

## 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

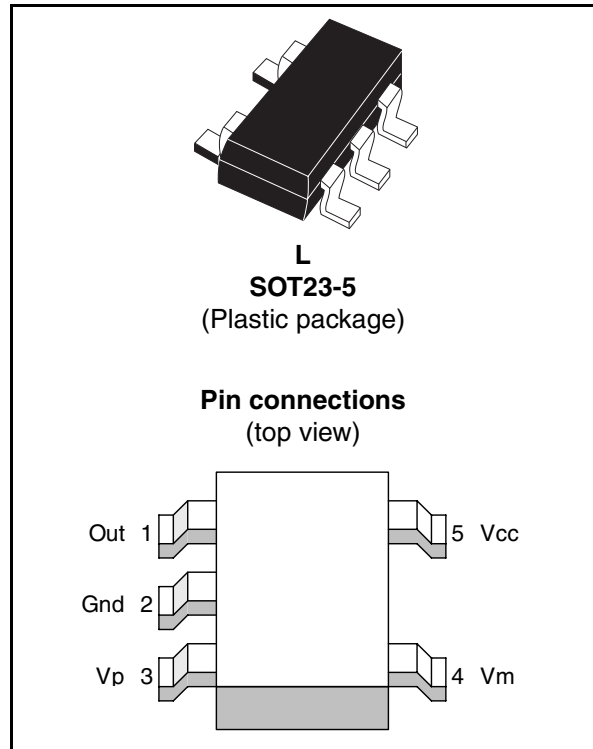
### Description

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**

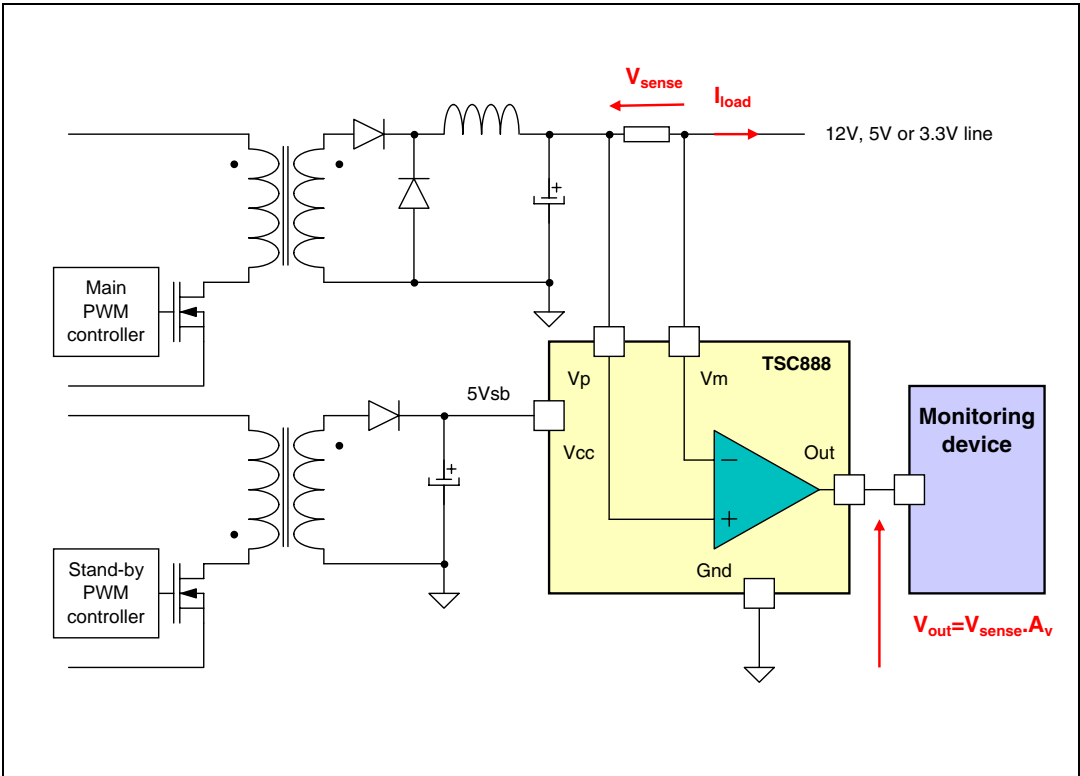


Table 1 describes the function of each pin. Their position is shown in the illustration on the cover page and in Figure 1 above.

**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:

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

**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	$\mu\text{A}$
$I_{ib}$	Input bias current	$V_{sense}=0\text{V}$		5.5	8	$\mu\text{A}$

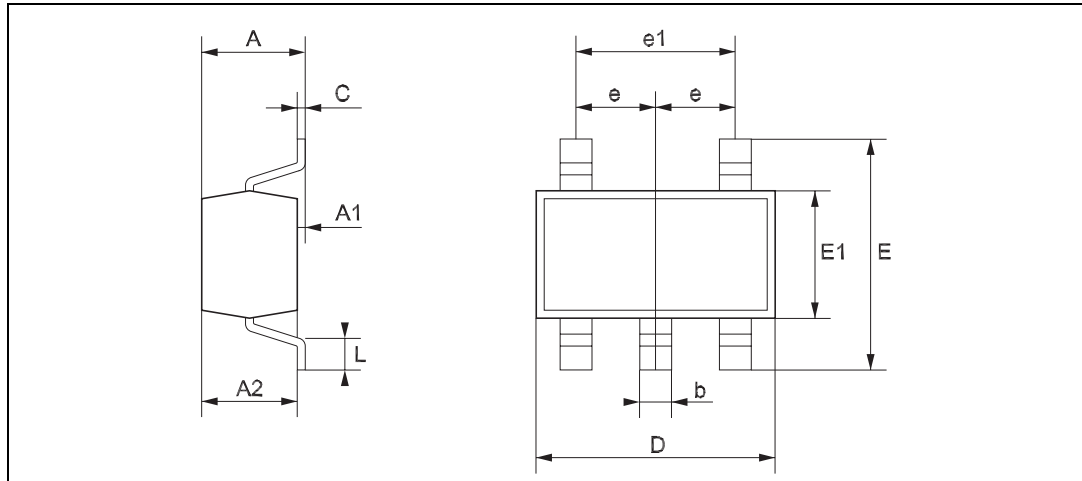
**Table 6. Output**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$A_v$	Gain	TSC888A TSC888B TSC888C		20 50 100		V/V
$\Delta V_{out}$	Total output voltage accuracy				$\pm 6$	%
$I_{sc}$	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](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.

**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2008 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)

