DATA SHEET

SA58780
Sense current amplifier with selectable gain

Product data
Supersedes data of 2002 Dec 10

2003 Nov 10

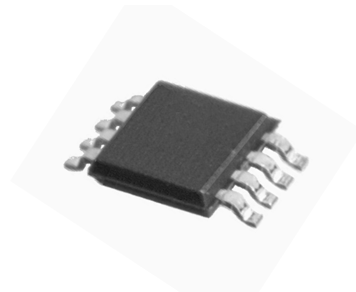
Philips
Semiconductors

PHILIPS

GENERAL DESCRIPTION

The SA58780 is a single amplifier that allows current sensing independent of the supply voltage. The input offset voltage is typically ±500 µV with typical offset drift of ±6 µV/°C. The SA58780 supply current is typically 150 µA and it operates from 3.0 V to 24 V single supply. The input common mode range is selectable for high and low ranges. The amplifIer gain is user selected for a "High" of 100 V/V or a "Low" of 50 V/V.

The SA58780 is ideal for battery charger applications in notebook computers and PDAs.



FEATURES

- Supply voltage range: 3 V to 24 V
- Low supply current: 150 µA (typical)
- Low input offset voltage: ±500 µV (typical)
- Low input offset drift: ±6 µV/°C (typical)
- Power supply rejection ratio (1 kHz): 80 dB (typical)
- Common mode rejection ratio (1 kHz): 100 dB (typical)
- Common mode input range selection:
  1.8 V to 24 V (I_{SEL} HIGH);
  –0.3 V to V_{CC} – 2.4 V (I_{SEL} LOW)
- Amplifier gain selection:
  G_{SEL} HIGH: G_V = 100 V/V;
  G_{SEL} LOW: G_V = 50 V/V

APPLICATIONS

- Notebook computers
- Personal digital assistants (PDA)

SIMPLIFIED DEVICE DIAGRAM

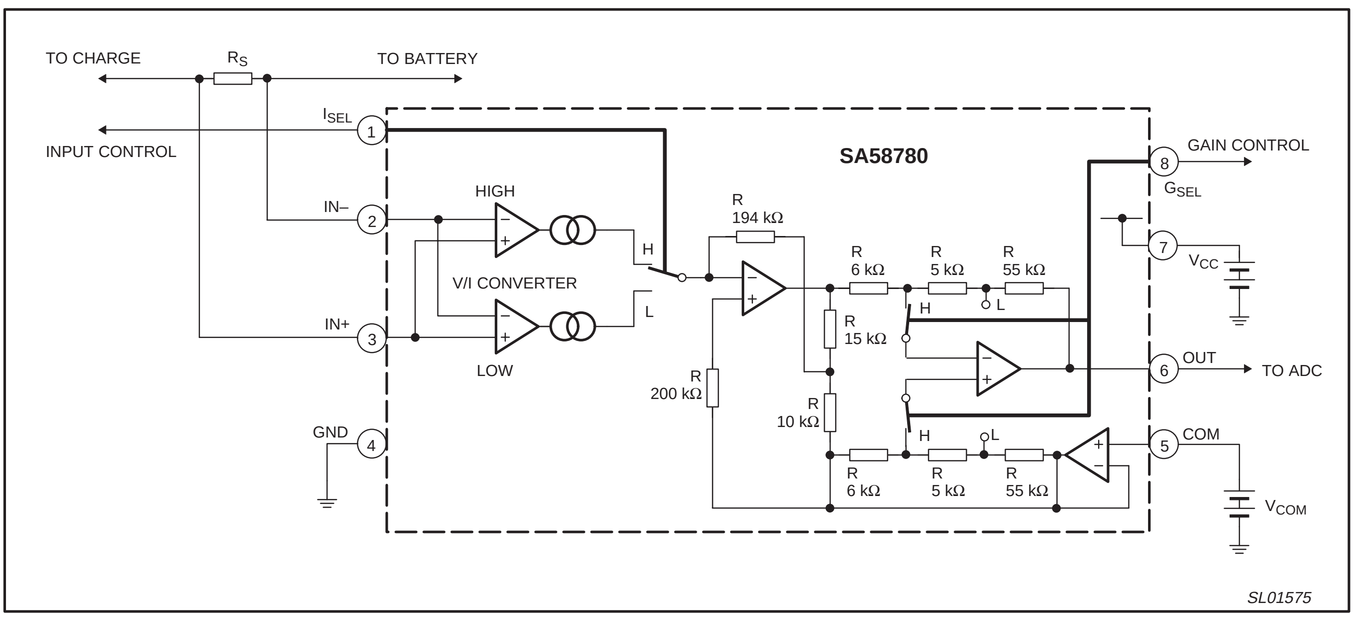


Figure 1. Simplified device diagram.

ORDERING INFORMATION

TYPE NUMBER	PACKAGE			TEMPERATURE RANGE
	NAME	DESCRIPTION	VERSION	
SA58780D	SO8	plastic small outline package; 8 leads; body width 3.9 mm	SOP005	–40 °C to +85 °C

PIN CONFIGURATION

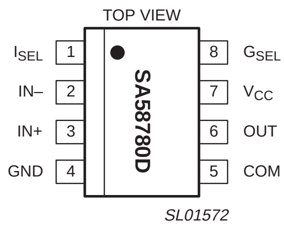
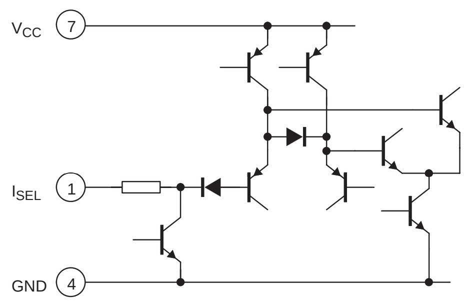
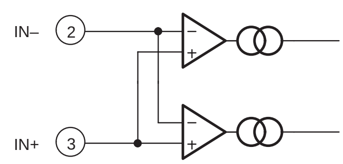
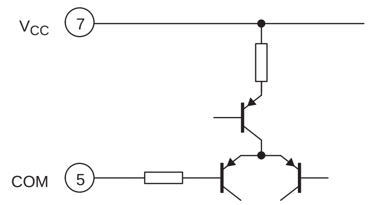
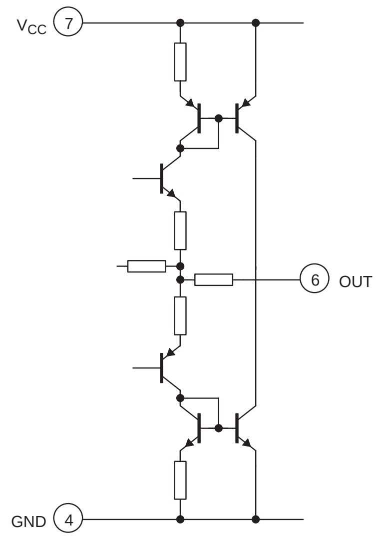
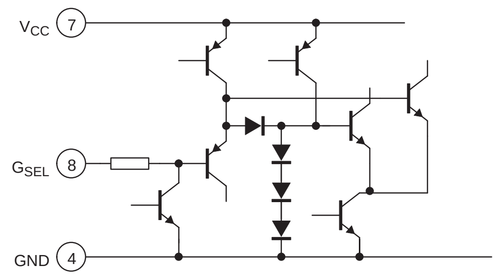


Figure 2. Pin configuration.

PIN DESCRIPTION AND EQUIVALENT CIRCUITS

PIN	SYMBOL	DESCRIPTION	INTERNAL EQUIVALENT CIRCUIT
1	I_{SEL}	Input common mode range selection HIGH: 1.8 V to 24 V LOW: –0.3 V to V_{CC} – 2.4 V	
4	GND	Ground	
2	IN–	Inverting input	
3	IN+	Non-inverting input	
5	COM	Reference voltage input	

<table>
<tr><th>PIN</th><th>SYMBOL</th><th>DESCRIPTION</th><th>INTERNAL EQUIVALENT CIRCUIT</th></tr>
<tr><td>6</td><td>OUT</td><td>Output</td><td rowspan="2">
</td></tr>
<tr><td>7</td><td>V_{CC}</td><td>Positive supply</td></tr>
<tr><td>8</td><td>G_{SEL}</td><td>Gain selection
HIGH: 100 V/V
LOW: 50 V/V</td><td>
</td></tr>
</table>

MAXIMUM RATINGS

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_{CC}	Single supply voltage	–0.3	+25	V
V_{IN}	Input voltage	–0.3	+25	V
T_{stg}	Storage temperature	–40	+125	°C
T_{amb}	Operating ambient temperature	–40	+85	°C
P_D	Power dissipation	–	300	mW

ELECTRICAL CHARACTERISTICS

V_{CC} = 5.0 V; V_{ICM} = 15 V; V_{COM} = 25 V; V_{ISEL} = 5 V; V_{GSEL} = 5 V; R_L = 10 kΩ; T_{amb} = 25 °C, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CC}	Supply voltage operating range		3.0	–	24	V
I_{CC}	Supply current		–	150	200	µA
$G_{v(high)}$	Voltage gain HIGH	G_{SEL} = 5 V	97	100	103	mV/mV
$G_{v(low)}$	Voltage gain LOW	G_{SEL} = 0 V	48.5	50	51.5	mV/mV
V_{IO1}	Input offset voltage 1	ΔV_{IN} = 0 V; V_{ISEL} = 5 V (HIGH)	–0.5	–	0.5	mV
V_{IO2}	Input offset voltage 2	ΔV_{IN} = 0 V; V_{ISEL} = 0 V (LOW)	–0.5	–	0.5	mV
ΔV_{IO1}	Input offset voltage 1 temperature coefficient	V_{ISEL} = 5 V	–4	–	4	µV/°C
ΔV_{IO2}	Input offset voltage 1 temperature coefficient	V_{ISEL} = 0 V	–6	–	6	µV/°C
$V_{I(CM)1}$	Common mode input voltage range 1	V_{ISEL} = 5 V (HIGH)	1.8	–	24	V
$V_{I(CM)2}$	Common mode input voltage range 1	V_{ISEL} = 0 V (LOW)	–0.3	–	V_{CC} – 2.4	V
$V_{I(dif)}$	Differential input voltage		–200	–	200	mV
$I_{i(bias)1}$	Input bias current 1	ΔV_{IN} = 0 V; V_{ISEL} = 5 V (HIGH)	0.8	1.2	1.6	µA
$I_{i(bias)2}$	Input bias current 2	ΔV_{IN} = 0 V; V_{ISEL} = 0 V (LOW)	–0.8	–1.2	–1.6	µA
$\Delta V_{IO}/\Delta T$	Input offset voltage temperature drift	T_{amb} = –40 to +85 °C	–	±1	±3	µV/°C
Z_i	Input impedance		100	–	–	kΩ
V_{COM}	COM voltage range	R_L = open	1.2	–	V_{CC} – 1.2	V
I_{ISEL}	I_{SEL} current	V_{ISEL} = 5 V	–	1.0	–	µA
V_{ISEL1}	I_{SEL} voltage range 1 (HIGH)		1.7	–	24	V
V_{ISEL2}	I_{SEL} voltage range 2 (LOW)		0	–	0.5	V
I_{GSEL}	G_{SEL} sink current	V_{GSEL} = 5 V	–	1.0	–	µA
V_{GSEL1}	G_{SEL} voltage range 1	(100 V/V)	1.7	–	24	V
V_{GSEL2}	G_{SEL} voltage range 2	(50 V/V)	0	–	0.5	V
V_{OUT}	Output voltage range	R_L = open	0.3	–	V_{CC} – 0.3	V
$I_{O(source)}$	Output source current	V_{OUT} = V_{CC} – 0.3 V	0.5	1.0	–	mA
$I_{O(sink)}$	Output sink current	V_{OUT} = 0.3 V	–0.5	–1.0	–	mA
f_{C1}	Cutoff frequency 1	V_{GSEL} = 5 V ($G_{v(high)}$ = 100 V/V); V_{OUT} = –3 dB	–	100	–	kHz
f_{C2}	Cutoff frequency 2	V_{GSEL} = 0 V ($G_{v(low)}$ = 50 V/V); V_{OUT} = –3 dB	–	140	–	kHz
PSRR1	Power supply rejection ratio 1	f = 1 kHz; V_{ISEL} = 5 V	70	80	–	dB
PSRR2	Power supply rejection ratio 2	f = 1 kHz; V_{ISEL} = 0 V	70	80	–	dB
CMRR1	Common mode rejection ratio 1	f = 1 kHz; V_{ISEL} = 5 V	70	80	–	dB
CMRR2	Common mode rejection ratio 2	f = 1 kHz; V_{ISEL} = 0 V	70	80	–	dB

TYPICAL CHARACTERIZATION CURVES

V_{CC} = 5.0 V; V_{GSEL} = V_{ISEL} = 5 V; R_L = 10 kΩ; T_{amb} = 25 °C; unless otherwise specified.

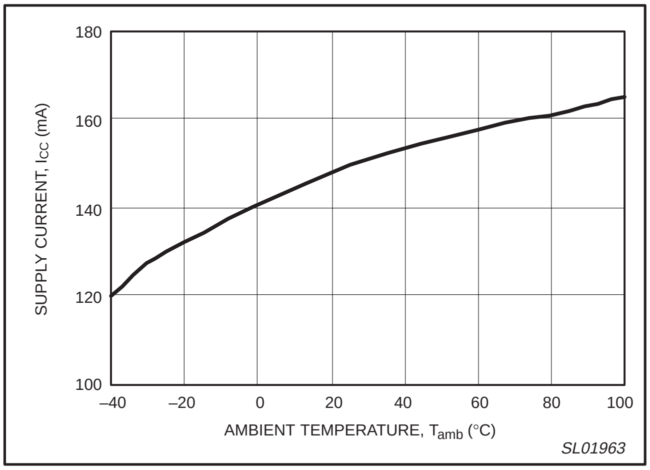


Figure 3. Supply current versus ambient temperature.

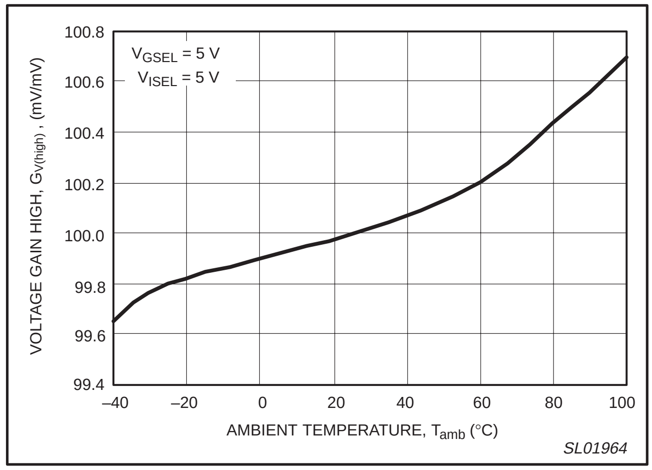


Figure 4. Voltage Gain 1 (HIGH) versus ambient temperature.

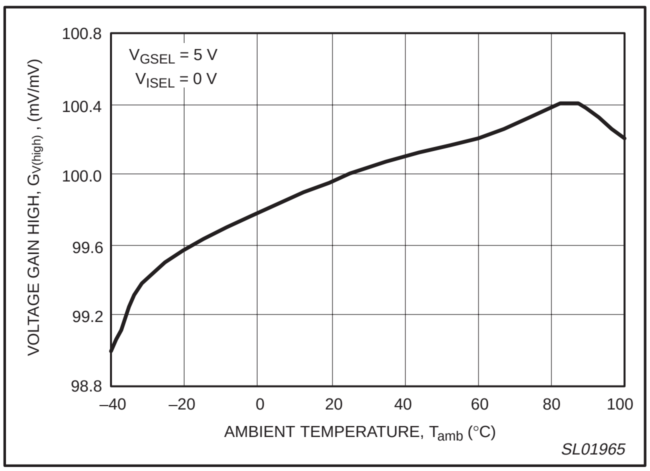


Figure 5. Voltage Gain 1 (HIGH) versus ambient temperature.

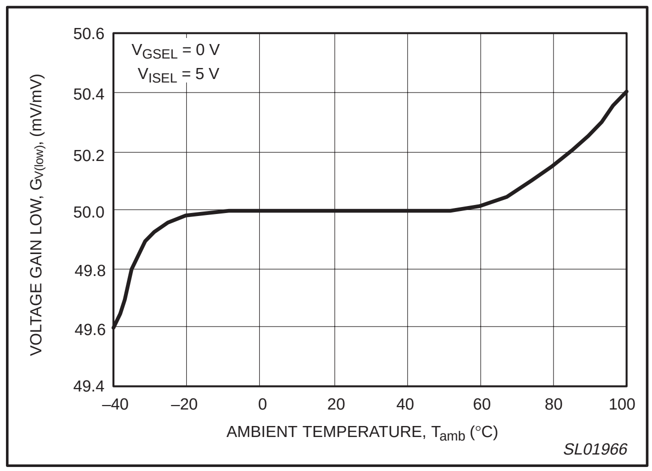


Figure 6. Voltage Gain 2 (LOW) versus ambient temperature.

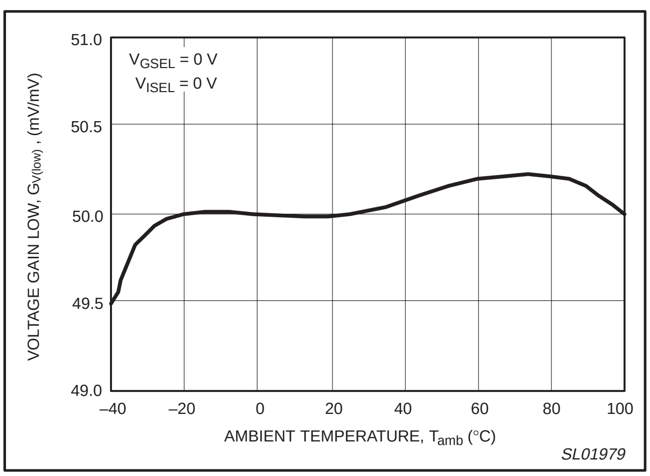


Figure 7. Voltage Gain 2 (LOW) versus ambient temperature.

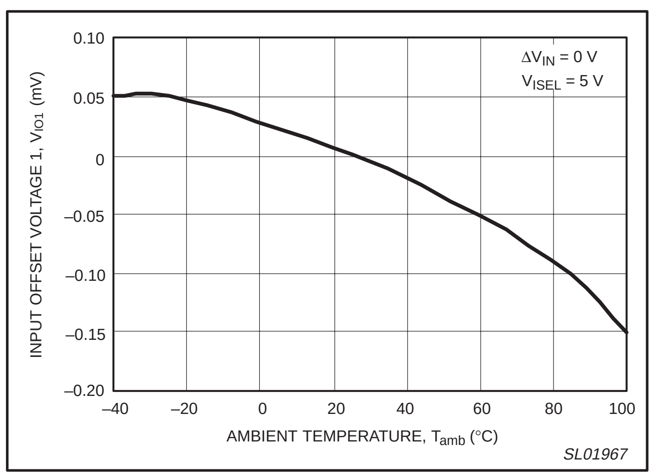


Figure 8. Input offset voltage 1 versus ambient temperature.

TYPICAL CHARACTERIZATION CURVES *(continued)*

V_{CC} = 5.0 V; V_{GSEL} = V_{ISEL} = 5 V; R_L = 10 kΩ; T_{amb} = 25 °C; unless otherwise specified.

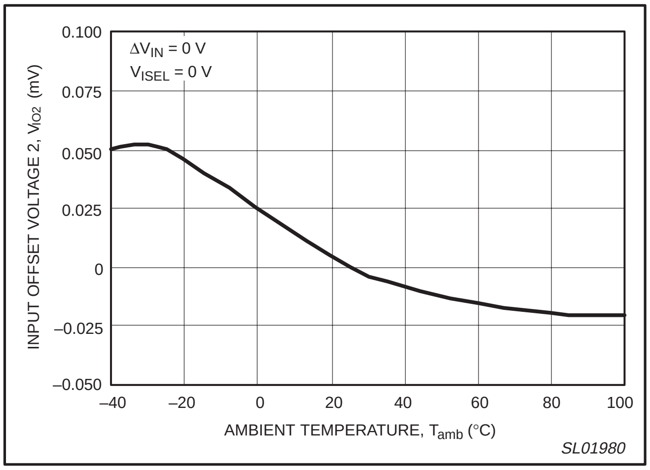


Figure 9. Input offset voltage 1 versus ambient temperature.

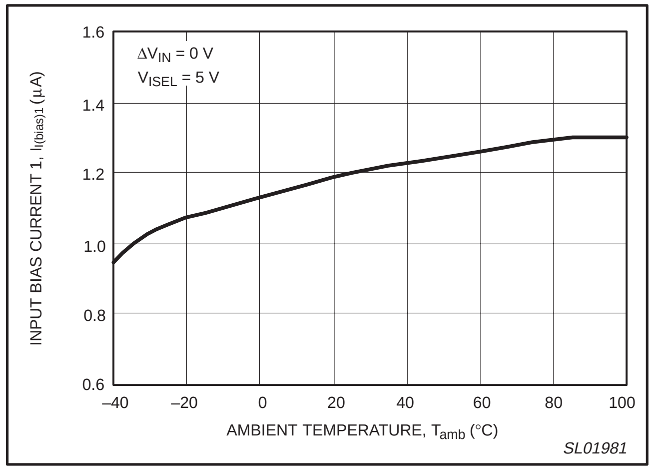


Figure 10. Input bias current versus ambient temperature.

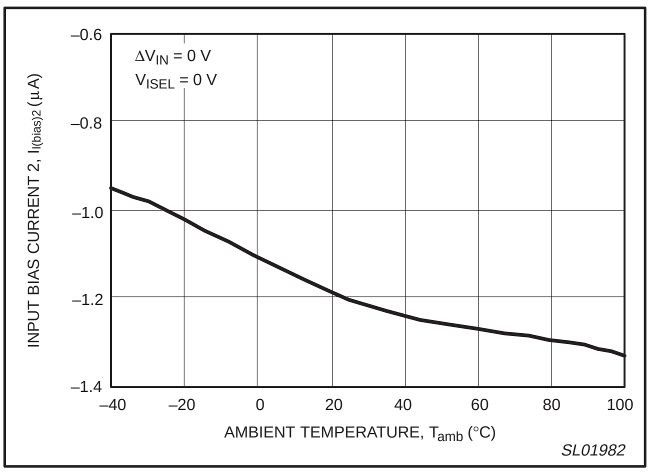


Figure 11. Input bias current versus ambient temperature.

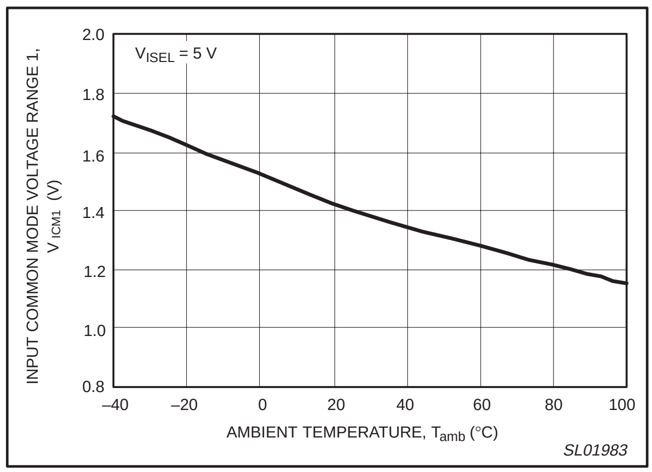


Figure 12. Input common mode voltage (minimum) versus ambient temperature.

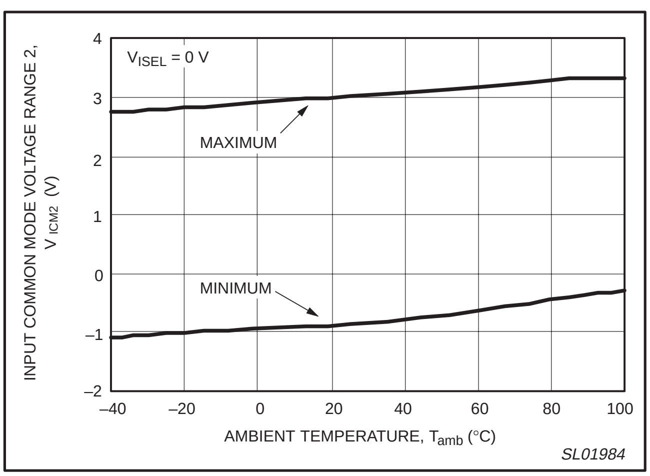


Figure 13. Input common mode voltage range 2 versus ambient temperature.

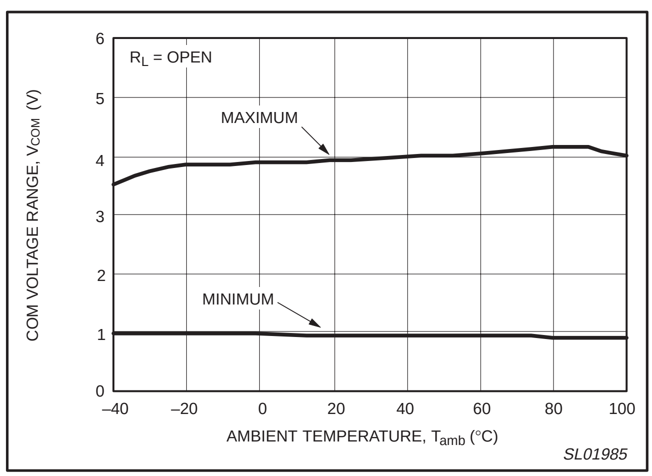


Figure 14. COM voltage range versus ambient temperature.

TYPICAL CHARACTERIZATION CURVES *(continued)*

V_{CC} = 5.0 V; V_{GSEL} = V_{ISEL} = 5 V; R_L = 10 kΩ; T_{amb} = 25 °C; unless otherwise specified.

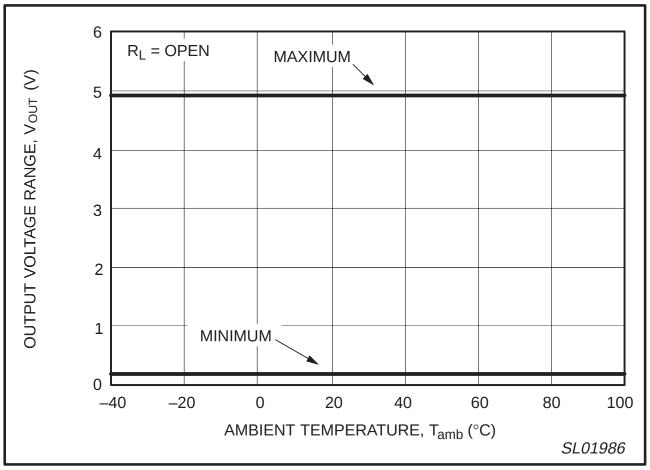


Figure 15. Output voltage range versus ambient temperature.

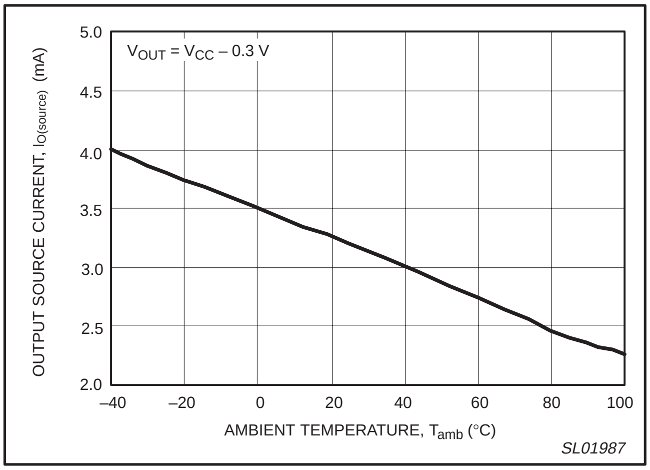


Figure 16. Output source current versus ambient temperature.

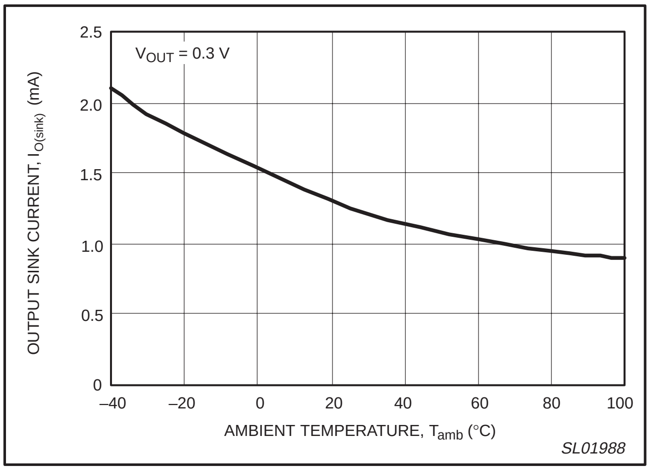


Figure 17. Output sink current versus ambient temperature.

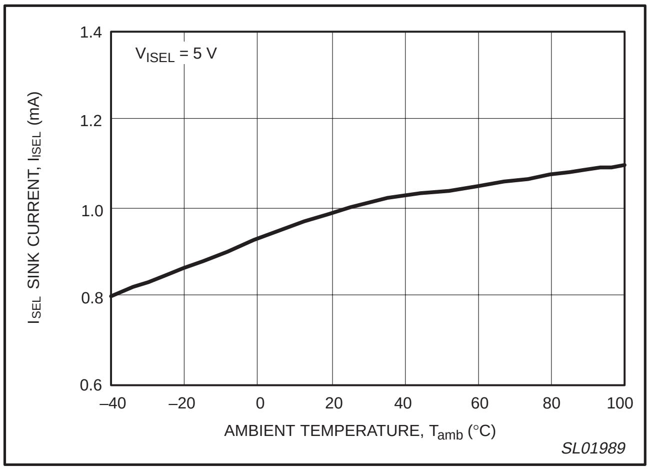


Figure 18. I_{SEL} sink current versus ambient temperature.

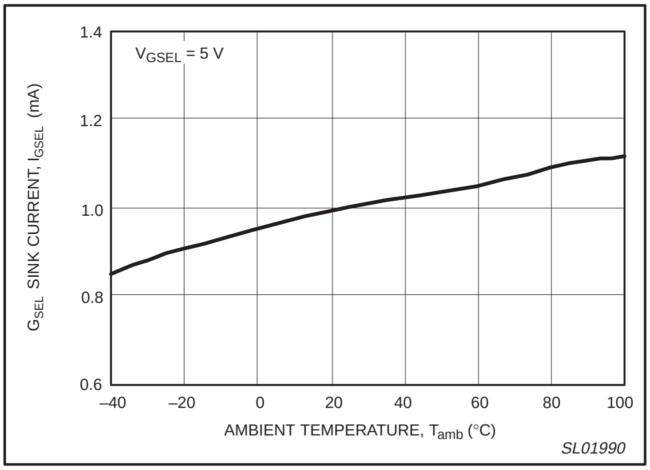


Figure 19. G_{SEL} sink current versus ambient temperature.

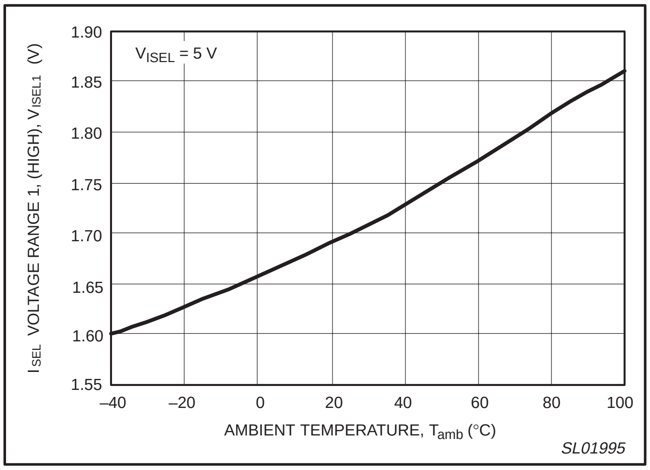


Figure 20. I_{SEL} voltage range 1 versus ambient temperature.

TYPICAL CHARACTERIZATION CURVES *(continued)*

V_{CC} = 5.0 V; V_{GSEL} = V_{ISEL} = 5 V; R_L = 10 kΩ; T_{amb} = 25 °C; unless otherwise specified.

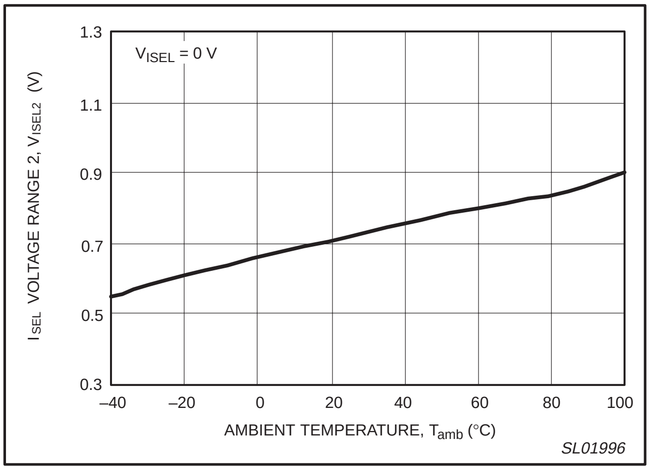


Figure 21. I_{SEL} voltage range 2 versus ambient temperature.

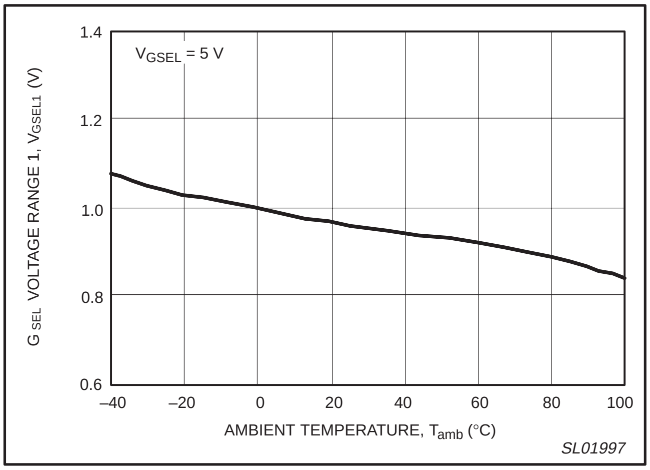


Figure 22. G_{SEL} voltage range 1 versus ambient temperature.

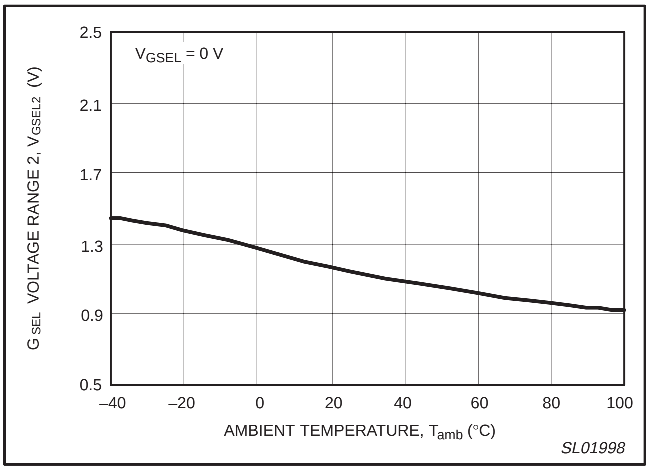


Figure 23. G_{SEL} voltage range 2 versus ambient temperature.

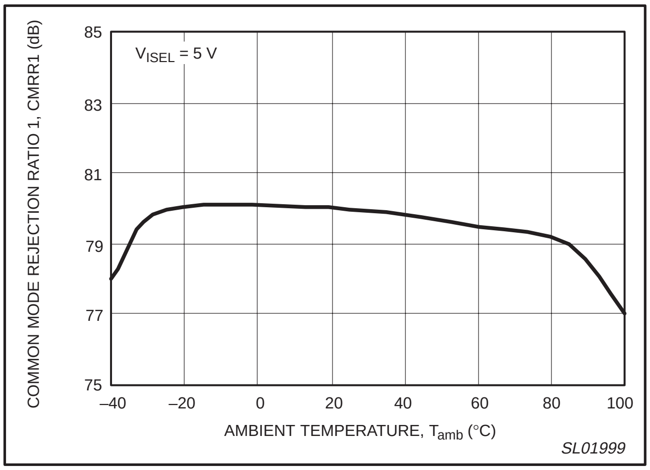


Figure 24. Common mode rejection ratio 1 versus ambient temperature.

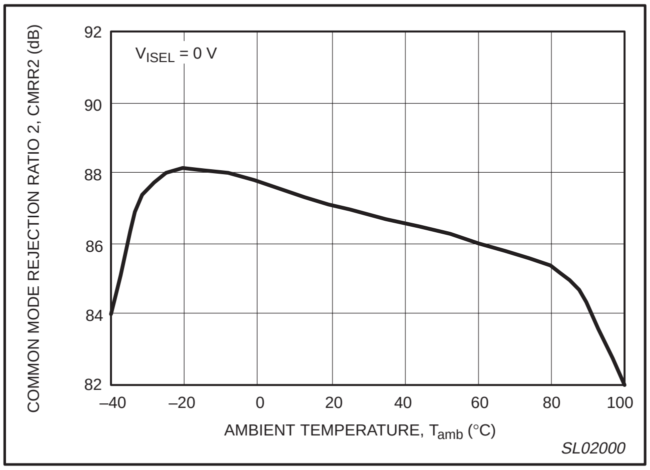


Figure 25. Common mode rejection ratio 2 versus ambient temperature.

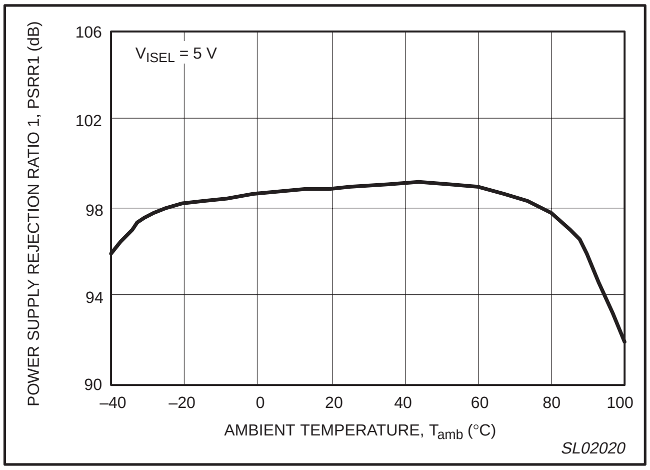


Figure 26. Power supply rejection ratio 1 versus ambient temperature.

TYPICAL CHARACTERIZATION CURVES *(continued)*

V_{CC} = 5.0 V; V_{GSEL} = V_{ISEL} = 5 V; R_L = 10 kΩ; T_{amb} = 25 °C; unless otherwise specified.

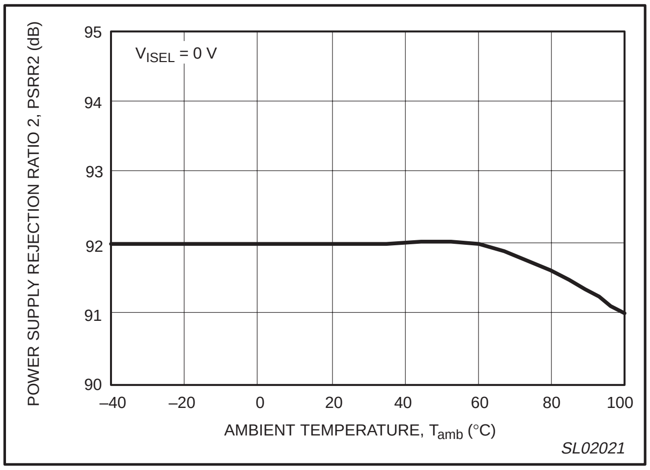


Figure 27. Power supply rejection ratio 2 versus ambient temperature.

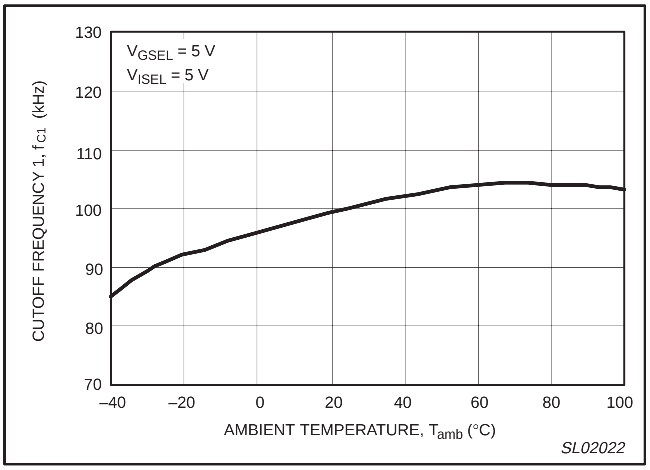


Figure 28. Cutoff frequency 1 versus ambient temperature.

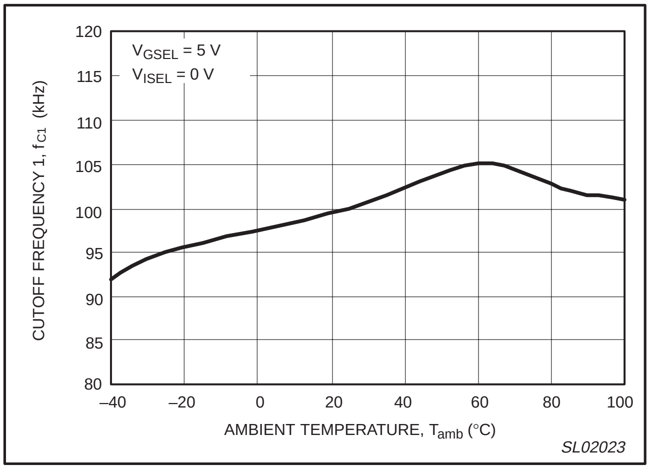


Figure 29. Cutoff frequency 1 versus ambient temperature.

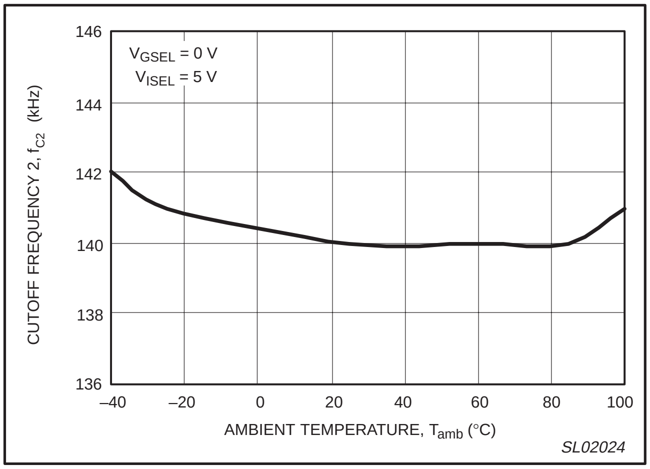


Figure 30. Cutoff frequency 2 versus ambient temperature.

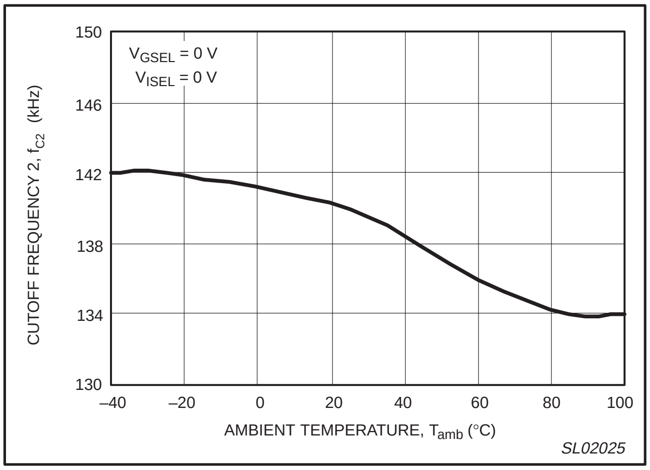


Figure 31. Cutoff frequency 2 versus ambient temperature.

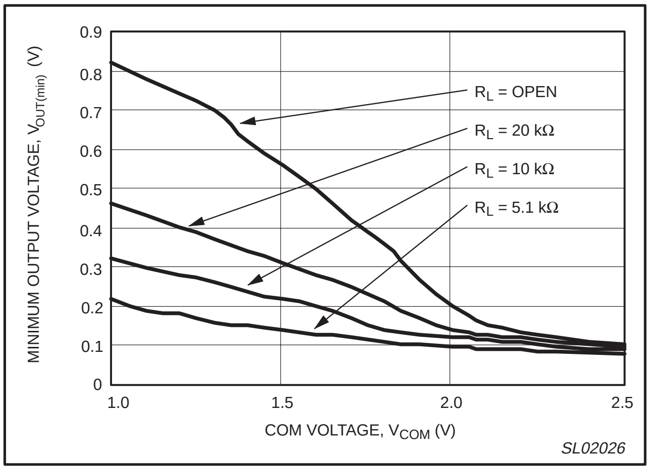


Figure 32. Minimum output voltage versus COM voltage.

TYPICAL CHARACTERIZATION CURVES *(continued)*

V_{CC} = 5.0 V; V_{GSEL} = V_{ISEL} = 5 V; R_L = 10 kΩ; T_{amb} = 25 °C; unless otherwise specified.

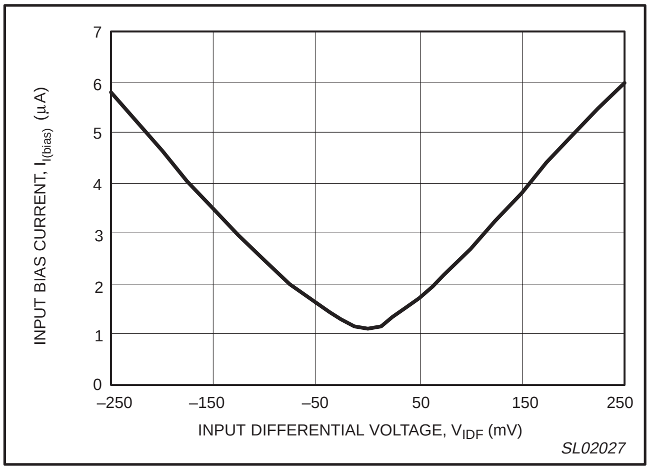


Figure 33. Input bias current versus input differential voltage.

APPLICATION INFORMATION

Battery current sensing circuit

The circuit shown in Figure 34 will sense when the load is drawing current from the battery, and the output of Pin 6 to an analog-to-digital converter can be used to provide a digital readout.

Pin 8, the Gain Select, is tied to ground. This gives a fixed G_V of 50 V/V. For a fixed G_V of 100 V/V, tie Pin 8 to V_{CC}. For selectable gain, Pin 8 may be connected to a user-controlled selector switch or the output of another device that will change state as the current rises and falls.

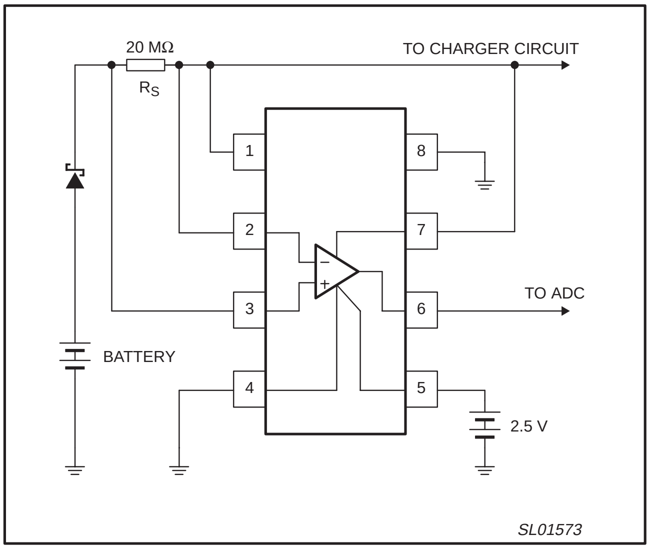


Figure 34. Battery current sensing circuit.

Charger current sensing

The only difference between the battery and charge current sense circuits is the diode position.

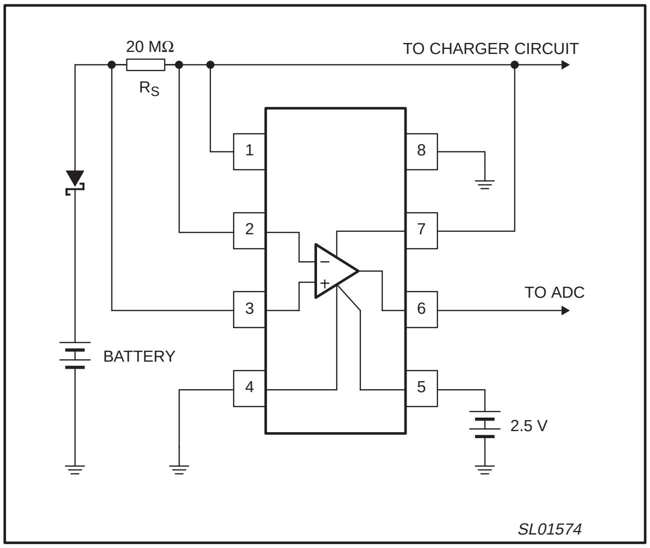


Figure 35. Charger current sensing circuit.

PACKING METHOD

The SA58780 is packed in reels, as shown in Figure 36.

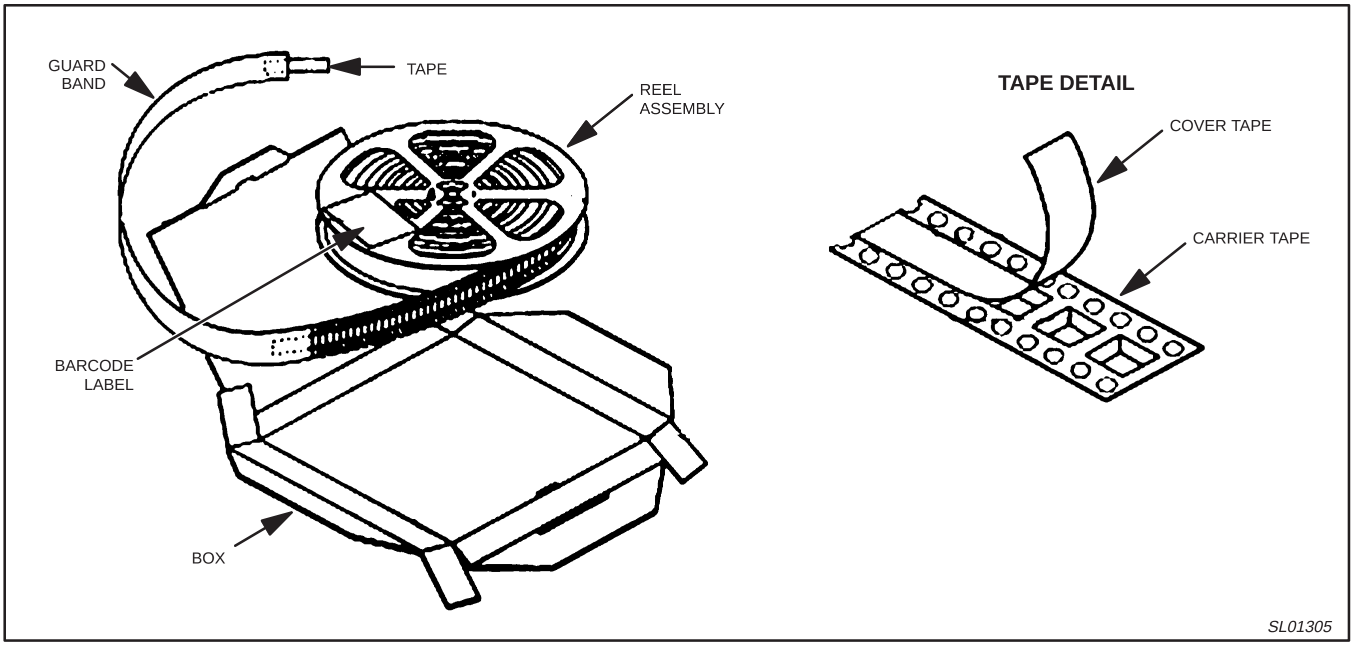
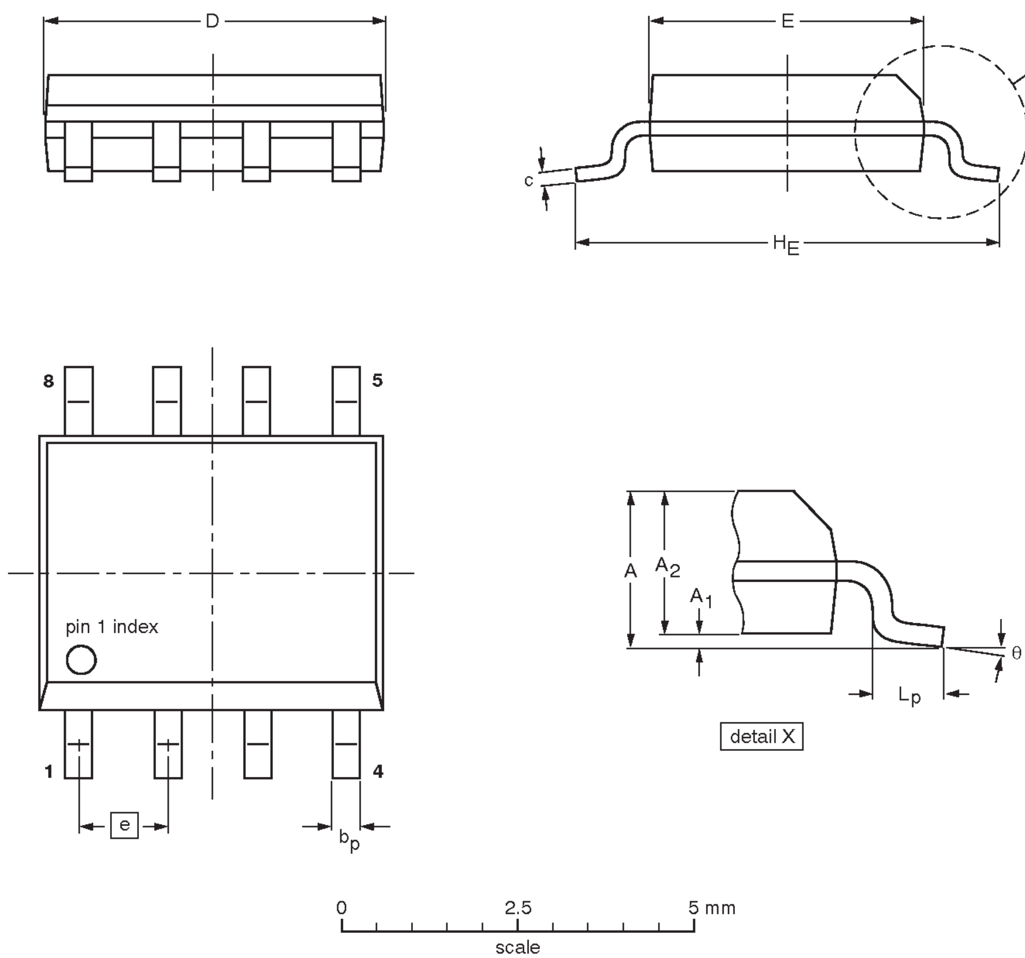


Figure 36. Tape and reel packing method

SO8: plastic small outline package; 8 leads; body width 3.9 mm **SOP005**

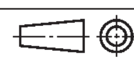


DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L_p	θ
mm	1.73	0.25 0.10	1.45 1.25	0.51 0.33	0.25 0.19	4.95 4.80	4.0 3.8	1.27	6.2 5.8	1.27 0.38	8° 0°
inches	0.068	0.010 0.004	0.057 0.049	0.013 0.020	0.0100 0.0075	0.20 0.19	0.16 0.15	0.050	0.244 0.228	0.050 0.015	

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			
SOP005	076E03	MS-012				03-10-07

REVISION HISTORY

Rev	Date	Description
_3	20031110	**Product data (9397 750 12303); ECN 853–2290 30333 of 09 September 2003.** **Supersedes data of 2002 Dec 10 (9397 750 10746).** Modifications: • Change package outline version to SOP005 in Ordering information table and Package outline sections.
_2	20021210	**Product data (9397 750 10746); ECN 853–2290 29179 of 11 November 2002.** **Supersedes data of 2001 Oct 03 (9397 750 08982).**
_1	20011003	**Product data; initial version (9397 750 08982). ECN 853–2290 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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[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

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