DATA SHEET

SA57022-XX

500 mA LDO with ON/OFF control and V$_{ref}$ bypass

Product data

Supersedes data of 2001 Oct 03

2003 Oct 13

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500 mA LDO with ON/OFF control and V_{ref} bypass

SA57022-XX

GENERAL DESCRIPTION

The SA57022-XX has an extremely precise fixed output with a typical accuracy of ±2%. It is designed to provide very low dropout and ultra low noise with an optional Bypass pin, and fast transient response. Supply current is reduced to zero (typical).

The SA57022-XX incorporates both over-temperature and over-current protection. The SA57022-XX is stable with an output capacitor of only 1.0 μF and has a maximum output current of 500 mA. It is available in the 7-pin small outline package (SOP002).

FEATURES

● Very low dropout voltage: 300 mV typ. (I_{out} = 500 mA)

● High precision output voltage: ±2%

● Output current capacity: 500 mA

● Low noise: 75 μV_{rms} typ. @ 20 Hz to 80 KHz, for C_n = 470 pF.

● Extremely good line regulation: 10 mV typical

● Extremely good load regulation: 20 mV typical

● Low temperature drift co-efficient to V_{out}: ±100 ppm/°C

● Internal current limit and thermal shut-down circuits

● Input voltage range: −0.3 V to 12 V

● Wide preset output voltage range: 1.8 V to 5 V

● Wide operating temperature range: −40 °C to +85 °C

APPLICATIONS

● Battery-operated systems

● Portable computers

● Cameras, VCRs and camcorders

● PCMCIA cards, modems, pagers

● Cellular/GSM/PHS phones

● Linear post-regulator for SMPS
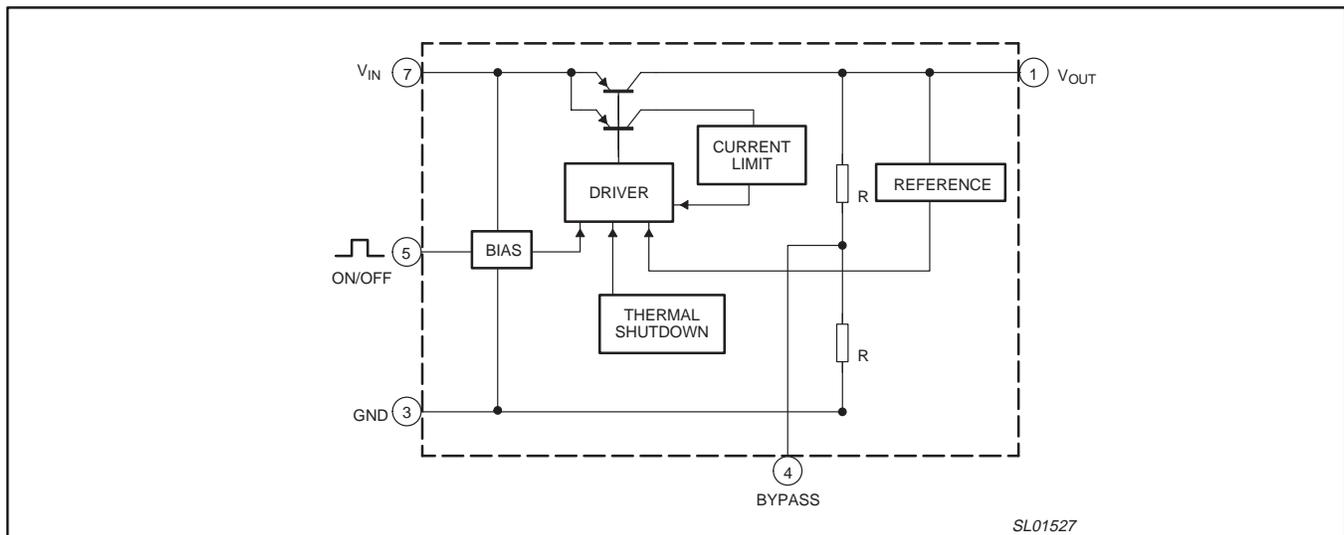
● Instrumentation

SIMPLIFIED SYSTEM DIAGRAM

Figure 1. Simplified system diagram.

500 mA LDO with ON/OFF control and V_{ref} bypass

SA57022-XX

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		TEMPERATURE RANGE
	DESCRIPTION	VERSION	
SA57022-**XX**D	small outline 7-pin surface mount (see dimensional drawing)	SOP002	−40 to +85 °C

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

XX	VOLTAGE (Typical)
18	1.8 V
25	2.5 V
28	2.8 V
30	3.0 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
SA57022-18	A L M x
SA57022-25	A L N x
SA57022-28	A L P x
SA57022-30	A L R x
SA57022-33	A L S x
SA57022-50	A L T x

PIN CONFIGURATION
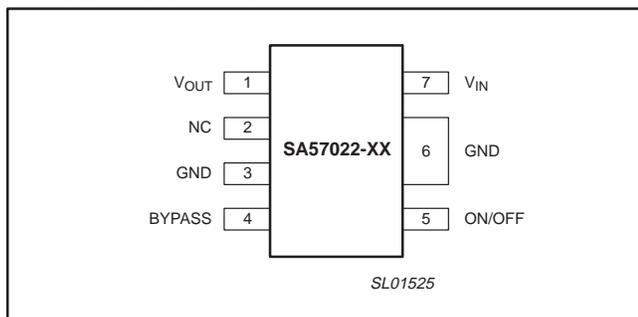
Figure 2. Pin configuration.

PIN DESCRIPTION

PIN	SYMBOL	DESCRIPTION
1	V_{OUT}	Regulated output voltage.
2	NC	No connection.
3	GND	Ground.
4	BYPASS	Reference bypass input. Connecting a 470 pF capacitor further reduces output noise.
5	ON/OFF	Output voltage On/Off control pin.
6	GND	Substrate ground pin. This pin must be connected to ground.
7	V_{IN}	Power supply input.

MAXIMUM RATINGS

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_{IN}	Supply voltage	−0.3	+12	V
$V_{IN(OPR)}$	Operating voltage	$V_{OUT(typ)}$ + 0.5	$V_{OUT(typ)}$ + 10	V
I_{OUT}	Output current	0	500	mA
T_{oper}	Operating temperature	−40	+85	°C
T_{stg}	Storage temperature	−40	+150	°C
P_D	Power dissipation (Note 1)	–	400	mW
P_D	Power dissipation (Note 2)	–	950	mW

NOTES:
1. Unattached.
2. Mounted on double-sided glass epoxy PCB, with copper ground plane 192 × 142 × 1.2 mm.

ELECTRICAL CHARACTERISTICS

T_{amb} = 25 °C; $V_{ON/OFF}$ = 1.6 V, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CC}	No-load input current	I_{OUT} = 0 mA	–	1.9	5	mA
$I_{CC(OFF)}$	Input current (off)	$V_{ON/OFF}$ = 0 V	–	0	1	μA
V_{OUT}	Output voltage (as % of V_{nom})	I_{OUT} = 250 mA	98%	–	102%	V
		SA57022-18	1.764	1.8	1.836	V
		SA57022-25	2.450	2.5	2.550	V
		SA57022-28	2.744	2.8	2.856	V
		SA57022-30	2.940	3.0	3.060	V
		SA57022-33	3.234	3.3	3.060	V
		SA57022-50	4.900	5.0	5.100	V
V_{IO}	Dropout voltage (Note 2)	V_{IN} = V_{OUT} – 0.2 V; I_{OUT} = 250 mA	–	0.3	0.5	V
$\Delta V1$	Line regulation	V_{IN} = V_{OUT} +1.5 V to V_{IN} = V_{OUT} +2.5 V; I_{OUT} = 250 mA	–	10	20	mV
$\Delta V2$	Load regulation	I_{OUT} = 0 to 250 mA	–	20	120	mV
$\Delta V_{OUT}/\Delta T$	V_{OUT} Temperature coefficient (Note 1)	T_j = –30 to +85 °C	–	100	–	ppm/°C
RR	Ripple rejection (Note 1)	f = 120 Hz; V_{ripple} = 1 V; I_{OUT} = 250 mA	50	64	–	dB
V_n	Output noise voltage (Note 1)	f_{BW} = 20 to 80 kHz; C_n = 470 pF	–	75	–	μV$_{rms}$
$I_{ON/OFF}$	ON/OFF pin input current	$V_{ON/OFF}$ = V_{IN}	10	20	30	μA
$V_{ON/OFF(H)}$	ON/OFF HIGH threshold voltage		1.6	–	V_{IN}+0.3	V
$V_{ON/OFF(L)}$	ON/OFF LOW threshold voltage		-0.3	–	0.4	V

NOTES:
1. The parameter is guaranteed by design.
2. This parameter is not guaranteed if V_{OUT} is less than 2 V.

500 mA LDO with ON/OFF control and V_{ref} bypass
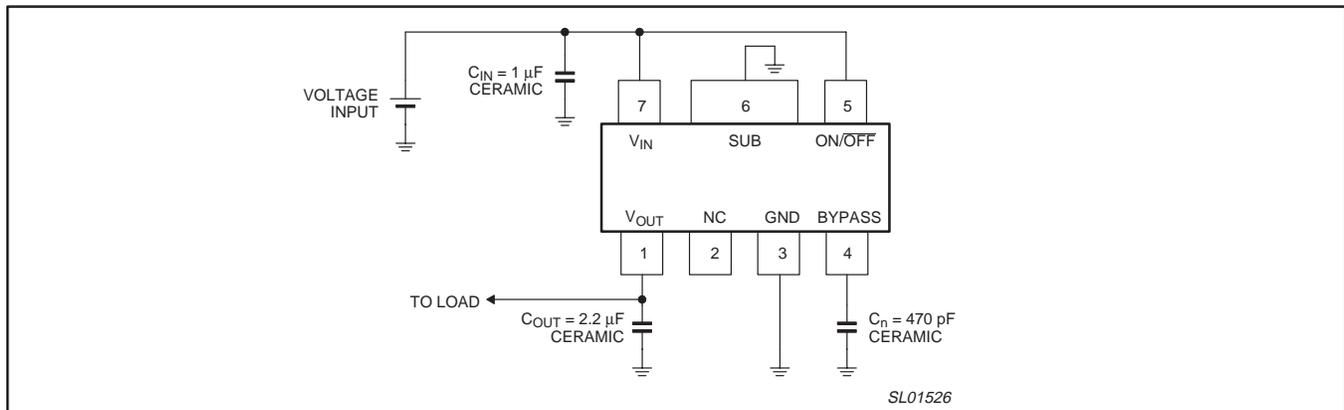
SA57022-XX

APPLICATION INFORMATION

Figure 3. Typical application circuit.

Input capacitor

An input capacitor of 1.0 µF (min) should be connected from V_{IN} to GND if there is more than 10 inches of wire between the regulator and the AC filter capacitor, or if a battery is operated as the power source. The capacitor should be less than 1 cm from the input pin.

Aluminum electrolytic or tantalum capacitor types can be used. (Because many aluminum electrolytic capacitors freeze at approximately –30 °C, solid tantalums are recommended for applications operating below –25 °C.) When operating from sources other than batteries, supply-noise rejection and transient response can be improved by increasing the value of the input and output capacitors and employing passive filtering techniques.

Output capacitor

Phase compensation is used to ensure stable operation even if load current varies. For this reason, an output capacitor with good frequency characteristics is needed. Set it as close to the circuit as possible, with wires as short as possible. A 1.0 µF capacitor from V_{OUT} to ground is recommended. The output capacitor should have an ESR (effective series resistance) of 5.0 Ω or less, and a resonant frequency above 1.0 MHz.

Optional BYPASS capacitor

A 470 pF capacitor connected from the BYPASS input to ground reduces noise present on the internal reference, which in turn significantly reduces output noise. This capacitor must have low leakage, because the pin is high impedance. If output noise is not a concern, this pin may be left unconnected. Larger capacitor values may be used, but results in a longer time period to rated output voltage when power is initially applied.

ON/OFF

The regulator is fully enabled when a logic HIGH is applied to this input. The regulator enters shutdown when a logic LOW is appplied to this input. During shutdown, regulator output voltage falls to zero,and supply current is reduced to 1.0 µA max, and V_{OUT} falls to zero. For use as an always-on regulator, connect ON/OFF pin to the supply voltage, as shown in Figure 3.

Optional BYPASS diode

If the voltage on the output pin rises above the input voltage, as might happen in some applications, the overcurrrent will flow via internal parasitic diodes from output to input. To prevent this, connect a bypass diode between the output and input pins.

Thermal shutdown

Integrated thermal protection circuitry shuts the regulator off when die temperature exceeds 150 °C. The regulator remains off until the die temperature drops to approximately 140 °C.

Power dissipation

The amount of power the regulator dissipates is primarily a function of input and output voltage, and output current. The following equation is used to calculate worst case actual power dissipation:

$$P_D \approx \left(V_{IN(max)} - V_{OUT(min)} \right) \times I_{LOAD(max)} \qquad \textbf{Eqn. (1)}$$

Where:

   P_D = worst case actual power dissipation
   $V_{IN(max)}$ = maximum voltage on V_{IN}
   $V_{OUT(min)}$ = minimum regulator output voltage
   $I_{LOAD(max)}$ = maximum output (load) current

The maximum allowable power dissipation, as shown in Equation (2), is a function of the maximum ambient temperature ($T_{amb(max)}$), the maximum allowable die temperature (125 °C), and the thermal resistance from junction-to-air ($R_{th(j-a)}$).

$$P_{D(max)} = \frac{T_{j(max)} - T_{amb(max)}}{R_{th(j-a)}} \qquad \textbf{Eqn. (2)}$$

The SUB (heat sink) pin must be connected to ground with a wide trace.

PCB layout hints

The component placement around the LDO should be done carefully to achieve good dynamic line and load response. The input and noise capacitor should be kept close to the LDO. The rise in junction temperature depends on how efficiently the heat is carried away from the junction to ambient. The junction to lead thermal impedance is a characteristic of the package and fixed. The thermal impedance between lead to ambient can be reduced by increasing the copper area on PCB. Increase the input, output and ground trace area to reduce the junction-to-ambient impedance.

PACKING METHOD

The SA57003 is packed in reels, as shown in Figure 4.
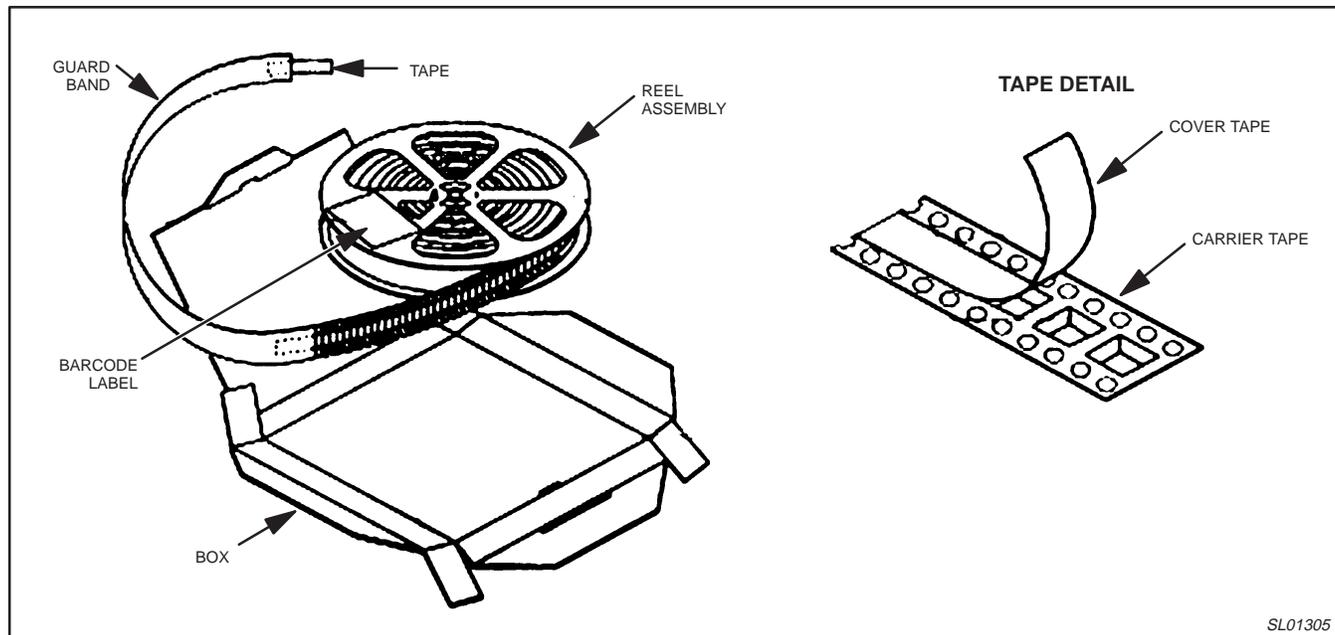
Figure 4. Tape and reel packing method

Plastic small outline package; 7 leads; body width 4.4 mm

SOP002

scale

0   2.5   5 mm
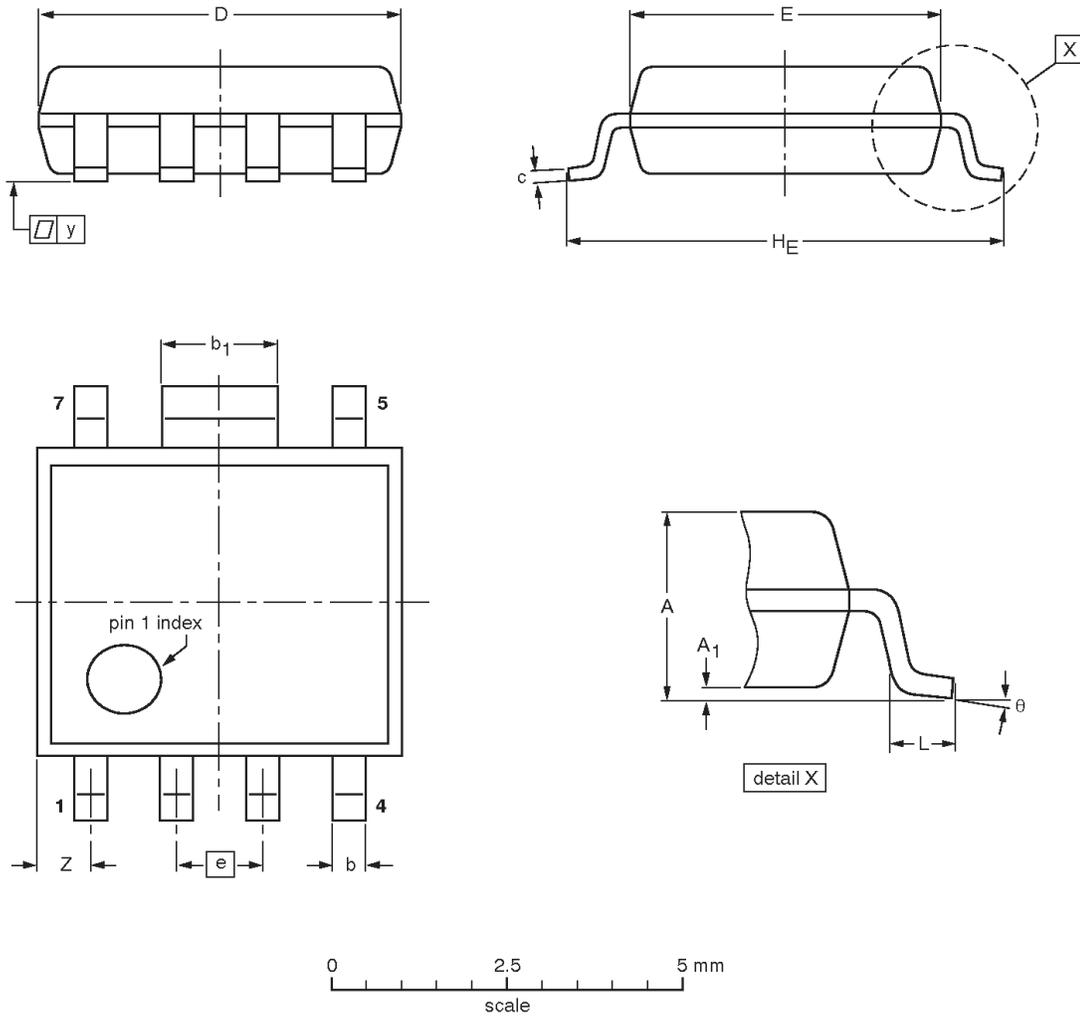
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	b	b_1	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	y	Z max.	θ
mm	1.7	0.1 0.0	0.5 0.3	1.87 1.47	0.25 0.10	5.3 4.7	4.6 4.2	1.27	6.5 5.9	0.6 0.2	0.1	0.895	10° 0°
inches	0.067	0.004 0.0	0.02 0.012	0.074 0.058	0.010 0.006	0.208 0.185	0.181 0.173	0.05	0.256 0.232	0.024 0.008	0.004	0.035	

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			
SOP002						03-06-23 03-10-07

REVISION HISTORY

Rev	Date	Description
_2	20031013	**Product data (9397 750 12112). ECN 853-2293 30328 of 09 September 2003.** Modifications: • Change package name from SOP-7B to SOP002 in Ordering information and Package outline sections.
_1	20011003	**Product data (9397 750 08967). ECN 853-2293 27197 of 03 October 2001.**

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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[1] Please consult the most recently issued data sheet before initiating or completing a design.

[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.

Definitions

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

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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