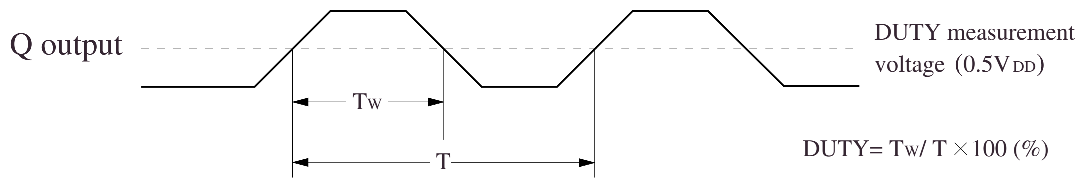


Switching Time Measurement Waveform

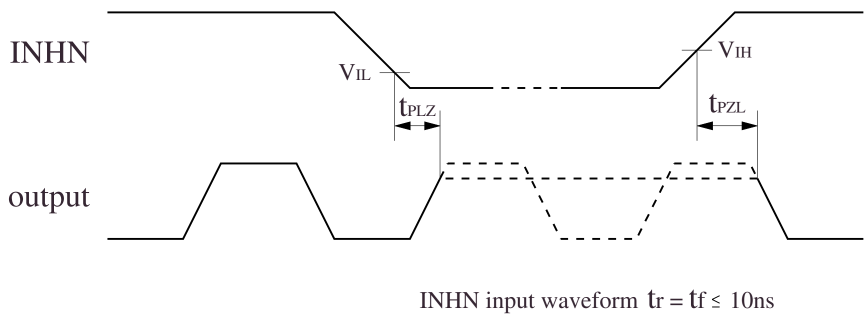
Output duty level, t_r, t_f



Output duty cycle



Output Enable/Disable Delay Times



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