

# DATA SHEET

## **SA57004-XX**

Low-noise 150 mA linear CMOS regulator

Product data  
Supersedes data of 2001 Aug 01  
File under Integrated Circuits, Standard Analog

2001 Dec 17

# Low-noise 150 mA linear CMOS regulator

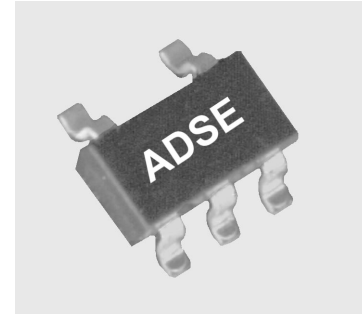
## SA57004-XX

### 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 SOT23-5 5-lead package.



### FEATURES

- Very low consumption current:
  - 1.5  $\mu\text{A}$  typ. (when not loaded, excluding CE current),
  - 0.1  $\mu\text{A}$  typ. (when off)
- High precision output voltage:  $\pm 2\%$
- Output current capacity: 150 mA
- Good line regulation: 0.05%/V typ.
- Low temperature drift co-efficient to  $V_{\text{OUT}}$ :  $\pm 100$  ppm/ $^{\circ}\text{C}$
- Built-in current limit circuit: 60 mA typ.
- Wide operating temperature range:  $-30$  to  $+85$   $^{\circ}\text{C}$
- 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

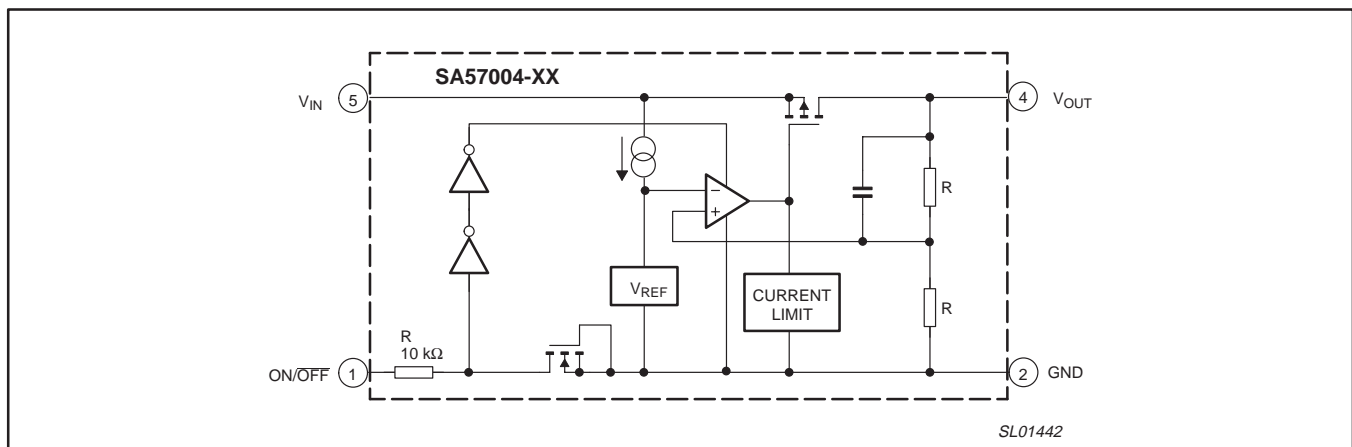


Figure 1. Simplified system diagram.

# Low-noise 150 mA linear CMOS regulator

# SA57004-XX

## ORDERING INFORMATION

TYPE NUMBER	PACKAGE		TEMPERATURE RANGE
	NAME	DESCRIPTION	
SA57004-XXGW	SOT23-5, SOT25, SO5	plastic small outline package; 5 leads (see dimensional drawing)	-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

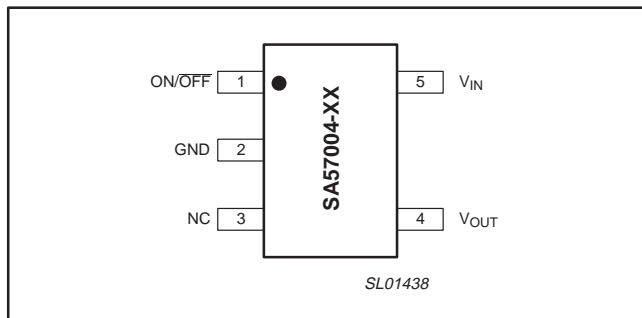


Figure 2. Pin configuration.

## PIN DESCRIPTION

PIN	SYMBOL	DESCRIPTION
1	ON/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

## Low-noise 150 mA linear CMOS regulator

SA57004-XX

**ELECTRICAL CHARACTERISTICS** $T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $V_{IN} = V_{CE}$ ; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	PART #	MIN.	TYP.	MAX.	UNIT
$I_{SS}$	quiescent current		all	–	1.5	3.0	$\mu\text{A}$
$I_{standby}$	standby current		all	–	0.1	1.0	$\mu\text{A}$
$\Delta V_{OUT}/\Delta V_{IN}$	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	–	$\pm 100$	–	ppm/ $^{\circ}\text{C}$
$I_{LIM}$	short current		all	–	60	–	mA
$I_{CE}$	CE terminal current		all	–	0.1	1.0	$\mu\text{A}$
$V_{CEH}$	CE HIGH voltage		all	$V_{IN} - 1$	–	$V_{IN}$	V
$V_{CEL}$	CE LOW voltage		all	–	–	0.25	V
RR	Ripple rejection	$f = 1\text{ kHz}$ ; $V_{IN} = 5\text{ }V_{DC}$ ; $0.5\text{ }V_{p-p}$ ; $I_{OUT} = 10\text{ mA}$	all	–	40	–	dB
$V_{OUT}$	output voltage	$V_{IN} - V_{OUT} = 2.0\text{ V}$ ; $10\text{ }\mu\text{A} \leq I_{OUT} \leq 10\text{ mA}$	–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	$V_{IN} - V_{OUT} = 2.0\text{ V}$	–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	$V_{IN} - V_{OUT} = 2.0\text{ V}$ ; $10\text{ }\mu\text{A} \leq I_{OUT} \leq 10\text{ mA}$	–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	$I_{OUT} = 1.0\text{ mA}$	–18	–	60	90	mV
			–28	–	40	60	mV
			–30	–	40	60	mV
			–32	–	35	55	mV
			–33	–	35	55	mV
			–50	–	25	40	mV

# Low-noise 150 mA linear CMOS regulator

SA57004-XX

## TYPICAL PERFORMANCE CURVES

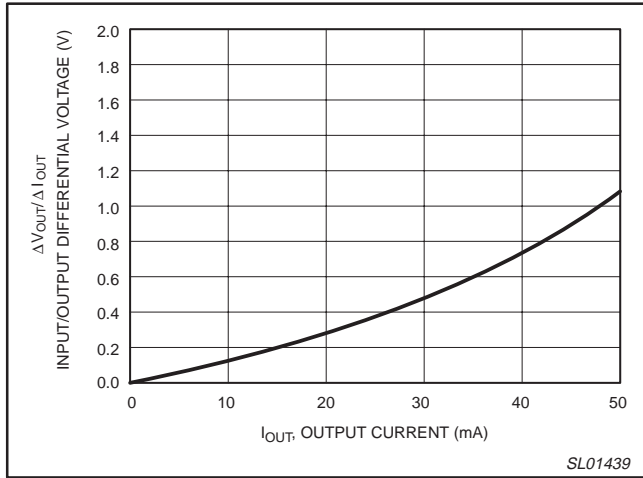


Figure 3. Input/output differential voltage.

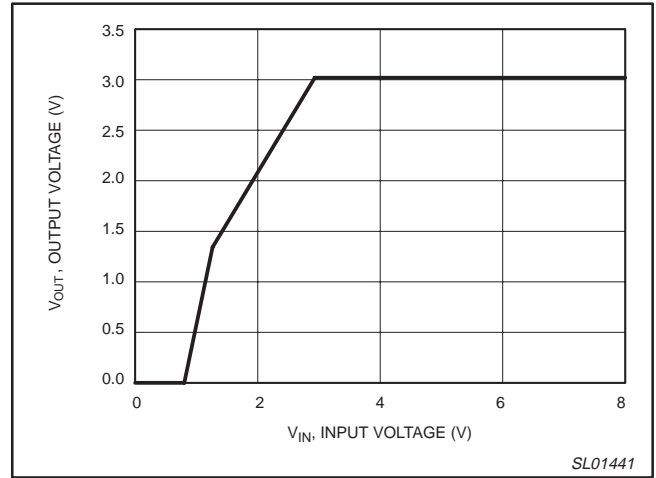


Figure 4. Line regulation.

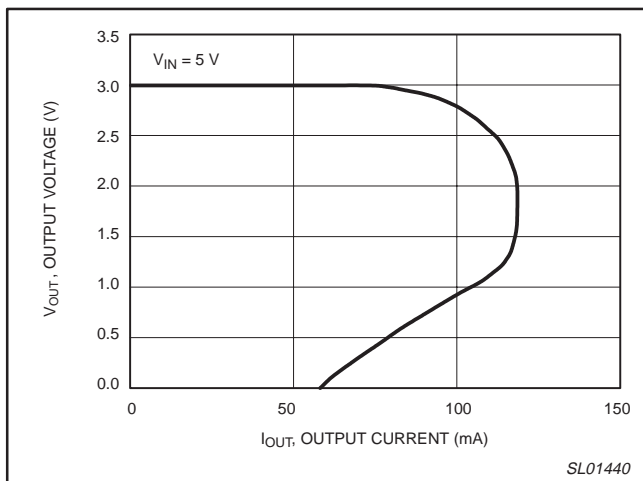


Figure 5. Load regulation.

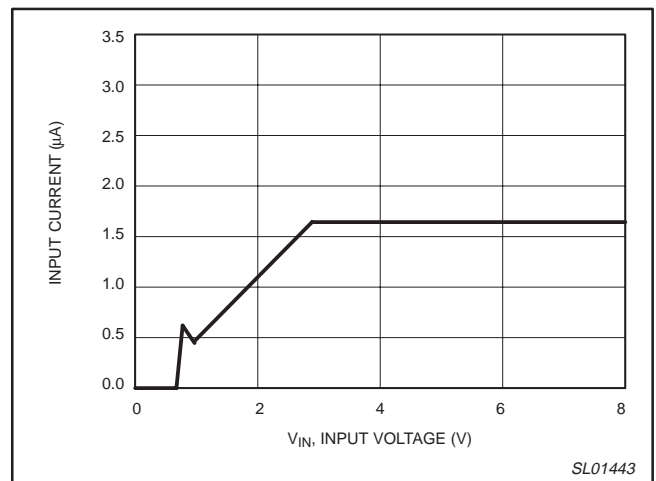


Figure 6. Input current.

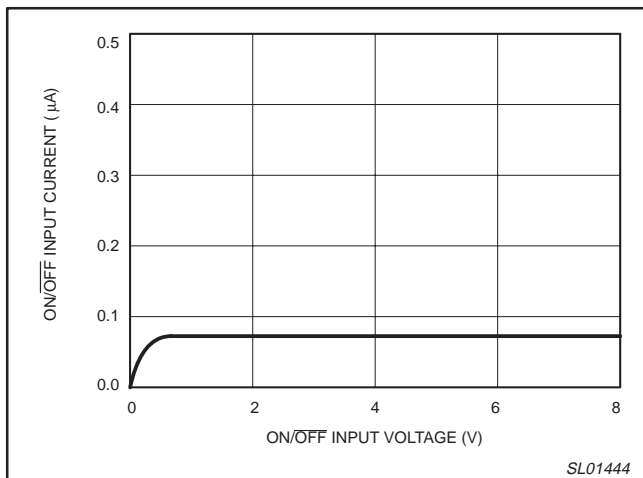


Figure 7. ON/OFF current versus ON/OFF input voltage.

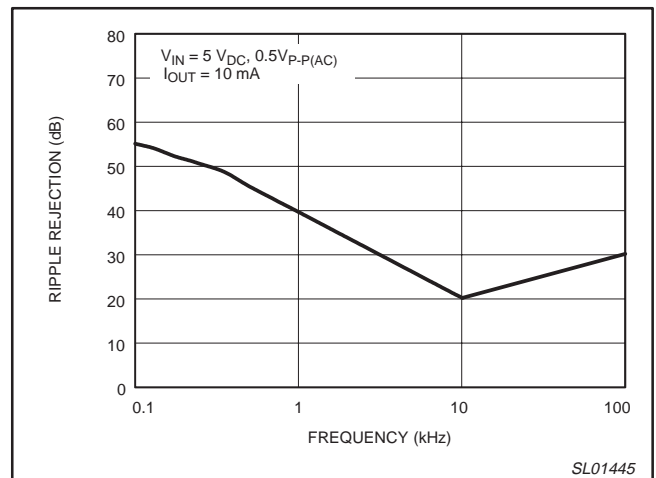


Figure 8. Ripple rejection.

Low-noise 150 mA linear CMOS regulator

SA57004-XX

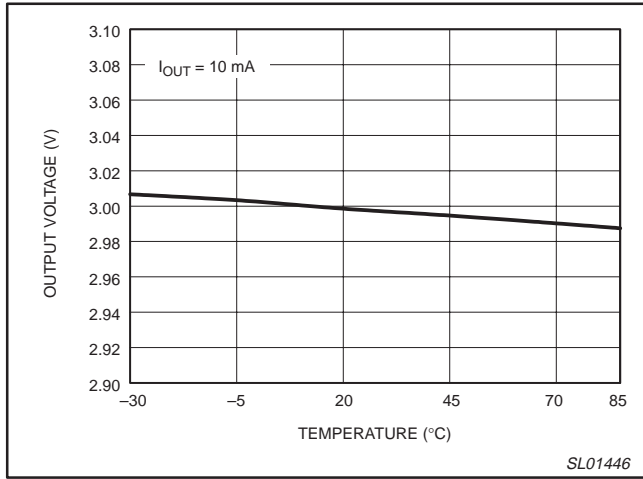


Figure 9. Typical output voltage versus temperature.

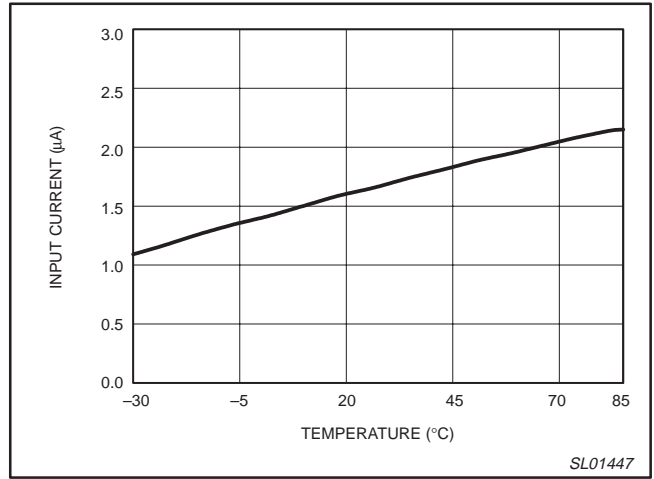


Figure 10. Input current versus temperature.

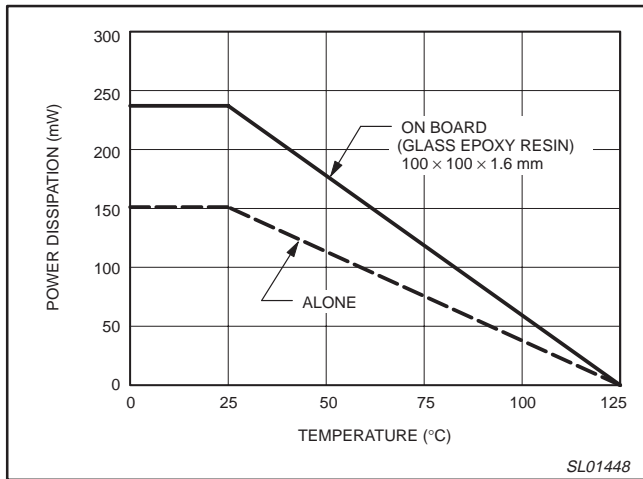


Figure 11. Power dissipation.

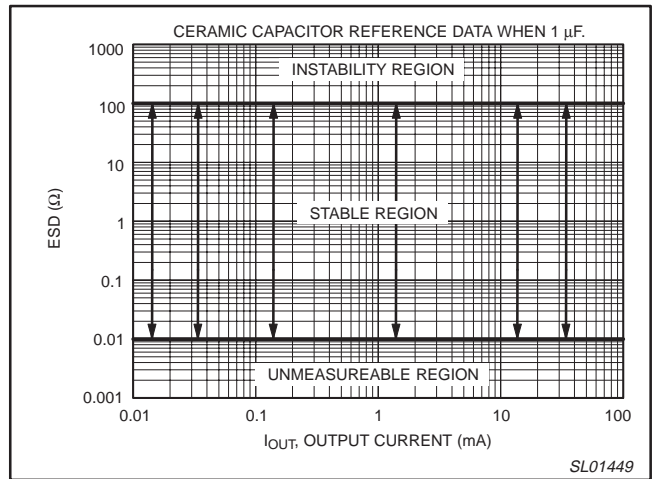


Figure 12. ESR stable region.

# Low-noise 150 mA linear CMOS regulator

SA57004-XX

## TEST CIRCUITS

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

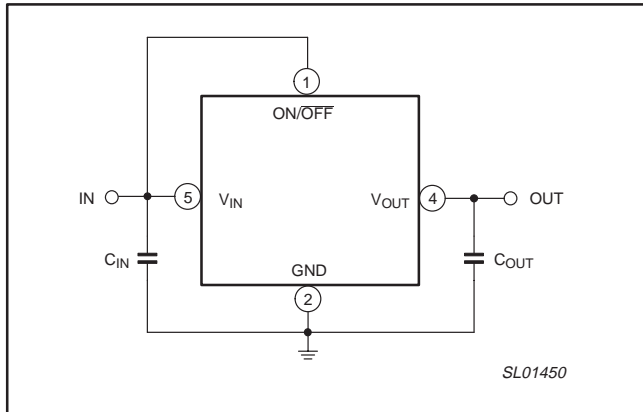


Figure 13. Basic test circuit.

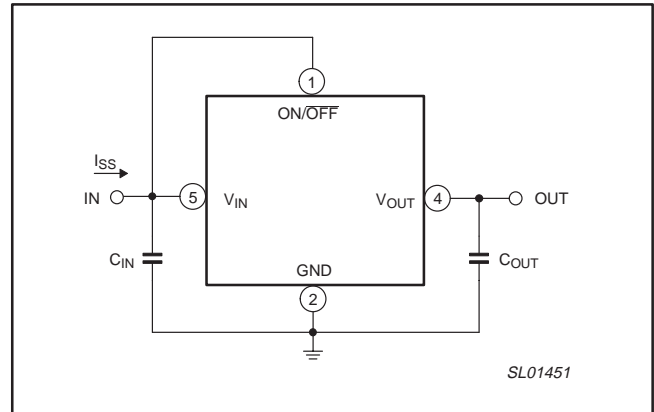


Figure 14. Supply current.

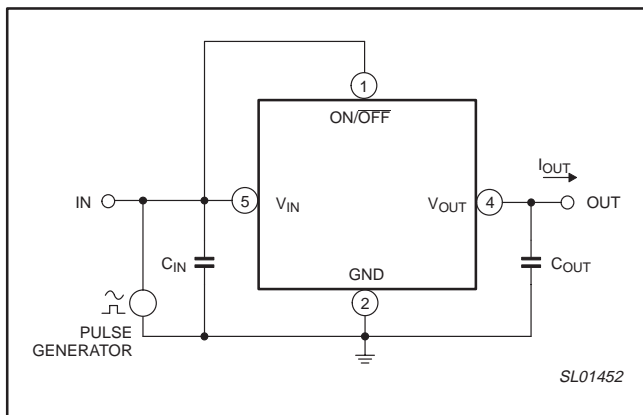


Figure 15. Ripple rejection (line transient response).

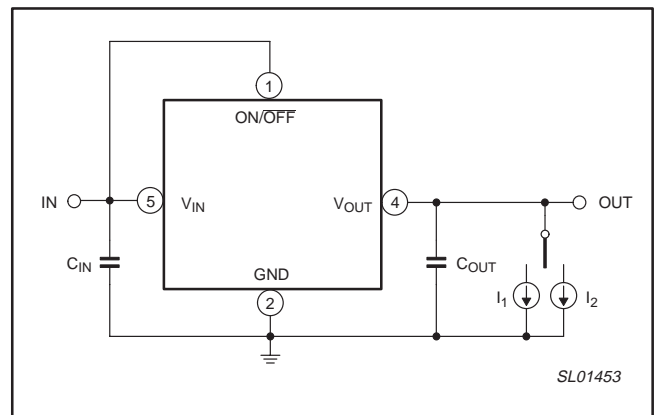


Figure 16. Load transient response.

# Low-noise 150 mA linear CMOS regulator

# SA57004-XX

## 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<sub>OUT</sub> 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.

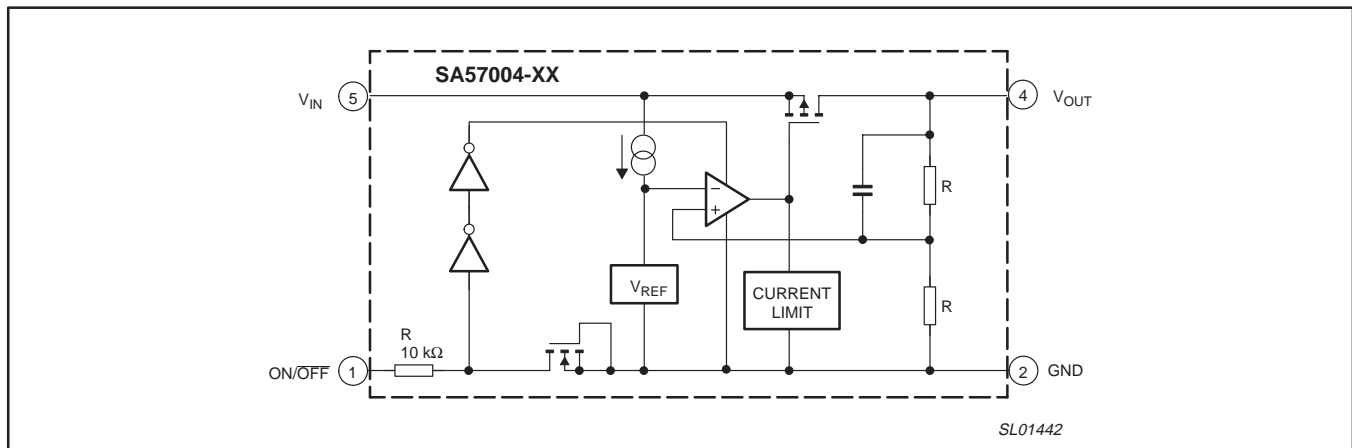


Figure 17. Functional diagram.

## APPLICATION INFORMATION

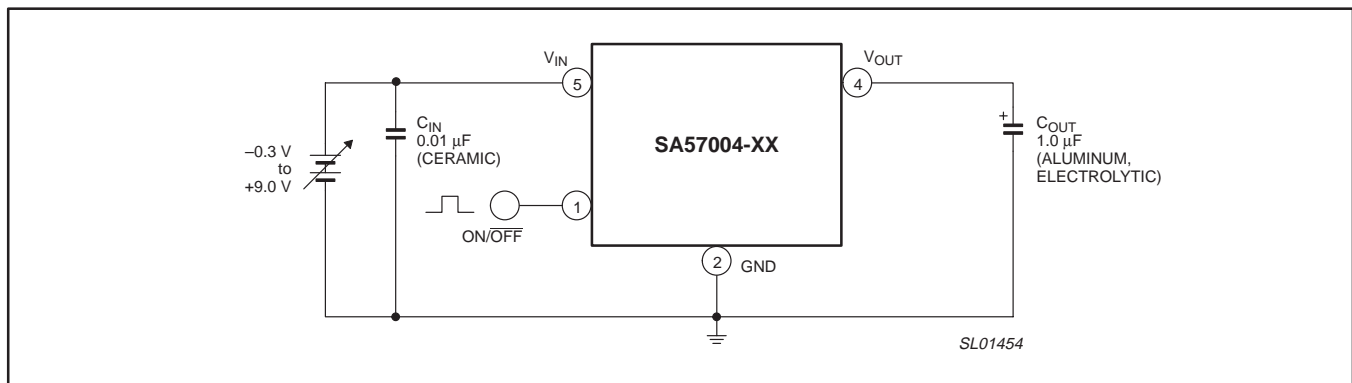


Figure 18. Typical application circuit.

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

**Input capacitor:** An input capacitor of  $\geq 1 \mu\text{F}$  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<sub>IN</sub> 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  $1 \mu\text{F}$ . Also it must have the ESR (Equivalent Series Resistance) value within the stable range shown in Figure 12, 'ESR stable region'.

**ON/OFF (Chip Enable) pin:** The ON/OFF pin must be actively terminated. If the function is not to be used, the pin should be tied to V<sub>IN</sub>.

**Line impedance of VDD and GND:** The V<sub>IN</sub> 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.



# Low-noise 150 mA linear CMOS regulator

SA57004-XX

## PACKING METHOD

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

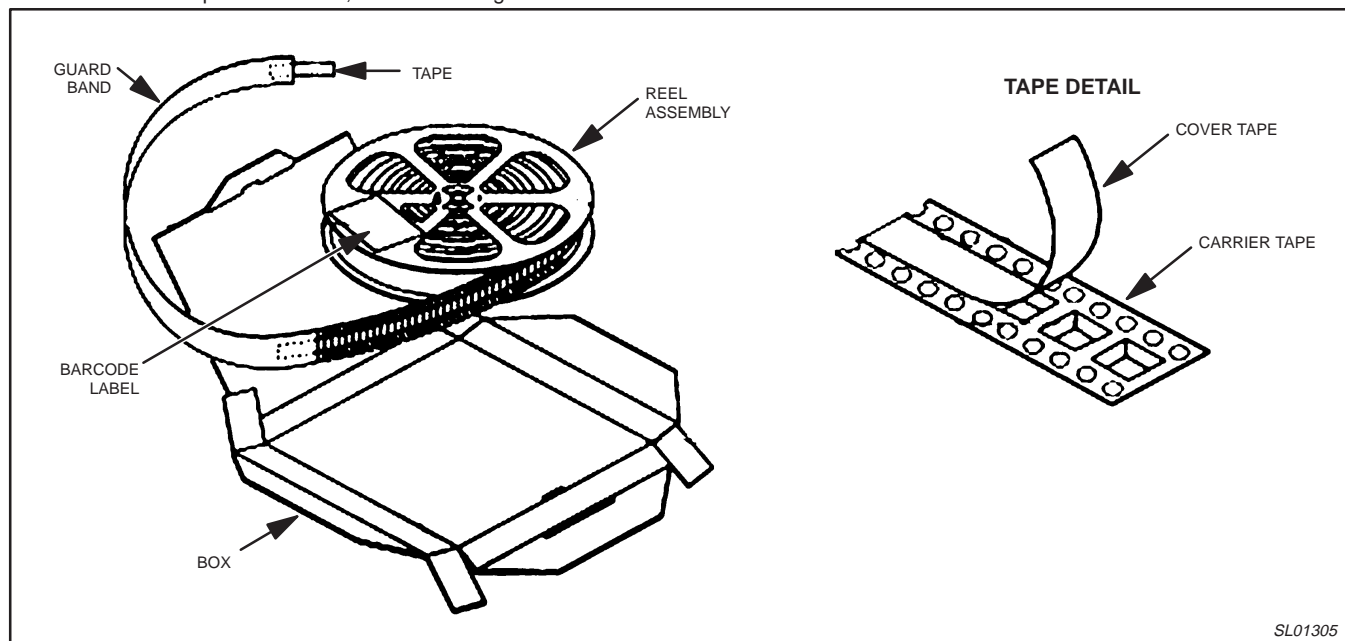
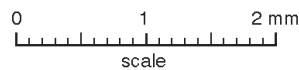
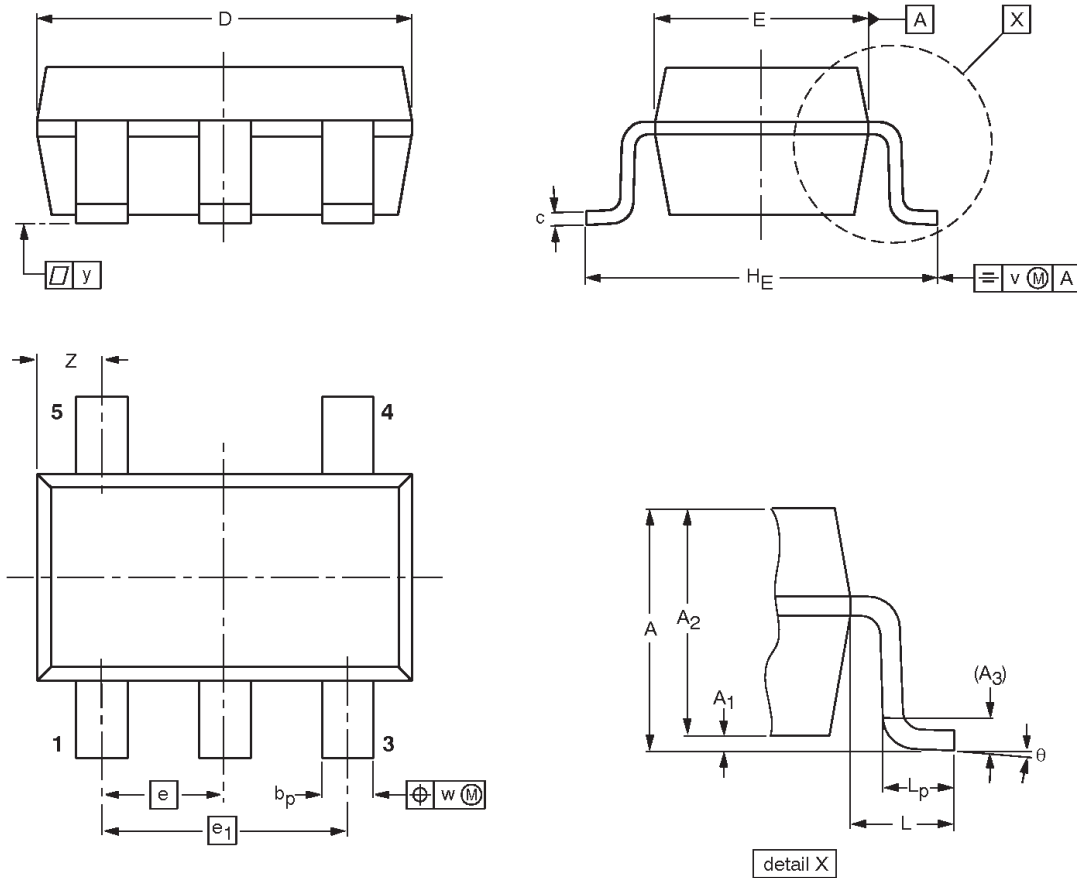


Figure 19. Tape and reel packing method

# Low-noise 150 mA linear CMOS regulator

SA57004-XX

## SOT23-5: plastic small outline package; 5 leads; body width 1.5 mm



**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>		y	θ
mm	1.35	0.05 0.15	1.2 1.0	0.025	0.55 0.41	0.22 0.08	3.00 2.70	1.70 1.50	0.95	1.90	3.00 2.60	0.60	0.55 0.35		0.1	8° 0°

**Note**

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

OUTLINE VERSION	REFERENCES			
	IEC	JEDEC	EIAJ	
		MO-178		

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Low-noise 150 mA linear CMOS regulator

SA57004-XX

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**NOTES**

## Low-noise 150 mA linear CMOS regulator

SA57004-XX

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Data sheet status [1]	Product status [2]	Definitions
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