

## Temperature sensor

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### SPECIFICATION

#### 1 FEATURES

- TSMC SiGe0.18  $\mu\text{m}$  technology
- Operating temperature range -45 ...+85  $^{\circ}\text{C}$
- Built-in 10 bit R-2R DAC
- Wide voltage range 2.8 ... 3.6 V
- Low consumption 58  $\mu\text{A}$
- Small area
- No external components required
- Supported foundries: TSMC, UMC, Global Foundries, SMIC, iHP, AMS, Vanguard, SilTerra

#### 2 APPLICATION

- On chip temperature measurement
- Pseudostatic analog digitalization
- Sensitive analog circuit
- Navigation receivers
- High clock digital VLSI

#### 3 OVERVIEW

Temperature sensor consists of built-in 10-bit R-2R DAC, diode and own reference voltage former. When requested, controller performs conversion of diode voltage level, which depends on temperature linearly. After conversion is done it sets “ready” flag to “1” and outputs 10-bit code. Die temperature is calculated with the following expression:  $\text{Temp} = (\text{code}-407)*0.625$ . The conversion time is 640  $\mu\text{s}$ .

With small size, usability and low current consumption, this device is ideal for use in controlling of the die temperature.

The block is fabricated on SMIC CMOS 0.18 $\mu\text{m}$  technology.

## 4 STRUCTURE

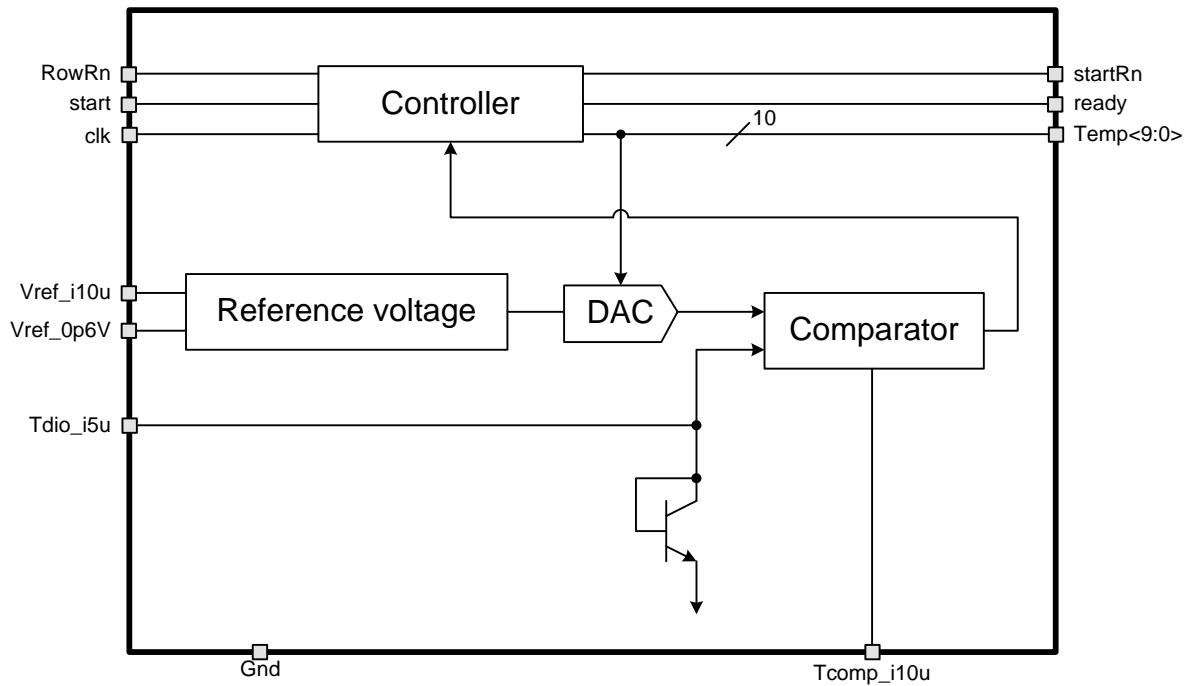


Figure 1: Temperature sensor structure.

## 5 PIN DESCRIPTION

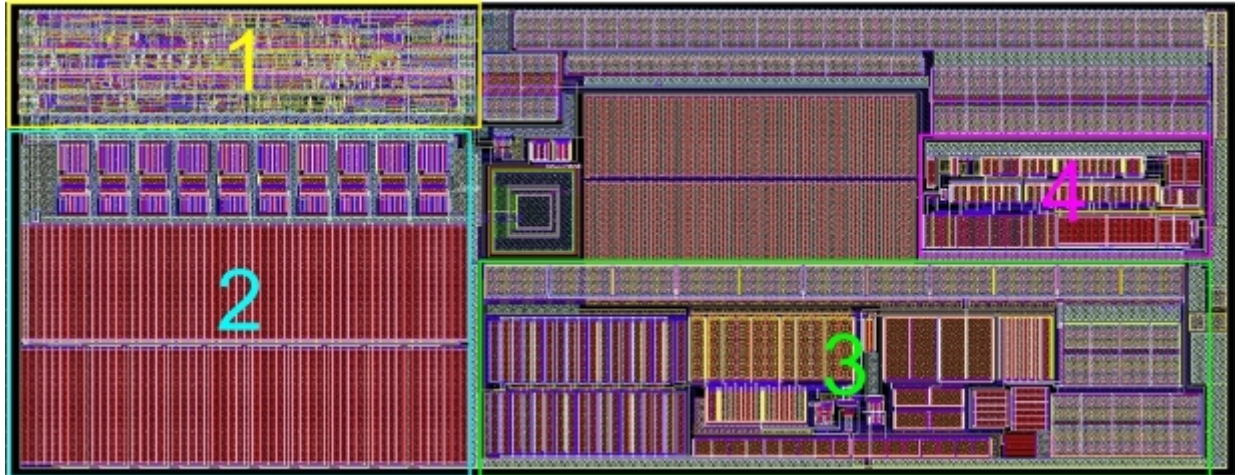
Name	Direction	Description
PowRn	I	Supply voltage reset
Start	I	Start mode
Ctr	I	Clock frequency
Tdio_i5u	IO	Diode reference current (5 $\mu$ A)
Tcomp_i10u	IO	Comparator reference current (10 $\mu$ A)
Vref_i10u	I	Reference current (10 $\mu$ A)
Vref_0p6V	I	Reference voltage
startRN	O	Automatic reset mode (regime)
ready	O	Availability indicator
Temp<9:0>	O	Temperature code
Vcc	IO	Supply voltage
Gnd	IO	Ground

## 6 LAYOUT DESCRIPTION

The block dimensions are given in the table 1.

**Table 1:** Block dimensions.

Dimension	Value	Unit
Height	151.8	$\mu\text{m}$
Width	399.3	$\mu\text{m}$



**Figure 2:** Device layout view.

1. Controller
2. DAC
3. Reference voltage
4. Comparator

## 7 OPERATING CHARACTERISTICS

### 7.1 TECHNICAL CHARACTERISTICS

Technology\_\_\_\_\_TSMC SiGe 0.18  $\mu\text{m}$   
 Status\_\_\_\_\_silicon proven  
 Area\_\_\_\_\_0.06mm<sup>2</sup>

### 7.2 ELECTRIC CHARACTERISTICS

The values of electrical characteristics are specified for  $V_{cc} = 2.8 \div 3.6$  V,  $T = -45 \div +85$  °C. Typical values are at  $V_{cc} = 3.0$  V and  $T = +27$  °C, unless otherwise specified.

Parameter	Symbol	Conditions	Value			Unit
			min	typ	max	
Supply voltage	$V_{cc}$	-	2.8	3.0	3.6	V
Temperature range	T	-	-45	27	85	°C
Clock frequency	$F_{clk}$	-	-	50	-	kHz
DAC resolution	K	-	-	10	-	bit
Accuracy step	N	-	-	0.8	-	$\pm$ °C
Absolute accuracy	$\delta$	-	-	5	-	$\pm$ °C
Current consumption	$I_{cc}$		-	58	100	$\mu\text{A}$
Standby current	$I_{stb}$	-	-	0.01	0.1	nA
Input logic level high	$V_{IH}$	For digital inputs	$0.7 V_{cc}$	-	$V_{cc}+0.25$	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