

# DATA SHEET

## **SA57031-XX**

Micropower 150 mA, low-noise, low dropout  
linear regulator with on/off

Product data  
Supersedes data of 2003 Feb 24

2003 Jun 23

# Micropower 150 mA, low-noise, low dropout linear regulator with on/off

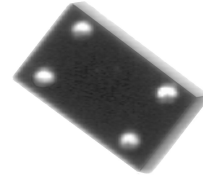
SA57031-XX

## GENERAL DESCRIPTION

The SA57031 is a 150 mA, fixed output voltage regulator designed to provide very low dropout voltage and low noise in battery powered and portable applications. The output voltage is preset to voltages between 1.8 to 5.0 Volts, in 100 mV increments.

The SA57031 achieves excellent performance in all specifications such as excellent power supply ripple rejection at low frequency, low supply-current, low dropout voltage, low power consumption, extremely small size with chip scaled package (CSP), extremely low output noise voltage, very fast start-up response time, precision output, fast dynamic response to line and load regulation, etc. This regulator consists of an internal voltage reference, and current limit.

The SA57031 is housed in a WL-CSP4 package (see dimensional drawing for layout).



Bottom View

## FEATURES

- Many Preset Output Voltages: 1.8 to 5.0 V in 0.1 V increments
- Wafer-level chip scale package (WL-CSP4)
- Extremely low PSRR: 80 dB typical at 1 kHz
- Low Dropout Voltage: 100 mV (typ) @ 50 mA output current
- Very Low Consumption Current: 100 mA typ. (when not loaded), 0.1 mA max. (when off)
- High precision Output Voltage:  $\pm 2\%$
- Output Current Capacity: 150 mA (typ)
- Low Noise: 30mVrms @ 10 Hz to 100 kHz
- Good Line Regulation: 0.01%/V typ.
- Good Load Regulation: 0.003%/mA typ.

- Low Temperature Drift Co-efficient to  $V_O$ :  $\pm 100$  ppm/ $^{\circ}\text{C}$
- Built-in Current Limiter
- Wide Operating Temperature Range:  $-40$  to  $+85$   $^{\circ}\text{C}$

## 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 (BOTTOM VIEW)

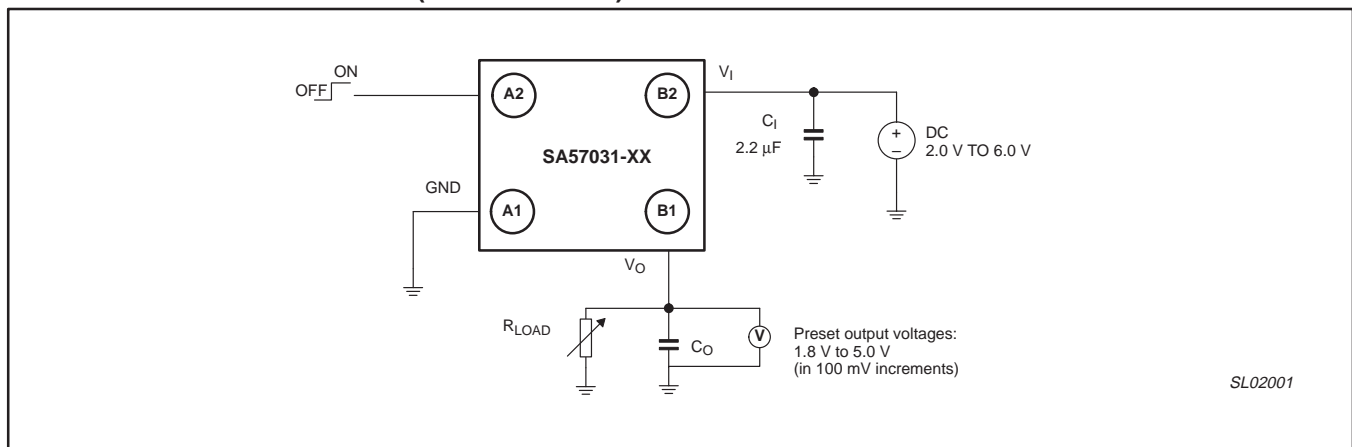


Figure 1. Simplified system diagram.

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## ORDERING INFORMATION

| TYPE NUMBER  | PACKAGE |  | TEMPERATURE RANGE |
|--------------|---------|--|-------------------|
|              | NAME    | DESCRIPTION                              |                   |
| SA57031-XXUK | WL-CSP4 | wafer level, chip-scale package; 4 bumps | -40 to +85 °C     |

**NOTE:**

The device has five voltage output options, indicated by the **XX** on the Type Number. Other voltages, between 2.5 to 5.0 V in 100 mV increments, are available on request.

| XX | VOLTAGE (Typical) |
|----|-------------------|
| 18 | 1.8 V             |
| 24 | 2.4 V             |
| 28 | 2.8 V             |

## PIN DESCRIPTION

| PIN | SYMBOL | DESCRIPTION                             |
|-----|--------|---|
| A1  | GND    | Device ground                           |
| B1  | VO     | Voltage output                          |
| B2  | VI     | Voltage input                           |
| A2  | ON/OFF | Control pin. Connect to VI if not used. |

## PIN CONFIGURATION (TOP VIEW)

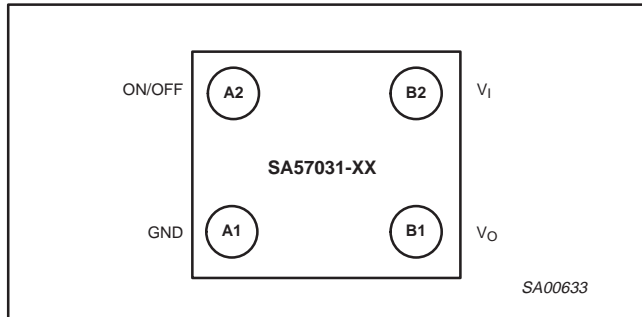


Figure 2. Pin configuration.

## MAXIMUM RATINGS

| Symbol | Parameter                   | Min  | Max  | Unit |
|--------|-----------------------------|------|------|------|
| Tstg   | Storage temperature range   | -40  | +150 | °C   |
| Toper  | Operating Temperature Range | -40  | +85  | °C   |
| VI     | Supply voltage              | -0.3 | +7   | V    |
| IO     | Output Current              | -    | 200  | mA   |
| P      | Power dissipation           | -    | 190  | mW   |

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## CHARACTERISTICS

T<sub>amb</sub> = 25 °C; V<sub>I</sub> = V<sub>O(nom)</sub> + 1 V; V<sub>ON/OFF</sub> = 2 V; I<sub>O</sub> = 1 mA unless otherwise specified.

| SYMBOL                 | PARAMETER                              | CONDITIONS   | MIN.  | TYP. | MAX.           | UNIT              |
|------------------------|--|--|-------|------|----------------|-------------------|
| I <sub>CC</sub>        | No-load input current                  | I <sub>O</sub> = 0 mA  | –     | 45   | 100            | μA                |
|                        |  | I <sub>O</sub> = 50 mA   | –     | 55   | –              |                   |
|                        |  | I <sub>O</sub> = 150 mA  | –     | 60   | –              |                   |
| I <sub>CC(OFF)</sub>   | Input current (off)                    | V <sub>ON/OFF</sub> = 0.25 V   | –     | 0.1  | 1              | μA                |
| I <sub>q</sub>         | Quiescent Current                      | I <sub>O</sub> = 0 to 150 mA   | –     | 100  | 190            | μA                |
| ΔV <sub>LNR</sub>      | Line regulation                        | V <sub>I</sub> = V <sub>O</sub> + 0.5 V to 6 V   | –     | 5    | 10             | mV                |
| ΔV <sub>LDR</sub>      | Load regulation                        | I <sub>O</sub> = 1 to 50 mA  | –     | 10   | 25             | mV                |
|                        |  | I <sub>O</sub> = 1 to 100 mA   | –     | 20   | 50             |                   |
|                        |  | I <sub>O</sub> = 1 to 150 mA   | –     | 30   | 70             |                   |
| ΔV <sub>O</sub> /ΔT    | V <sub>O</sub> Temperature coefficient | T <sub>j</sub> = –30 to +85 °C   | –     |      | –              | ppm/°C            |
| PSRR                   | Power supply ripple rejection          | f = 1 kHz; I <sub>O</sub> = 1 mA; V <sub>ripple</sub> = 0.5 V; V <sub>O</sub> = 1.8 to 4.0 V | –     | 80   | –              | dB                |
|                        |  | f = 1 kHz; I <sub>O</sub> = 1 mA; V <sub>ripple</sub> = 0.5 V; V <sub>O</sub> = 4.1 to 5.0 V | –     | 70   | –              |                   |
| V <sub>n</sub>         | Output noise voltage                   | f <sub>BW</sub> = 20 to 80 kHz; C <sub>O</sub> = 2.2 μF                                      | –     | 30   | –              | μV <sub>rms</sub> |
| I <sub>ON/OFF</sub>    | Output short-circuit current           | V <sub>I</sub> = V <sub>O</sub> + 1 V; V <sub>O</sub> = 0 V                                  | –     | 30   | –              | mA                |
| V <sub>ON/OFF(H)</sub> | ON/OFF HIGH threshold voltage          |  | 1.5   | –    | V <sub>I</sub> | V                 |
| V <sub>ON/OFF(L)</sub> | ON/OFF LOW threshold voltage           |  | 0     | –    | 0.25           | V                 |
| R <sub>ON/OFF</sub>    | ON/OFF Pull-down resistance            |  | 2.5   | 5    | 15             | MΩ                |
| V <sub>O</sub>         | Output voltage (nominal)               |  | x0.98 | nom  | x1.02          | V                 |
| V <sub>dropout</sub>   | Dropout voltage                        | V <sub>O</sub> = 2.0 to 2.3  | –     | 0.25 | 0.35           | V                 |
|                        |  | V <sub>O</sub> = 2.4 to 2.7  | –     | 0.24 | 0.29           |                   |
|                        |  | V <sub>O</sub> = 2.8 to 5.0  | –     | 0.23 | 0.26           |                   |

## PRESET OUTPUT VOLTAGES

| Part Number  | Min   | Typ   | Max   |
|--------------|-------|-------|-------|
| SA57031-25UK | 2.450 | 2.500 | 2.550 |
| SA57031-28UK | 2.744 | 2.800 | 2.856 |
| SA57031-30UK | 2.940 | 3.000 | 3.060 |
| SA57031-33UK | 3.234 | 3.300 | 3.366 |
| SA57031-36UK | 3.528 | 3.600 | 3.672 |

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## TYPICAL PERFORMANCE CURVES

Shown for the SA57031-28UK only;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $V_I = V_O + 1\text{ V}$ ;  $V_{On/Off} = V_I$ ;  $C_{in} = 2.2\text{ }\mu\text{F}$ ,  $C_O = 2.2\text{ }\mu\text{F}$  unless otherwise specified

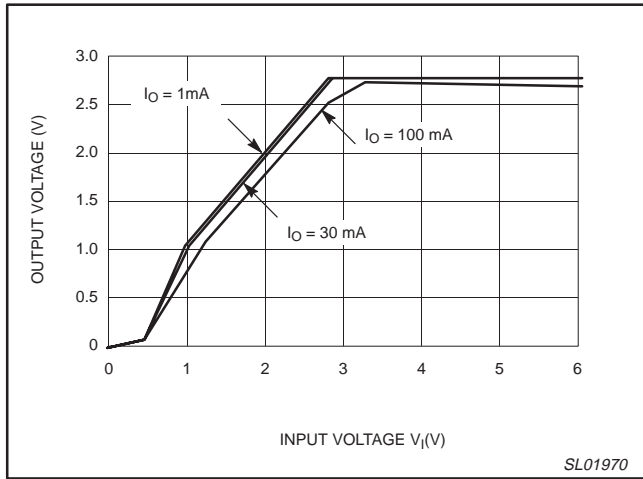


Figure 3. Output voltage versus input voltage.

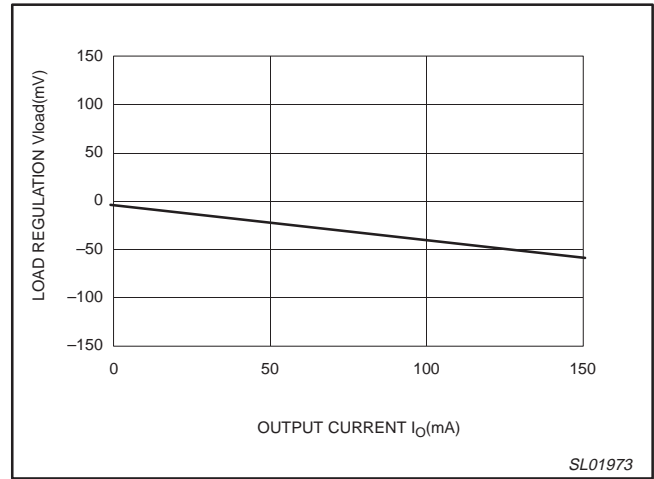


Figure 6. Load regulation versus load current.

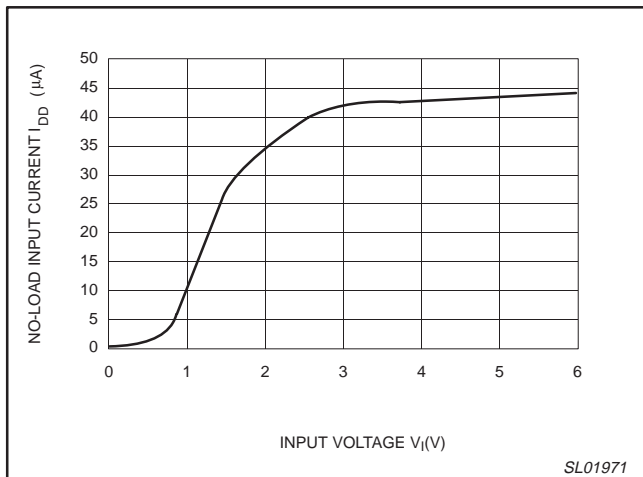


Figure 4. No-load input current versus input voltage.

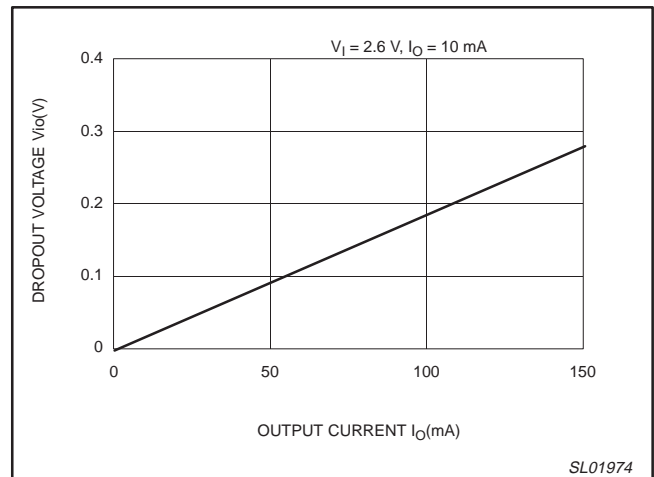


Figure 7. Dropout voltage versus output current.

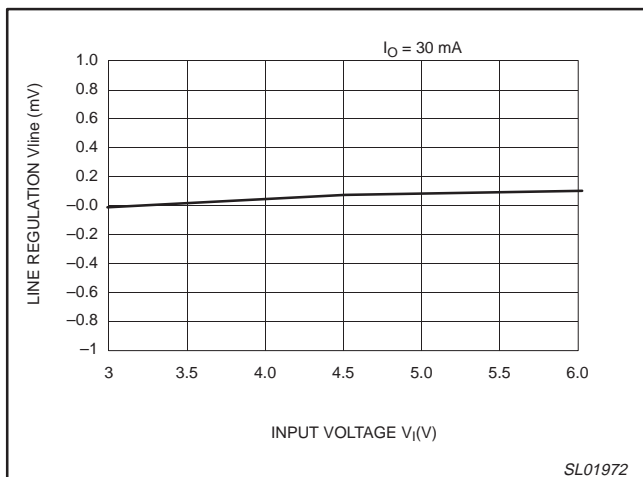


Figure 5. Line regulation versus input voltage.

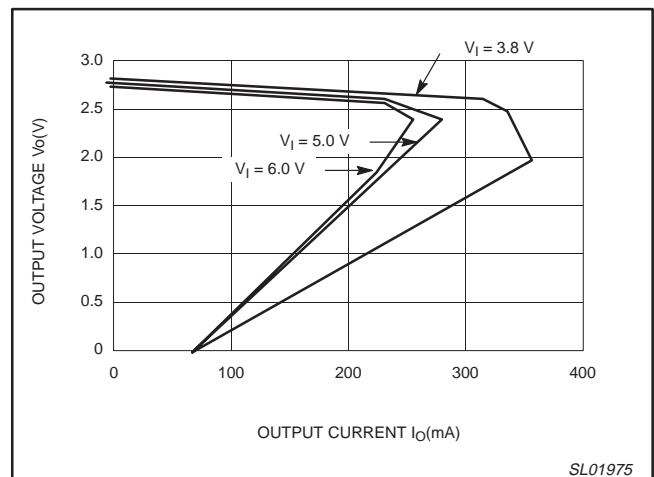


Figure 8. Current limit versus output current.

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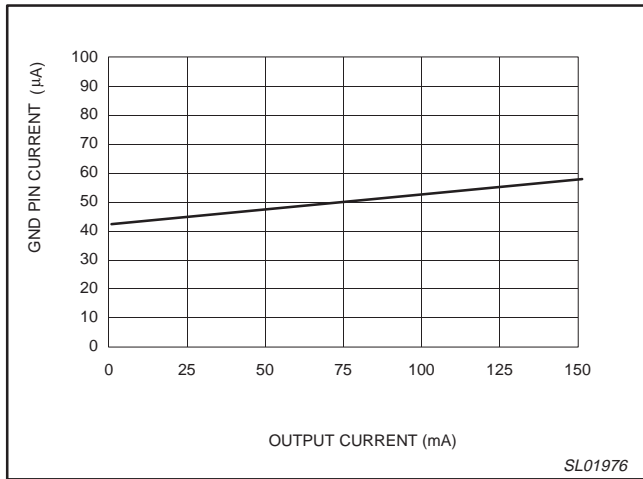


Figure 9. Ground pin current.

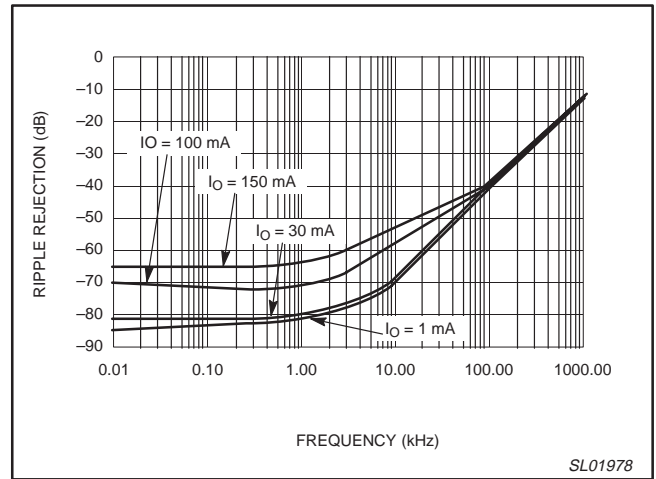


Figure 11. Ripple rejection.

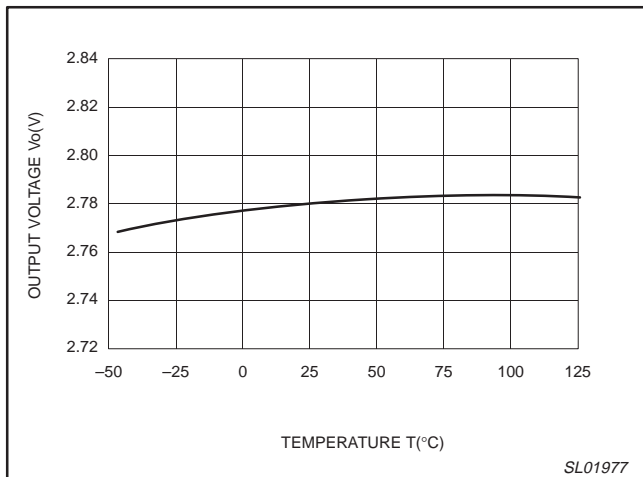


Figure 10. Output voltage versus ambient temperatures.

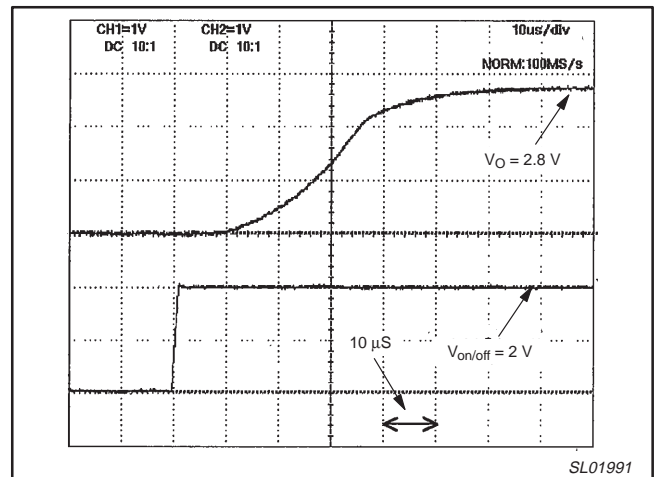


Figure 12. On/off control pin.

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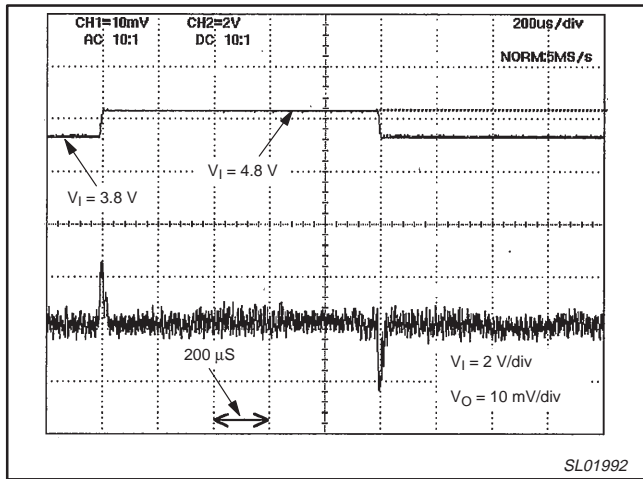


Figure 13. Line transient response.

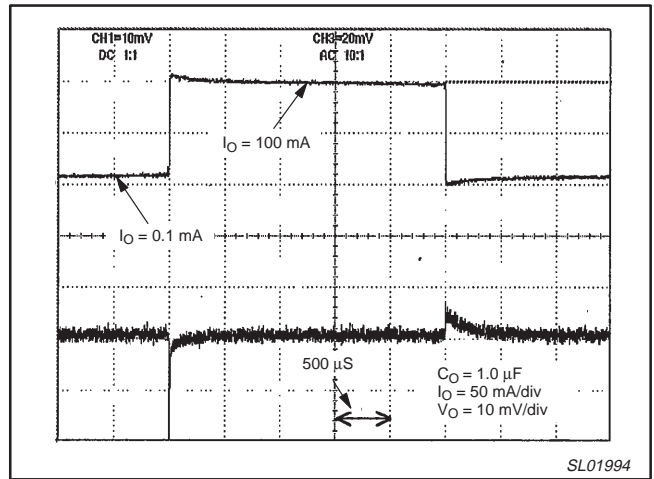


Figure 15. Load transient response.

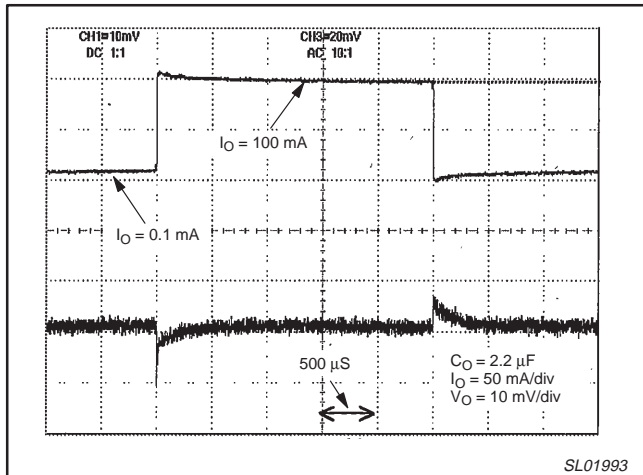


Figure 14. Load transient response.

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## TECHNICAL DISCUSSION

As illustrated in Figure 16, the SA57031 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 VO pin.

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. If the feedback voltage is too high, the pass transistor gate is pulled up, allowing less current to pass to the output, resulting in a decrease in output voltage.

The reference is connected to the error amplifier's inverting input. The error amplifier compares the reference with the feedback

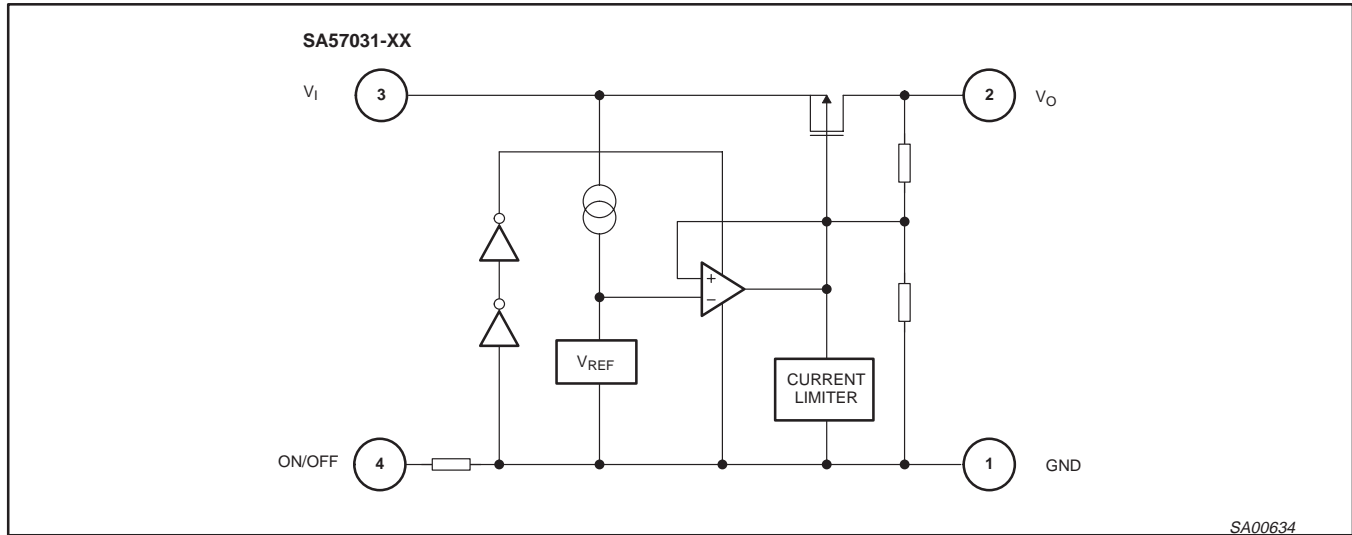


Figure 16. Block diagram (bottom view).



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## APPLICATION INFORMATION

The following points have to be kept in mind for good performance while using these devices.

### Input Capacitor

An input capacitor of 2.2  $\mu\text{F}$  is required between the SA57031 input pin and the circuit ground. This capacitor must be located as close as possible to the  $V_I$  or GND pin (not more than 1 cm away from the pin) and returned to a clean analog ground. Any good quality ceramic, tantalum, or film capacitor will work.

### Output Capacitor

Phase compensation is used 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 has to be at least 2.2 $\mu\text{F}$  and has to have B-type temperature characteristics.

### ON/OFF (Chip Enable) Pin

The ON/OFF pin must be actively terminated, not floating. If the function is not needed, the pin should be tied to  $V_I$  to permanently enable the device.

### Line Impedance of $V_I$ and GND

The  $V_I$  and GND lines should be sufficiently wide to minimize impedance. If the impedance of these lines is high, there is a chance to pick up noise or malfunction.

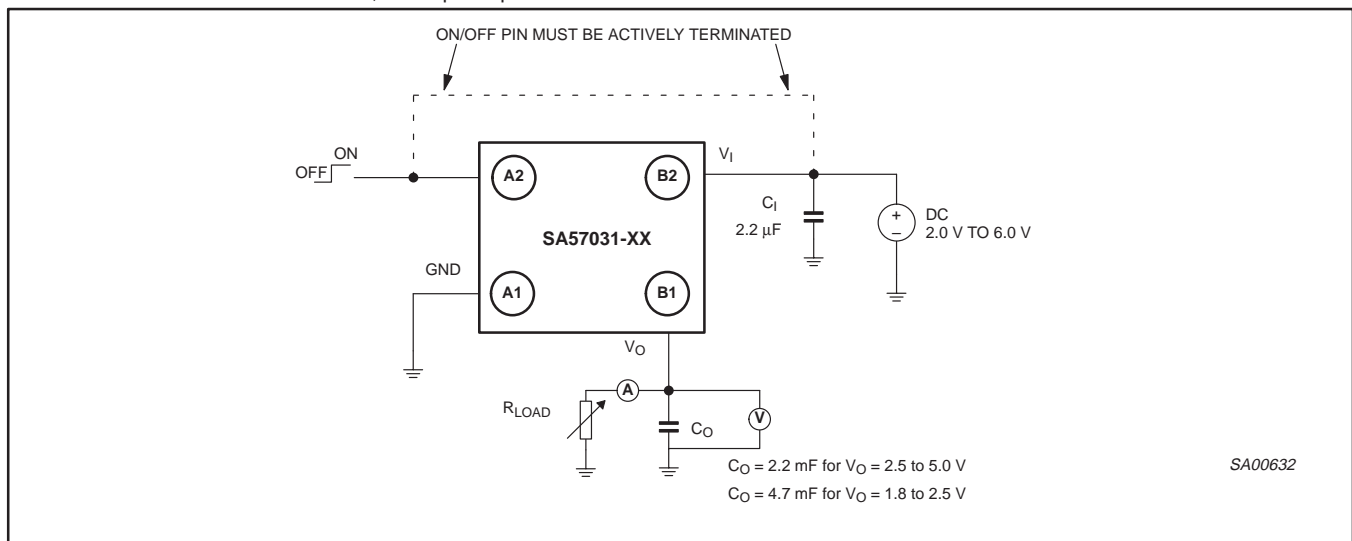


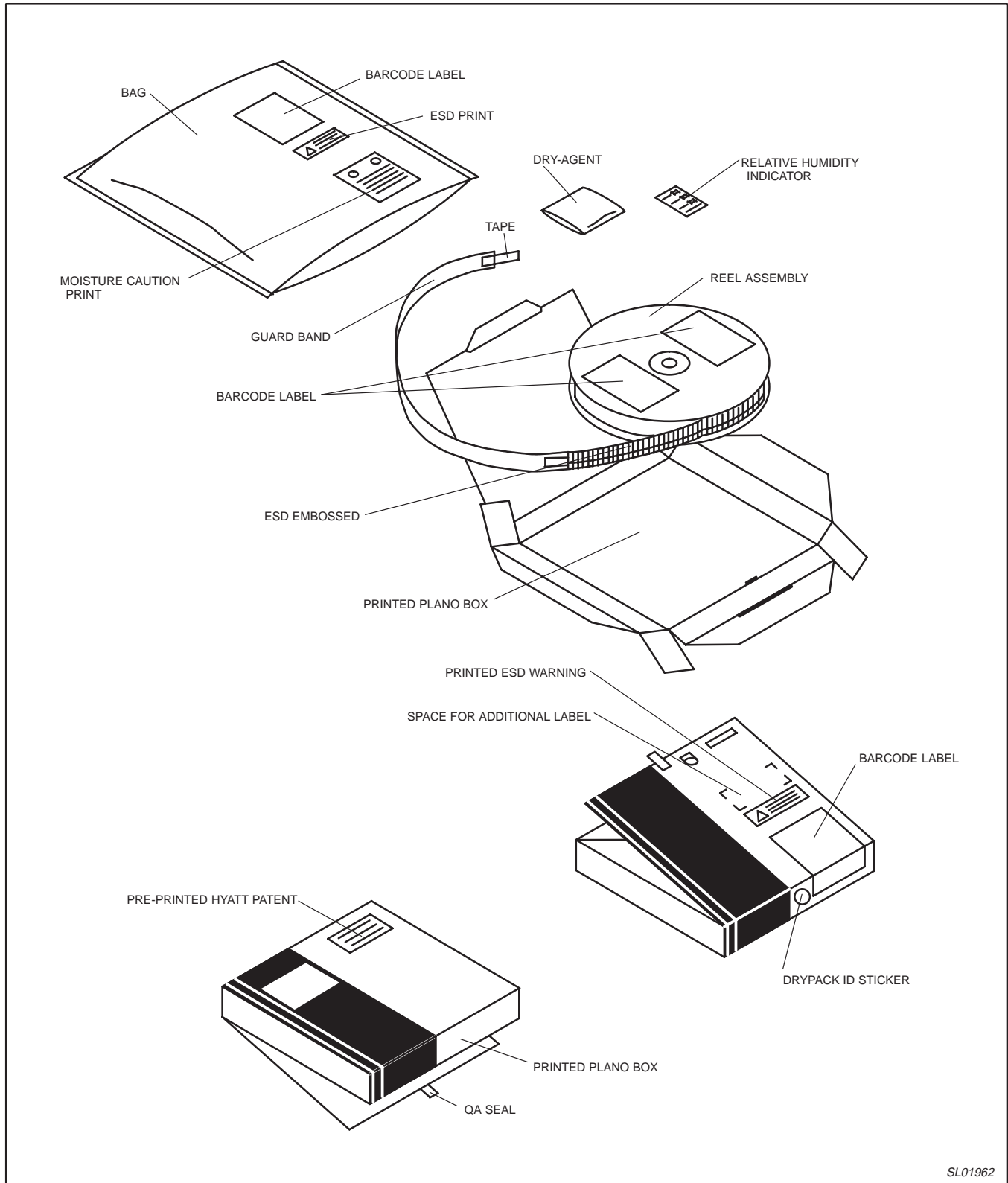
Figure 17. Typical application circuit.

# Micropower 150 mA, low-noise, low dropout linear regulator with on/off

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## PACKING METHOD

The SA57031-XX is packed in reels, as shown in Figure 18.

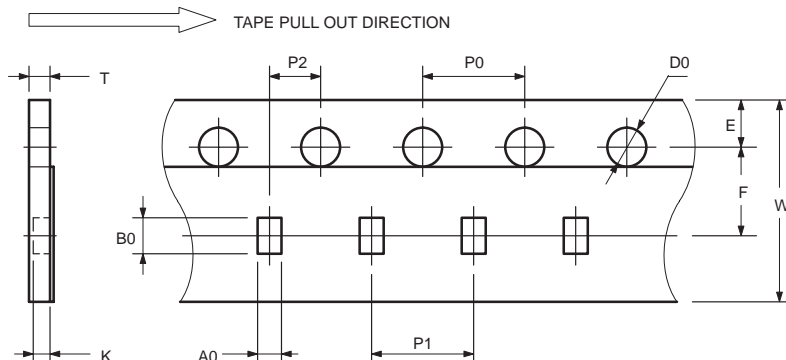


SL01962

Figure 18. Tape and reel packing method

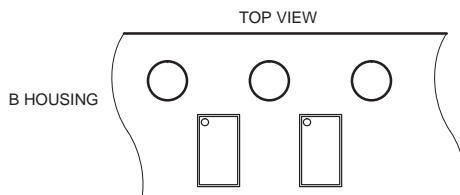
# Micropower 150 mA, low-noise, low dropout linear regulator with on/off

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**NOTES:**

1. IC pull out direction TAPE PULL OUT DIRECTION



2. Carrier tape material:  
paper type, with ESD protection.
3. The length of the leader:  
More than 400 mm which include 40 holes or more without any products.  
IT's must have the top cover tape.
4. The length of trailer:  
More than 40 mm which include without any products.  
IT's must have the top copy tape.  
The end of trailer must be detached from reel.

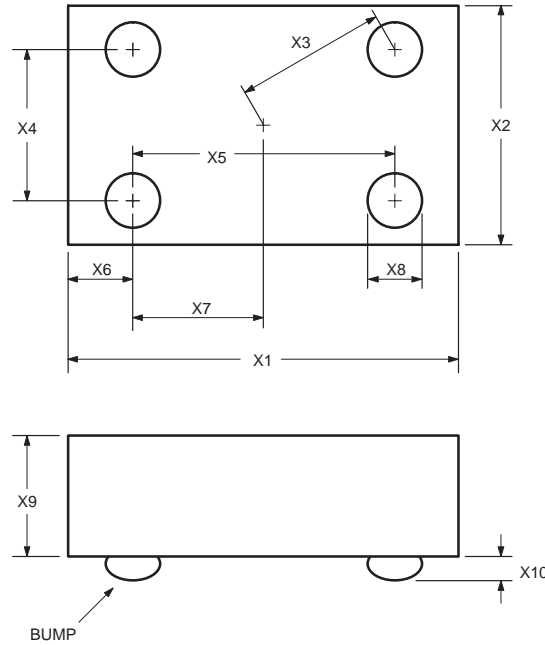
| UNIT | A0    | B0    | W    | F     | E     | P1    | P2    | P0   | ∅D0   | T     | K     |
|------|-------|-------|------|-------|-------|-------|-------|------|-------|-------|-------|
| mm   | 0.90  | 1.40  | 8.0  | 3.5   | 1.75  | 4.0   | 2.0   | 4.0  | 1.55  | 0.60  | 0.58  |
|      | ±0.03 | ±0.03 | ±0.1 | ±0.05 | ±0.05 | ±0.05 | ±0.05 | ±0.1 | ±0.03 | ±0.03 | ±0.03 |

SL02002

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**WL-CSP4: wafer level, chip-scale package; 4 bumps**



**DIMENSIONS (mm are the original dimensions)**

| UNIT | X1           | X2           | X3  | X4  | X5    | X6    | X7    | X8           | X9           | X10          |
|------|--------------|--------------|-----|-----|-------|-------|-------|--------------|--------------|--------------|
| mm   | 1.32<br>1.26 | 0.82<br>0.76 | 0.5 | 0.5 | 0.866 | 0.212 | 0.433 | 0.23<br>0.13 | 0.42<br>0.38 | 0.10<br>0.06 |

SL02098

# Micropower 150 mA, low-noise, low dropout linear regulator with on/off

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## REVISION HISTORY

| Rev | Date     | Description  |
|-----|----------|--|
| _2  | 20030623 | <b>Product data (9397 750 11664); ECN 853-2361 30063 dated 23 June 2003. Supersedes SA57031-XX_1 (9397 750 11001) of 2003 Feb 24.</b><br>Modifications:<br>• WL-CSP4 package outline dimensional drawing modified. |
| _1  | 20030224 | <b>Product data (9397 750 11001); ECN 853-2361 28634 dated 2002 Jul 18</b>   |

## Data sheet status

| Level | Data sheet status <sup>[1]</sup> | Product status <sup>[2] [3]</sup> | 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.  |
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[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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