

# DATA SHEET

## **SA58780**

Sense current amplifier with selectable gain

Product data

2001 Oct 03

File under Integrated Circuits, Standard Analog

## Sense current amplifier with selectable gain

SA58780

## GENERAL DESCRIPTION

The SA58780 is a single amplifier that allows current sensing independent of the supply voltage. The input offset voltage is typically  $\pm 500 \mu\text{V}$  with typical offset drift of  $\pm 6 \mu\text{V}/^\circ\text{C}$ . The SA58780 supply current is typically  $150 \mu\text{A}$  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:  $150 \mu\text{A}$  (typical)
- Low input offset voltage:  $\pm 500 \mu\text{V}$  (typical)
- Low input offset drift:  $\pm 6 \mu\text{V}/^\circ\text{C}$  (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 ( $I_{\text{SEL}} \text{ HIGH}$ );
  - $-0.3 \text{ V}$  to  $V_{\text{CC}} - 2.4 \text{ V}$  ( $I_{\text{SEL}} \text{ LOW}$ )
- Amplifier gain selection:
  - $G_{\text{SEL}} \text{ HIGH}$ :  $G_V = 100 \text{ V/V}$ ;
  - $G_{\text{SEL}} \text{ LOW}$ :  $G_V = 50 \text{ V/V}$

## APPLICATIONS

- Notebook computers
- Personal digital assistants (PDA)

## SIMPLIFIED DEVICE DIAGRAM

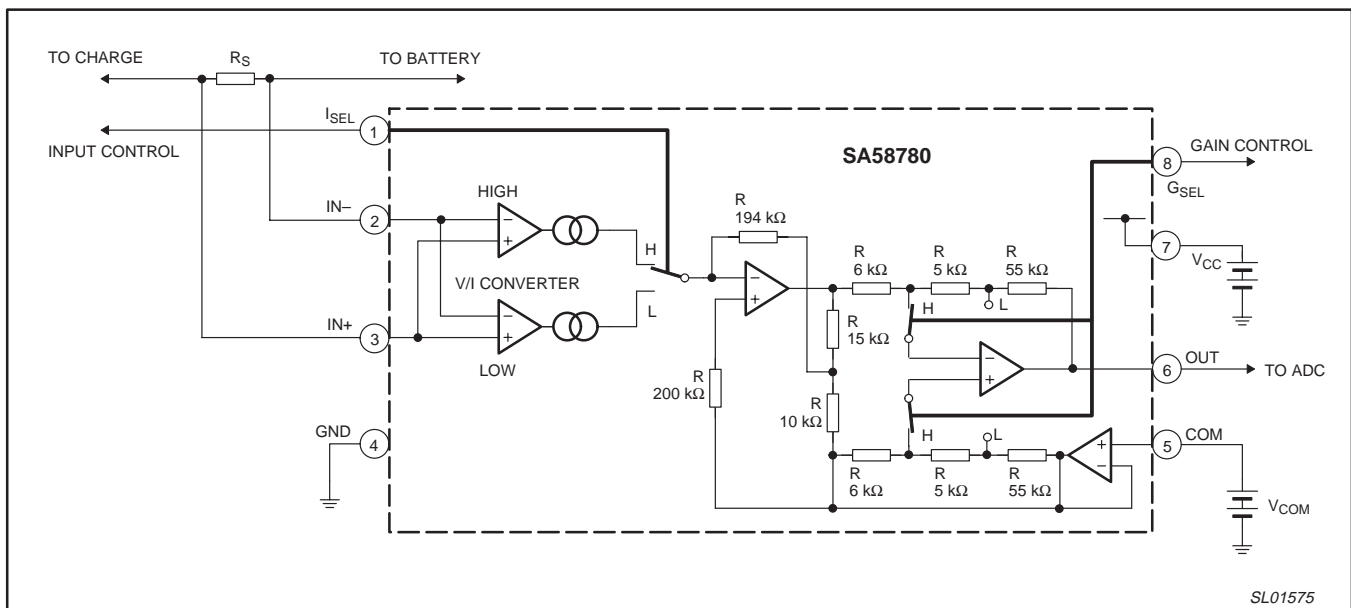


Figure 1. Simplified device diagram.

# Sense current amplifier with selectable gain

# SA58780

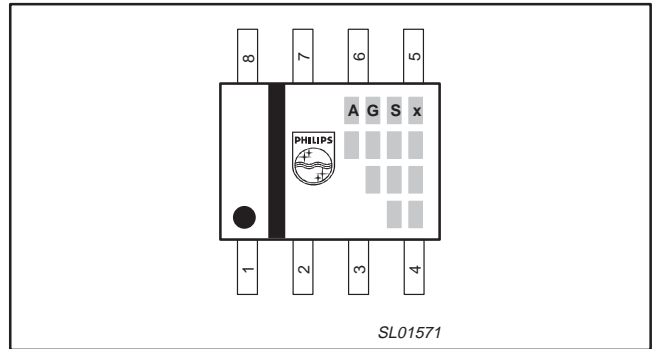
## ORDERING INFORMATION

| TYPE NUMBER | PACKAGE |   | TEMPERATURE RANGE |
|-------------|---------|---|-------------------|
|             | NAME    | DESCRIPTION   |                   |
| SA58780D    | SO8     | plastic small outline package; 8 leads; body width 3.9 mm | -20 to +85 °C     |

## Part number marking

Each device is marked with three or four lines of alphanumeric codes. The first three letters of the top line designate the product. The fourth letter, represented by 'x', is a date tracking code. The remaining lines are for manufacturing codes.

| Part number | Marking |
|-------------|---------|
| SA58780D    | A G S x |



## PIN CONFIGURATION

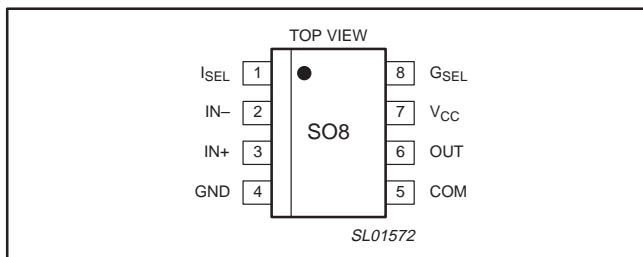


Figure 2. Pin configuration.

## PIN DESCRIPTION AND EQUIVALENT CIRCUITS

| PIN | SYMBOL | DESCRIPTION   | INTERNAL EQUIVALENT CIRCUIT |
|-----|--------|---|-----------------------------|
| 1   | ISEL   | Input common mode range selection<br>HIGH: 1.8 V to 24 V<br>LOW: -0.3 V to $V_{CC} - 2.4$ V |                             |
| 4   | GND    | Ground  |                             |
| 2   | IN-    | Inverting input   |                             |
| 3   | IN+    | Non-inverting input   |                             |

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| PIN | SYMBOL           | DESCRIPTION                                    | INTERNAL EQUIVALENT CIRCUIT |
|-----|------------------|--|-----------------------------|
| 5   | COM              | Reference voltage input                        |                             |
| 6   | OUT              | Output   |                             |
| 7   | V <sub>CC</sub>  | Positive supply                                |                             |
| 8   | G <sub>SEL</sub> | Gain selection<br>HIGH: 100 V/V<br>LOW: 50 V/V |                             |

## MAXIMUM RATINGS

| SYMBOL           | PARAMETER                     | MIN. | MAX. | UNIT |
|------------------|-------------------------------|------|------|------|
| V <sub>CC</sub>  | Single supply voltage         | -0.3 | +25  | V    |
| V <sub>IN</sub>  | Input voltage                 | -0.3 | +25  | V    |
| T <sub>stg</sub> | Storage temperature           | -40  | +125 | °C   |
| T <sub>amb</sub> | Operating ambient temperature | -20  | +85  | °C   |
| P <sub>D</sub>   | Power dissipation             | -    | 300  | mW   |

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**ELECTRICAL CHARACTERISTICS**

$V_{CC} = 5.0\text{ V}$ ;  $V_{ICM} = 15\text{ V}$ ;  $V_{COM} = 25\text{ V}$ ;  $V_{ISEL} = 5\text{ V}$ ;  $V_{GSEL} = 5\text{ V}$ ;  $R_L = 10\text{ k}\Omega$ ;  $T_{amb} = 25\text{ }^\circ\text{C}$ , 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            | $\mu\text{A}$                |
| $G_{V(\text{high})}$     | Voltage gain HIGH                              | $G_{SEL} = 5\text{ V}$   | 97   | 100     | 103            | mV/mV                        |
| $G_{V(\text{low})}$      | Voltage gain LOW                               | $G_{SEL} = 0\text{ V}$   | 48.5 | 50      | 51.5           | mV/mV                        |
| $V_{IO1}$                | Input offset voltage 1                         | $\Delta V_{IN} = 0\text{ V}$ ; $V_{ISEL} = 5\text{ V (HIGH)}$                                  | –0.5 | –       | 0.5            | mV                           |
| $V_{IO2}$                | Input offset voltage 2                         | $\Delta V_{IN} = 0\text{ V}$ ; $V_{ISEL} = 0\text{ V (LOW)}$                                   | –0.5 | –       | 0.5            | mV                           |
| $\Delta V_{IO1}$         | Input offset voltage 1 temperature coefficient | $V_{ISEL} = 5\text{ V}$  | –4   | –       | 4              | $\mu\text{V}/^\circ\text{C}$ |
| $\Delta V_{IO2}$         | Input offset voltage 2 temperature coefficient | $V_{ISEL} = 0\text{ V}$  | –6   | –       | 6              | $\mu\text{V}/^\circ\text{C}$ |
| $V_{I(\text{CM})1}$      | Common mode input voltage range 1              | $V_{ISEL} = 5\text{ V (HIGH)}$   | 1.8  | –       | 24             | V                            |
| $V_{I(\text{CM})2}$      | Common mode input voltage range 2              | $V_{ISEL} = 0\text{ V (LOW)}$  | –0.3 | –       | $V_{CC} - 2.4$ | V                            |
| $V_{I(\text{dif})}$      | Differential input voltage                     |  | –200 | –       | 200            | mV                           |
| $I_{i(\text{bias})1}$    | Input bias current 1                           | $\Delta V_{IN} = 0\text{ V}$ ; $V_{ISEL} = 5\text{ V (HIGH)}$                                  | 0.8  | 1.2     | 1.6            | $\mu\text{A}$                |
| $I_{i(\text{bias})2}$    | Input bias current 2                           | $\Delta V_{IN} = 0\text{ V}$ ; $V_{ISEL} = 0\text{ V (LOW)}$                                   | –0.8 | –1.2    | –1.6           | $\mu\text{A}$                |
| $\Delta V_{IO}/\Delta T$ | Input offset voltage temperature drift         | $T_{amb} = -20\text{ to }+75\text{ }^\circ\text{C}$  | –    | $\pm 1$ | $\pm 3$        | $\mu\text{V}/^\circ\text{C}$ |
| $Z_i$                    | Input impedance                                |  | 100  | –       | –              | $\text{k}\Omega$             |
| $V_{COM}$                | COM voltage range                              | $R_L = \text{open}$  | 1.2  | –       | $V_{CC} - 1.2$ | V                            |
| $I_{SEL}$                | $I_{SEL}$ current                              | $V_{ISEL} = 5\text{ V}$  | –    | 1.0     | –              | $\mu\text{A}$                |
| $V_{ISEL1}$              | $I_{SEL}$ 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                         | $V_{GSEL} = 5\text{ V}$  | –    | 1.0     | –              | $\mu\text{A}$                |
| $V_{GSEL1}$              | $G_{SEL}$ 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                           | $R_L = \text{open}$  | 0.3  | –       | $V_{CC} - 0.3$ | V                            |
| $I_{O(\text{source})}$   | Output source current                          | $V_{OUT} = V_{CC} - 0.3\text{ V}$  | 0.5  | 1.0     | –              | mA                           |
| $I_{O(\text{sink})}$     | Output sink current                            | $V_{OUT} = 0.3\text{ V}$   | –0.5 | –1.0    | –              | mA                           |
| $f_{C1}$                 | Cutoff frequency 1                             | $V_{GSEL} = 5\text{ V}$ ( $G_{V(\text{high})} = 100\text{ V/V}$ );<br>$V_{OUT} = -3\text{ dB}$ | –    | 100     | –              | kHz                          |
| $f_{C2}$                 | Cutoff frequency 2                             | $V_{GSEL} = 0\text{ V}$ ( $G_{V(\text{low})} = 50\text{ V/V}$ );<br>$V_{OUT} = -3\text{ dB}$   | –    | 140     | –              | kHz                          |
| PSRR1                    | Power supply rejection ratio 1                 | $f = 1\text{ kHz}$ ; $V_{ISEL} = 5\text{ V}$   | 70   | 80      | –              | dB                           |
| PSRR2                    | Power supply rejection ratio 2                 | $f = 1\text{ kHz}$ ; $V_{ISEL} = 0\text{ V}$   | 70   | 80      | –              | dB                           |
| CMRR1                    | Common mode rejection ratio 1                  | $f = 1\text{ kHz}$ ; $V_{ISEL} = 5\text{ V}$   | 70   | 80      | –              | dB                           |
| CMRR2                    | Common mode rejection ratio 2                  | $f = 1\text{ kHz}$ ; $V_{ISEL} = 0\text{ V}$   | 70   | 80      | –              | dB                           |

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## APPLICATION INFORMATION

### Battery current sensing circuit

The circuit shown in Figure 3 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.

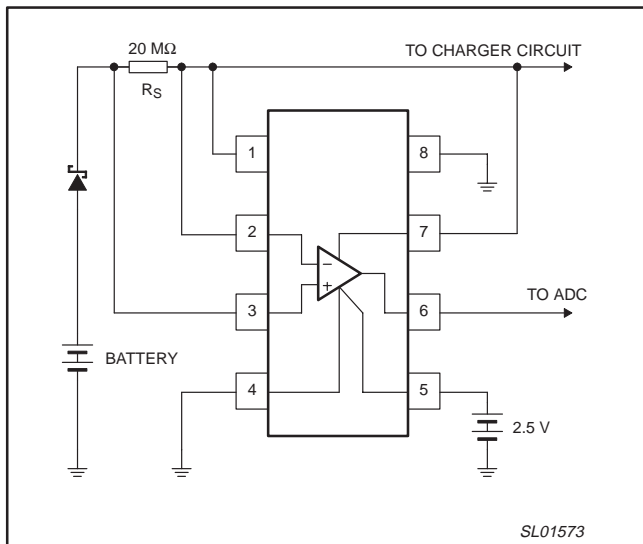


Figure 3. Battery current sensing circuit.

### Charger current sensing

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

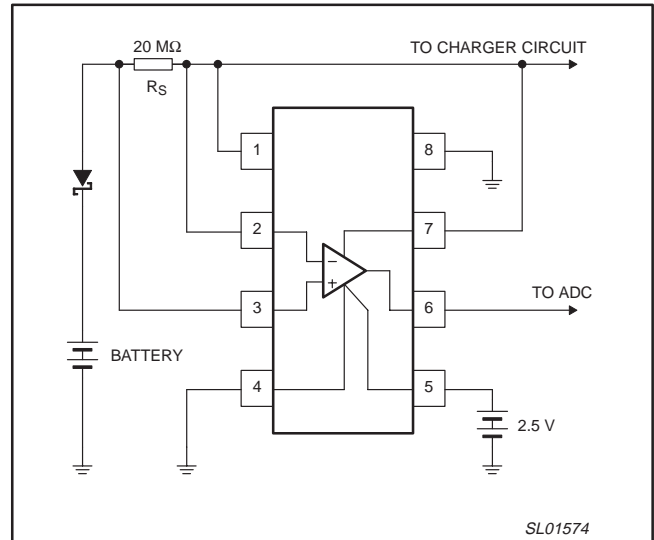


Figure 4. Charger current sensing circuit.

## PACKING METHOD

The SA58780 is packed in reels, as shown in Figure 5.

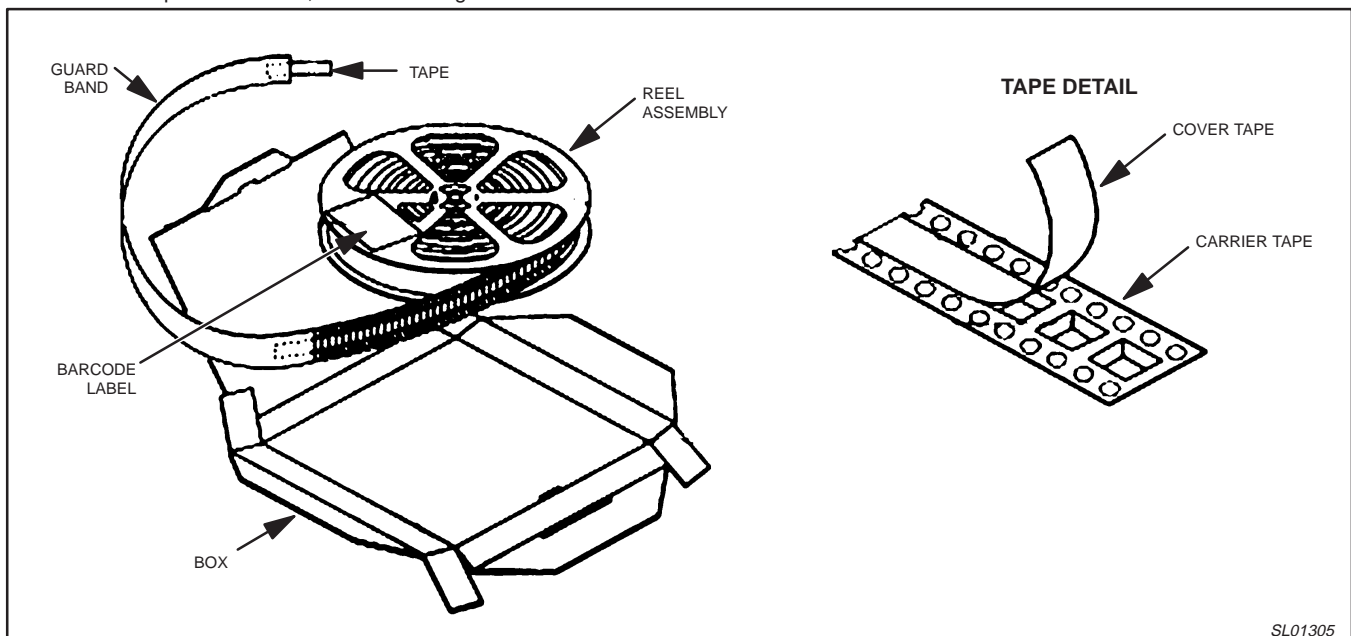
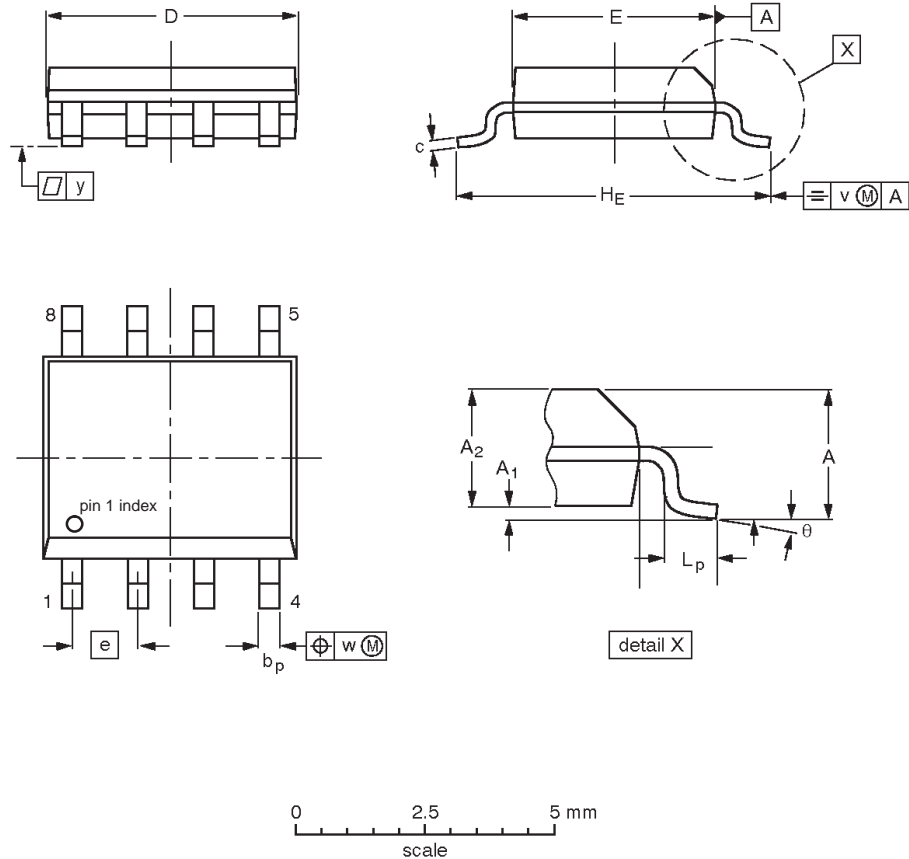


Figure 5. Tape and reel packing method

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



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

| UNIT   | A max. | A <sub>1</sub> | A <sub>2</sub> | B <sub>2</sub> | b <sub>p</sub> | c                | D <sup>(1)</sup> | E <sup>(2)</sup> | e     | H <sub>E</sub> | L <sub>p</sub> | y     | θ        |
|--------|--------|----------------|----------------|----------------|----------------|------------------|------------------|------------------|-------|----------------|----------------|-------|----------|
| mm     | 1.73   | 0.25<br>0.10   | 1.45<br>1.25   | 4.95<br>4.80   | 0.51<br>0.33   | 0.25<br>0.19     | 4.95<br>4.80     | 4.0<br>3.8       | 1.27  | 6.2<br>5.8     | 1.27<br>0.38   | 0.076 | 8°<br>0° |
| inches | 0.068  | 0.010<br>0.004 | 0.057<br>0.049 | 0.189<br>0.195 | 0.013<br>0.020 | 0.0100<br>0.0075 | 0.20<br>0.19     | 0.16<br>0.15     | 0.050 | 0.244<br>0.228 | 0.050<br>0.015 | 0.003 |          |

**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 |        |      |
|-----------------|------------|--------|------|
|                 | IEC        | JEDEC  | EIAJ |
| SO8             | 076E03     | MS-012 |      |

## Sense current amplifier with selectable gain

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## Data sheet status

| Data sheet status <sup>[1]</sup> | Product status <sup>[2]</sup> | Definitions  |
|----------------------------------|-------------------------------|--|
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