

## 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

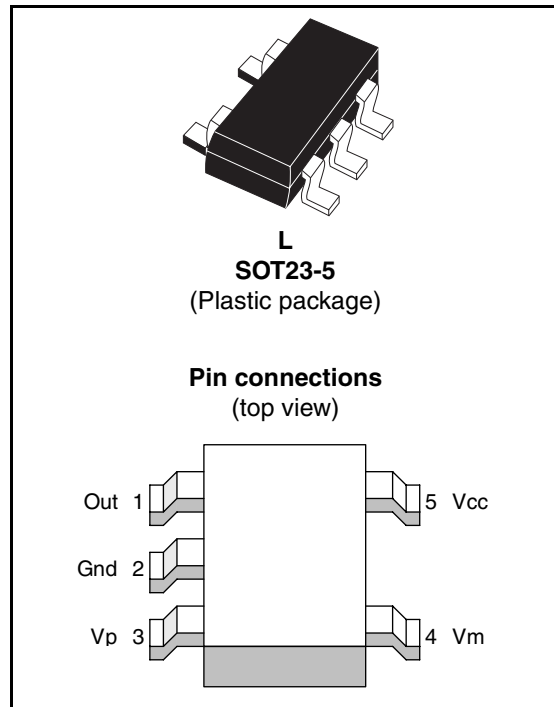
### Description

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.

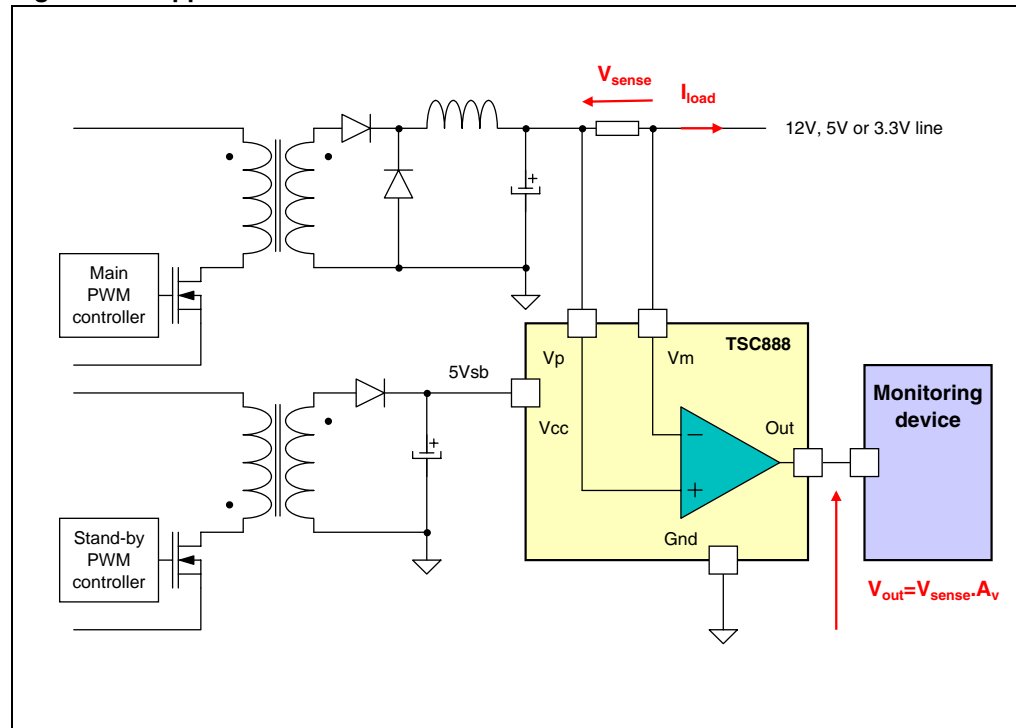
Current consumption lower than 1 mA and wide supply voltage range allow to connect the power supply to either side of the current measurement shunt with minimal error.



# 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 ( $V_p - V_m$ )	$\pm 2$	V
$V_{in}$	Input pin voltages ( $V_p, V_m$ ) <sup>(1)</sup>	-0.3 to 30	V
$V_{CC}$	DC supply voltage <sup>(1)</sup>	-0.3 to 25	V
$V_{out}$	DC output pin voltage <sup>(1)</sup>	-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) <sup>(2)</sup>	1	kV
	Machine model (MM) <sup>(3)</sup>	100	V

1. Voltage values are measured with respect to the Gnd pin.
2. Human body model: 100 pF discharged through a 1.5k $\Omega$  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  $\Omega$ ), 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:

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

**Table 4. Supply**

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

**Table 5. Input**

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

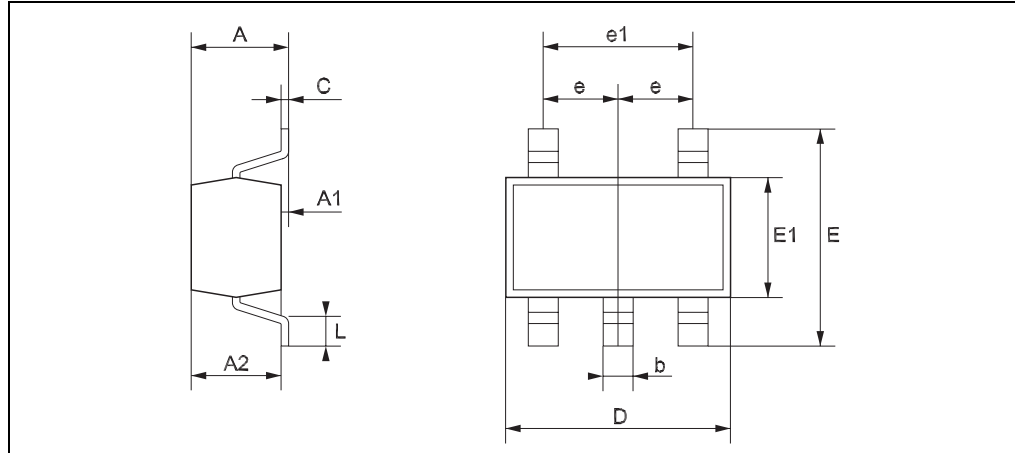
**Table 6. Output**

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

## 4 Package information

In order to meet environmental requirements, STMicroelectronics offers these devices in ECOPACK<sup>®</sup> 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](http://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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