

# DATA SHEET

## **SA57000-XX**

CapFREE™ 150 mA, low-noise, low dropout  
regulator with thermal protection

Product data  
Supersedes data of 2001 Jul 12  
File under Integrated Circuits, Standard Analog

2001 Aug 27

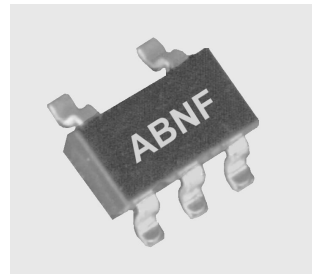
# CapFREE™ 150 mA, low-noise, low dropout regulator with thermal protection

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## GENERAL DESCRIPTION

The CapFREE™ SA57000 is the first in a new family of unique low dropout regulators. It needs no external capacitors, offers a low output noise voltage of  $30 \mu\text{V}_{\text{RMS}}$ , and an ultra-low dropout voltage of  $55 \text{ mV}$  @  $50 \text{ mA}$  output current. To accommodate high density layouts, it is packaged in the small footprint 5 leaded SOT23-5 (SO5). It is ideal for all portable and cellular phone applications.

Additional features include power and thermal shutdown, output current limitation, power OK status, thermal warning, and external logic-controlled on-off via the PWRON pin.



## FEATURES

- CapFREE: No output capacitor needed, stable for all capacitive loads, regardless of ESR
- Low  $30 \mu\text{V}_{\text{RMS}}$  noise without noise bypass capacitor
- Preset output voltages to 2.5 V, 2.8 V, 3.0 V, 3.3 V and 3.6 V; other voltages available upon request. 2% output voltage accuracy
- 150 mA maximum output current with current limitation
- Typical dropout voltage  $55 \text{ mV}$  @  $50 \text{ mA}$  output current
- $85 \mu\text{A}$  typical ground current
- Thermal-overload and short-circuit protection
- PWROK pin: both power status and thermal warning indicator
- PWRON pin offers logic-controlled shutdown
- Maximum line regulation:  $0.1\%/V$
- Maximum load regulation:  $0.02\%/mA$ .

## APPLICATIONS

- Cordless and mobile phones
- Industrial and medical equipment
- Other battery-powered equipment.

## SIMPLIFIED SYSTEM DIAGRAM

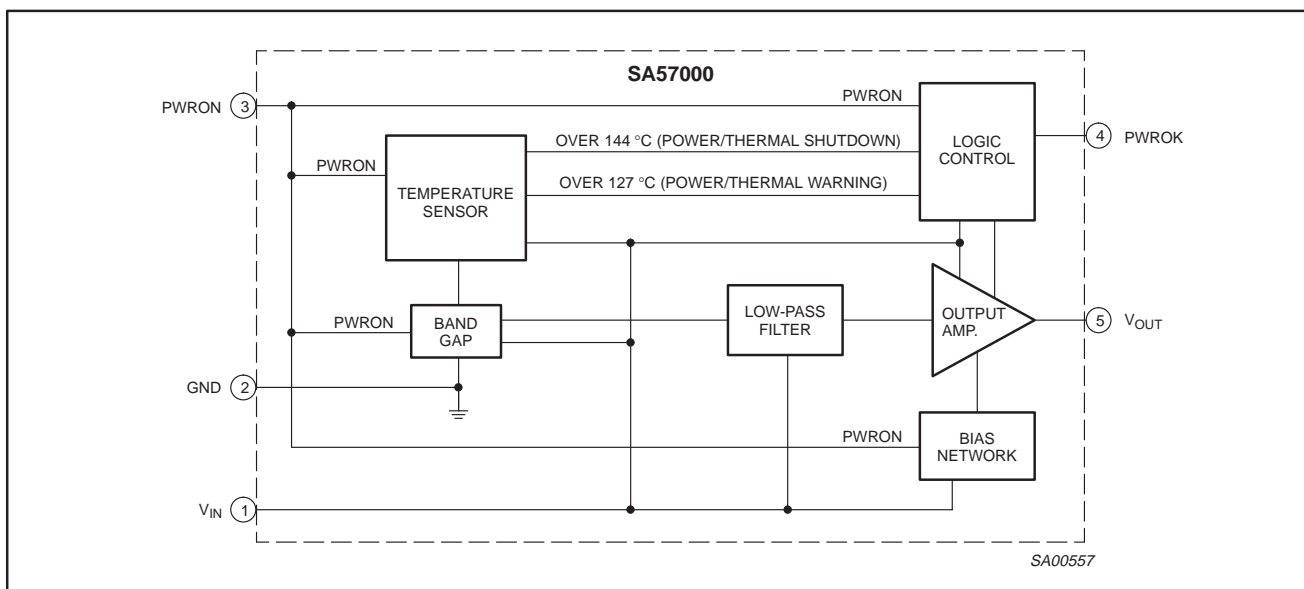


Figure 1. Simplified system diagram.

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## ORDERING INFORMATION

TYPE NUMBER	PACKAGE			TEMPERATURE RANGE
	NAME	DESCRIPTION	VERSION	
SA57000-XXD	SOT23-5, SOT25, SO5	plastic small outline package; 5 leads (see dimensional drawing)	SOT680-1	-40 to +85 °C

**NOTE:**

The device has five voltage output options, indicated by the **XX** on the Type Number.

XX	VOLTAGE (Typical)
25	2.5 V
28	2.8 V
30	3.0 V
33	3.3 V
36	3.6 V

## Part number marking

Each package is marked with a four letter code. The first three letters designate the product. The fourth letter, represented by 'x', is a date tracking code.

Part number	Marking
SA57000-25D	A B K x
SA57000-28D	A B L x
SA57000-30D	A B M x
SA57000-33D	A B N x
SA57000-36D	A B P x

## PIN CONFIGURATION

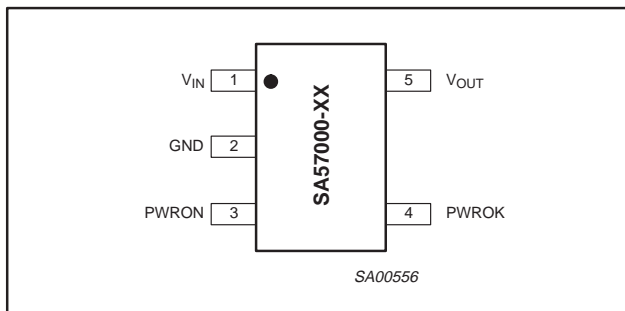


Figure 2. Pin configuration.

## PIN DESCRIPTION

PIN	SYMBOL	DESCRIPTION
1	V <sub>IN</sub>	Regulator input. V <sub>OUT(nom)</sub> + 0.1 V to 5.5 V. No bypass capacitor required.
2	GND	Ground.
3	PWRON	Power-on input. Active-HIGH. A logic LOW powers down regulator. The shutdown quiescent current is typically 50 nA. Connect to V <sub>IN</sub> for manual operation.
4	PWROK	Power OK indicator, including thermal warning. Trips (goes LOW) at 127 °C (±2°), or when power falls typically 6% below V <sub>OUT(nom)</sub> .
5	V <sub>OUT</sub>	Regulator output. Sources up to 150 mA. No bypass capacitors required.

## MAXIMUM RATINGS

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V <sub>IN</sub>	V <sub>IN</sub> to GND voltage	-0.3	5.5	V <sub>dc</sub>
V <sub>PWRON</sub>	PWRON to GND voltage	-0.3	5.5	V <sub>dc</sub>
V <sub>OUT</sub>	OUT to GND voltage	-0.3	V <sub>IN</sub> + 0.3	V <sub>dc</sub>
T <sub>amb</sub>	Operating ambient temperature	-40	+85	°C
T <sub>j</sub>	Junction temperature	-	+150	°C
T <sub>stg</sub>	Storage temperature	-65	+160	°C
P	Power dissipation	-	575	mW
R <sub>th(j-a)</sub>	Thermal resistance from junction to ambient	-	140	°C/W

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## CHARACTERISTICS

 $V_{IN} = V_{OUT(nom)} + 0.5 \text{ V}$ . (Note 1.)

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{IN}$	input voltage		$V_{OUT(nom)}$	–	5.5	V
	output voltage accuracy <sup>2</sup>	$I_{OUT} = 1 \text{ mA}$ $T_{amb} = +25 \text{ °C}$ $-40 \text{ °C} \leq T_{amb} \leq +85 \text{ °C}$	– –2.0	$\pm 1$ –	– 2.0	% %
$I_{LIM}$	current limit		160	300	–	mA
$I_Q$	ground pin current	$I_{OUT} = 1 \text{ mA to } 150 \text{ mA}$	–	85	150	$\mu\text{A}$
	dropout voltage <sup>3</sup>	$I_{OUT} = 1 \text{ mA}$	–	1	–	mV
		$I_{OUT} = 50 \text{ mA}$	–	55	120	mV
		$I_{OUT} = 150 \text{ mA}$	–	165	–	mV
$\Delta V_{LNR}$	line regulation	$V_{IN} = (V_{OUT} + 0.1 \text{ V}) \text{ to } 5.5 \text{ V}; I_{OUT} = 20 \text{ mA}$	–	–	0.1	%/V
$\Delta V_{LDR}$	load regulation	$I_{OUT} = 1 \text{ mA to } 150 \text{ mA}$	–	0.01	0.02	%/mA
$e_n$	output voltage noise	$f = 10 \text{ Hz to } 100 \text{ kHz}, C_{OUT} = 10 \text{ }\mu\text{F}$	–	30	–	$\mu\text{V}_{RMS}$
<b>Shutdown</b>						
$V_{IH}$	PWROK input threshold (HIGH ON-state)	$V_{IN} \rightarrow V_{OUT(nom)} \rightarrow 5.5 \text{ V}$	$0.7 \times V_{IN}$	–	–	V
$V_{IL}$	PWROK input threshold (HIGH ON-state)	$V_{IN} \rightarrow V_{OUT(nom)} \rightarrow 5.5 \text{ V}$	–	–	$0.3 \times V_{IN}$	V
$I_{PWROK}$	PWROK input bias current	$V_{PWROK} = V_{IN}$ $T_{amb} = +25 \text{ °C}$ $T_{amb} = +85 \text{ °C}$	– –	0.01 0.05	1 –	$\mu\text{A}$ $\mu\text{A}$
$I_{Q(SHDN)}$	shutdown supply current	$V_{OUT} = 0 \text{ V}$ $T_{amb} = +25 \text{ °C}$ $T_{amb} = +85 \text{ °C}$	– –	0.05 0.2	1 1	$\mu\text{A}$ $\mu\text{A}$
$t_{PWROK}$	power-on start-up time <sup>4</sup>	$I_{OUT} = 1 \text{ mA}, C_{OUT} = 100 \text{ nF}$ $T_{amb} = +25 \text{ °C}$ $T_{amb} = -40 \text{ to } +85 \text{ °C}$	– –	25 35	100 200	$\mu\text{s}$ $\mu\text{s}$
<b>Thermal protection (Note 2)</b>						
$T_{SHDN}$	thermal shut-down temperature		–	144	–	$^{\circ}\text{C}$
$\Delta T_{SHDN}$	thermal shut-down hysteresis		–	13	–	$^{\circ}\text{C}$
<b>PWROK output (power and temperature OK) (Note 2)</b>						
	PWROK trip temperature		–	127	–	$^{\circ}\text{C}$
	PWROK trip temperature hysteresis		–	12	–	$^{\circ}\text{C}$
	PWROK trip as percentage of $V_{OUT(nom)}$		–3.5	–6	–8	%
	PWROK hysteresis as percentage of $V_{OUT(nom)}$		–	2	–	%
	PWROK output (when tripped)	$I_{SINK} = 0.5 \text{ mA}$	–	0.1	0.4	V

### NOTES:

- Limits are production tested at  $T_{amb} = +25 \text{ °C}$ . All devices are 100% production tested at  $25 \text{ °C}$ . Limits over the operating temperature are guaranteed by design.
- Accuracy  $\pm 2 \text{ °C}$  over temperature range guaranteed by design and characterization.
- The dropout voltage is defined as  $V_{IN} - V_{OUT}$  where  $V_{OUT}$  is 100 mV below the value of  $V_{OUT}$  for  $V_{IN} = V_{OUT} + 0.5 \text{ V}$ .
- Time needed for  $V_{OUT}$  to reach 95% of  $V_{OUT(nom)}$ .

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## TYPICAL PERFORMANCE CURVES

Measurements taken with the SA57000-33 (3.3 volt output).

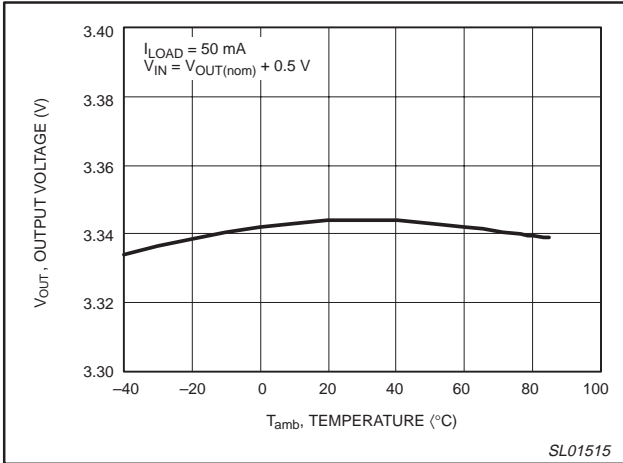


Figure 3. Output voltage versus temperature.

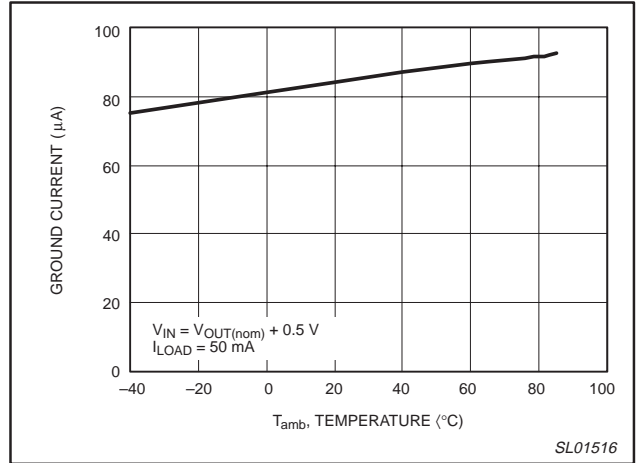


Figure 4. Ground current versus temperature.

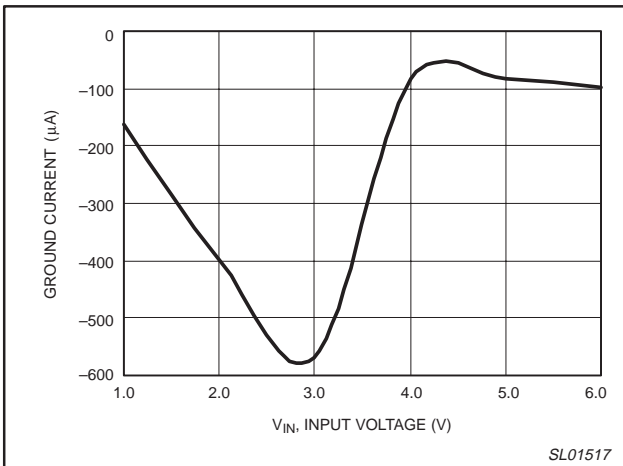


Figure 5. Ground current versus input voltage (no load).

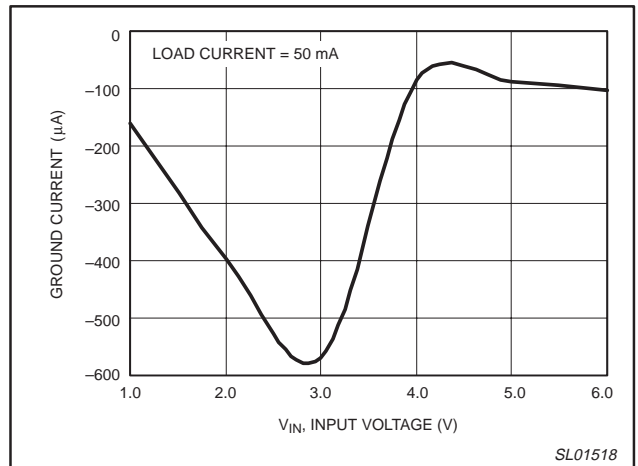


Figure 6. Ground current versus input voltage with load.

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## PACKING METHOD

The SA57000-XX is packed in reels, as shown in Figure 7.

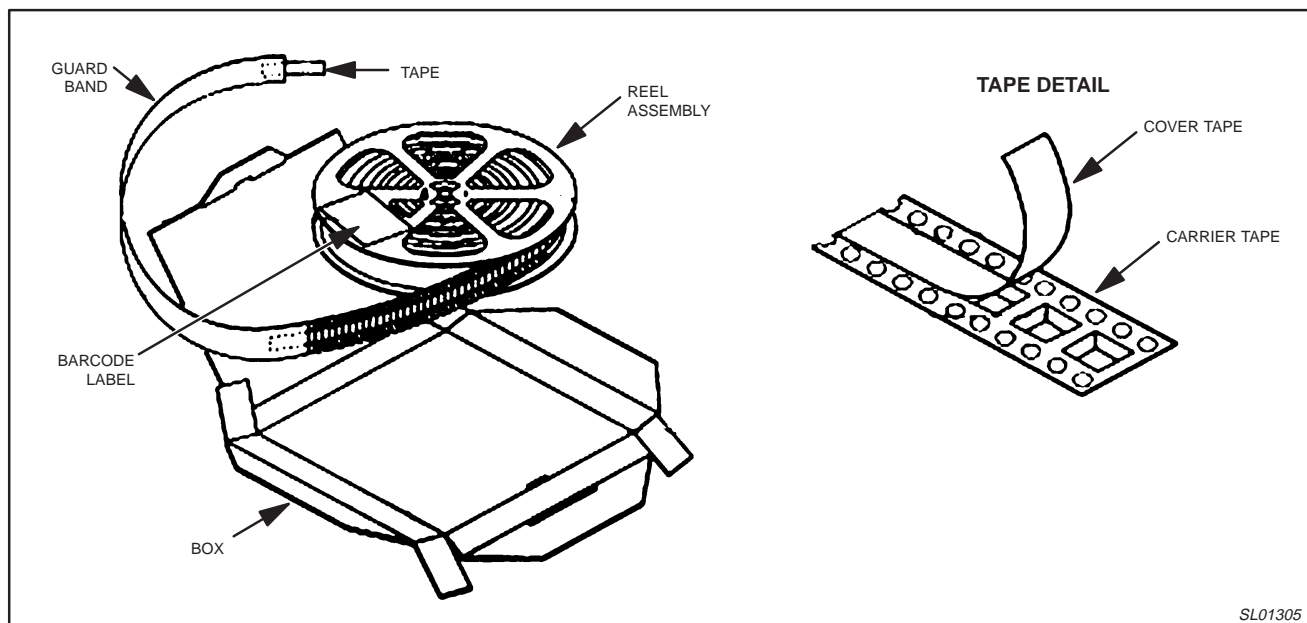


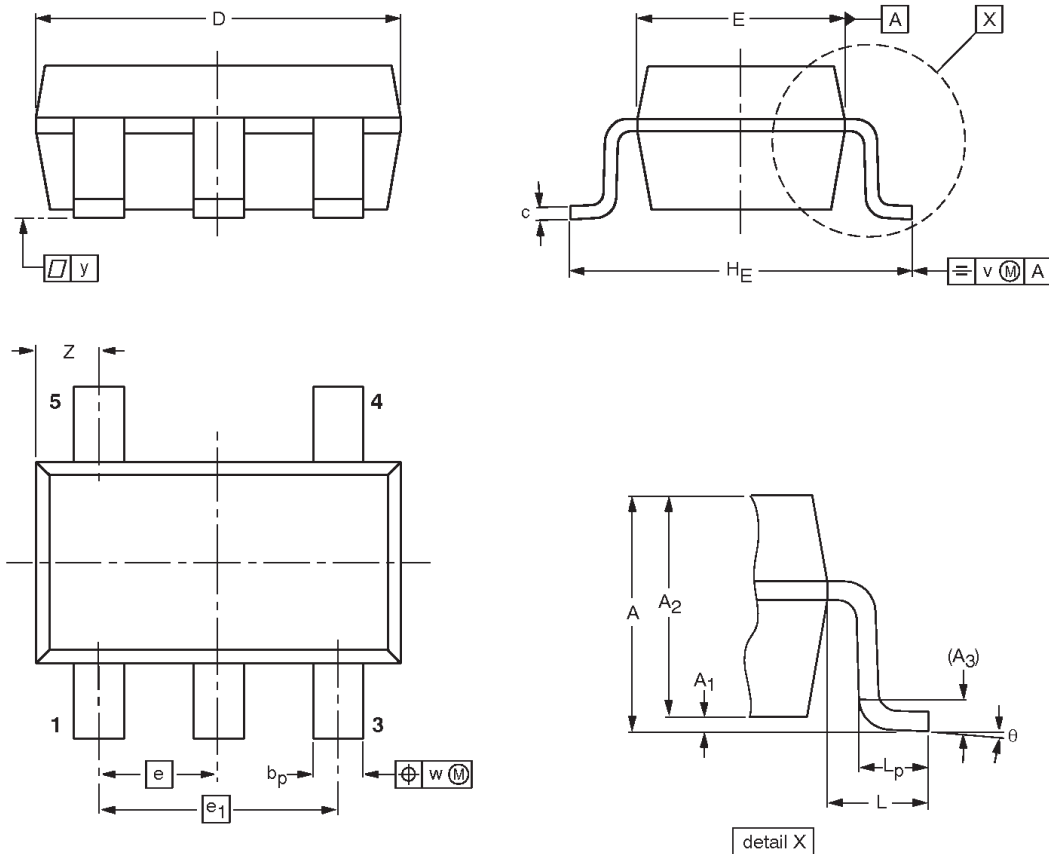
Figure 7. Tape and reel packing method

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SO5: plastic small outline package; 5 leads; body width 1.6 mm

SOT680-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	e <sub>1</sub>	H <sub>E</sub>	L	L <sub>p</sub>	v	w	y	Z	θ
mm	1.45	0.05 0.15	1.3 0.9	0.20	0.50 0.30	0.22 0.08	3.05 2.75	1.75 1.45	0.95	1.90	3.00 2.60	0.60	0.60 0.30	0.2	0.2	0.1	0.75 0.25	8° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT680-1		MO-178				01-03-22

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## Data sheet status

Data sheet status <sup>[1]</sup>	Product status <sup>[2]</sup>	Definitions
Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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