

## Temperature sensor

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### SPECIFICATION

#### 1 FEATURES

- SMIC CMOS 0.18 $\mu$ m
- Built-in 10-bit R-2R DAC
- Operating temperature range -45 ...+100 °C
- Wide voltage range 2.5 ... 3.6 V with own reference voltage former
- Low current consumption 186.3  $\mu$ A
- Independent reference voltage source available
- Small area
- No external components required
- Supported foundries: TSMC, UMC, Global Foundries, SMIC

#### 2 APPLICATION

- On chip temperature measurement
- Pseudostatic analog digitization
- Sensitive analog circuit
- Navigation receiver
- 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:  $Temp = (code-407)*0.625$

The conversion time is 640  $\mu$ 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 $\mu$ m technology.

## 4 STRUCTURE

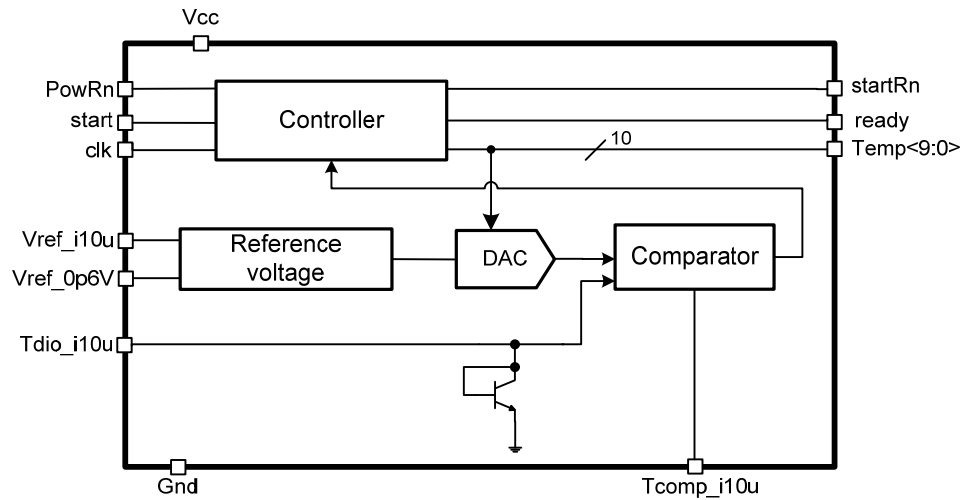


Figure 1: Temperature sensor structure.

## 5 PIN DESCRIPTION

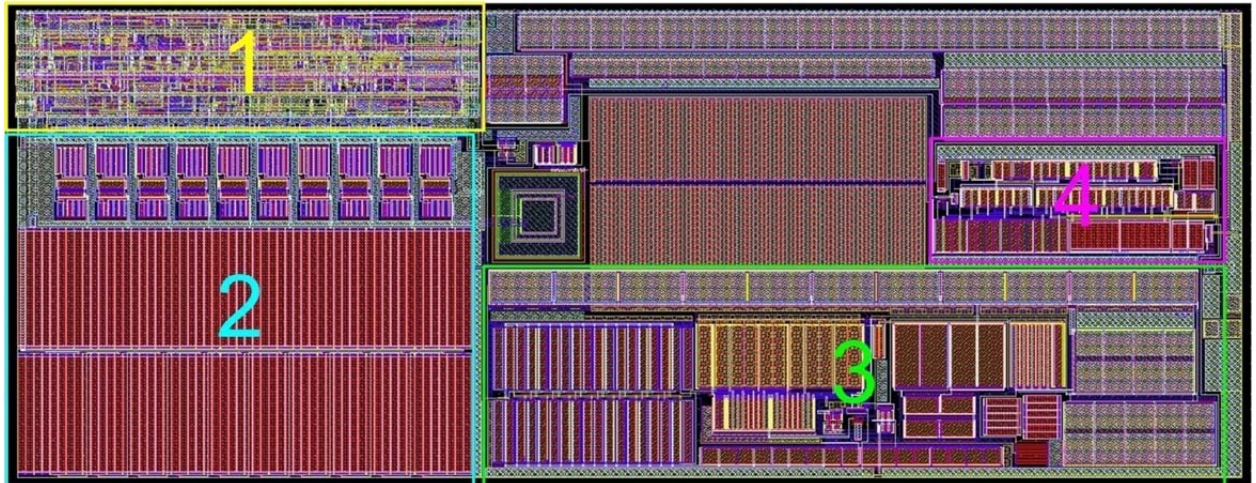
Name	Direction	Description
PowRn	I	Supply voltage reset
start	I	Start mode
ctr	I	Clock frequency
Tdio_i10u	IO	Diode reference current (10 $\mu$ A)
Tcomp_i10u	IO	Comparator reference current (10 $\mu$ A)
Vref_i10u	I	Reference current (10 $\mu$ A)
Vref_0p6V	I	Reference voltage
startRN	O	Automatic reset mode
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 \_\_\_\_\_ SMIC CMOS 0.18 $\mu$ m  
 Status \_\_\_\_\_ silicon verification  
 Area \_\_\_\_\_ 0.06mm<sup>2</sup>

### 7.2 ELECTRICAL CHARACTERISTICS

The values of electrical characteristics are specified for  $V_{cc} = 2.7\div 3.6$  V and  $T = -45 \div +100$  C. Typical values are at  $V_{cc} = 3.15$  V and  $T = +27^\circ$  C, unless otherwise specified.

Parameter	Symbol	Condition	Value			Unit
			min	typ	max	
Supply voltage	$V_{cc}$	-	2.7	3.15	3.6	V
Temperature operating range	T	-	-45	27	100	$^\circ$ C
Clock frequency	$F_{clk}$	-	-	20	-	kHz
ADC resolution	K	-	-	10	-	bit
Accuracy step	N	-	-	0.58	0.62	$\pm^\circ$ C
Absolute accuracy	$\delta$	-	-	2.57	-	$\pm^\circ$ C
Current consumption	$I_{cc}$	in continuous operation	-	186.3	-	$\mu$ A
		32 measurements per second	3	3.82	5.32	
		1 measurement per second	0.09	0.12	0.17	
Current consumption in a standby mode	$I_{stb}$	-	-	1	18.5	nA
Input logic-high level	$V_{IH}$	For digital inputs	$0.7 V_{cc}$	-	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:
  - Section “Technical characteristics” (refer to [page 4](#))