

DATA SHEET

LP2985-XX

Micropower 150 mA low noise,
low dropout linear regulator

Product data
Supersedes data of 2003 Oct 17

2003 Oct 31

Micropower 150 mA low noise, low dropout linear regulator

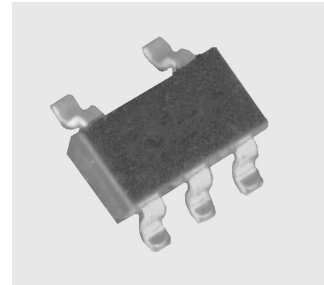
LP2985-XX

GENERAL DESCRIPTION

The LP2985-XX is a 150 mA, fixed output voltage regulator designed to provide very low dropout and low noise in battery powered and portable applications. The output voltage is preset to 1.5, 1.8, 2.8, 3.0, 3.3, 3.6, or 5.0 V.

Designed with an optimized PNP process, the LP2985-XX achieves unequalled performance in all specifications critical to battery-powered designs such as low supply-current, low dropout voltage, low power consumption, small size, fast dynamic response to line and load, precision output, etc. This regulator consists of an internal voltage reference, an error amplifier, a driver with current limiter and a thermal shut-down mechanism.

The LP2985-XX is housed in a small outline 5-lead package (SOT23-5/SOP003).



FEATURES

- Very low consumption current: 85 mA typ. (when not loaded), 0.1 mA max. (when off)
- Very low dropout voltage: 100 mV typ. ($I_{OUT} = 50$ mA)
- High precision output voltage: $\pm 2\%$
- Output current capacity: 150 mA
- Low noise: 30 mV_{RMS} @ 20 Hz to 80 kHz ($C_n = 10$ nF)
- Good line regulation: 0.01%/V typ.
- Good load regulation: 30 mV typ. ($I_{OUT} = 1$ to 150 mA)
- Low temperature drift co-efficient to V_{OUT} : ± 100 ppm/ $^{\circ}$ C
- Built-in current limit and thermal shut-down
- Wide operating temperature range: -40 to $+85$ $^{\circ}$ C
- Preset output voltages: 1.5, 1.8, 2.5, 2.8, 3.0, 3.3, 3.6, or 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 DEVICE DIAGRAM

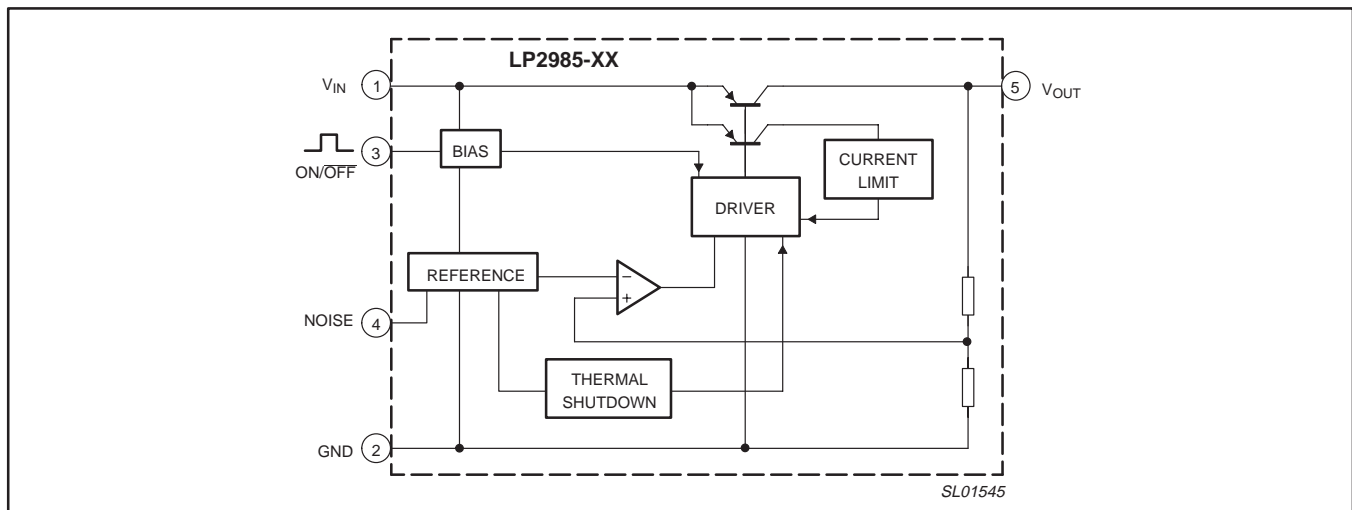


Figure 1. Simplified device diagram.

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ORDERING INFORMATION

TYPE NUMBER	PACKAGE		TEMPERATURE RANGE
	DESCRIPTION	VERSION	
LP2985-XXD	Plastic small outline package; 5 leads; body width 1.6 mm	SOP003	-40 to +85 °C

NOTE:

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

XX	VOLTAGE (Typical)
15	1.5 V
18	1.8 V
25	2.5 V
28	2.8 V
30	3.0 V
33	3.3 V
36	3.6 V
50	5.0 V

Part number marking

Each device 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
LP2985-15D	A N L x
LP2985-18D	A A B x
LP2985-25D	A S J x
LP2985-28D	A A C x
LP2985-30D	A B G x
LP2985-33D	A B H x
LP2985-36D	A N B x
LP2985-50D	A B J x

PIN CONFIGURATION

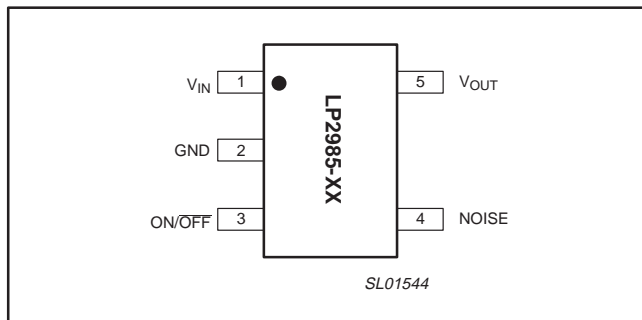


Figure 2. Pin configuration.

PIN DESCRIPTION

PIN	SYMBOL	DESCRIPTION
1	V_{IN}	Voltage input.
2	GND	Device ground.
3	ON/OFF	ON/OFF control pin. Connect to V_{IN} if not used.
4	NOISE	Noise decrease pin, for connecting external capacitor.
5	V_{OUT}	Voltage output.

MAXIMUM RATINGS

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_{IN}	Supply voltage	-0.3	+12.0	V
T_{oper}	Operating temperature	-40	+85	°C
T_{stg}	Storage temperature	-40	+150	°C
P_D	Power dissipation	-	150	mW

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ELECTRICAL CHARACTERISTICS

$T_{amb} = 25\text{ }^{\circ}\text{C}$, $V_{IN} = V_{OUT(nom)} + 1\text{ V}$, $V_{ON/OFF} = 2.0\text{ V}$, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CC}	No-load input current	$I_{OUT} = 0\text{ mA}$	–	85	130	μA
$I_{CC(OFF)}$	Standby input current	$V_{ON/OFF}$	–	0	0.1	μA
V_{OUT}	Output voltage		98	–	102	% V_{nom}
		LP2885-15	1.47	1.5	1.53	V
		LP2885-18	1.764	1.8	1.836	V
		LP2885-25	2.45	2.5	2.55	V
		LP2885-28	2.744	2.8	2.856	V
		LP2885-30	2.940	3.0	3.060	V
		LP2885-33	3.234	3.3	3.366	V
		LP2885-36	3.528	3.6	3.672	V
LP2885-50	4.900	5.0	5.100	V		
$V_{IN-V_{OUT}}$	Dropout voltage	$V_{IN} = V_{OUT(typ)} + 1\text{ to }10\text{ V}$	–	0.1	0.2	V
ΔV_{LNR}	Line regulation	$V_{IN} = V_{OUT(typ)} + 1\text{ to }10\text{ V}$	–	10	20	mV
ΔV_{LDR}	Load regulation	$I_{OUT} = 1\text{ to }150\text{ mA}$	–	30	90	mV
$\Delta V_{OUT}/\Delta T$	V_{OUT} temperature coefficient	$-30\text{ }^{\circ}\text{C} \leq T_j \leq +85\text{ }^{\circ}\text{C}$	–	100	–	ppm/ $^{\circ}\text{C}$
RR1	Ripple rejection 1	$f = 120\text{ Hz}$; $V_{ripple} = 1\text{ V}$	50	70	–	dB
RR2	Ripple rejection 2	$f = 1\text{ kHz}$; $C_n = 0.01\text{ }\mu\text{F}$; $V_{ripple} = 1\text{ V}$	–	60	–	dB
V_n	Output noise voltage	$f_{BW} = 20\text{ Hz to }80\text{ kHz}$; $C_n = 0.01\text{ }\mu\text{F}$	–	30	–	μV_{RMS}
$I_{ON/OFF}$	ON/OFF pin input current	$V_{ON/OFF} = 5.0\text{ V}$	–	5	15	μA
V_{OFF}	ON/OFF low threshold voltage		–0.3	–	0.4	V
V_{ON}	ON/OFF high threshold voltage		1.6	–	$V_{IN} + 0.3$	V

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TYPICAL PERFORMANCE CURVES

2.8 V product. Except where noted otherwise, $T_{amb} = 25\text{ }^{\circ}\text{C}$; $V_{IN} = V_O + 1\text{ V}$; $V_{cont} = 2\text{ V}$; $C_i = 1\text{ }\mu\text{F}$; $C_o = 1\text{ }\mu\text{F}$; $C_n = 0.01\text{ }\mu\text{F}$.

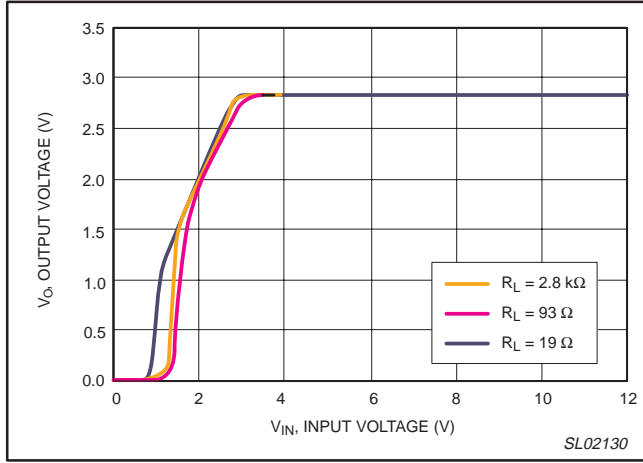


Figure 3. Output voltage versus input voltage.

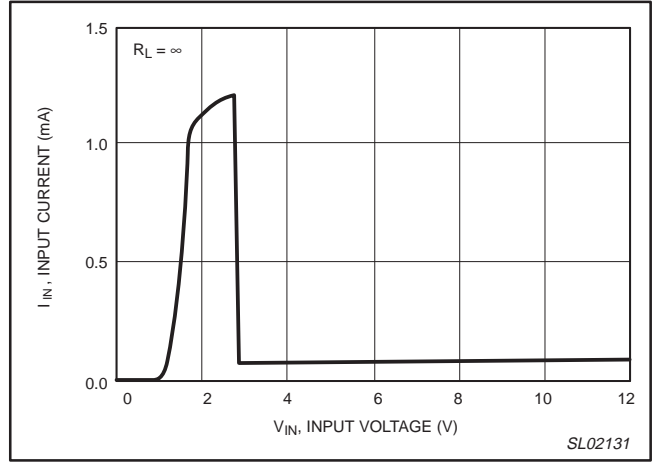


Figure 4. Input current versus input voltage.

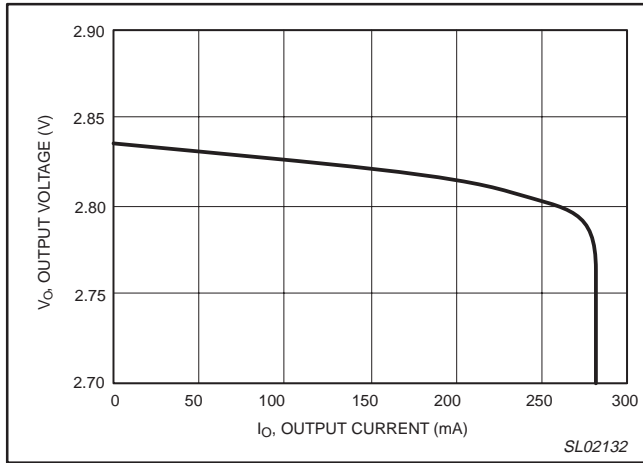


Figure 5. Load regulation.

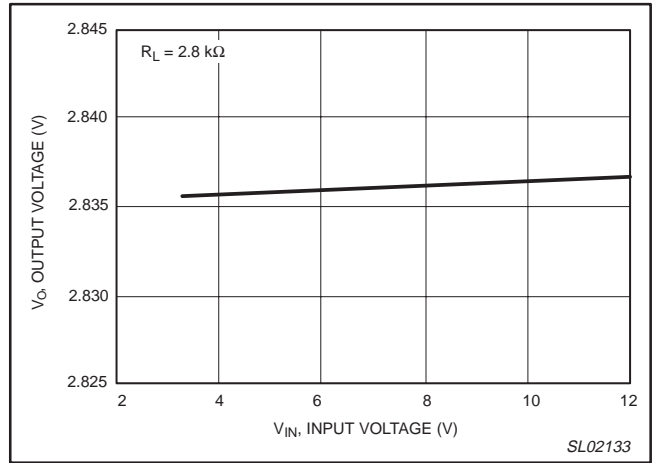


Figure 6. Line regulation.

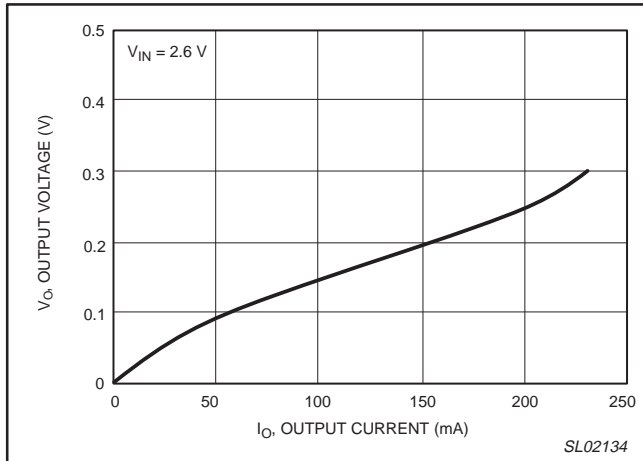


Figure 7. Dropout voltage versus output current.

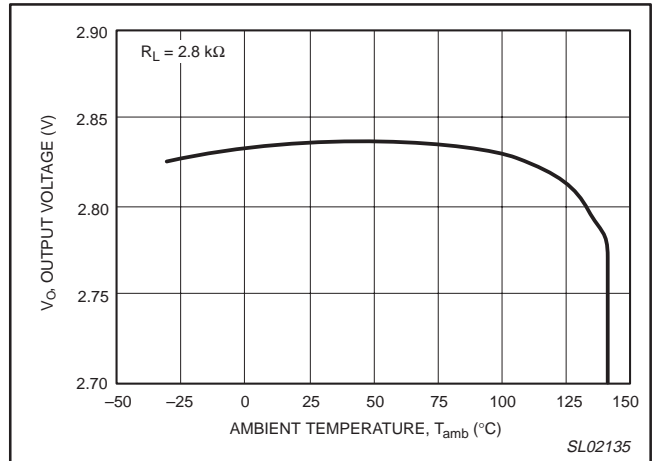


Figure 8. Output voltage versus T_{amb} .

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TYPICAL PERFORMANCE CURVES (continued)

2.8 V product. Except where noted otherwise, $T_{amb} = 25\text{ }^{\circ}\text{C}$; $V_{IN} = V_O + 1\text{ V}$; $V_{cont} = 2\text{ V}$; $C_i = 1\text{ }\mu\text{F}$; $C_o = 1\text{ }\mu\text{F}$; $C_n = 0.01\text{ }\mu\text{F}$.

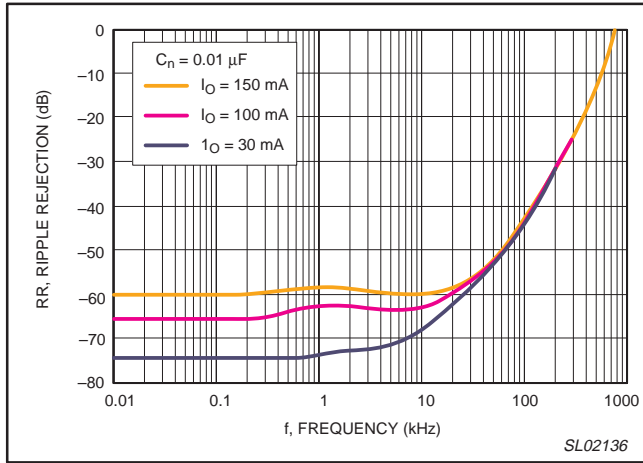


Figure 9. Ripple rejection ($C_n = 0.01\text{ }\mu\text{F}$).

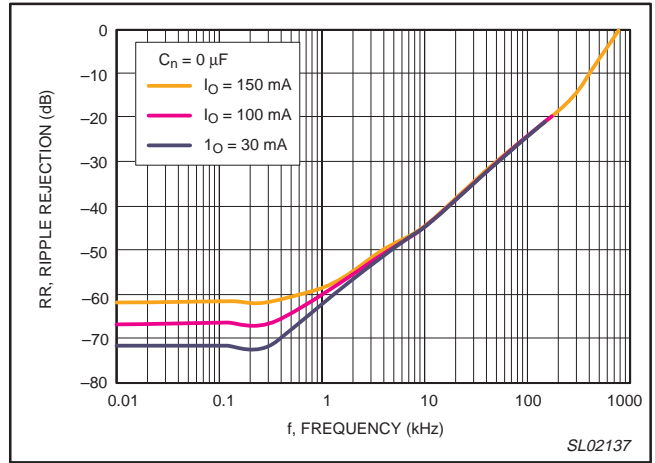


Figure 10. Ripple rejection ($C_n = 0\text{ }\mu\text{F}$).

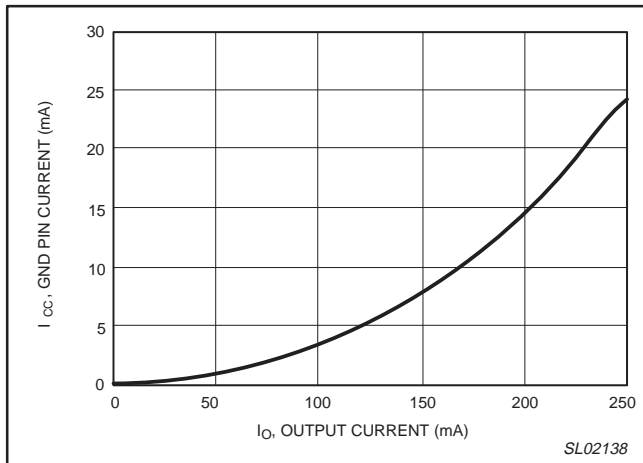


Figure 11. GND pin current.

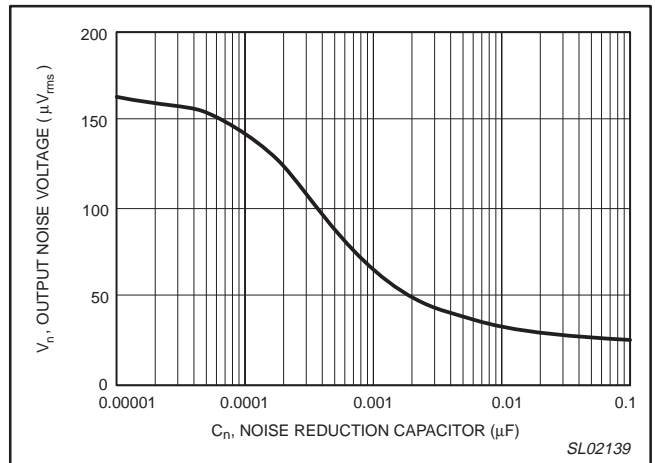


Figure 12. Output noise voltage.

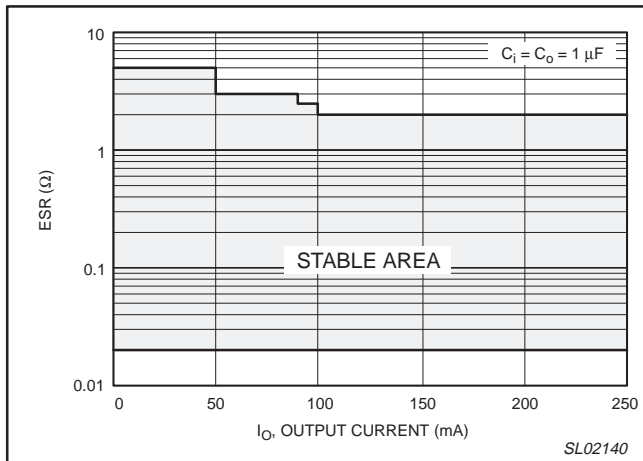


Figure 13. ESR stability area ($C_i = C_o = 1\text{ }\mu\text{F}$).

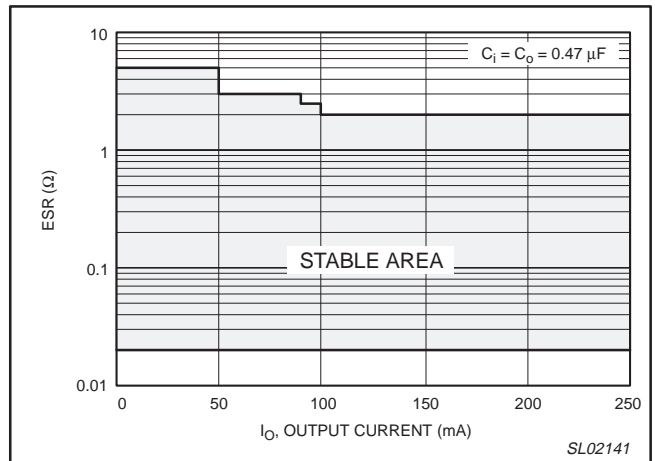


Figure 14. ESR stability area ($C_i = C_o = 0.47\text{ }\mu\text{F}$).

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TYPICAL PERFORMANCE CURVES (continued)

2.8 V product. Except where noted otherwise, $T_{amb} = 25\text{ }^{\circ}\text{C}$; $V_{IN} = V_O + 1\text{ V}$; $V_{cont} = 2\text{ V}$; $C_i = 1\text{ }\mu\text{F}$; $C_o = 1\text{ }\mu\text{F}$; $C_n = 0.01\text{ }\mu\text{F}$.

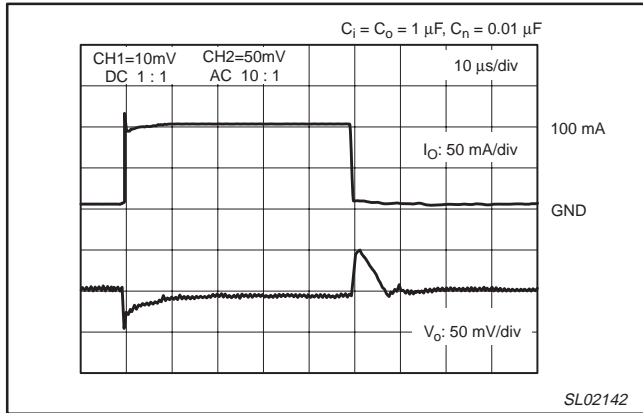


Figure 15. Load transient response
($I_O = 0 \rightarrow 100\text{ mA}$); ($C_i = C_o = 1\text{ }\mu\text{F}$; $C_n = 0.01\text{ }\mu\text{F}$).

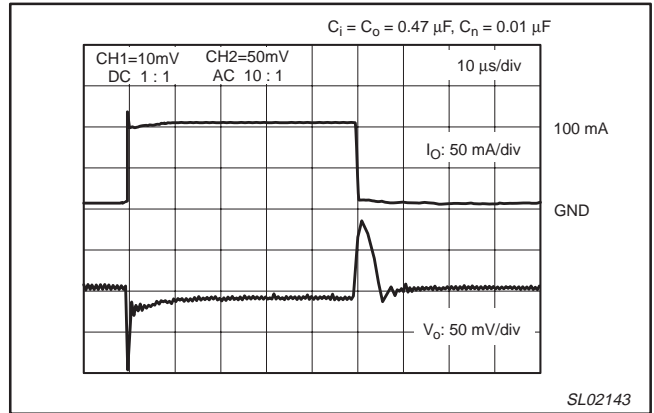


Figure 16. Load transient response
($I_O = 0 \rightarrow 100\text{ mA}$); ($C_i = C_o = 0.47\text{ }\mu\text{F}$; $C_n = 0.01\text{ }\mu\text{F}$).

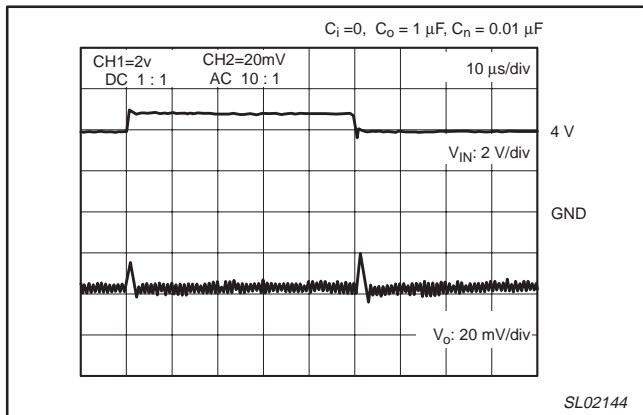


Figure 17. Line transient response
($V_{IN} = 3.8 \rightarrow 4.8\text{ V}$; $I_O = 30\text{ mA}$);
($C_i = 0$; $C_o = 1\text{ }\mu\text{F}$; $C_n = 0.01\text{ }\mu\text{F}$).

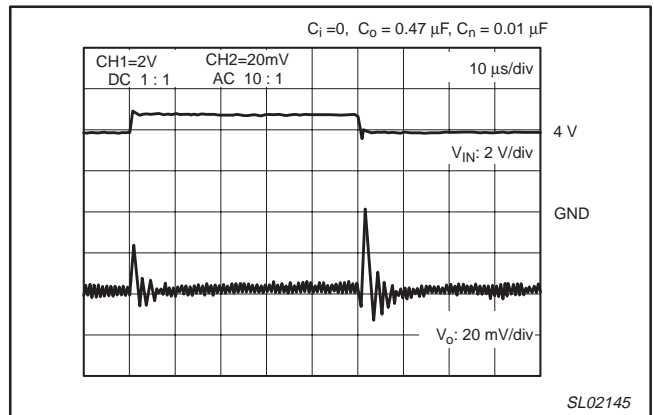


Figure 18. Line transient response
($V_{IN} = 3.8 \rightarrow 4.8\text{ V}$; $I_O = 30\text{ mA}$);
($C_i = 0$; $C_o = 0.47\text{ }\mu\text{F}$; $C_n = 0.01\text{ }\mu\text{F}$).

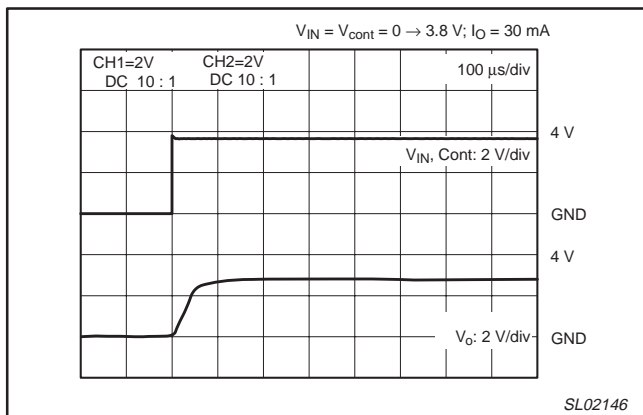


Figure 19. Turn-on transient response
 $V_{in} = V_{cont} = 0 \rightarrow 3.8\text{ V}$; $I_O = 30\text{ mA}$)

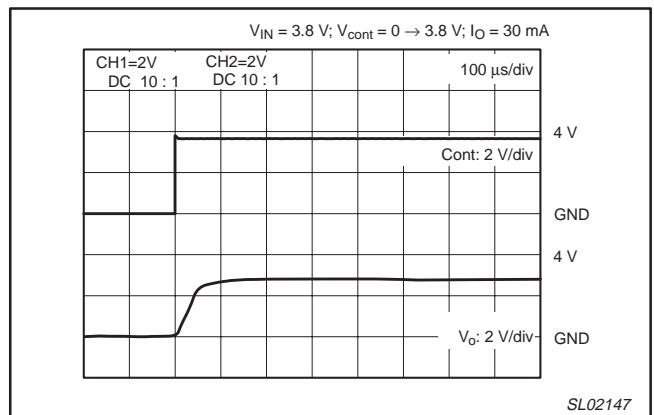


Figure 20. Turn-on transient response
 $V_{in} = 3.8\text{ V}$; $V_{cont} = 0 \rightarrow 3.8\text{ V}$; $I_O = 30\text{ mA}$)

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TECHNICAL DISCUSSION

As illustrated in Figure 21, the LP2985-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. 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.

An external bypass capacitor connected to the NOISE pin reduces noise at the output.

Additional functional blocks include a current-limiter, thermal sensor and shut-down logic. 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.

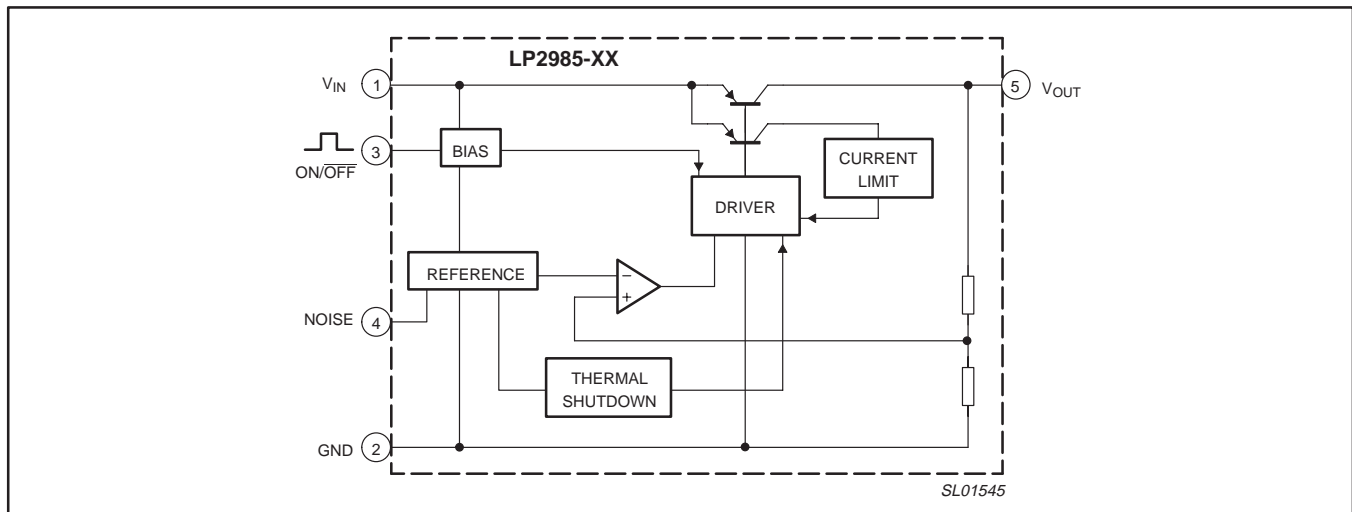


Figure 21. Block diagram.

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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 greater than 1 μF is required between the LP2985-XX input pin and the circuit ground (the amount of capacitance may be increased without limit). This capacitor must be located as close as possible to the V_{IN} 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 must be at least 1 μF and must have B-type temperature characteristics. Also it must have the ESR (Equivalent Series Resistance) value within the stable range shown in the ESR versus I_{O} plot.

ON/OFF (Chip Enable) Pin

The ON/OFF pin must be actively terminated, not floating. If the function is not to be used, the pin should be tied to V_{IN} .

Line Impedance of V_{IN} and GND

The V_{IN} 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.

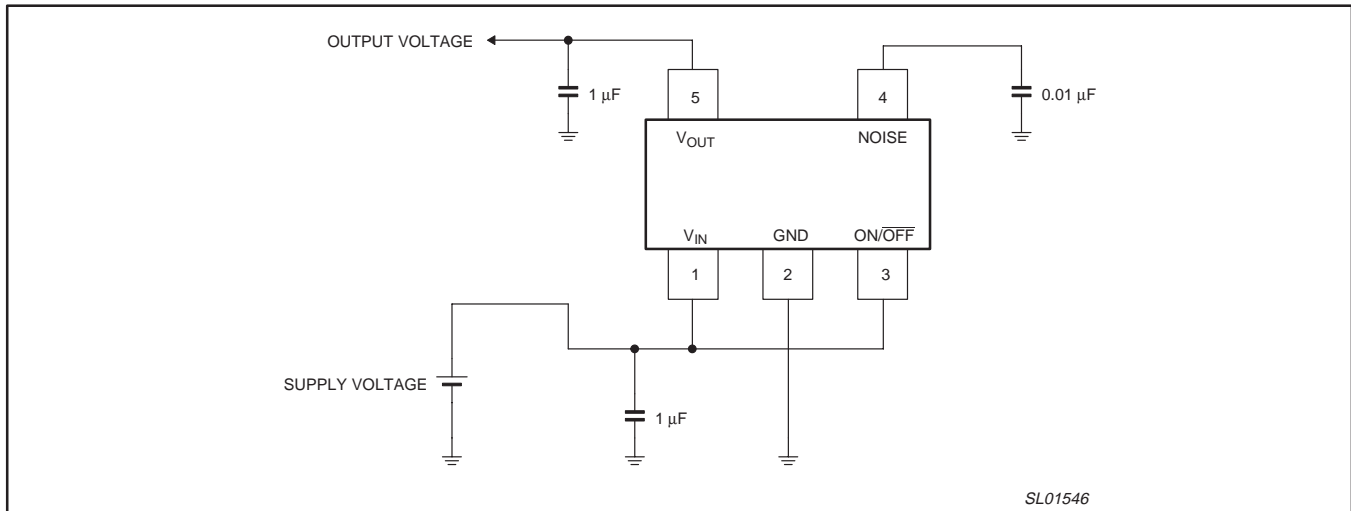


Figure 22. Typical application circuit, device always ON.

TEST CIRCUITS

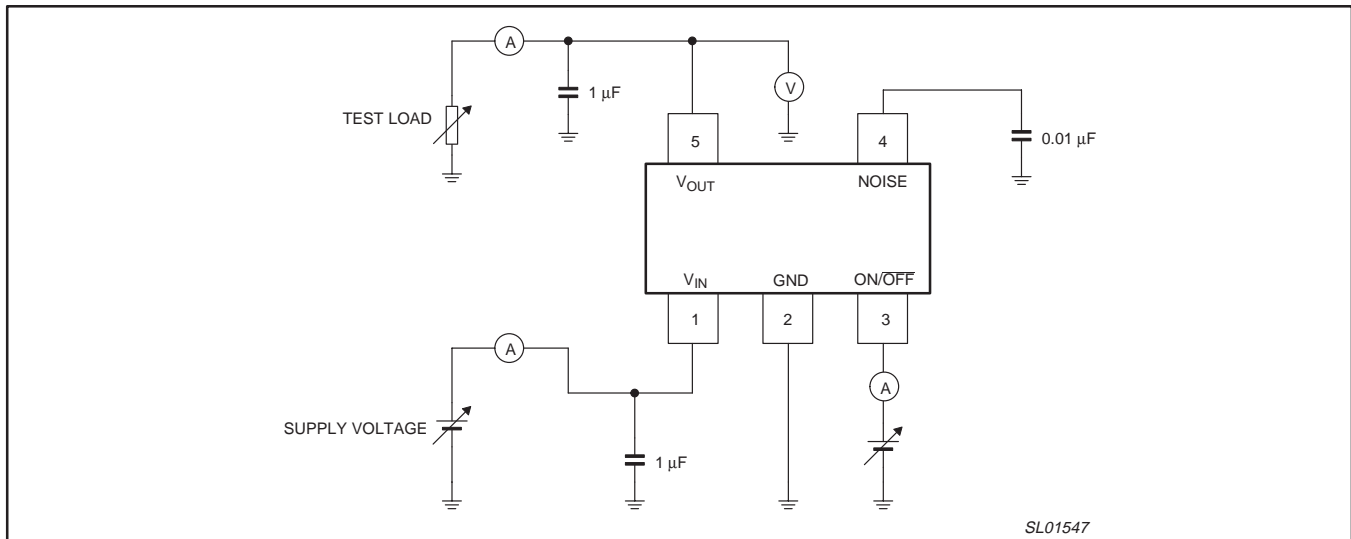


Figure 23. Test circuit.

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PACKING METHOD

The LP2985-XX is packed in reels, as shown in Figure 24.

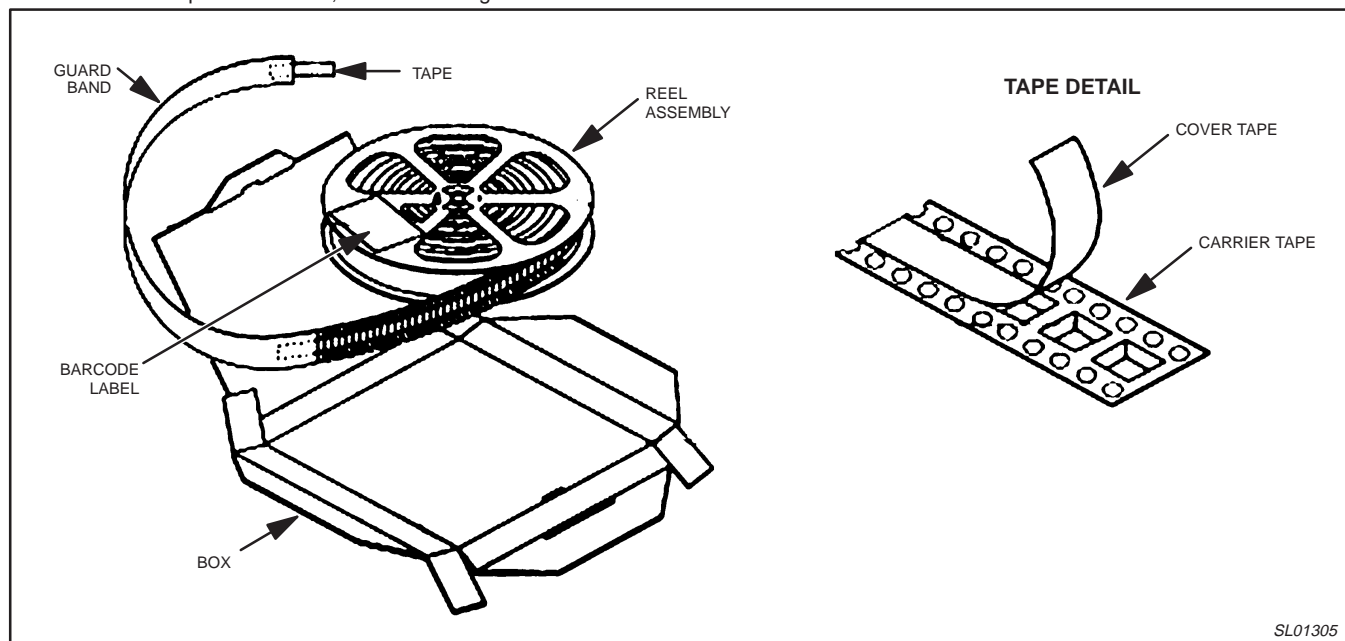


Figure 24. Tape and reel packing method

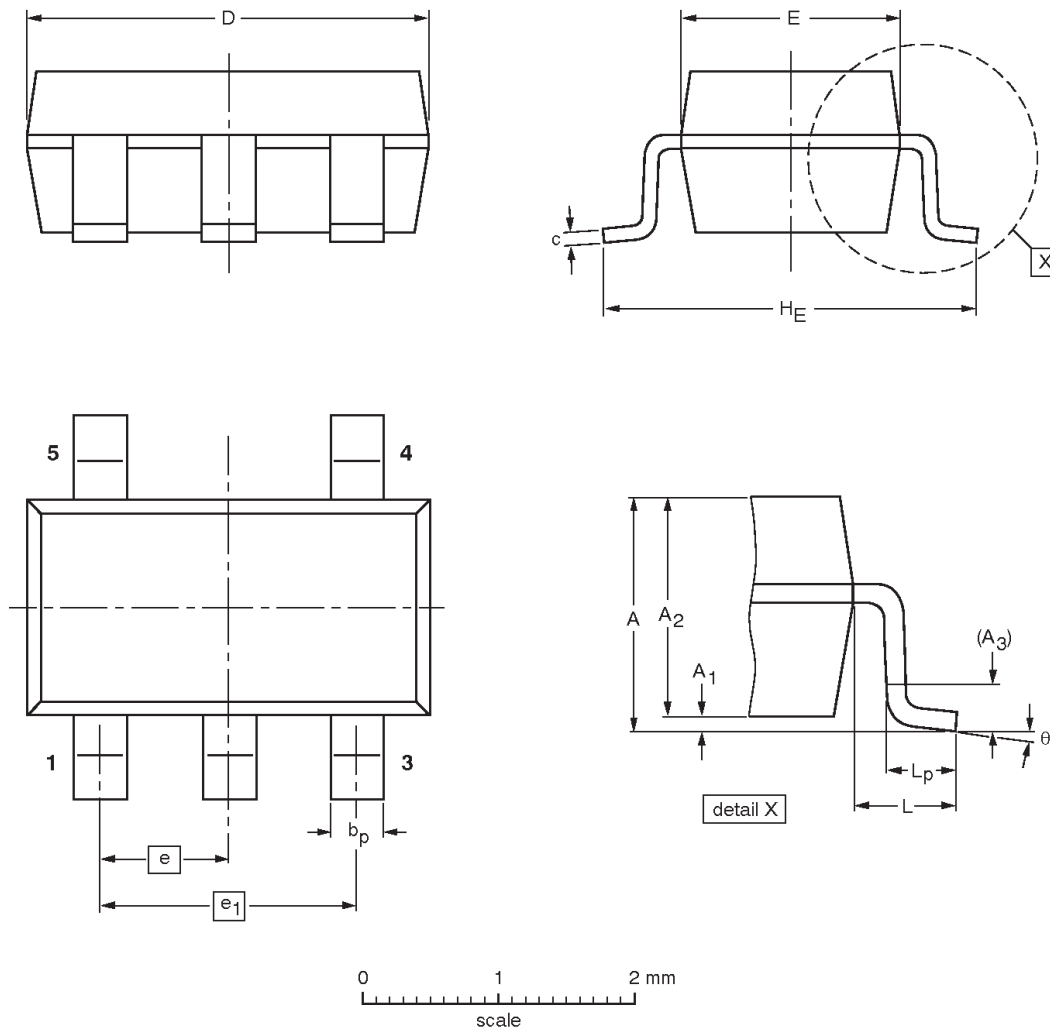
SL01305

Micropower 150 mA low noise,
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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

**Micropower 150 mA low noise,
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REVISION HISTORY

Rev	Date	Description
_3	20031031	Product data (9397 750 12242). ECN 853-2291 01-A14288 of 31 October 2003. Supersedes data of 17 Oct 2003 (9397 750 12098). Modifications: <ul style="list-style-type: none">• Added 2.5 V output voltage option.• Features on page 2: "Wide operating temperature range: -30 to +85 °C" changed to "Wide operating temperature range: -40 to +85 °C".
_2	20031017	Product data (9397 750 12098). ECN 853-2291 29545 of 14 February 2003. Supersedes data of 03 Oct 2001 (9397 750 08962).
_1	20011003	Product data (9397 750 08962). ECN 853-2291 27197 of 03 October 2001.

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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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Document order number:

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