

OVERVIEW

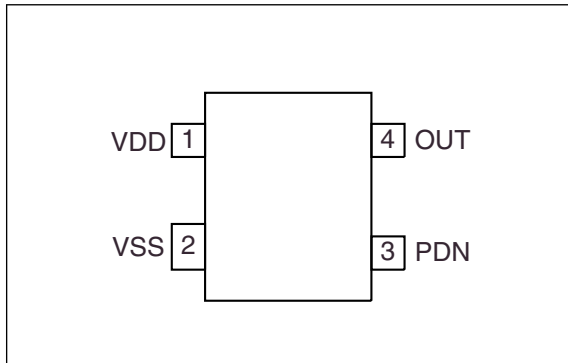
The SM6610 series are high-accuracy analog output temperature sensor ICs in ultra-small packages. They are implemented using CMOS for low-voltage operation and low-current consumption. They feature a power-down function whereby the device operates intermittently to further reduce current consumption.

FEATURES

- High linearity: $\pm 0.5\%$ typ. ($T_a = -20$ to 80°C)
- Operating temperature range: -40 to 100°C ($V_{DD} \geq 2.7\text{V}$)
- Maximum output current load: $\pm 250\mu\text{A}$
- Output reference: V_{SS}
- Low current consumption: $5.5\mu\text{A}$ typ. ($T_a = 25^\circ\text{C}$)
- Low stand-by current: $0.5\mu\text{A}$ max.
- Very small plastic package: SC82AB
- Power down function
- Molybdenum-gate CMOS Process

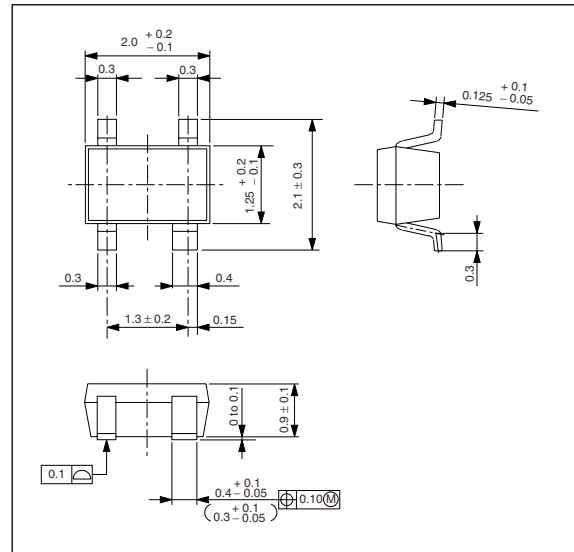
PINOUT

(Top view)



PACKAGE DIMENSIONS

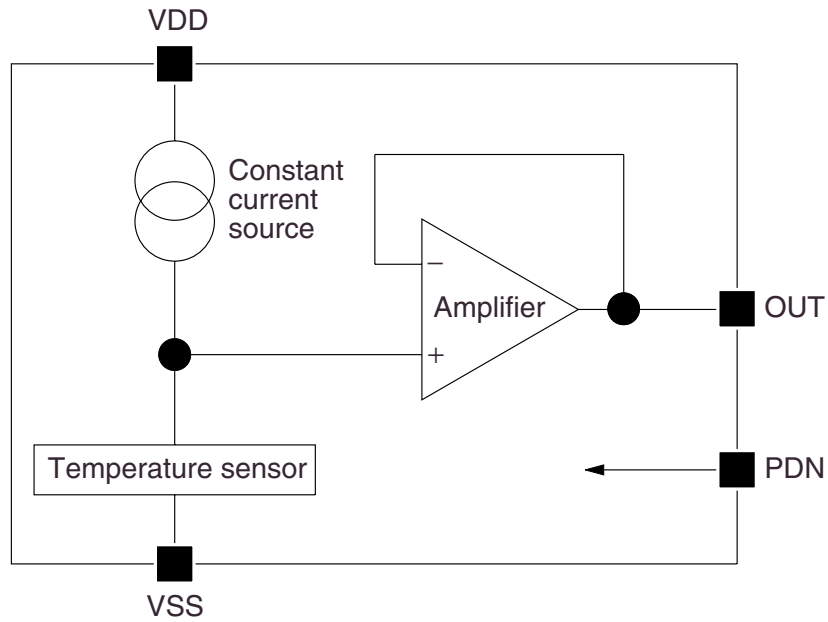
(Unit: mm)



ORDERING INFORMATION

Device	Output center voltage [V] ($T_a = 25^\circ\text{C}$)	Temperature coefficient [$\text{mV}/^\circ\text{C}$]	Operating voltage [V]	Accuracy [$^\circ\text{C}$]	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

$V_{DD} = 5.0\text{ V}$, $V_{SS} = 0\text{ V}$, $T_a = -40\text{ to }100\text{ }^\circ\text{C}$ unless otherwise noted.

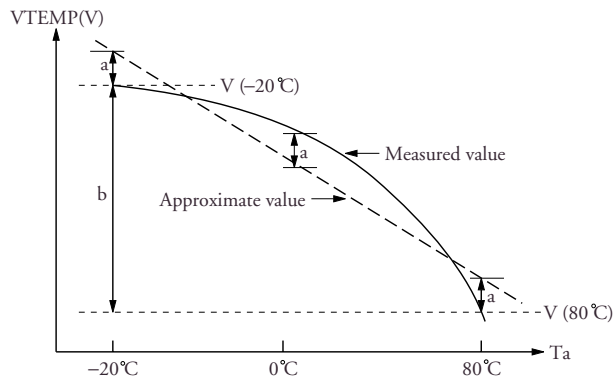
Parameter	Symbol	Condition	Rating			Unit	
			min	typ	max		
Current consumption	I_{DD}	No load, $T_a = +25\text{ }^\circ\text{C}$	–	5.5	10.0	μA	
Output voltage	V_{OUT}	$T_a = -30\text{ }^\circ\text{C}$	AH version	2.456	2.509	2.563	V
		$T_a = +25\text{ }^\circ\text{C}$		1.877	1.930	1.984	V
		$T_a = +100\text{ }^\circ\text{C}$		1.065	1.118	1.172	V
		$T_a = -30\text{ }^\circ\text{C}$	BH version	1.850	1.891	1.932	V
		$T_a = +25\text{ }^\circ\text{C}$		1.409	1.450	1.491	V
		$T_a = +100\text{ }^\circ\text{C}$		0.784	0.825	0.866	V
		$T_a = -30\text{ }^\circ\text{C}$	LH version	2.477	2.509	2.541	V
		$T_a = +25\text{ }^\circ\text{C}$		1.898	1.930	1.962	V
		$T_a = +100\text{ }^\circ\text{C}$		1.086	1.118	1.150	V
		$T_a = -30\text{ }^\circ\text{C}$	MH version	1.867	1.891	1.915	V
		$T_a = +25\text{ }^\circ\text{C}$		1.425	1.450	1.475	V
		$T_a = +100\text{ }^\circ\text{C}$		0.801	0.825	0.849	V
Temperature coefficient ¹	T_C	$T_a = -30\text{ to }+100\text{ }^\circ\text{C}$	AH, LH version	-11.1	-10.7	-10.3	$\text{mV}/^\circ\text{C}$
			BH, MH version	-8.5	-8.2	-7.9	$\text{mV}/^\circ\text{C}$
Linearity ²	N_L	$T_a = -20\text{ to }+80\text{ }^\circ\text{C}$	–	± 0.5	–	%	
Maximum capacitive load	C_L		–	–	100	pF	
Maximum output current load	I_L	$V_{DD} = 2.4\text{ V}$	BH, MH version	–	–	± 50	μA
		$V_{DD} = 4.5\text{ V}$	All versions	–	–	± 250	μA
Start up time	t_D	$C_L = 100\text{ pF}$	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: $T_C = (V_{OUT} (@100^\circ\text{C}) - V_{OUT} (@-30^\circ\text{C}))/130$

2. Linearity: $N_L = (a/b) \times 100$

a: Maximum deviation between measured and approximate value in the range of $-20\text{ }^\circ\text{C}$ to $+80\text{ }^\circ\text{C}$.

b: Measured value difference between the values at $-20\text{ }^\circ\text{C}$ and $+80\text{ }^\circ\text{C}$.



TYPICAL PERFORMANCE CHARACTERISTICS (Reference value)

SM6610AH, LH

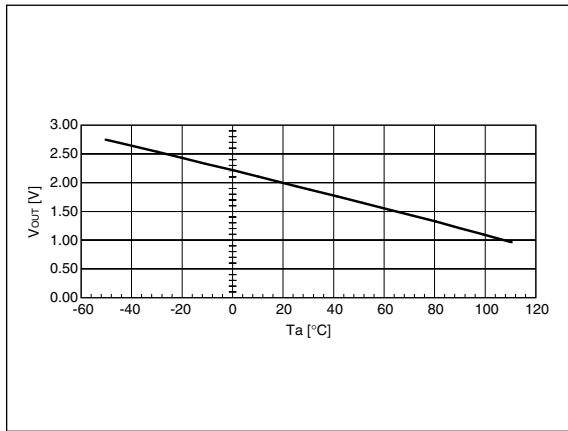


Figure 1. Temperature vs. Output voltage

SM6610BH, MH

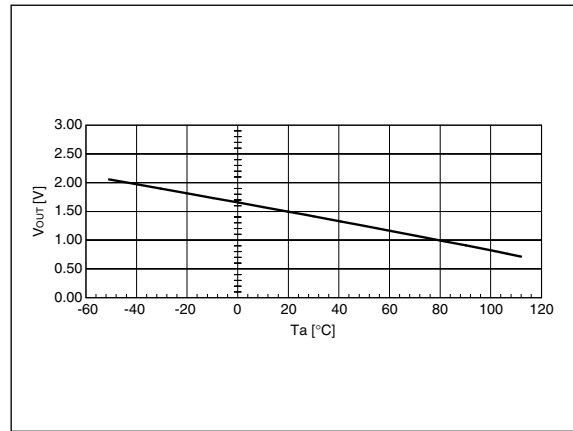


Figure 4. Temperature vs. Output voltage

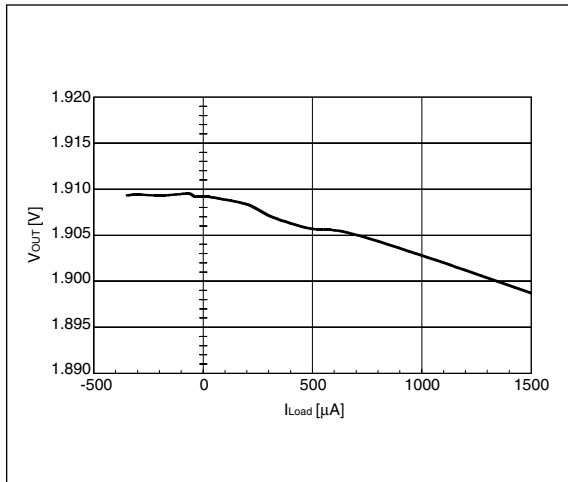


Figure 2. Load current vs. Output voltage
(Ta = 25°C, V_{DD} = 4.0V)

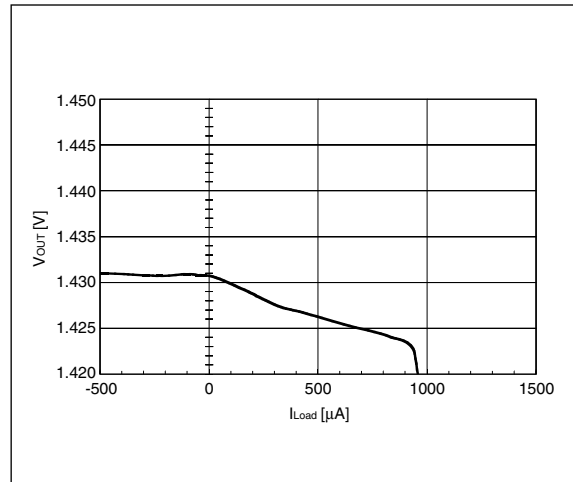


Figure 5. Load current vs. Output voltage
(Ta = 25°C, V_{DD} = 2.4V)

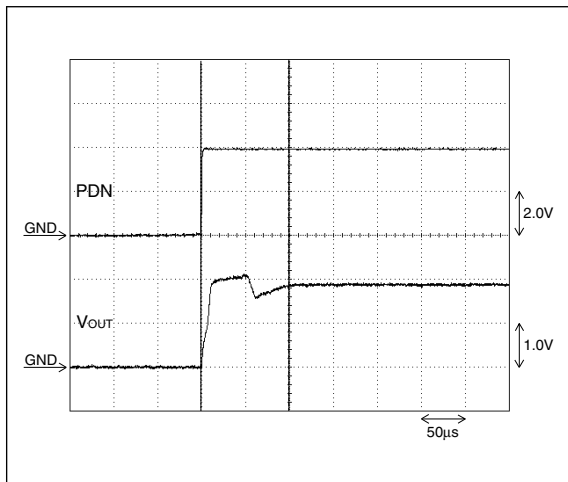


Figure 3. PDN start up response
(Ta = 25°C, V_{DD} = 4.0V, C_L = 100pF)

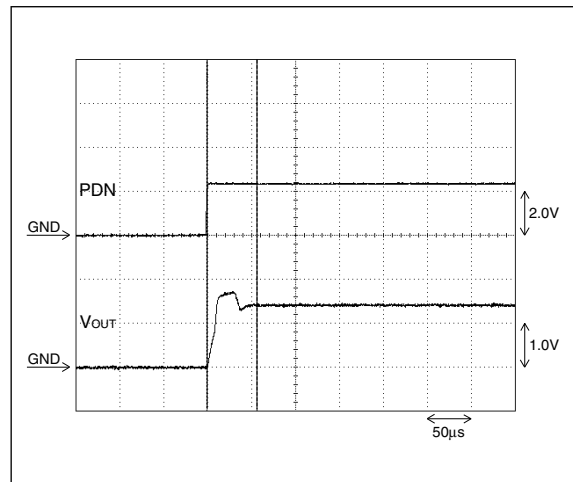
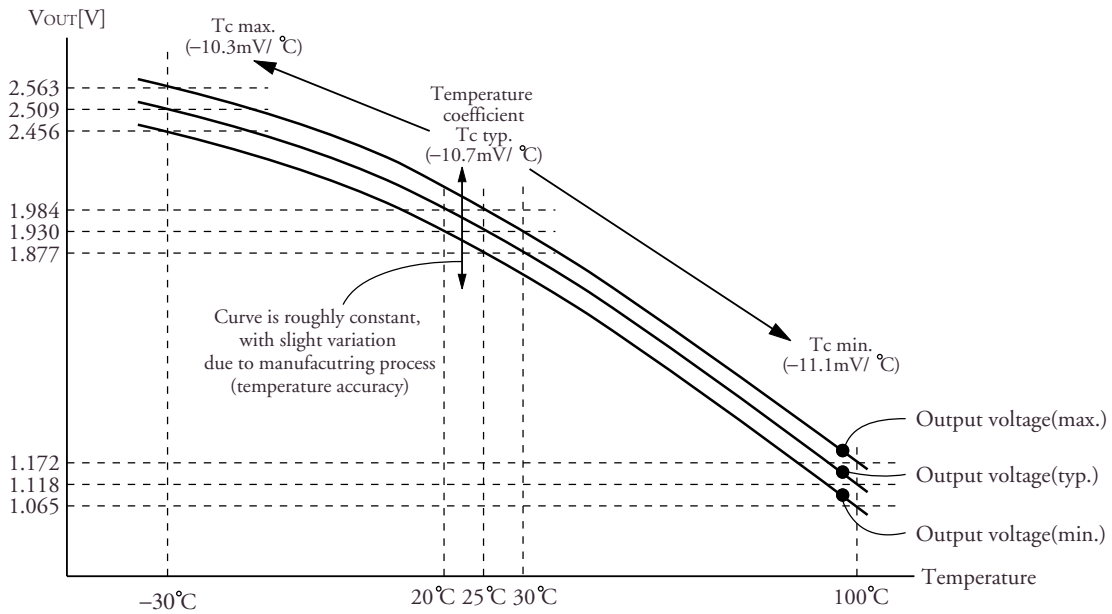


Figure 6. PDN start up response
(Ta = 25°C, V_{DD} = 2.4V, C_L = 100pF)

TEMPERATURE ACCURACY, TEMPERATURE COEFFICIENT, AND LINEARITY

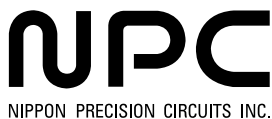
The SM6610 temperature coefficient is determined by the physical constants and the temperature of the circuit structure used. It does not depend on the variation between devices due to manufacturing processes. The temperature coefficient range from minimum to maximum is thus not caused by solid-state 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 $\pm 5^\circ\text{C}$, and the SM6610LH/MH have an accuracy of $\pm 3^\circ\text{C}$. The curve for the SM6610AH is shown below.



Please pay your attention to the following points at time of using the products shown in this document.

The products shown in this document (hereinafter "Products") are not intended to be used for the apparatus that exerts harmful influence on human lives due to the defects, failure or malfunction of the Products. Customers are requested to obtain prior written agreement for such use from NIPPON PRECISION CIRCUITS INC. (hereinafter "NPC"). Customers shall be solely responsible for, and indemnify and hold NPC free and harmless from, any and all claims, damages, losses, expenses or lawsuits, due to such use without such agreement. NPC reserves the right to change the specifications of the Products in order to improve the characteristic or reliability thereof. NPC makes no claim or warranty that the contents described in this document do not infringe any intellectual property right or other similar right owned by third parties. Therefore, NPC shall not be responsible for such problems, even if the use is in accordance with the descriptions provided in this document. Any descriptions including applications, circuits, and the parameters of the Products in this document are for reference to use the Products, and shall not be guaranteed free from defect, inapplicability to the design for the mass-production products without further testing or modification. Customers are requested not to export or re-export, directly or indirectly, the Products to any country or any entity not in compliance with or in violation of the national export administration laws, treaties, orders and regulations. Customers are requested appropriately take steps to obtain required permissions or approvals from appropriate government agencies.



NIPPON PRECISION CIRCUITS INC.

4-3, Fukuzumi 2-chome, Koto-ku,
Tokyo 135-8430, Japan
Telephone: +81-3-3642-6661
Facsimile: +81-3-3642-6698
<http://www.npc.co.jp/>
Email: sales@npc.co.jp

NC9919CE 2003.04