

# Voltage-controlled oscillator

## SPECIFICATION

### 1 FEATURES

- TSMC018 SiGe
- Low phase noise
- Wide frequency range
- Adjustable output amplitude
- Low current consumption
- Supported foundries: TSMC, UMC, Global Foundries, SMIC, iHP, AMS, Vanguard, SilTerra

### 2 APPLICATION

- Phase-locked loop synthesizer

### 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 ( $V_{ctrl}$ ).

Frequency tuning range (1159...1958 MHz) 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 TSMC018 SiGe technology.

### 4 STRUCTURE

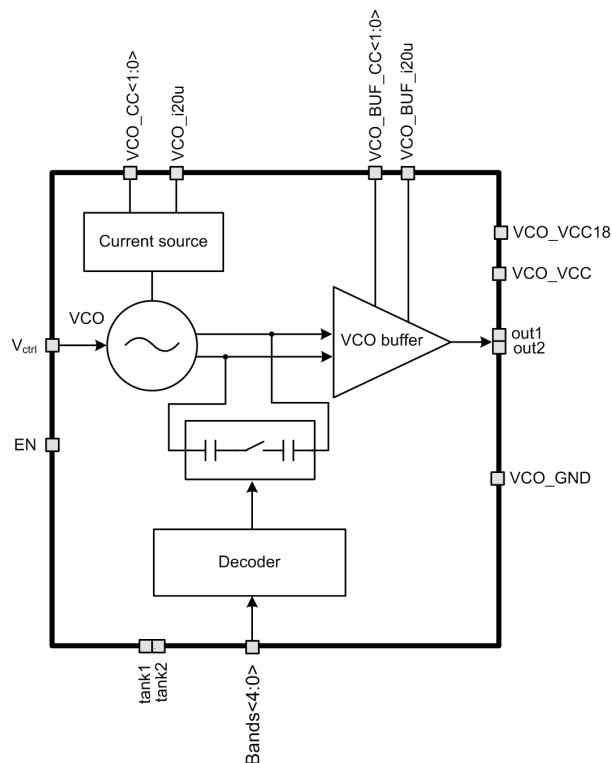


Figure 1: Voltage-controlled oscillator structure

## 5 PIN DESCRIPTION

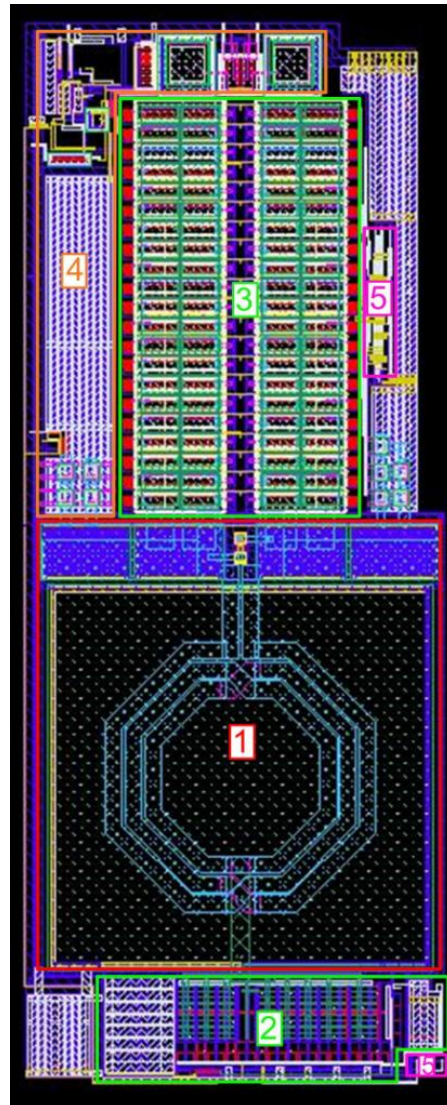
| Name              | Direction | Description                                   |
|-------------------|-----------|---|
| VCO_i20u          | IO        | VCO reference current                         |
| VCO_BUF_i20u      | IO        | VCO output buffer current                     |
| V <sub>ctrl</sub> | I         | Control voltage                               |
| EN                | I         | VCO enable/disable                            |
| Bands<4:0>        | I         | Digital code defined a subband selection      |
| VCO_BUF_CC<1:0>   | I         | VCO output buffer current consumption control |
| VCO_CC<1:0>       | I         | VCO current consumption control               |
| tank1             | O         | VCO differential output, unused               |
| tank2             | O         |   |
| out1              | O         | VCO output buffer differential output         |
| out2              | O         |   |
| VCO_VCC18         | IO        | Supply voltage 1.8 V                          |
| VCO_VCC           | IO        | Supply voltage 3 V                            |
| VCO_GND           | IO        | Ground  |

## 6 LAYOUT DESCRIPTION

Voltage controlled oscillator dimensions are given in the table 1.

**Table 1:** Block dimensions.

| Dimension | Value | Unit          |
|-----------|-------|---------------|
| Height    | 923   | $\mu\text{m}$ |
| Width     | 367   | $\mu\text{m}$ |



**Figure 2:** VCO layout view

1. VCO core
2. Current source
3. Band cells
4. VCO buffer
5. Decoder

## 7 OPERATING CHARACTERISTICS

### 7.1 TECHNICAL CHARACTERISTICS

Technology \_\_\_\_\_ TSMC018 SiGe  
 Status \_\_\_\_\_ silicon proven  
 Area \_\_\_\_\_ 0.34 mm<sup>2</sup>

### 7.2 ELECTRICAL CHARACTERISTICS

The values of electrical characteristics are specified for  $V_{cc\_3.0v} = 2.8 \div 3.6$  V,  $V_{cc\_1.8v} = 1.6 \div 2.0$  V and  $T = -40 \div +85^{\circ}\text{C}$ . Typical values are at  $V_{cc\_3.0v} = 3.15$  V,  $V_{cc\_1.8v} = 1.8$  V and  $T = +27^{\circ}\text{C}$ ., unless otherwise specified.

| Parameter                   | Symbol         | Condition           | Value             |        |                       | Unit               |
|-----------------------------|----------------|---------------------|-------------------|--------|-----------------------|--------------------|
|                             |                |                     | min               | typ    | max                   |                    |
| Supply voltage              | $V_{cc\_1.8v}$ | -                   | 1.6               | 1.8    | 2.0                   | V                  |
|                             | $V_{cc\_3.0v}$ | -                   | 2.8               | 3.15   | 3.6                   |                    |
| Operating temperature range | T              | -                   | -40               | +27    | +85                   | $^{\circ}\text{C}$ |
| VCO frequency tuning range  | F              | Min. frequency      | -                 | 1159   | 1282                  | MHz                |
|                             |                | Max. frequency      | 1841              | 1958   | -                     | MHz                |
| Phase noise                 | NF             | 100 KHz             | -                 | -93    | -                     | dBm/Hz             |
|                             |                | 1 MHz               | -                 | -124.6 | -                     |                    |
| Control voltage             | $V_{ctrl}$     | -                   | 0.3               | -      | 2.6                   | V                  |
| Tuning sensitivity          | K              | $V_{ctrl} = 1$ V    | -                 | 47     | -                     | MHz/V              |
| Adjustable output amplitude | $A_{out\ p-p}$ | Differential output | 400               | -      | -                     | mV                 |
| Supply current              | $I_{cc}$       | -                   | 3.41              | 4.35   | 5.03                  | mA                 |
| Stand-by current            | $I_{stb}$      | -                   | -                 | 5      | 300                   | nA                 |
| Input logic-level high      | $V_{IH}$       | For digital inputs  | $0.7V_{cc\_3.0v}$ | -      | $V_{cc\_3.0v} + 0.25$ | V                  |
| Input logic-level low       | $V_{IL}$       |                     | -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