DATA SHEET

SA57004-XX
Low-noise 150 mA linear CMOS regulator

Product data
Supersedes data of 2001 Dec 17

2003 Oct 15

Philips Semiconductors

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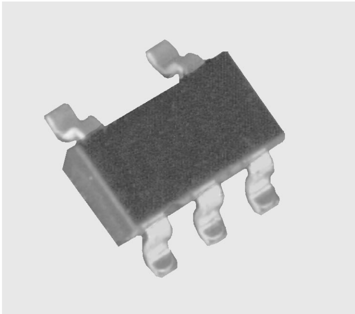
Low-noise 150 mA linear CMOS regulator SA57004-XX

GENERAL DESCRIPTION



The SA57004 is a 150 mA, fixed output voltage regulator designed to provide low noise in battery powered and portable applications. The output voltage is preset to voltages in the range of 1.8 to 5.0 Volts.

Designed with CMOS process, the SA57004 achieves unequalled performance in specifications critical to battery-powered designs such as low supply-current, low power consumption, small size, fast dynamic response to line and load, precision output, and so on. Each of these regulators consists of an internal voltage reference, an error amplifier, resistors, a current limiting circuit and a chip enable circuit.

The SA57004 series are housed in the small outline 5-lead package (SOP003).

FEATURES

- Very low consumption current:
  1.5 µA typ. (when not loaded, excluding CE current),
  0.1 µA typ. (when off)
- High precision output voltage: ±2%
- Output current capacity: 150 mA
- Good line regulation: 0.05%/V typ.
- Low temperature drift co-efficient to V_{OUT}: ±100 ppm/°C
- Built-in current limit circuit: 60 mA typ.
- Wide operating temperature range: –30 to +85 °C
- Wide preset output voltage range: 1.8 to 5.0 V

APPLICATIONS

- Cellular phones, cordless phones and 2-way radios
- Electronic notebooks, PDAs and palmtop computers
- Cameras, VCRs and camcorders
- PCMCIA cards
- Modems
- Battery-powered or hand-held instruments

SIMPLIFIED SYSTEM DIAGRAM

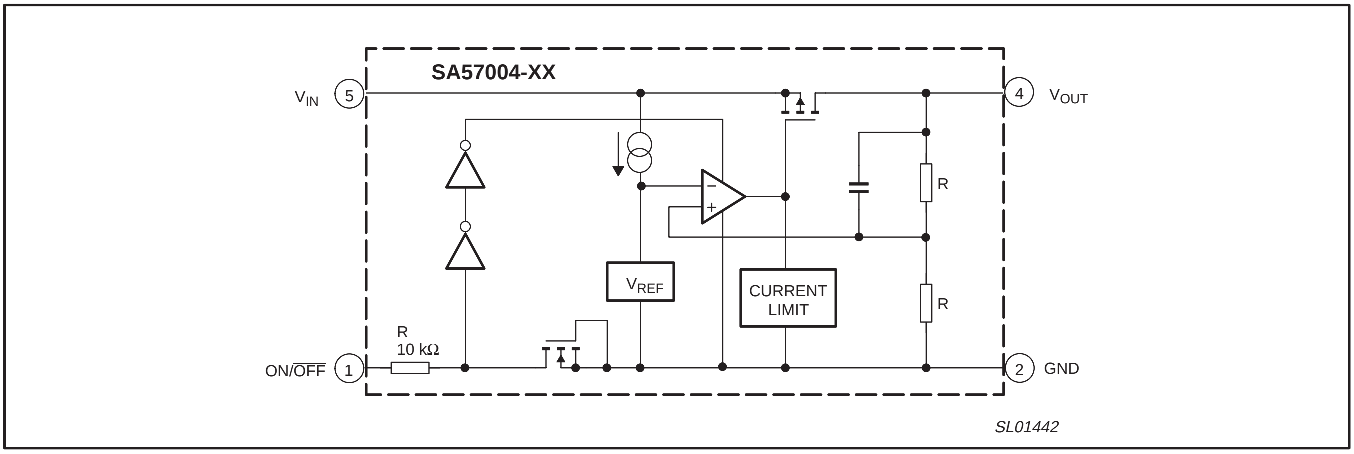


Figure 1. Simplified system diagram.

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		TEMPERATURE RANGE
	DESCRIPTION	VERSION	
SA57004-**XX**GW	plastic small outline package; 5 leads (see dimensional drawing)	SOP003	–30 to +85 °C

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

XX	VOLTAGE (Typical)
18	1.8 V
28	2.8 V
30	3.0 V
32	3.2 V
33	3.3 V
50	5.0 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
SA57004-18GW	A D N x
SA57004-28GW	A D P x
SA57004-30GW	A D R x
SA57004-32GW	A D S x
SA57004-33GW	A D T x
SA57004-50GW	A D U x

PIN CONFIGURATION

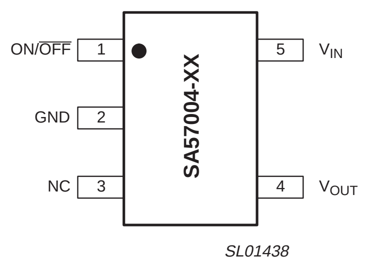


Figure 2. Pin configuration.

PIN DESCRIPTION

PIN	SYMBOL	DESCRIPTION
1	ON/$\overline{\text{OFF}}$	On/Off control pin. Connect CE with V_{IN} if not used. CE = LOW, output OFF CE = HIGH, output ON
2	GND	Device ground.
3	NC	No connection.
4	V_{OUT}	Voltage output.
5	V_{IN}	Voltage input.

MAXIMUM RATINGS

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_{IN}	Power supply voltage	–0.3	9.0	V
I_O	Output current	–	150	mA
T_{oper}	Operating temperature	–30	+85	°C
T_j	Junction temperature	–	+125	°C
$T_{j(max)}$	Maximum junction temperature	–	+150	°C
T_{stg}	Storage temperature	–40	+125	°C
P	Power dissipation	–	150	mW

ELECTRICAL CHARACTERISTICS

T_{amb} = 25 5C; V_{IN} = V_{CE}; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	PART #	MIN.	TYP.	MAX.	UNIT
I_{SS}	quiescent current		all	–	1.5	3.0	µA
$I_{standby}$	standby current		all	–	0.1	1.0	µA
$\Delta V_{OUT}/\Delta V_{IN}$	line regulation		all	0	0.05	0.2	%/V
V_{IN}	input voltage		all	–	–	8.0	V
$\Delta V_{OUT}/\Delta V_{OPT}$	V_{OUT} temperature coefficient		all	–	±100	–	ppm/°C
I_{LIM}	short current		all	–	60	–	mA
I_{CE}	CE terminal current		all	–	0.1	1.0	µA
V_{CEH}	CE HIGH voltage		all	V_{IN} – 1	–	V_{IN}	V
V_{CEL}	CE LOW voltage		all	–	–	0.25	V
RR	Ripple rejection	f = 1 kHz; V_{IN} = 5 V_{DC}; 0.5 V_{p-p}; I_{OUT} = 10 mA	all	–	40	–	dB
V_{OUT}	output voltage	$V_{IN} – V_{OUT}$ = 2.0 V; 10 µA ≤ I_{OUT} ≤ 10 mA	–18	1.76	1.8	1.84	V
			–28	2.74	2.8	2.86	V
			–30	2.94	3.0	3.06	V
			–32	3.14	3.2	3.26	V
			–33	3.23	3.3	3.37	V
			–50	4.9	5.0	5.1	V
I_{OUT}	output current	$V_{IN} – V_{OUT}$ = 2.0 V	–18	35	–	–	mA
			–28	35	–	–	mA
			–30	50	–	–	mA
			–32	50	–	–	mA
			–33	50	–	–	mA
			–50	80	–	–	mA
$\Delta V_{OUT}/\Delta I_{OUT}$	load regulation	$V_{IN} – V_{OUT}$ = 2.0 V; 10 µA ≤ I_{OUT} ≤ 10 mA	–18	–	30	45	mV
			–28	–	30	45	mV
			–30	–	40	60	mV
			–32	–	40	60	mV
			–33	–	40	60	mV
			–50	–	60	90	mV
V_{DIFF}	input/output differential voltage	I_{OUT} = 1.0 mA	–18	–	60	90	mV
			–28	–	40	60	mV
			–30	–	40	60	mV
			–32	–	35	55	mV
			–33	–	35	55	mV
			–50	–	25	40	mV

TYPICAL PERFORMANCE CURVES

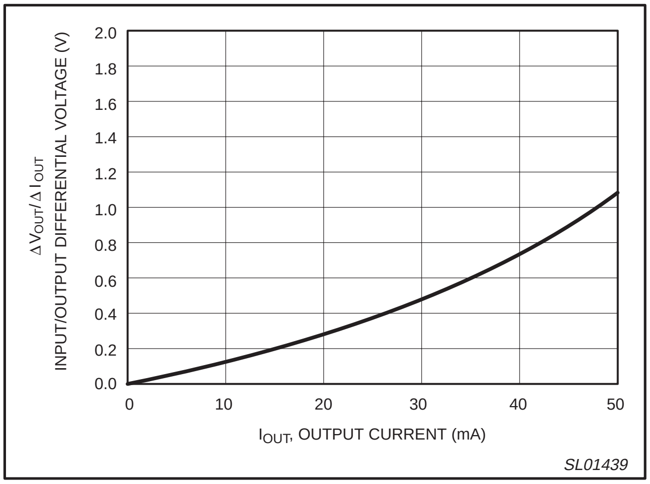


Figure 3. Input/output differential voltage.

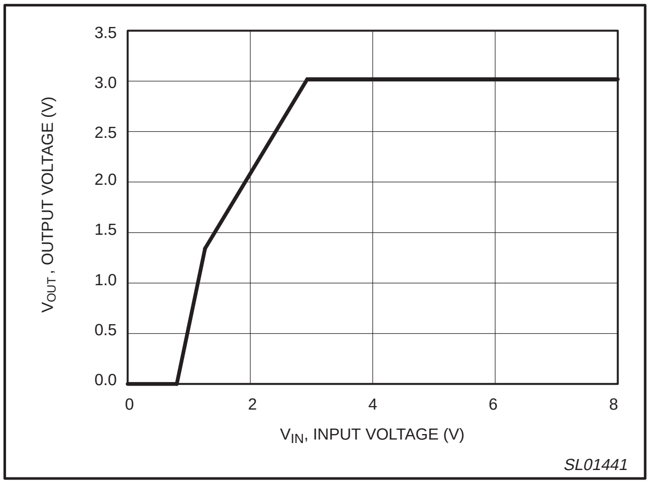


Figure 4. Line regulation.

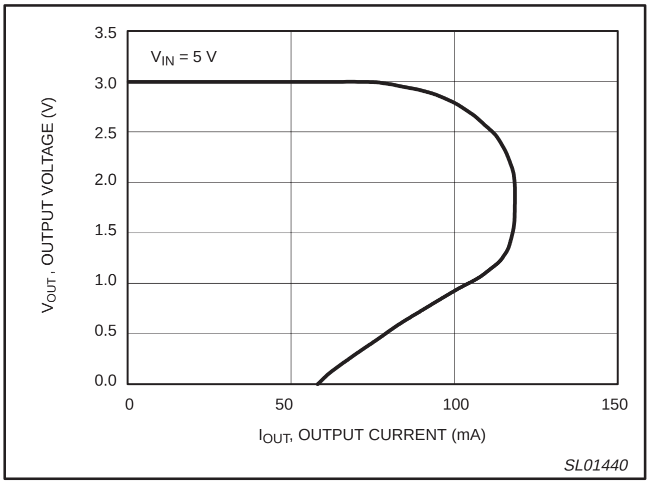


Figure 5. Load regulation.

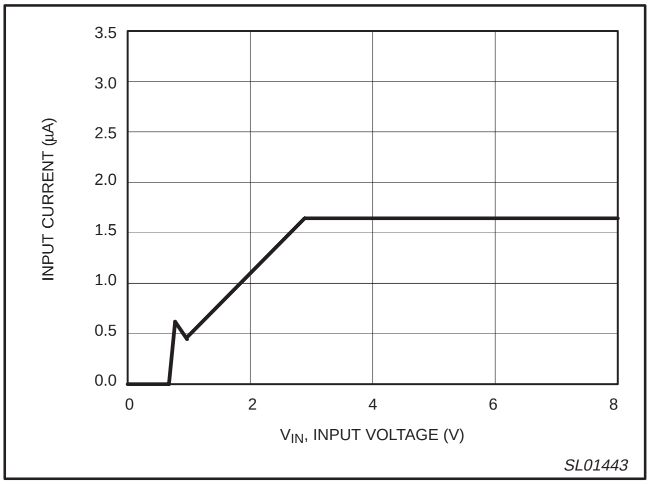


Figure 6. Input current.

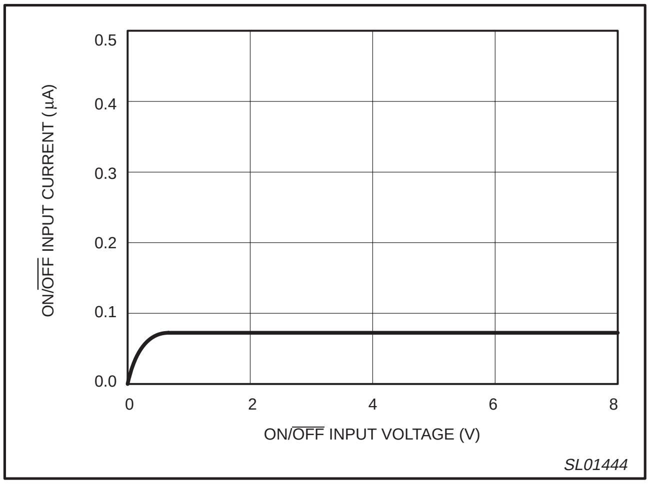


Figure 7. ON/OFF current versus ON/OFF input voltage.

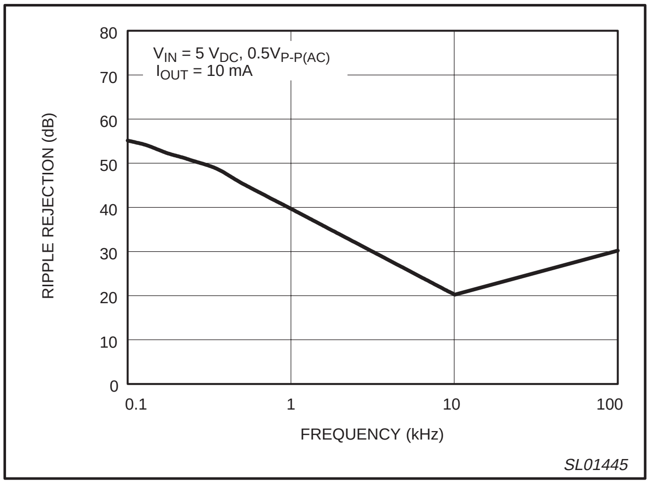


Figure 8. Ripple rejection.

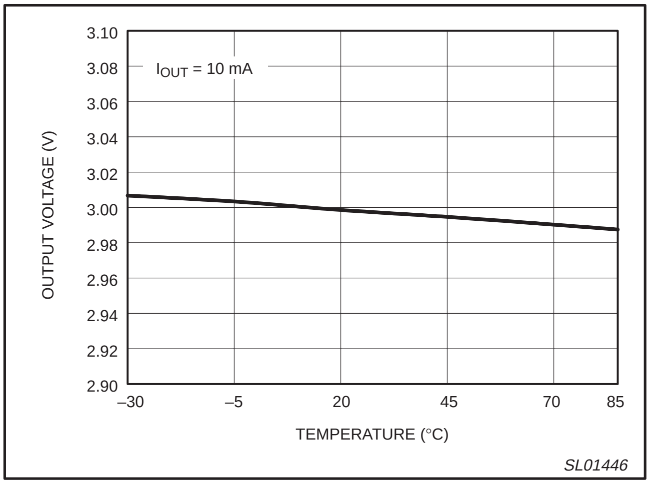


Figure 9. Typical output voltage versus temperature.

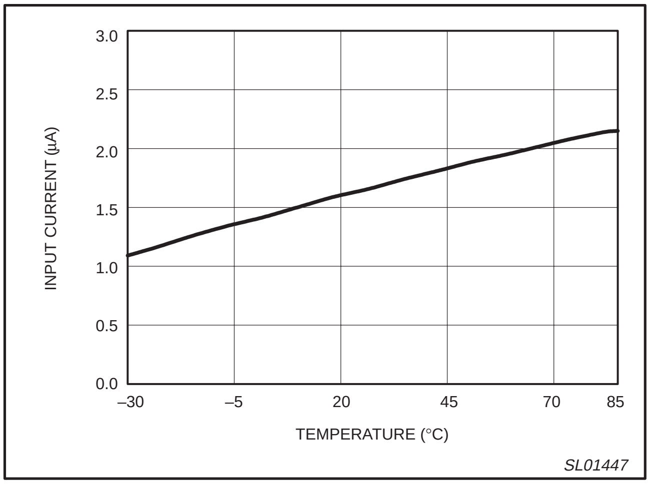


Figure 10. Input current versus temperature.

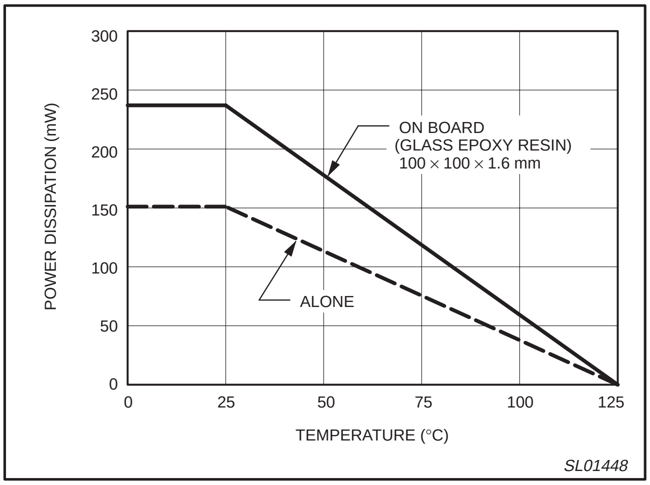


Figure 11. Power dissipation.

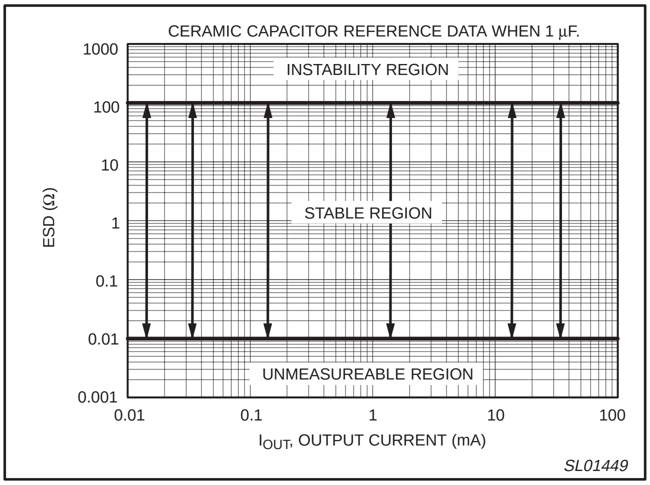


Figure 12. ESR stable region.

TEST CIRCUITS

In all cases, C_{IN}, $C_{OUT} \geq 1$ µF.

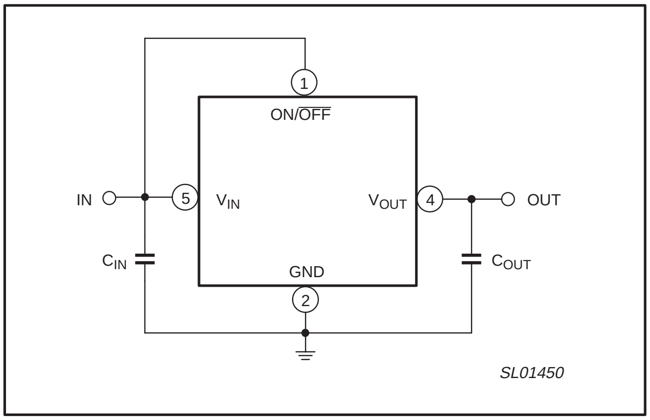


Figure 13. Basic test circuit.

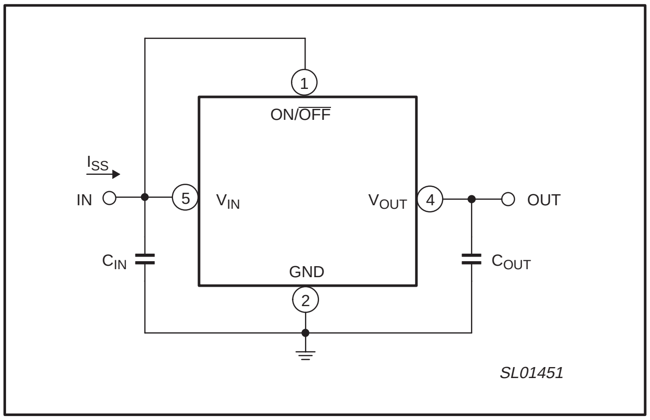


Figure 14. Supply current.

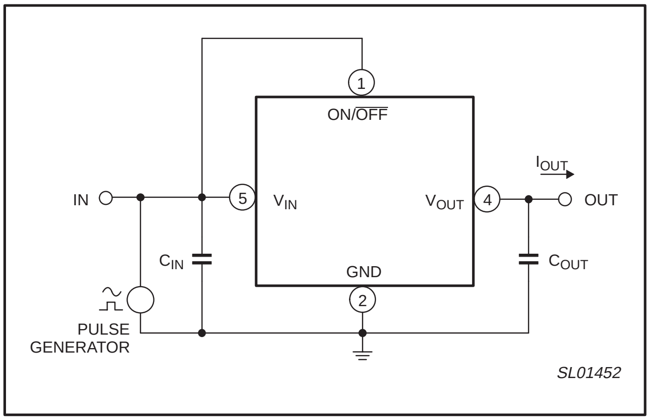


Figure 15. Ripple rejection (line transient response).

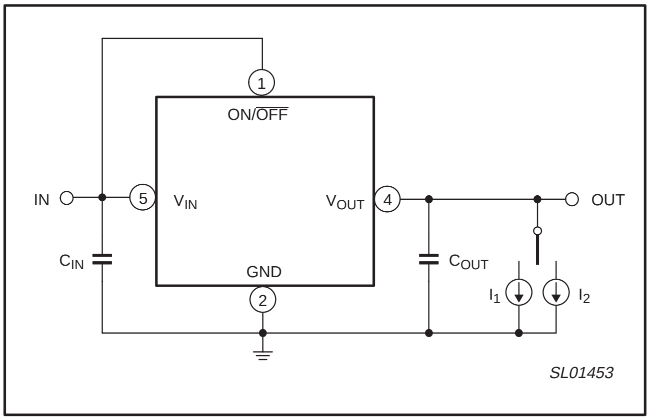


Figure 16. Load transient response.

TECHNICAL DISCUSSION

As illustrated in Figure 17, the SA57004-XX consists of a band-gap voltage reference, an error amplifier, P-channel pass transistor, current limit circuit and an internal feedback voltage divider. The output voltage is fed back through an internal resistor voltage divider connected to the V_{OUT} pin.

The reference is connected to the error amplifier's inverting input. The error amplifier compares the reference with the feedback voltage and amplifies the difference. If the feedback voltage is lower than the reference voltage, the pass transistor's gate is pulled lower, which allows more current to pass to the output and increase the output voltage. On the other hand, if the feedback voltage is too high the pass transistor gate is pulled up, allowing less current to pass to the output, resulting a decrease in output voltage.

The current-limiter monitors and controls the pass-transistor's gate voltage, limiting the output current to its specified maximum value. Thus it can withstand a short-circuited output for an indefinite amount of time without damaging the part.

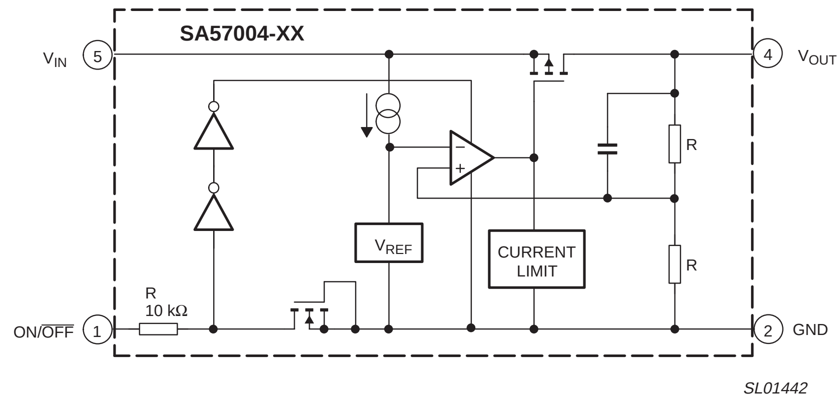


Figure 17. Functional diagram.

APPLICATION INFORMATION

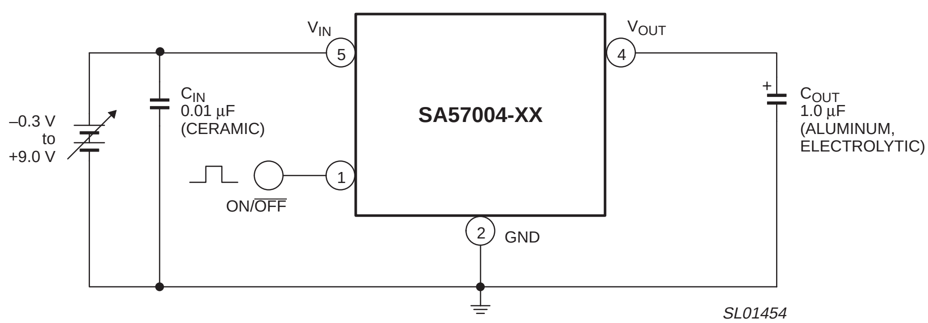


Figure 18. Typical application circuit.

The following points must be considered for good performance from these devices:

Input capacitor: An input capacitor of ≥1 µF is required between the SA57004-XX input and the ground (the amount of capacitance may be increased without limit).

This capacitor must be located as close as possible to V_{IN} or GND pin (not more than 1 cm) and returned to a clean analog ground. Any good quality ceramic, tantalum or film capacitor will work.

Output capacitor: Phase compensation is made for securing stable operation even if the load current varies. For this reason, an output capacitor with good frequency characteristics is needed. Set it as close to the circuit as possible and make the wiring as short as possible.

The value of the output capacitance must be at least 1 µF. Also it must have the ESR (Equivalent Series Resistance) value within the stable range shown in Figure 12, 'ESR stable region'.

ON/$\overline{\text{OFF}}$ (Chip Enable) pin: The ON/$\overline{\text{OFF}}$ pin must be actively terminated. If the function is not to be used, the pin should be tied to V_{IN}.

Line impedance of VDD and GND: The V_{IN} and GND lines should be sufficiently wide. Otherwise, when the impedance of these lines is high, there is a chance to pick up noise or malfunction.

PACKING METHOD

The SA57004-XX is packed in reels, as shown in Figure 19.

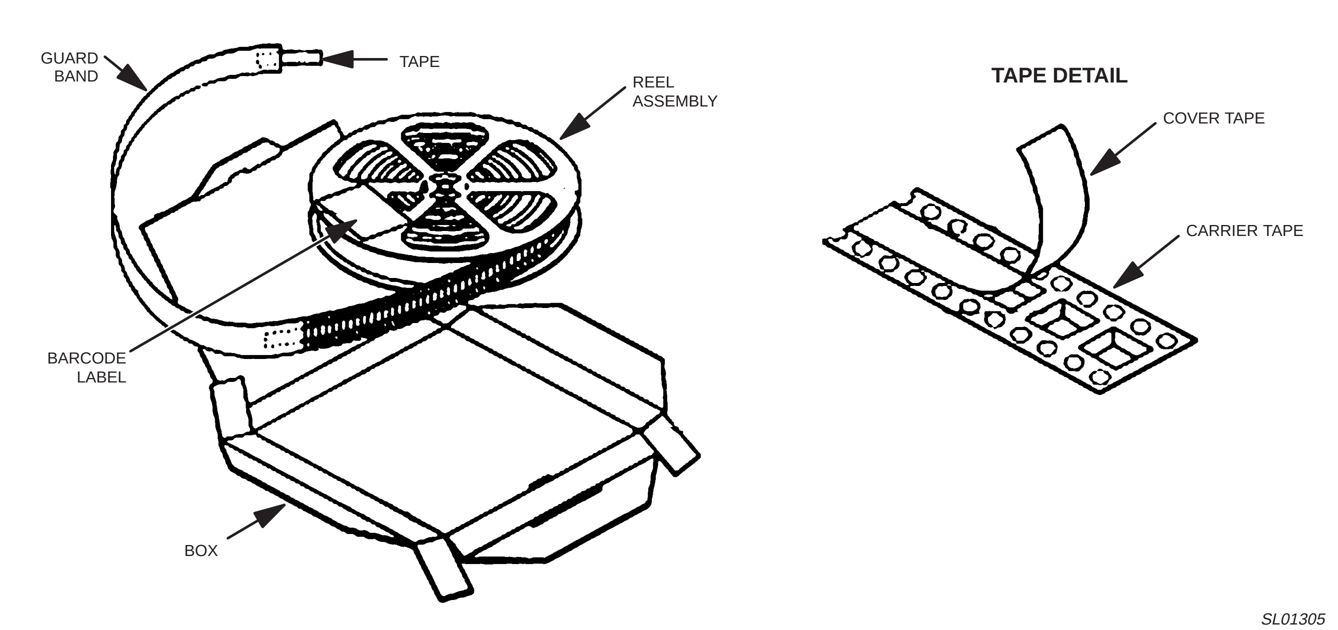
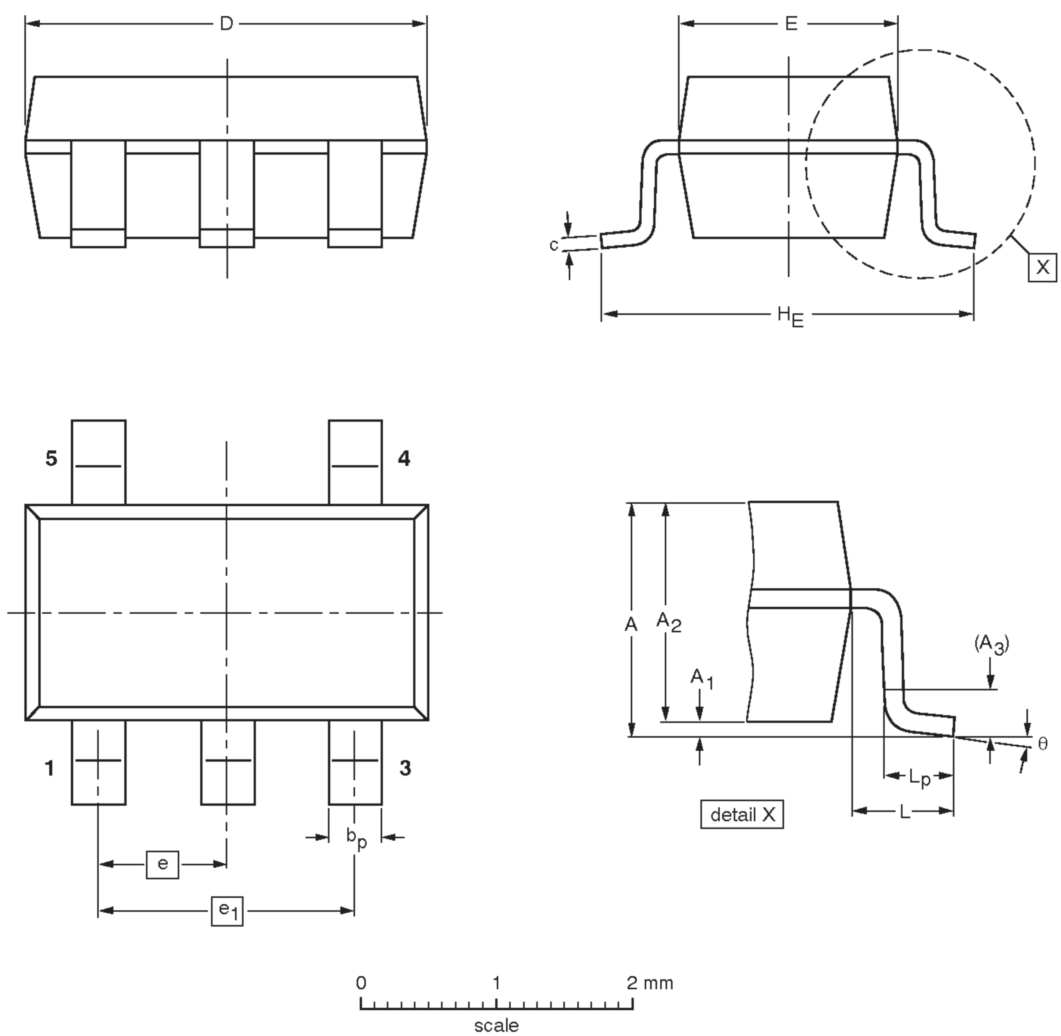


Figure 19. Tape and reel packing method

Plastic small outline package; 5 leads; body width 1.6 mm **SOP003**

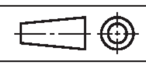


DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(2)	e	e_1	H_E	L	L_p	θ
mm	1.35	0.15 0.05	1.2 1.0	0.25	0.50 0.25	0.22 0.08	3.0 2.7	1.7 1.5	0.95	1.9	3.0 2.6	0.6	0.55 0.35	8° 0°

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOP003		MO-178				~~03-06-25~~ 03-10-07

Low-noise 150 mA linear CMOS regulator SA57004-XX

REVISION HISTORY

Rev	Date	Description
_3	20031015	**Product data (9397 750 12096). ECN 853-2276 30326 of 09 September 2003. Supersedes data of 2001 Dec 17 (9397 750 09272).** Modifications: ● Change package outline version to SOP003 in Ordering information table and Package outline sections.
_2	20011217	**Product data (9397 750 09272). ECN 853-2276 27466 of 17 December 2001. Supersedes data of 2001 Aug 01.**

Data sheet status

Level	Data sheet status [1]	Product status [2] [3]	Definitions
I	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.
II	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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[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL http://www.semiconductors.philips.com.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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