SM6610 series

CMOS Monolithic Analog Output Temperature Sensor IC

OVERVIEW

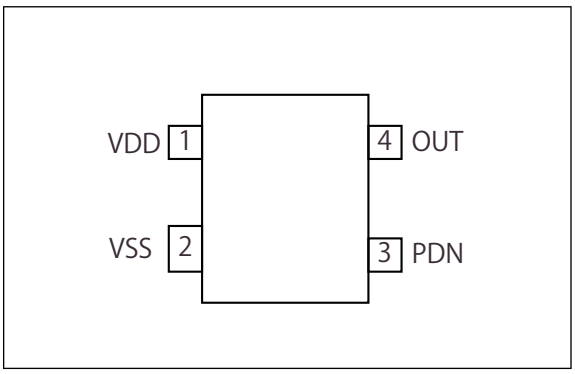
The SM6610 series are high-accuracy analog output temperature sensor ICs in ultra-small packages. They are implemented using CMOS for low-voltage operation and low-current consumption. They feature a power-down function whereby the device operates intermittently to further reduce current consumption.

FEATURES

- High linearity: ± 0.5% typ. (Ta = – 20 to 80°C)
- Operating temperature range: – 40 to 100°C ($V_{DD} \geq 2.7V$)
- Output reference: VSS
- Low current consumption: 5.5µA typ. (Ta = 25°C)
- Low stand-by current: 0.5µA max.
- Very small plastic package: SC82AB
- Power down function
- Molybdenum-gate CMOS Process

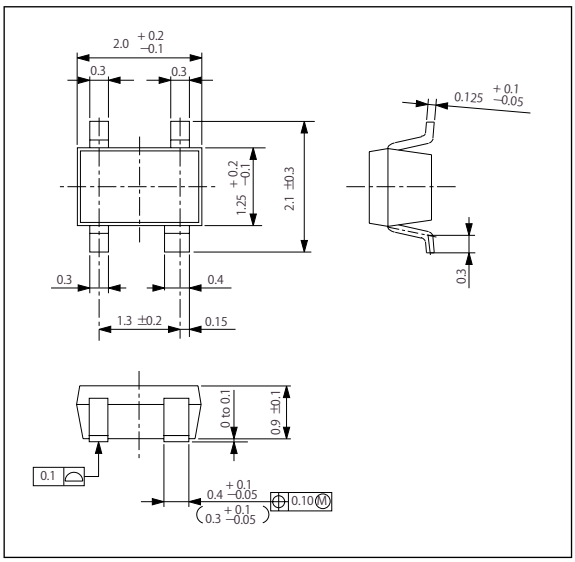
PINOUT

(Top view)



PACKAGE DIMENSIONS

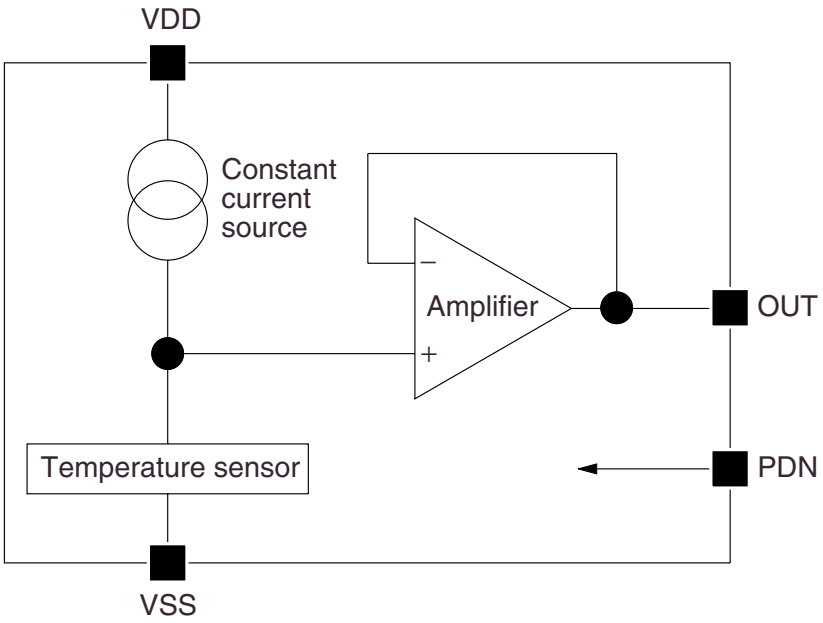
(Unit: mm)



ORDERING INFORMATION

Device	Output center voltage [V] (Ta = 25°C)	Temperature coefficient [mV/°C]	Operating voltage [V]	Accuracy [°C]	Package
SM6610AH	1.930	– 10.7	4.0 to 5.5	± 5.0	SC82AB
SM6610BH	1.450	– 8.2	2.4 to 5.5	± 5.0	
SM6610LH	1.930	– 10.7	4.0 to 5.5	± 3.0	
SM6610MH	1.450	– 8.2	2.4 to 5.5	± 3.0	

BLOCK DIAGRAM



PIN DESCRIPTION

Number	Name	Description
1	VDD	Positive power supply
2	VSS	Ground
3	PDN[1]	Power down control. Power down when LOW.
4	OUT	Sensor output

1. Connect PDN to VDD when the power down function is not used.

SPECIFICATIONS

Absolute Maximum Ratings

V_{SS} = 0V

Parameter	Symbol	Condition	Rating	Unit
Supply voltage range	V_{DD}		– 0.5 to 7.0	V
Input voltage range	V_{IN}		– 0.5 to V_{DD} + 0.5	V
Output voltage range	V_{OUT}		– 0.5 to V_{DD} + 0.5	V
Storage temperature range	T_{stg}		– 55 to 125	°C
Power dissipation	P_D		10	mW

Recommended Operating Conditions

V_{SS} = 0V

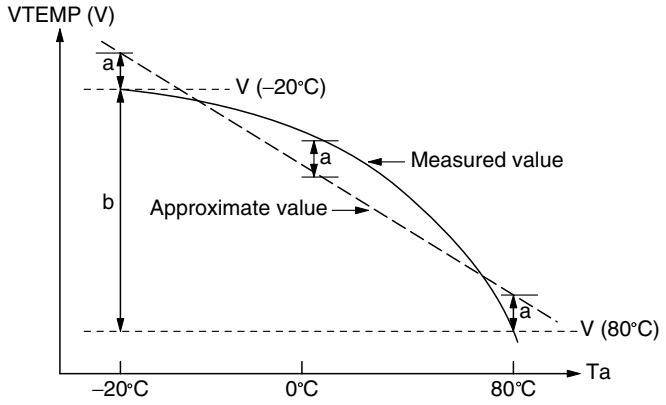
Parameter	Symbol	Condition		Rating	Unit
Supply voltage range	V_{DD}	AH, LH version		4.0 to 5.5	V
		BH, MH version		2.4 to 5.5	V
Operating temperature range	T_{opr}	AH, LH version		– 40 to 100	°C
		BH, MH version	V_{DD} = 2.4 to 2.7V	– 20 to 100	°C
			V_{DD} = 2.7 to 5.5V	– 40 to 100	°C

DC Characteristics

V_{DD} = 5.0V, V_{SS} = 0V, Ta = – 40 to 100°C unless otherwise noted.

Parameter	Symbol	Condition		Rating min	Rating typ	Rating max	Unit
Current consumption	I_{DD}	No load, Ta = + 25°C		–	5.5	10.0	µA
Output voltage	V_{OUT}	Ta = – 30°C	AH version	2.456	2.509	2.563	V
		Ta = + 25°C		1.877	1.930	1.984	V
		Ta = + 100°C		1.065	1.118	1.172	V
		Ta = – 30°C	BH version	1.850	1.891	1.932	V
		Ta = + 25°C		1.409	1.450	1.491	V
		Ta = + 100°C		0.784	0.825	0.866	V
		Ta = – 30°C	LH version	2.477	2.509	2.541	V
		Ta = + 25°C		1.898	1.930	1.962	V
		Ta = + 100°C		1.086	1.118	1.150	V
		Ta = – 30°C	MH version	1.867	1.891	1.915	V
		Ta = + 25°C		1.425	1.450	1.475	V
		Ta = + 100°C		0.801	0.825	0.849	V
Temperature coefficient[1]	T_C	Ta = – 30 to + 100°C	AH, LH version	– 11.1	– 10.7	– 10.3	mV/°C
			BH, MH version	– 8.5	– 8.2	– 7.9	mV/°C
Linearity[2]	N_L	Ta = – 20 to + 80°C		–	± 0.5	–	%
Maximum capacitive load	C_L			–	–	100	pF
Maximum output current load	I_L	V_{DD} = 2.4V	BH, MH version	– 50	–	–	µA
		V_{DD} = 4.5V	All versions	– 250	–	–	µA
Start up time	t_D	C_L = 100pF	AH, LH version	–	–	300	µs
			BH, MH version	–	–	200	µs
PDN Input voltage	V_{IH}			V_{DD} – 0.3	–	–	V
	V_{IL}			–	–	V_{SS} + 0.3	V

1. Temperature coefficient: $T_C = (V_{OUT}$ (@100°C) – V_{OUT} (@– 30°C))/130
2. Linearity: $N_L = (a/b) \times 100$
   a: Maximum deviation between measured and approximate value in the range of – 20°C to + 80°C.
   b: Measured value difference between the values at – 20°C and + 80°C.



TYPCAL PERFORMANCE CHARACTERISTICS (Reference value)

SM6610AH, LH

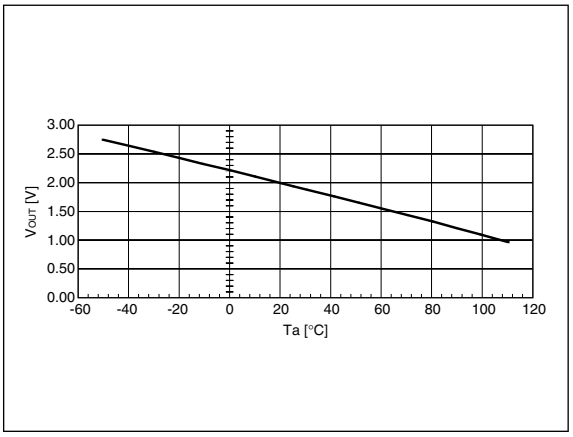


Figure 1. Temperature vs. Output voltage

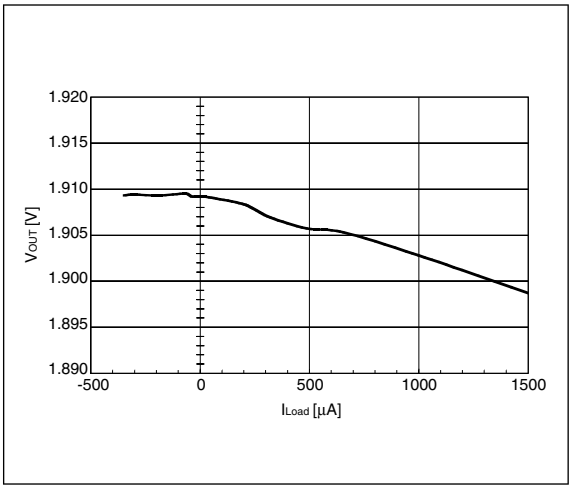


Figure 2. Load current vs. Output voltage
(Ta = 25°C, V_{DD} = 4.0V)

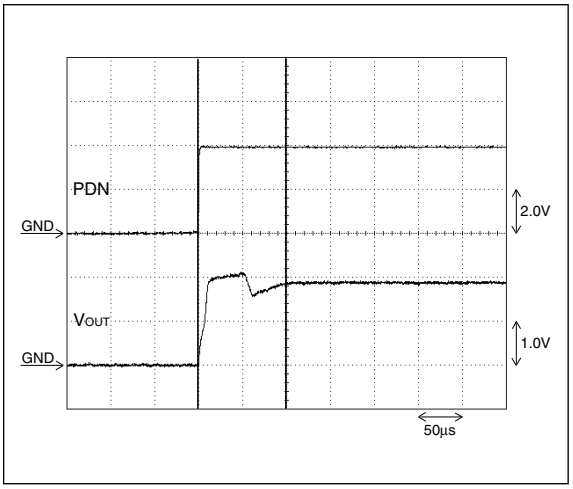


Figure 3. PDN start up response
(Ta = 25°C, V_{DD} = 4.0V, C_L = 100pF)

SM6610BH, MH

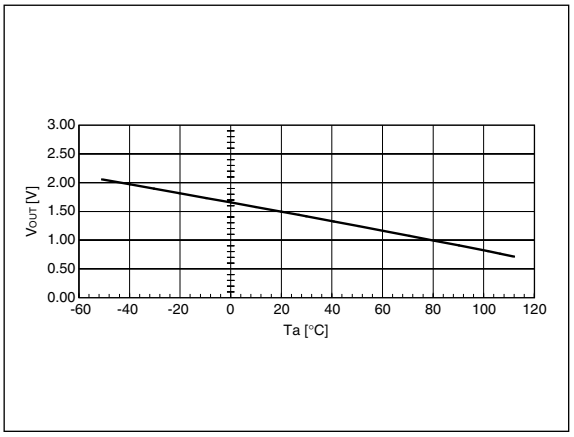


Figure 4. Temperature vs. Output voltage

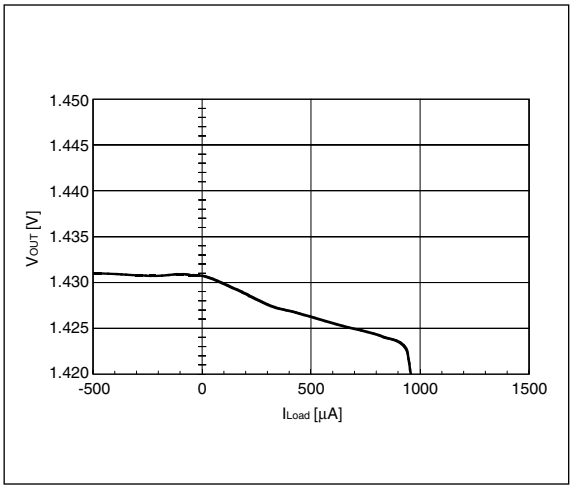


Figure 5. Load current vs. Output voltage
(Ta = 25°C, V_{DD} = 2.4V)

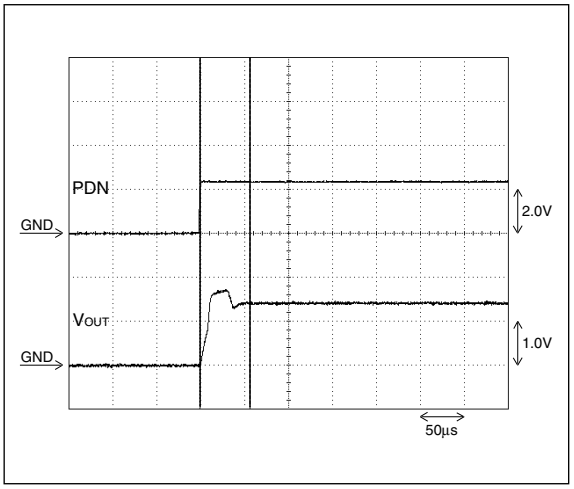
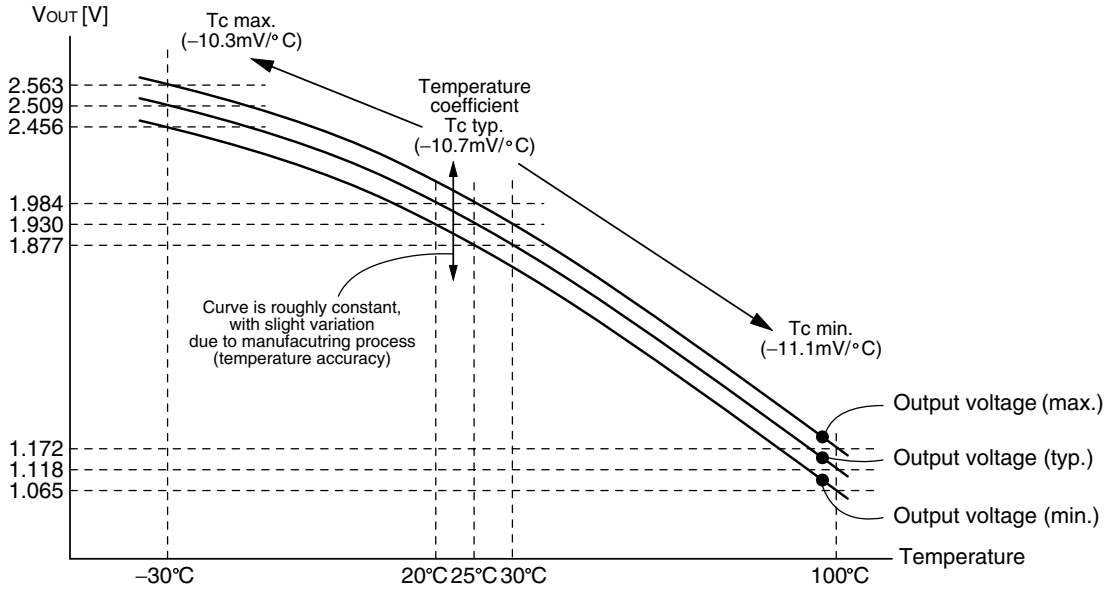


Figure 6. PDN start up response
(Ta = 25°C, V_{DD} = 2.4V, C_L = 100pF)

TEMPERATURE ACCURACY, TEMPERATURE COEFFICIENT, AND LINEARITY

The SM6610 temperature coefficient is determined by the physical constants and the temperature of the circuit structure used. It does not depend on the variation between devices due to manufacturing processes. The temperature coefficient range from minimum to maximum is thus not caused by solid-state variations, but by the temperature.

The temperature vs. output voltage characteristic is not linear. The temperature coefficient is small at low temperatures (gentle gradient) and increases as the temperature gets higher (steep gradient). The temperature vs. output voltage characteristic curve shape is roughly fixed, however, the characteristic does change slightly due to the temperature accuracy of the device. The SM6610AH/BH have an accuracy of ± 5°C, and the SM6610LH/MH have an accuracy of ± 3°C. The curve for the SM6610AH is shown below.



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