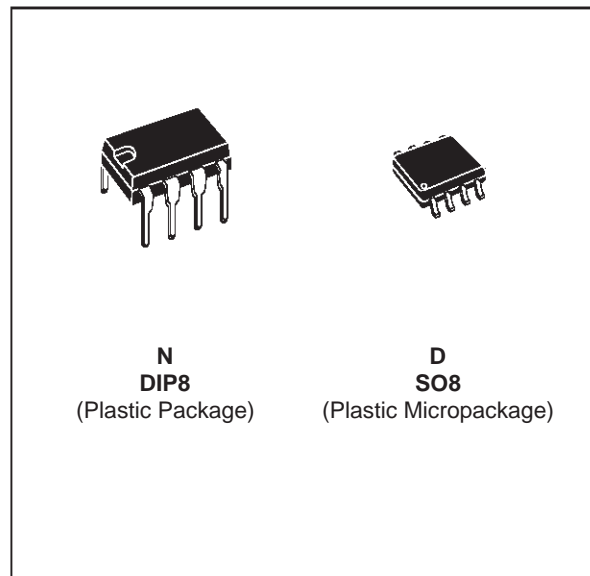




# TS921

## RAIL TO RAIL HIGH OUTPUT CURRENT SINGLE OPERATIONAL AMPLIFIER

- RAIL TO RAIL INPUT AND OUTPUT
- LOW NOISE :  $9\text{nV}/\sqrt{\text{Hz}}$
- LOW DISTORTION
- HIGH OUTPUT CURRENT : **80mA**  
(able to drive  $32\Omega$  loads)
- HIGH SPEED : **4MHz**, **1V/ $\mu\text{s}$**
- OPERATING FROM **2.7V to 12V**
  
- ESD INTERNAL PROTECTION : 1.5KV
- LATCH-UP IMMUNITY



### DESCRIPTION

The TS921 is a RAIL TO RAIL single BiCMOS operational amplifier optimized and fully specified for 3V and 5V operations.

It exhibits a very low noise, low distortion and high output current capability making this device an excellent choice for high quality, low voltage or battery operated audio systems.

The TS921 remains stable when charging the output with capacitive loads up to 500pF.

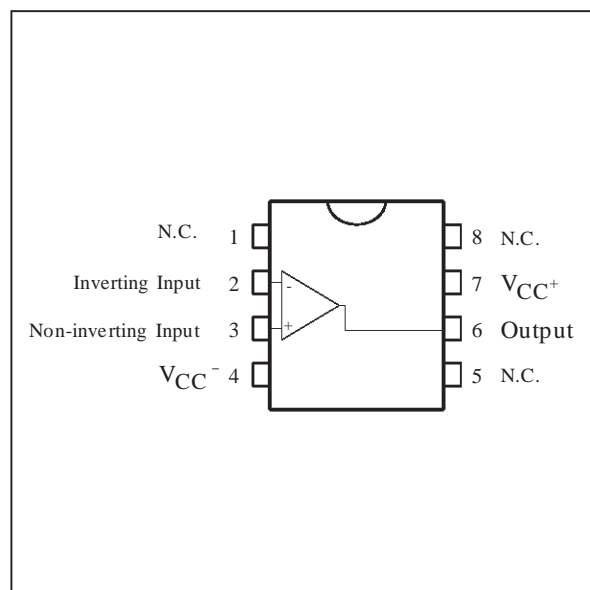
### APPLICATIONS

- headphone amplifier
- piezoelectric speaker
- sound cards, multimedia systems
- line driver, actuator driver
- servo amplifier
- mobile phone and portable communication sets
- instrumentation with low noise as a key factor

### ORDER CODES

Part Number	Temperature Range	Package	
		N	D
TS921I	-40, +125°C	•	•

### PIN CONNECTIONS (top view)



**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply Voltage - (note 1)	12	V
$V_{id}$	Differential Input Voltage - (note 2)	$\pm 1$	V
$V_i$	Input Voltage - (note 3)	-0.3 to 14	V
$T_{oper}$	Operating Free Air Temperature Range	-40 to +125	$^{\circ}\text{C}$
$T_{stg}$	Storage Temperature	-65 to +150	$^{\circ}\text{C}$
$T_j$	Maximum Junction Temperature	150	$^{\circ}\text{C}$
	Output Short Circuit Duration	see note 4	$^{\circ}\text{C}$

**Notes :**

1. All voltage values, except differential voltage are with respect to network ground terminal.
2. Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.
3. The magnitude of input and output voltages must never exceed  $V_{CC}^{+} + 0.3\text{V}$ .
4. Short-circuits can cause excessive heating.

**OPERATING CONDITIONS**

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply Voltage	2.7 to 12	V
$V_{icm}$	Common Mode Input Voltage Range	$V_{CC}^{-} - 0.2$ to $V_{CC}^{+} + 0.2$	V

**ELECTRICAL CHARACTERISTICS**

$V_{CC}^+ = 3V$ ,  $T_{amb} = 25^{\circ}C$  (unless otherwise specified)

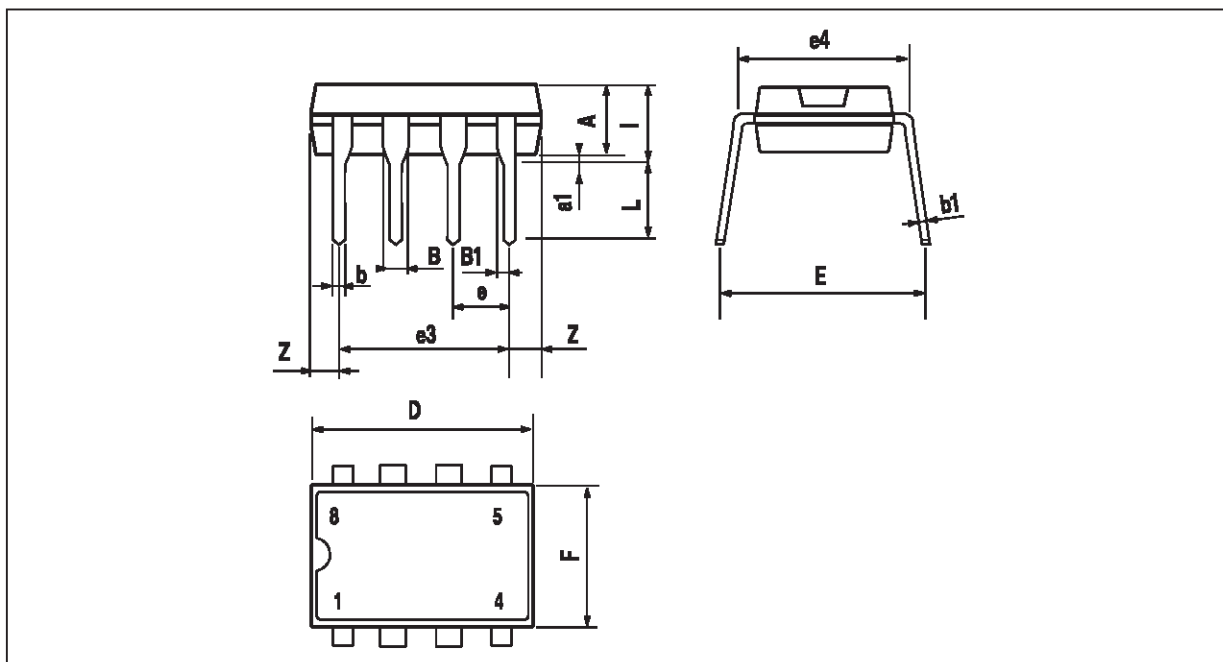
Symbol	Parameter	Min.	Typ.	Max.	Unit
$V_{io}$	Input Offset Voltage $T_{min.} \leq T_{amb} \leq T_{max.}$			3 5	mV
$DV_{io}$	Input Offset Voltage Drift		2		$\mu V/^{\circ}C$
$i_{io}$	Input Offset Current $V_{out} = 1.5V$			30	nA
$i_{ib}$	Input Bias Current $V_{out} = 1.5V$		15	100	nA
$V_{OH}$	High Level Output Voltage $R_L = 600\Omega$ $R_L = 32\Omega$	2.87	2.63		V
$V_{OL}$	Low Level Output Voltage $R_L = 600\Omega$ $R_L = 32\Omega$		180	100	mV
$A_{vd}$	Large Signal Voltage Gain ( $V_{out} = 2V_{pk-pk}$ ) $R_L = 600\Omega$ $R_L = 32\Omega$		35 16		V/mV
$I_{CC}$	Supply Current no load, $V_{out} = V_{CC}/2$		1	1.5	mA
GBP	Gain Bandwidth Product $R_L = 600\Omega$		4		MHz
CMR	Common Mode Rejection Ratio	60	80		dB
SVR	Supply Voltage Rejection Ratio $V_{CC} = 2.7$ to $3.3V$	60	80		dB
$I_o$	Output Short Circuit Current	50	80		mA
SR	Slew Rate	0.7	1		V/ $\mu s$
$\phi_m$	Phase Margin at Unity Gain $R_L = 600\Omega, C_L = 100pF$		68		Degrees
$G_m$	Gain Margin $R_L = 600\Omega, C_L = 100pF$		12		dB
$e_n$	Equivalent Input Noise Voltage $f = 1kHz$		9		$\frac{nV}{\sqrt{Hz}}$
THD	Total Harmonic Distortion $V_{out} = 2V_{pk-pk}, F = 1kHz, A_V = 1, R_L = 600\Omega$		0.005		%

**ELECTRICAL CHARACTERISTICS**

$V_{CC}^+ = 5V$ ,  $T_{amb} = 25^{\circ}C$  (unless otherwise specified)

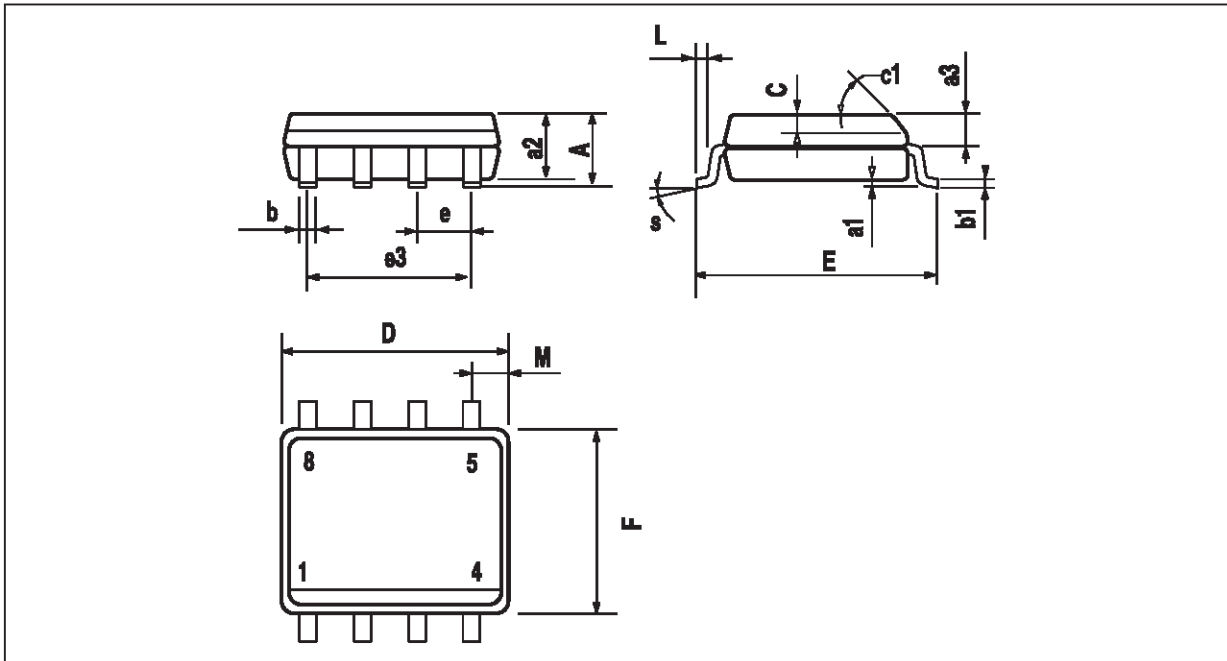
Symbol	Parameter	Min.	Typ.	Max.	Unit
$V_{io}$	Input Offset Voltage $T_{min.} \leq T_{amb} \leq T_{max.}$			3 5	mV
$DV_{io}$	Input Offset Voltage Drift		2		$\mu V/^{\circ}C$
$i_{io}$	Input Offset Current $V_{out} = 1.5V$			30	nA
$i_{ib}$	Input Bias Current $V_{out} = 1.5V$		15	100	nA
$V_{OH}$	High Level Output Voltage $R_L = 600\Omega$ $R_L = 32\Omega$	4.85	4.4		V
$V_{OL}$	Low Level Output Voltage $R_L = 600\Omega$ $R_L = 32\Omega$		300	120	mV
$A_{vd}$	Large Signal Voltage Gain ( $V_{out} = 2V_{pk-pk}$ ) $R_L = 600\Omega$ $R_L = 32\Omega$		35 16		V/mV
$I_{CC}$	Supply Current no load, $V_{out} = V_{CC}/2$		1	1.5	mA
GBP	Gain Bandwidth Product $R_L = 600\Omega$		4		MHz
CMR	Common Mode Rejection Ratio	60	80		dB
SVR	Supply Voltage Rejection Ratio $V_{CC} = 2.7$ to $3.3V$	60	80		dB
$I_o$	Output Short Circuit Current	50	80		mA
SR	Slew Rate	0.7	1		V/ $\mu s$
$\phi_m$	Phase Margin at Unity Gain $R_L = 600\Omega, C_L = 100pF$		68		Degrees
$G_m$	Gain Margin $R_L = 600\Omega, C_L = 100pF$		12		dB
$e_n$	Equivalent Input Noise Voltage $f = 1kHz$		9		$\frac{nV}{\sqrt{Hz}}$
THD	Total Harmonic Distortion $V_{out} = 2V_{pk-pk}, F = 1kHz, A_V = 1, R_L = 600\Omega$		0.005		%

**PACKAGE MECHANICAL DATA**  
**8 PINS - PLASTIC PACKAGE**



Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0.260
i			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060

**PACKAGE MECHANICAL DATA**  
 8 PINS - PLASTIC MICROPACKAGE (SO)



Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.25	0.004		0.010
a2			1.65			0.065
a3	0.65		0.85	0.026		0.033
b	0.35		0.48	0.014		0.019
b1	0.19		0.25	0.007		0.010
C	0.25		0.5	0.010		0.020
c1	45° (typ.)					
D	4.8		5.0	0.189		0.197
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		3.81			0.150	
F	3.8		4.0	0.150		0.157
L	0.4		1.27	0.016		0.050
M			0.6			0.024
S	8° (max.)					

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