

#### Low-current Consumption Crystal Oscillator Module ICs

#### **OVERVIEW**

The CF5012 series are low-current consumption 3rd-harmonic crystal oscillator module ICs. Internal circuit optimization means these devices have reduced current consumption in comparison with our existing 3rd-harmonic oscillator devices. The crystal oscillator circuit has a built-in thin-film feedback resistor with good temperature characteristics and built-in capacitors with excellent frequency response, resulting in a stable 3rd-order overtone oscillator with only the connection of a crystal element.

#### **FEATURES**

- 3rd-harmonic oscillation
- 2.7 to 3.6V operating supply voltage range
- 30 to 45MHz recommended operating frequency range
- Inverter amplifier feedback resistor built-in
- Oscillator capacitors C<sub>G</sub>, C<sub>D</sub> built-in
- Output three-state function (high impedance in standby mode)

- f<sub>O</sub> output frequency (oscillator frequency)
- 8mA output drive capability  $(V_{DD} = 2.7V)$
- 6.5mA (typ) low current consumption  $(V_{DD} = 3V, C_L = 15pF, f = 40MHz)$
- CMOS output duty level
- Chip form (CF5012×××)

#### **SERIES CONFIGURATION**

Vanatan	Recommended		Built-in capa	<b>5</b> # 63	
Version	operating frequency [MHz]	gm ratio	C <sub>G</sub>	C <sub>D</sub>	$R_f[k\Omega]$
CF5012ANB	30 to 45	1.0	8	15	3.1

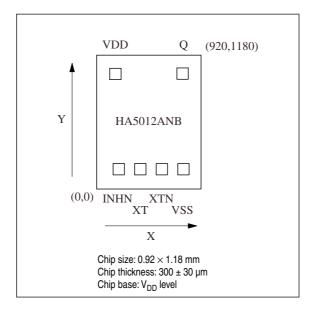
Note: Recommended operating frequency is not the guaranteed value but is measured using NPC's standard crystal.

#### **ORDERING INFORMATION**

Device	Package		
CF5012×××-1	Chip form		

### **PAD LAYOUT**

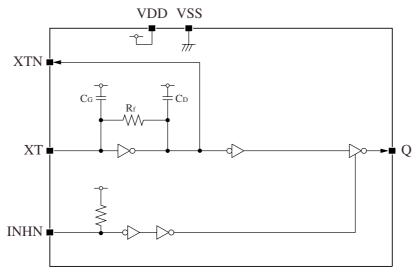
 $(Unit: \mu m)$ 



### **PIN DESCRIPTION and PAD DIMENSIONS**

Name	1/0	I/O Description		Pad dimensions [µm]		
Name	1/0		Description		Y	
INHN	I	Output state control input. High impedance when LOW. Pull-up resistor built in		195	174.4	
XT	I	Amplifier input	Crystal oscillator connection pins.	385	174.4	
XTN	0	Amplifier output	Crystal oscillator connected between XT and XTN	575	174.4	
VSS	-	Ground		765	174.4	
Q	0	Output. Output frequency. High impedance in standby mode		757.6	1017.6	
VDD	-	Supply voltage		165.4	1014.6	

### **BLOCK DIAGRAM**



Substrate potential:  $V_{\rm DD}$ 

### **SPECIFICATIONS**

# **Absolute Maximum Ratings**

 $V_{SS} = 0V$ 

Parameter	Symbol	Condition	Rating	Unit
Supply voltage range	V <sub>DD</sub>		-0.5 to +7.0	V
Input voltage range	V <sub>IN</sub>		-0.5 to V <sub>DD</sub> + 0.5	V
Output voltage range	V <sub>OUT</sub>		-0.5 to V <sub>DD</sub> + 0.5	V
Operating temperature range	T <sub>opr</sub>		-40 to +85	°C
Storage temperature range	T <sub>stg</sub>		-65 to +150	°C
Output current	l <sub>out</sub>		25	mA

## **Recommended Operating Conditions**

 $V_{SS}$  = 0V, f  $\leq$  45MHz,  $C_L$  = 15pF unless otherwise noted.

Parameter	Cumbal	Condition	Rating			Unit
Parameter	Symbol		min	typ	max	Onit
Supply voltage	V <sub>DD</sub>		2.7	-	3.6	V
Input voltage	V <sub>IN</sub>		V <sub>SS</sub>	-	V <sub>DD</sub>	V
Operating temperature	T <sub>OPR</sub>		-20	-	+80	°C

### **Electrical Characteristics**

 $V_{\rm DD}$  = 2.7 to 3.6V,  $V_{\rm SS}$  = 0V, Ta = -20 to +80°C unless otherwise noted.

Parameter	Cumbal	Condition		Rating			Unit
Parameter	Symbol			min	typ	max	OIIII
HIGH-level output voltage	V <sub>OH</sub>	Q: Measurement cct 1, V <sub>DD</sub> = 2.7V, I <sub>OH</sub> = 8	BmA	2.2	2.4	-	٧
LOW-level output voltage	V <sub>OL</sub>	Q: Measurement cct 2, V <sub>DD</sub> = 2.7V, I <sub>OL</sub> = 8	mA	-	0.3	0.4	٧
Output lookaga aurrant	,	Q: Measurement cct 2, INHN = LOW,	$V_{OH} = V_{DD}$	-	-	10	μA
Output leakage current	I <sub>Z</sub>	$V_{DD} = 3.6V$	V <sub>OL</sub> = V <sub>SS</sub>	_	-	10	μA
HIGH-level input voltage	V <sub>IH</sub>	INHN		0.7V <sub>DD</sub>	-	-	٧
LOW-level input voltage	V <sub>IL</sub>	INHN		_	-	0.3V <sub>DD</sub>	٧
Current consumption	I <sub>DD</sub>	Measurement cct 3, load cct 1, INHN = open, $C_L = 15pF$ , $f = 40MHz$		_	6.5	13	mA
INHN pull-up resistance	R <sub>UP</sub>	Measurement cct 4		40	100	250	kΩ
Feedback resistance	R <sub>f</sub>	Measurement cct 5		2.63	3.1	3.57	kΩ
D 711	C <sub>G</sub>	Decimal and the state of the st		7	8	9	pF
Built-in capacitance C <sub>D</sub>		Design value, determined by the internal wafer pattern		13	15	17	pF

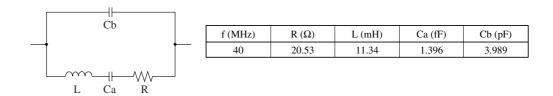
## **Switching Characteristics**

 $V_{\rm DD}$  = 2.7 to 3.6V,  $V_{\rm SS}$  = 0V, Ta = -20 to +80°C unless otherwise noted.

Parameter	Symbol	Condition	Rating			- Unit
Parameter Symbo		Condition		typ	max	
Output rise time	t <sub>r</sub>	Measurement cct 3, load cct 1, $0.1V_{DD}$ to $0.9V_{DD}$ , $C_L$ = 15pF	-	2.0	4.0	ns
Output fall time	t <sub>f</sub>	Measurement cct 3, load cct 1, $0.9V_{DD}$ to $0.1V_{DD}$ , $C_{L}$ = 15pF	-	2.0	4.0	ns
Output duty cycle <sup>1</sup>	Duty	Measurement cct 3, load cct 1, Ta = 25°C, $V_{DD}$ = 3.0V, $C_L$ = 15pF, f = 40MHz	40	-	60	%
Output disable delay time	t <sub>PLZ</sub>	Measurement cct 3, load cct 1, Ta = 25°C, V <sub>DD</sub> = 3.0V,	-	-	100	ns
Output enable delay time	t <sub>PZL</sub>	C <sub>L</sub> = 15pF	-	-	100	ns

<sup>1.</sup> Monitored in sample lots.

## Current consumption and Output waveform with NPC's standard crystal



### **FUNCTIONAL DESCRIPTION**

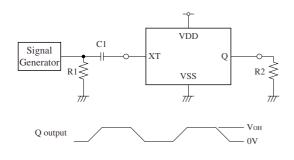
### **Standby Function**

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

INHN	Q	Oscillator		
HIGH (or open)	f <sub>O</sub> output frequency	Normal operation		
LOW	High impedance	Normal operation		

### **MEASUREMENT CIRCUITS**

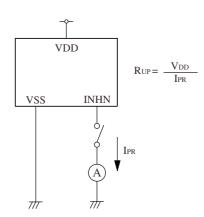
#### Measurement cct 1



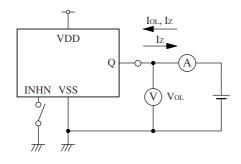
 $2.0V_{P-P}$  , 10MHz sine wave input signal C1 :  $0.001\mu F$ 

C1 :  $0.001\mu$ R1 :  $50\Omega$ R2 :  $275\Omega$ 

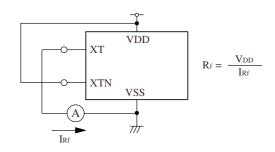
#### Measurement cct 4



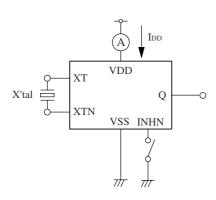
#### Measurement cct 2



#### **Measurement cct 5**

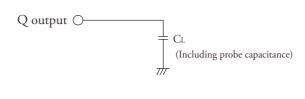


#### Measurement cct 3



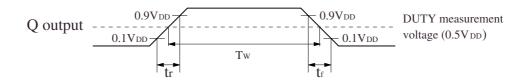
## Load cct 1

C<sub>L</sub> = 15pF

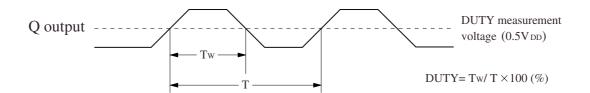


## **Switching Time Measurement Waveform**

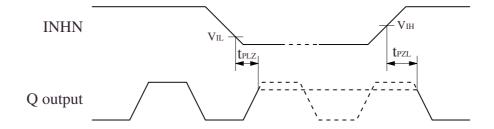
## $T_r, T_f, Duty$



### Output duty cycle



# **Output Enable/Disable Delay**



INHN input waveform  $tr = tf \le 10$ ns

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