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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

Philips
Semiconductors

PHILIPS

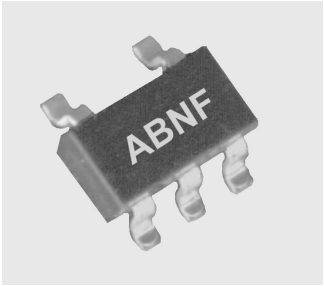
CapFREE™ 150 mA, low-noise, low dropout regulator with thermal protection

SA57000-XX

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 μV_{RMS}, and an ultra-low dropout voltage of 55 mV @ 50 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 μV_{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 mV @ 50 mA output current
- 85 µA 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

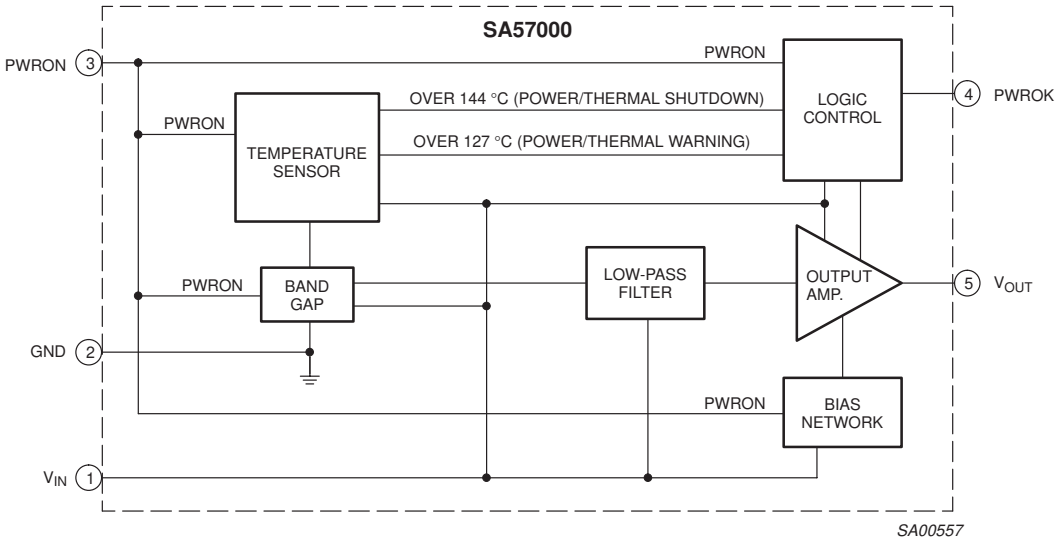


Figure 1. Simplified system diagram.

CapFREE is a trademark of Philips Electronics North America Corporation.

ORDERING INFORMATION

TYPE NUMBER	PACKAGE			TEMPERATURE RANGE
	NAME	DESCRIPTION	VERSION	
SA57000-**XX**D	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

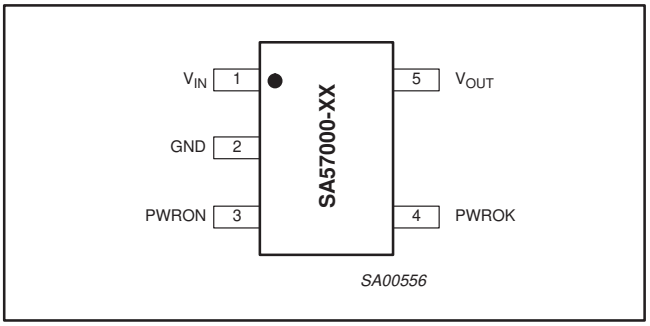


Figure 2. Pin configuration.

PIN DESCRIPTION

PIN	SYMBOL	DESCRIPTION
1	V_{IN}	Regulator input. $V_{OUT(nom)}$ + 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_{IN} 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 $V_{OUT(nom)}$.
5	V_{OUT}	Regulator output. Sources up to 150 mA. No bypass capacitors required.

MAXIMUM RATINGS

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_{IN}	V_{IN} to GND voltage	–0.3	5.5	V_{dc}
V_{PWRON}	PWRON to GND voltage	–0.3	5.5	V_{dc}
V_{OUT}	OUT to GND voltage	–0.3	V_{IN} + 0.3	V_{dc}
T_{amb}	Operating ambient temperature	–40	+85	°C
T_j	Junction temperature	–	+150	°C
T_{stg}	Storage temperature	–65	+160	°C
P	Power dissipation	–	575	mW
$R_{th(j-a)}$	Thermal resistance from junction to ambient	–	140	°C/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{IN}	input voltage		$V_{OUT(nom)}$	–	5.5	V
	output voltage accuracy [2]	I_{OUT} = 1 mA				
		T_{amb} = +25 °C	–	±1	–	%
		–40 °C ≤ T_{amb} ≤ +85 °C	–2.0	–	2.0	%
I_{LIM}	current limit		160	300	–	mA
I_Q	ground pin current	I_{OUT} = 1 mA to 150 mA	–	85	150	µA
	dropout voltage [3]	I_{OUT} = 1 mA	–	1	–	mV
		I_{OUT} = 50 mA	–	55	120	mV
		I_{OUT} = 150 mA	–	165	–	mV
ΔV_{LNR}	line regulation	V_{IN} = (V_{OUT} + 0.1 V) to 5.5 V; I_{OUT} = 20 mA	–	–	0.1	%/V
ΔV_{LDR}	load regulation	I_{OUT} = 1 mA to 150 mA	–	0.01	0.02	%/mA
e_n	output voltage noise	f = 10 Hz to 100 kHz, C_{OUT} = 10 µF	–	30	–	μV_{RMS}
Shutdown						
V_{IH}	PWRON input threshold (HIGH ON-state)	$V_{IN} \rightarrow V_{OUT(nom)} \rightarrow 5.5$ V	0.7 × V_{IN}	–	–	V
V_{IL}	PWRON input threshold (HIGH ON-state)	$V_{IN} \rightarrow V_{OUT(nom)} \rightarrow 5.5$ V	–	–	0.3 × V_{IN}	V
I_{PWRON}	PWRON input bias current	$V_{PWRON} = V_{IN}$				
		T_{amb} = +25 °C	–	0.01	1	µA
		T_{amb} = +85 °C	–	0.05	–	µA
$I_{Q(SHDN)}$	shutdown supply current	V_{OUT} = 0 V				
		T_{amb} = +25 °C	–	0.05	1	µA
		T_{amb} = +85 °C	–	0.2	1	µA
t_{PWRON}	power-on start-up time [4]	I_{OUT} = 1 mA, C_{OUT} = 100 nF				
		T_{amb} = +25 °C	–	25	100	µs
		T_{amb} = –40 to +85 °C	–	35	200	µs
Thermal protection (Note 2)						
T_{SHDN}	thermal shut-down temperature		–	144	–	°C
ΔT_{SHDN}	thermal shut-down hysteresis		–	13	–	°C
PWROK output (power and temperature OK) (Note 2)						
	PWROK trip temperature		–	127	–	°C
	PWROK trip temperature hysteresis		–	12	–	°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 mA	–	0.1	0.4	V

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

TYPCIAL PERFORMANCE CURVES

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

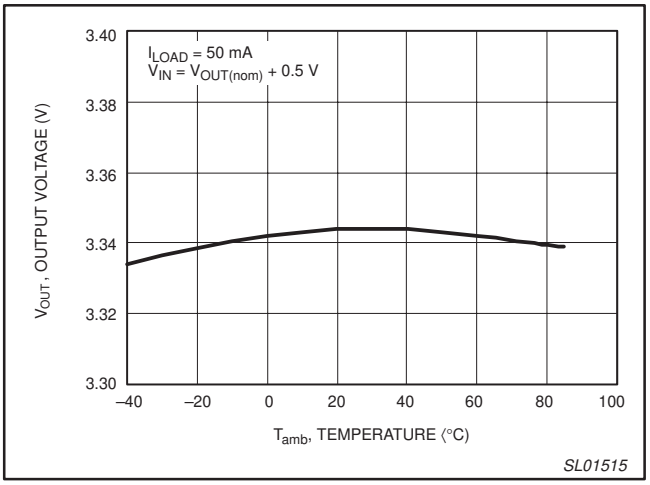


Figure 3. Output voltage versus temperature.

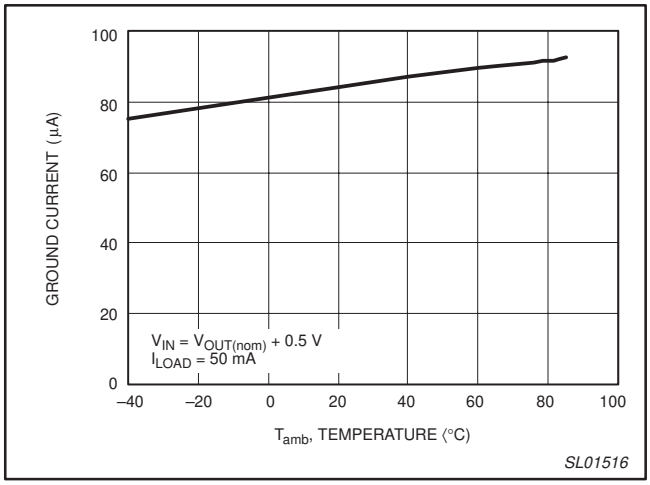


Figure 4. Ground current versus temperature.

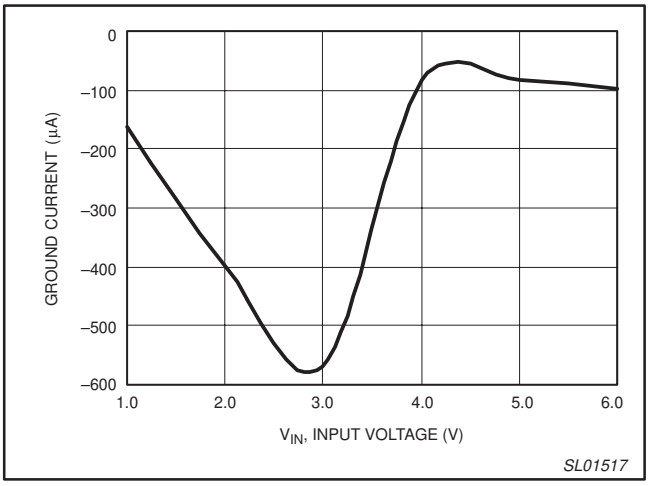


Figure 5. Ground current versus input voltage (no load).

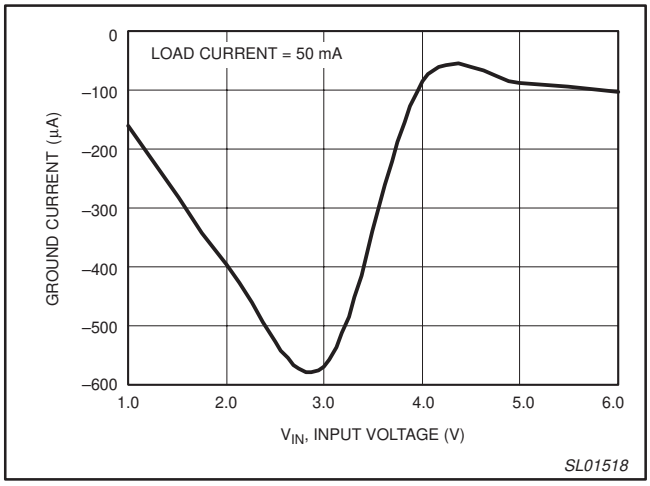


Figure 6. Ground current versus input voltage with load.

PACKING METHOD

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

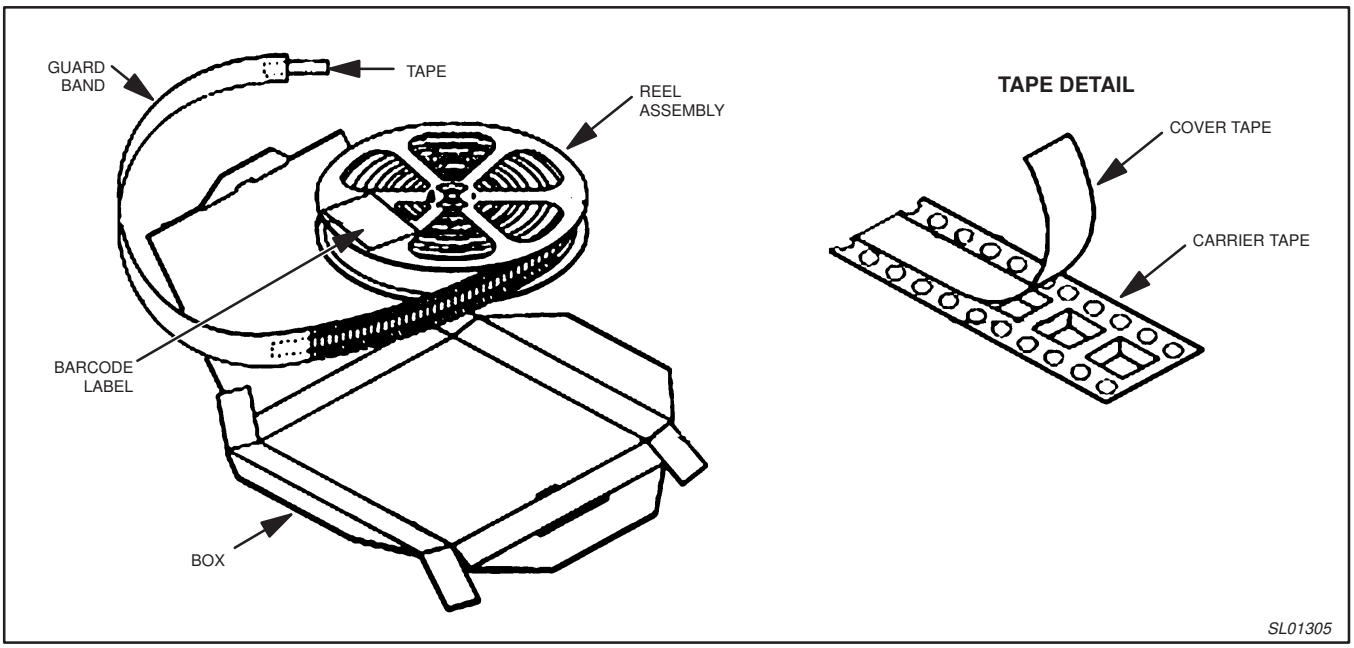
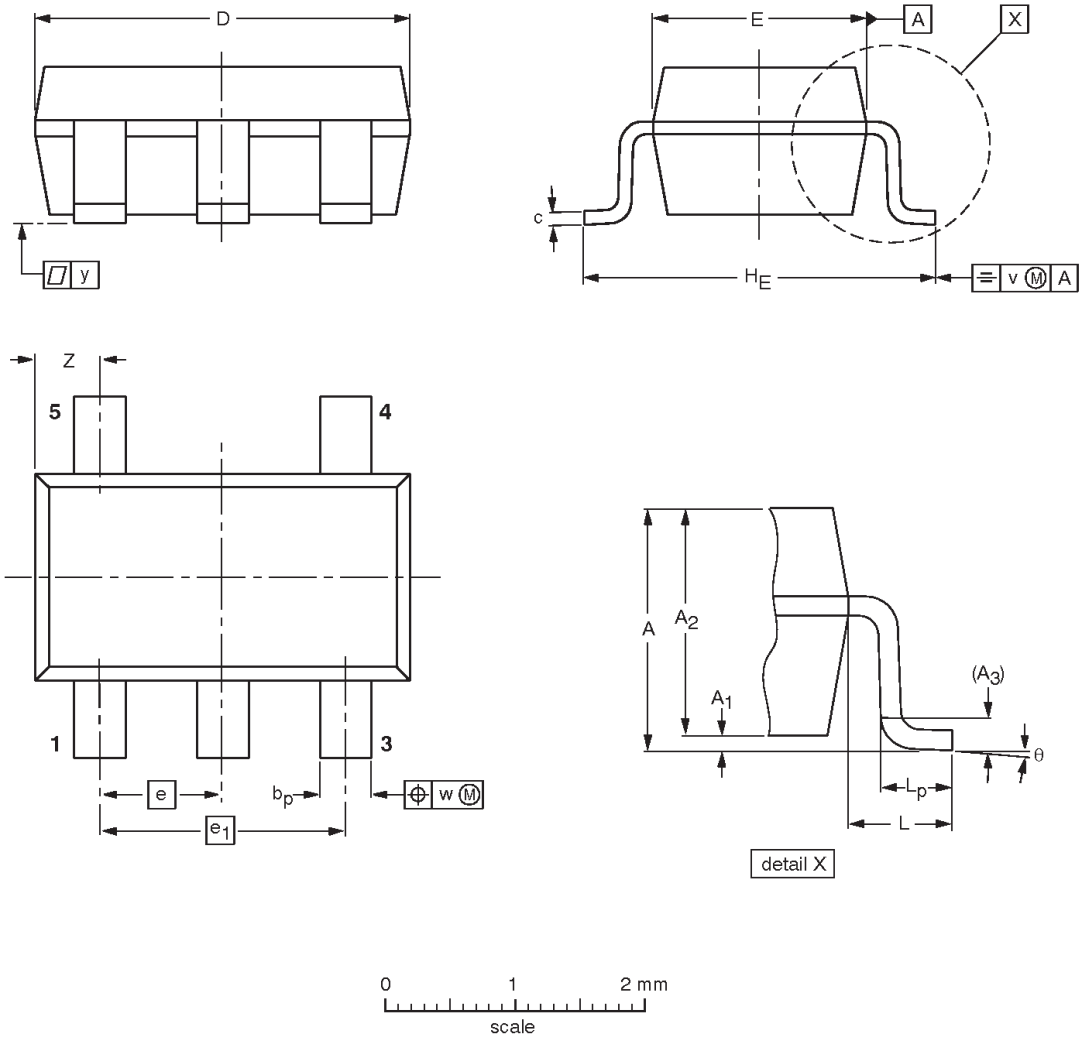


Figure 7. Tape and reel packing method

SO5: plastic small outline package; 5 leads; body width 1.6 mm **SOT680-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	e_1	H_E	L	L_p	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^o 0^o

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

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

SA57000-XX

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Data sheet status [1]	Product status [2]	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.
Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
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