

# Voltage-controlled oscillator

## SPECIFICATION

### 1 FEATURES

- SMIC CMOS 0.18 $\mu$ m
- Wide frequency range (2.8...3.3 GHz)
- Wide range of control voltage (300...1500 mV)
- Built-in switched capacitor sections for VCO frequency adjustment
- No external components required
- Supported foundries: TSMC, UMC, Global Foundries, SMIC, iHP, AMS, Vanguard, SilTerra

### 2 APPLICATION

- Phase-locked loop synthesizer
- Functional signal generators

### 3 OVERVIEW

Voltage-controlled oscillator (VCO) is the generator that can be tuned over a wide range of frequencies by applying a control voltage to it. The device uses internal oscillation circuit and operates without external components. Frequency tuning range is defined by a control voltage of a built-in switched capacitor sections, and the built-in varicap is used for a fine adjustment. The block is fabricated on SMIC CMOS 0.18 $\mu$ m technology.

### 4 STRUCTURE

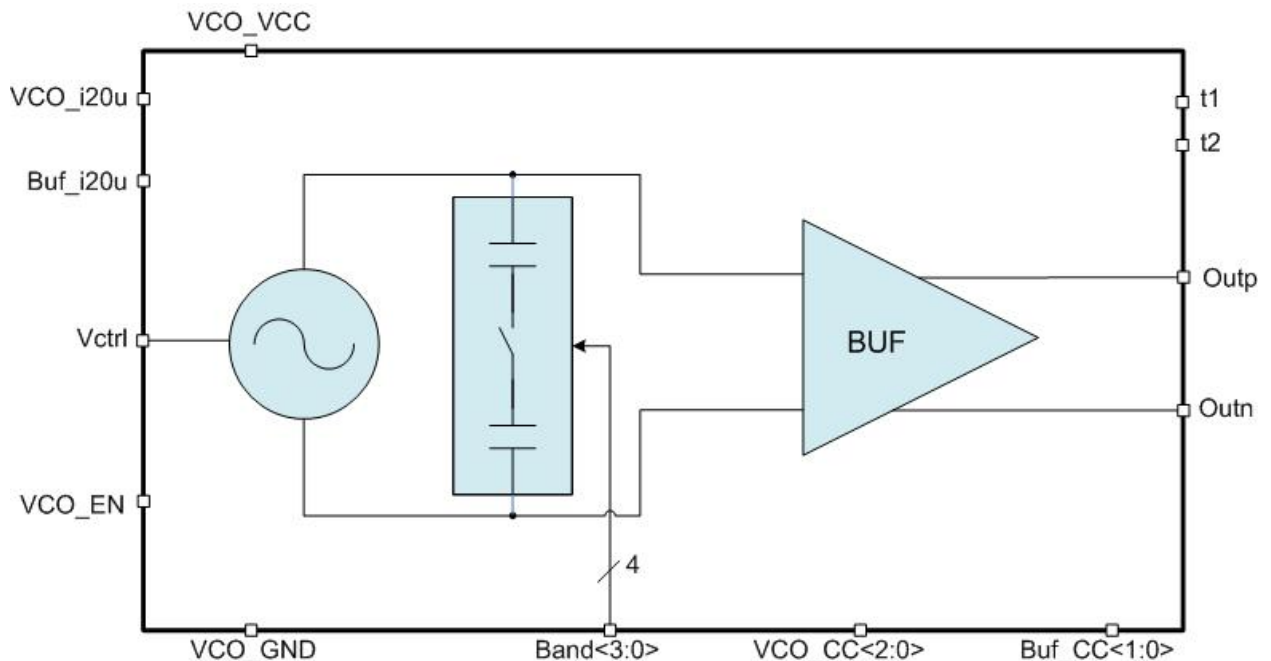


Figure 1: Voltage-controlled oscillator structure.

## 5 PIN DESCRIPTION

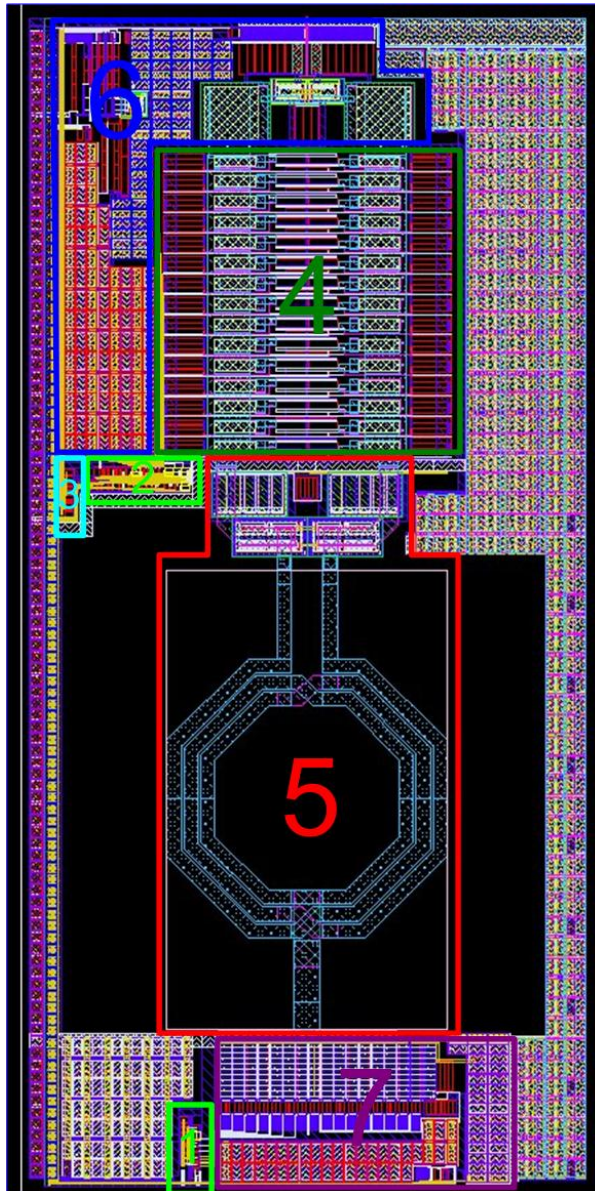
Name	Direction	Description
VCO_i20u	IO	VCO core reference current (20 $\mu$ A)
BUF_i20u	IO	VCO buffer reference current (20 $\mu$ A)
VCO_EN	I	Buffer enable / disable
Vctrl	IO	Control voltage input
Band<3:0>	I	Switching capacitor sections
VCO_CC<2:0>	IO	VCO core current selection
Buf_CC<1:0>	IO	Buffer current selection
t1	IO	VCO core outputs
t2	IO	
Outp	IO	VCO core differential output
Outn	IO	
VCO_VCC	IO	Supply voltage
VCO_GND	IO	Ground

## 6 LAYOUT DESCRIPTION

The block dimensions are given in the table 1.

**Table 1:** Block dimensions.

Dimension	Value	Unit
Height	314.37	$\mu\text{m}$
Width	660.67	$\mu\text{m}$



**Figure 2:** Device layout view.

1. Decoder of VCO core reference current source
2. Trimmer capacitors decoder
3. Decoder of VCO buffer reference current source
4. Switched capacitors sections
5. VCO core
6. VCO buffer
7. VCO and buffer current source

## 7 OPERATING CHARACTERISTICS

### 7.1 TECHNICAL CHARACTERISTICS

Technology \_\_\_\_\_ SMIC CMOS 0.18 $\mu$ m  
 Status \_\_\_\_\_ silicon proven  
 Area \_\_\_\_\_ 0.21 mm<sup>2</sup>

### 7.2 ELECTRICAL CHARACTERISTICS

The values of electrical characteristics are specified for  $V_{cc} = 1.7 \div 1.9$  V and  $T = -45 \div +85$  °C. Typical values are at  $V_{cc} = 1.8$  V,  $T = +27$  °C, unless otherwise specified.

Parameter	Symbol	Condition	Value			Unit
			min	typ	max	
Supply voltage	$V_{cc}$	-	1.7	1.8	1.9	V
Operating temperature range	T	-	-45	27	85	°C
Oscillation frequency	$F_{VCO}$	-	2.8	-	3.3	GHz
Output amplitude	$A_{VCO}$	Differential output	742	-	-	mV
Control voltage	$V_{ctrl}$	-	0.3	-	1.5	V
Phase noise	$PhN_{100K}$	at 100 kHz	-	-90	-	dBc/Hz
Tuning sensitivity	$K_{VCO}$	-	75.5	-	110.1	MHz/V
Current consumption in an active mode	$I_{cc}$	-	-	-	3.75	mA
Current consumption in a standby mode	$I_{stb}$	-	-	26	-	nA
Input logic-high level	$V_{IH}$	For digital inputs	$0.7V_{cc}$	-	3.6	V
Input logic-low level	$V_{IL}$		-0.25	-	0.3	V

## 8 DELIVERABLES

IP contents:

- Schematic or NetList
- Layout or blackbox
- Extracted view (optional)
- GDSII
- DRC, LVS, antenna report
- Test bench with saved configurations (optional)
- Documentation

## REVISION HISTORY

1. From version 1.0:
  - Table “Pin description” (refer to page 2)