

Low cost high-side current sense amplifier

Features

- Independent supply and input common-mode voltages
- Wide common-mode operating range: 2.8 V to 24 V
- Wide supply voltage range: 4 to 24 V
- Low current consumption: I_{CC} max = 1 mA
- Internally fixed gain: 20 V/V, 50 V/V or 100 V/V
- Buffered output

Applications

- Desktop computers and servers SMPS
- Photovoltaic/solar systems
- Battery chargers
- Notebook computers
- DC motor control

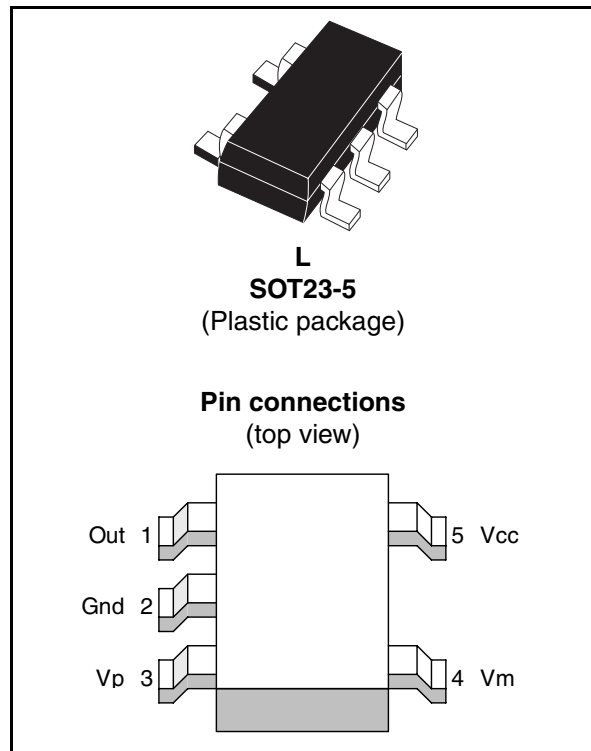
Description

The TSC888 measures a small differential voltage on a high-side shunt resistor and translates it into a ground-referenced output voltage. The gain is internally fixed.

Wide input common-mode voltage range, low quiescent current, and tiny SOT23-5 packaging make the TSC888 ideal for use in a wide variety of applications.

Input common-mode and power supply voltages are independent. Common-mode voltage can range from 2.8 V to 24 V in operating conditions.

Current consumption lower than 1 mA and wide supply voltage range allow to connect the power supply to either side of the current measurement shunt with minimal error.



1 Application schematics and pin description

The TSC888 high-side current-sense amplifier features a 2.8 V to 24 V input common-mode range that is independent of supply voltage. The main advantage of this feature is to allow high-side current sensing at voltages much greater than the supply voltage (V_{CC}). The TSC888 can therefore be supplied by a 5 Vsb line and monitor a 3.3 V, 5 V or 12 V power line. Considering the wide supply voltage operating range (4 V to 24 V) another option available in most cases is to connect the V_{CC} pin to the V_p pin.

Figure 1. Application schematics

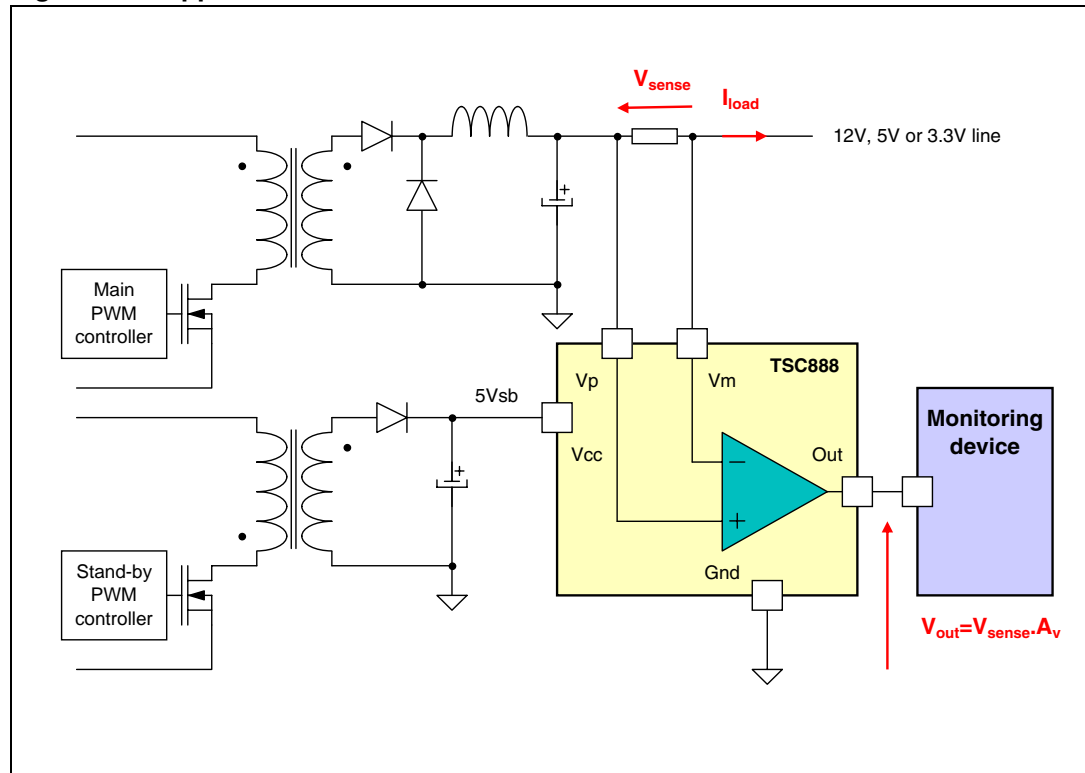


Table 1 describes the function of each pin. Their position is shown in the illustration on the cover page and in Figure 1 above.

Table 1. Pin description

| Symbol | Type | Function |
|--------|---------------|--|
| Out | Analog output | The out voltage is proportional to the magnitude of the sense voltage $V_p - V_m$. |
| Gnd | Power supply | Ground line. |
| Vcc | Power supply | Positive power supply line. |
| Vp | Analog input | Connection for the external sense resistor. The measured current enters the shunt on the V_p side. |
| Vm | Analog input | Connection for the external sense resistor. The measured current exits the shunt on the V_m side. |

2 Absolute maximum ratings and operating conditions

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|------------|--|------------------|------|
| V_{id} | Input pins differential voltage ($V_p - V_m$) | ± 2 | V |
| V_{in} | Input pin voltages (V_p, V_m) ⁽¹⁾ | -0.3 to 30 | V |
| V_{CC} | DC supply voltage ⁽¹⁾ | -0.3 to 25 | V |
| V_{out} | DC output pin voltage ⁽¹⁾ | -0.3 to V_{CC} | V |
| T_{stg} | Storage temperature | -55 to 150 | °C |
| T_j | Maximum junction temperature | 150 | °C |
| R_{thja} | SOT23-5 thermal resistance junction to ambient | 250 | °C/W |
| ESD | Human body model (HBM) ⁽²⁾ | 1 | kV |
| | Machine model (MM) ⁽³⁾ | 100 | V |

1. Voltage values are measured with respect to the Gnd pin.
2. Human body model: 100 pF discharged through a 1.5k Ω resistor between two pins of the device, done for all couples of pin combinations with other pins floating.
3. Machine model: a 200 pF cap is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω), done for all couples of pin combinations with other pins floating.

Table 3. Operating conditions

| Symbol | Parameter | Value | Unit |
|------------|--|-----------|------|
| V_{CC} | DC supply voltage from T_{min} to T_{max} | 4.0 to 24 | V |
| T_{oper} | Operational temperature range (T_{min} to T_{max}) | -40 to 85 | °C |
| V_{icm} | Common mode operating range | 2.8 to 24 | V |

3 Electrical characteristics

The electrical characteristics given in the following tables are measured under the following test conditions unless otherwise specified:

$$T_{amb}=25^{\circ}\text{C}, V_{CC}=5\text{V}, V_{sense}=V_p-V_m=50\text{mV}, V_m=12\text{V}, \text{no load on Out}$$

Table 4. Supply

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------|----------------------|-----------------|------|------|------|------|
| I_{CC} | Total supply current | $V_{sense} = 0$ | | | 1 | mA |

Table 5. Input

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------|--|---|------|------|------|---------------|
| CMR | DC common mode rejection Variation of V_{out} versus V_{icm} referred to input | $2.8\text{V} < V_{icm} < 24\text{V}$ $V_{sense} = 30\text{mV}$ | | 95 | | dB |
| SVR | Supply voltage rejection Variation of V_{out} versus V_{CC} referred to input | $4.0\text{V} < V_{CC} < 24\text{V}$ $V_{sense} = 30\text{mV}$ | | 95 | | dB |
| I_{lk} | Input leakage current | $V_{CC}=0\text{V}$ | | | 1 | μA |
| I_{ib} | Input bias current | $V_{sense}=0\text{V}$ | | 5.5 | 8 | μA |

Table 6. Output

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|------------------|--|--|------|-----------------|---------|------|
| A_v | Gain | TSC888A TSC888B TSC888C | | 20 50 100 | | V/V |
| ΔV_{out} | Total output voltage accuracy | | | | ± 6 | % |
| I_{sc} | Short-circuit current | OUT connected to V_{CC} or GND | 2 | | | mA |
| V_{OH} | Output stage high-state saturation voltage $V_{OH}=V_{CC}-V_{out}$ | $V_{sense}=1\text{V}$ $I_{out}=1\text{mA}$ | | 0.8 | 1 | V |
| V_{OL} | Output stage low-state saturation voltage | $V_{sense}=-1\text{V}$ $I_{out}=1\text{mA}$ | | 50 | 100 | mV |

4 Package information

In order to meet environmental requirements, STMicroelectronics offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an STMicroelectronics trademark. ECOPACK specifications are available at: www.st.com.

Figure 2. SOT23-5 package mechanical drawing

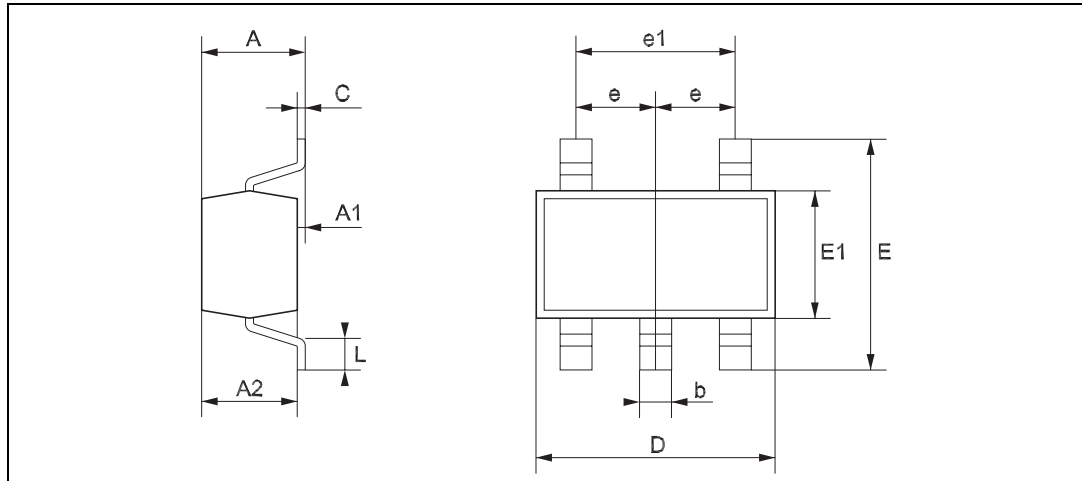


Table 7. SOT23-5 package mechanical data

| Ref. | Dimensions | | | | | |
|------|-------------|------|------|-------|------|-------|
| | Millimeters | | | Mils | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 0.90 | | 1.45 | 35.4 | | 57.1 |
| A1 | 0.00 | | 0.15 | 0.00 | | 5.9 |
| A2 | 0.90 | | 1.30 | 35.4 | | 51.2 |
| b | 0.35 | | 0.50 | 13.7 | | 19.7 |
| C | 0.09 | | 0.20 | 3.5 | | 7.8 |
| D | 2.80 | | 3.00 | 110.2 | | 118.1 |
| E | 2.60 | | 3.00 | 102.3 | | 118.1 |
| E1 | 1.50 | | 1.75 | 59.0 | | 68.8 |
| e | | 0.95 | | | 37.4 | |
| e1 | | 1.9 | | | 74.8 | |
| L | 0.35 | | 0.55 | 13.7 | | 21.6 |

5 Ordering information

Table 8. Order codes

| Order code | Temperature range | Package | Packaging | Marking | Gain |
|------------|-------------------|---------|-------------|---------|------|
| TSC888AILT | -40°C, +85°C | SOT23-5 | Tape & reel | O111 | 20 |
| TSC888BILT | | | | O112 | 50 |
| TSC888CILT | | | | O113 | 100 |

6 Revision history

Table 9. Document revision history

| Date | Revision | Changes |
|-------------|----------|------------------|
| 26-Jun-2008 | Rev 1 | Initial release. |

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