

# **TS821**

## 1.225V micropower shunt voltage reference

### Features

- 1.225V typical output voltage
- Ultra low operating current: 45µA maximum at 25°C
- High precision @ 25°C
  - +/- 2% (standard version)
  - +/- 1% (A grade)
  - +/- 0.5% (B grade)
- High stability when used with capacitive loads
- Industrial temperature range: -40°C to +85°C
- 120ppm/°C maximum temperature coefficient

### Applications

- Computers
- Instrumentation
- Battery chargers
- Switch mode power supply
- Battery operated equipment

### Description

The TS821 is a low power shunt voltage reference providing a stable 1.225V output voltage over the industrial temperature range (-40°C to +85°C). Availabe in SOT23-3 surface mount package, it can be designed in applications where space saving is critical.

The low operating current is a key advantage for power restricted designs. In addition, the TS821 is very stable and can be used in a broad range of application conditions.



### 1

## Absolute maximum ratings and operating conditions

Symbol	Parameter	Value	Unit
I <sub>k</sub>	Reverse breakdown current	20	mA
۱ <sub>f</sub>	Forward current	10	mA
Pd	Power dissipation <sup>(1)</sup> SOT23-3	360	mW
T <sub>stg</sub>	Storage temperature	-65 to +150	°C
	Human body model (HBM) <sup>(2)</sup>	2	kV
230	Machine model (MM) <sup>(3)</sup>	200	V
T <sub>lead</sub>	Lead temperature (soldering, 10 seconds)	260	°C

Table 1. Absolute maximum ratings (AMR)

1.  $P_d$  is calculated with  $T_{amb} = 25^{\circ}C$  and  $T_j = 150^{\circ}C$  and  $R_{thja} = 340^{\circ}C/W$  for the SOT23-3L package.

2. Human body model: 100pF discharged through a  $1.5k\Omega$  resistor between two pins of the device, done for all couples of pin combinations with other pins floating.

 Machine model: a 200pF cap is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5Ω), done for all couples of pin combinations with other pins floating.

Table 2.	Operating	conditions
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Symbol	Parameter	Value	Unit
I <sub>min</sub>	Minimum operating current	45	μΑ
I <sub>max</sub>	Maximum operating current	12	mA
T <sub>oper</sub>	Operating free air temperature range	-40 to +85	°C



### TS821

## 2 Electrical characteristics

Table 3.	TS821 (2% precision) T <sub>amb</sub>	= 25°C <sup>(1)</sup> (unless	otherwise specified)
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Symbol	Parameter	Test conditions		Тур.	Max.	Unit
	Reverse breakdown voltage	I <sub>k</sub> = 100μA	1.200	1.225	1.250	V
V <sub>k</sub>	Reverse breakdown voltage tolerance	$I_{k} = 100\mu A$ -40°C < T <sub>amb</sub> < +85°C	-25 +34		+25 +34	mV
	Minimum operating current	$T_{amb} = 25^{\circ}C$		40	45	
<sup>I</sup> k-min		$-40^{\circ}\text{C} < \text{T}_{amb} < +85^{\circ}\text{C}$			50	μΑ
$\Delta V_{ref} / \Delta T$	Average temperature coefficient	I <sub>k</sub> = 100μA			120	ppm/°C
A)/ /A1	Reverse breakdown voltage change	I <sub>k-min</sub> < I <sub>k</sub> < 1mA -40°C < T <sub>amb</sub> < +85°C		0.3	0.7 1	m\/
Δv <sub>k</sub> /Δi <sub>k</sub>	with operating current range	1mA < I <sub>k</sub> < 12mA -40°C < T <sub>amb</sub> < +85°C		2.5	8 10	IIIV
R <sub>ka</sub>	Static impedance	$\Delta I_k = 45 \mu A$ to 1mA		0.25	0.5	Ω
K <sub>vh</sub>	Long term stability	$I_{k} = 100 \mu A, t = 1000 hrs$		120		ppm
En	Wide band noise	I <sub>k</sub> = 100μA, 10Hz < f < 10kHz		200		nV/√Hz

 Limits are 100% production tested at 25°C. Behavior at the temperature range limits is guaranteed through correlation and by design.

Table 4.	TS821A (1% precision) T <sub>amb</sub>	= 25°C <sup>(1)</sup> (unless	otherwise specified)
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Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
	Reverse breakdown voltage	I <sub>k</sub> = 100μA	1.213	1.225	1.237	V
V <sub>k</sub>	Reverse breakdown voltage tolerance	$I_{k} = 100\mu A$ -40°C < T <sub>amb</sub> < +85°C	-12 -22		+12 +22	mV
I <sub>k-min</sub>	Minimum operating current	$T_{amb} = 25^{\circ}C$		40	45	
		-40°C < T <sub>amb</sub> < +85°C			50	μΑ
$\Delta V_{ref} / \Delta T$	Average temperature coefficient	I <sub>k</sub> = 100μA			120	ppm/°C
Reverse breakdown voltage change		I <sub>k-min</sub> < I <sub>k</sub> < 1mA -40°C < T <sub>amb</sub> < +85°C		0.3	0.7 1	m\/
Δv <sub>k</sub> /Δi <sub>k</sub>	with operating current range	1mA < I <sub>k</sub> < 12mA -40°C < T <sub>amb</sub> < +85°C		2.5	5 7	
R <sub>ka</sub>	Static impedance	$\Delta I_k = 45 \mu A$ to 1mA		0.25	0.5	Ω
K <sub>vh</sub>	Long term stability	$I_{k} = 100 \mu A, t = 1000 hrs$		120		ppm
En	Wide band noise	I <sub>k</sub> = 100μA 10Hz < f < 10kHz		200		nV/√Hz

 Limits are 100% production tested at 25°C. Behavior at the temperature range limits is guaranteed through correlation and by design.



Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit	
	Reverse breakdown voltage	I <sub>k</sub> = 100μA	1.219	1.225	1.231	V	
V <sub>k</sub>	Reverse breakdown voltage tolerance	$I_{k} = 100\mu A$ -40°C < T <sub>amb</sub> < +85°C	-6 -16		+6 +16	mV	
l <sub>k-min</sub>	Minimum operating current	$T_{amb} = 25^{\circ}C$		40	45		
		$-40^{\circ}\text{C} < \text{T}_{amb} < +85^{\circ}\text{C}$			50	μΑ	
$\Delta V_{ref} / \Delta T$	Average temperature coefficient	I <sub>k</sub> = 100μA			120	ppm/°C	
A)/ /A1	Reverse breakdown voltage change	I <sub>k-min</sub> < I <sub>k</sub> < 1mA -40°C < T <sub>amb</sub> < +85°C		0.3	0.7 1	m)/	
$\Delta v_{k'} \Delta v_{k}$ with operating current ra	with operating current range	1mA < I <sub>k</sub> < 12mA -40°C < T <sub>amb</sub> < +85°C		2.5	5 7		
R <sub>ka</sub>	Static impedance	$\Delta I_k = 45 \mu A$ to 1mA		0.25	0.5	W	
K <sub>vh</sub>	Long term stability	$I_k = 100 \mu A, t = 1000 hrs$		120		ppm	
En	Wide band noise	I <sub>k</sub> = 100μA 10Hz < f < 10kHz		200		nV/√Hz	

Table 5.TS821B (0.5% precision)  $T_{amb} = 25^{\circ}C^{(1)}$  (unless otherwise specified)

1. Limits are 100% production tested at 25°C. Behavior at the temperature range limits is guaranteed through correlation and by design.



#### Reference voltage versus cathode current current 12 100 8 Cathode current (µA) Cathode current (mA) 50 4 0 0 -4

1.5

#### Reference voltage versus cathode Figure 2. Figure 1.







-0.5

0

0.5

Reference voltage (V)

1

-8

-1





Figure 5. Static impedance versus temperature



Figure 6. Noise voltage versus frequency



#### Figure 7. Pulse response for Ik=100µA





ЗV

1.225V

Output

2

0

Input





#### 3 **Package information**

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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 8. Test circuit for pulse response at I<sub>k</sub>=100µA









# 4 Ordering information

### Table 6. Order codes

Part number	Precision	Temperature range	Package	Packing	Marking
TS821ILT	2%				L213
TS821AILT	1%	-40°C to +85°C	SOT23-3	Tape & reel	L212
TS821BILT	0.5%				L211

## 5 Revision history

Table 7.	Document	revision	history
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Date	Revision	Changes
10-Nov-2005	1	Initial release.
24-Jul-2007	2	Removed information related to TO-92. Format update.

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