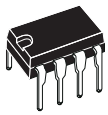
TS522

Precision low noise dual operational amplifier

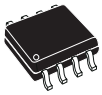
Datasheet −production data

Features

- Large output voltage swing: +14.3 V/-14.6 V
- Low input offset voltage 850 µV max.
- Low voltage noise: 4.5 nV/√Hz
- High gain bandwidth product: 15 MHz
- High slew rate: 7 V/µs
- Low distortion: 0.002%
- ESD internal protection 2 kV
- Excellent frequency stability

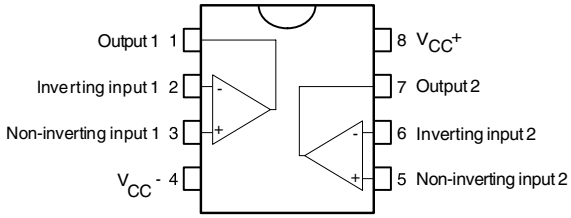


N
DIP8
(plastic package)



D
SO8
(plastic micropackage)

Pin connections
top view



Description

The TS522 device is a monolithic dual operational amplifier mainly dedicated to audio applications. The TS522 device offers a very low input offset voltage as well as low voltage noise (4.5 nV/√Hz) and high dynamic performances (15 MHz gain bandwidth product, 7 V/µs slew rate).

The output stage allows a large output voltage swing and symmetrical source and sink currents.

1 Absolute maximum ratings and operating conditions

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	±18 to 36	V
V_{id}	Differential input voltage(1)	±30	V
V_i	Input voltage(1)	±15	V
	Output short-circuit duration(2)	Infinite	
T_j	Maximum junction temperature	+ 150	°C
T_{stg}	Storage temperature range	-65 to +150	°C
R_{thja}	Thermal resistance junction-to-ambient(3), (4) SO-8 DIP8	 125 85	°C/W
R_{thjc}	Thermal resistance junction-to-case(3), (4) SO-8 DIP8	 40 41	°C/W
ESD	HBM: human body model(5)	2	kV
	MM: machine model(6)	200	V
	CDM: charged device model(7)	1.5	kV

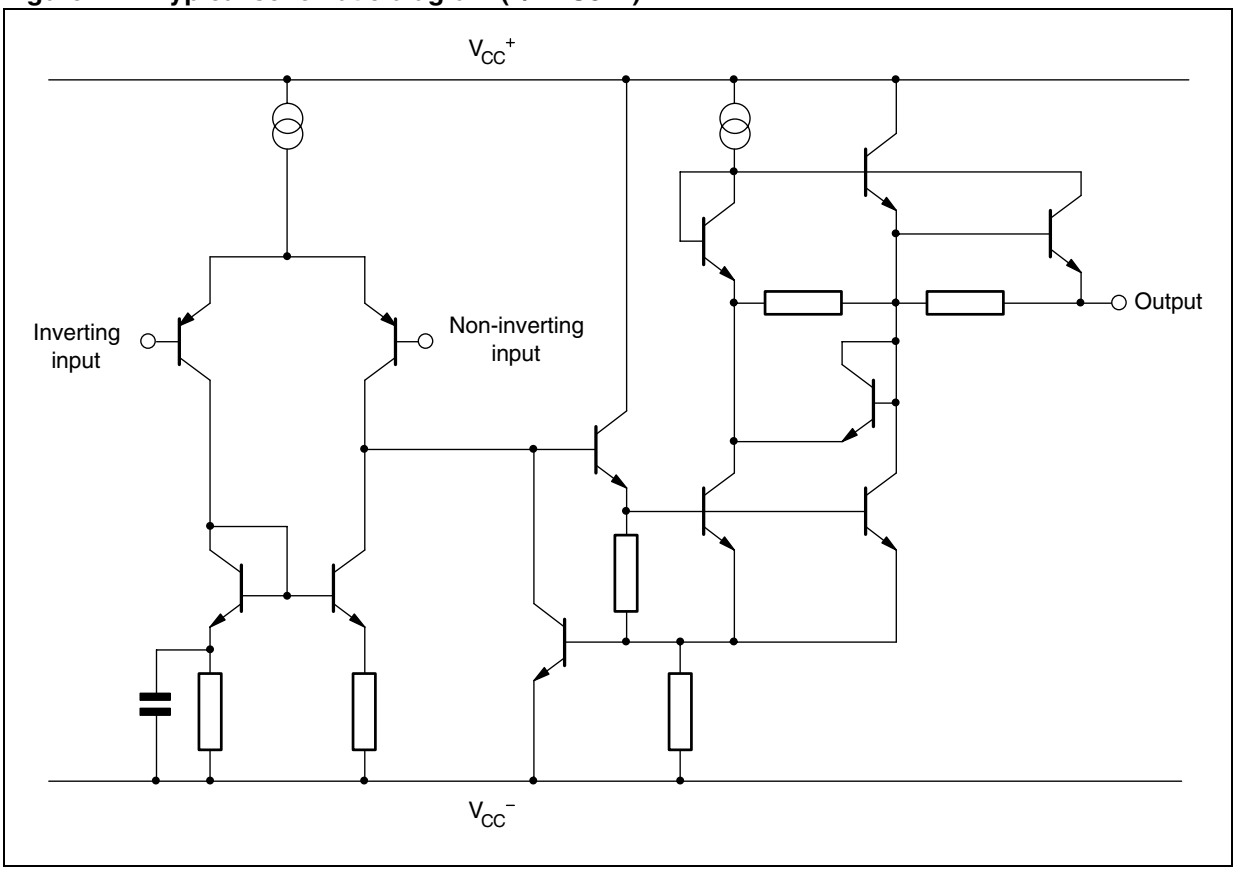
1. Either or both input voltages must not exceed the magnitude of V_{CC}^+ or V_{CC}^-.
2. Power dissipation must be considered to ensure maximum junction temperature (T_j) is not exceeded.
3. Short-circuits can cause excessive heating and destructive dissipation.
4. R_{th} are typical values.
5. Human body model: a 100 pF capacitor is charged to the specified voltage, then discharged through a 1.5 kΩ resistor between two pins of the device. This is done for all couples of connected pin combinations while the other pins are floating.
6. Machine model: a 200 pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω). This is done for all couples of connected pin combinations while the other pins are floating.
7. Charged device model: all pins and the package are charged together to the specified voltage and then discharged directly to ground through only one pin. This is done for all pins.

Table 2. Operating conditions

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	±2.5 to ±15	V
T_{oper}	Operating free air temperature range	-40 to 125	°C

2 Schematic diagram

Figure 1. Typical schematic diagram (1/2 TS522)



3 Electrical characteristics

Table 3. Electrical characteristics at V_{CC}+ = 15 V, V_{CC}- = -15 V, T_{amb} = 25 °C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input offset voltage (V_o = 0 V, V_{ic} = 0 V) T_{amb} = +25 °C $T_{min} \le T_{amb} \le T_{max}$			 0.85 1.7	mV
ΔV_{io}	Input offset voltage drift V_{ic} = 0 V, V_o = 0 V, $T_{min} \le T_{amb} \le T_{max}$		 2		µV/°C
I_{io}	Input offset current (V_{ic} = 0 V, V_o = 0 V) T_{amb} = +25 °C $T_{min} \le T_{amb} \le T_{max}$		 10	 150 175	nA
I_{ib}	Input bias current (V_{ic} = 0 V, V_o = 0 V) T_{amb} = +25 °C $T_{min} \le T_{amb} \le T_{max}$		 250	 750 800	nA
V_{icm}	Common mode input voltage range (ΔV_{io} = 5 mV, V_o = 0 V)	 ±13	 ±14		V
A_{vd}	Large signal voltage gain (R_L = 2 kΩ, V_o = ±10 V) T_{amb} = +25 °C $T_{min} \le T_{amb} \le T_{max}$	 90 85	 100		dB
$\pm V_{opp}$	Output voltage swing (V_{id} = ±1 V) R_L = 600 Ω R_L = 600 Ω R_L = 2.0 kΩ R_L = 2.0 kΩ R_L = 10 kΩ R_L = 10 kΩ	 13.2 13.5	 12.2 -12.7 14 -14.2 14.3 -14.6	 -13.2 -14	V
CMR	Common mode rejection ratio (V_{ic} = ±13 V)	80	100		dB
SVR	Supply voltage rejection ratio V_{CC}^+/V_{CC}^- = +15 V/-15 V to +5 V/-5 V	 80	 105		dB
I_o	Output short-circuit current (V_{id} = ±1 V, output to ground) Source Sink	 15 20	 29 37		mA
I_{CC}	Supply current (V_o = 0 V, all amplifiers) T_{amb} = +25 °C $T_{min} \le T_{amb} \le T_{max}$		 4	 5 5.5	mA
SR	Slew rate (V_i = -10 V to +10 V, R_L = 2 kΩ, C_L = 100 pF, A_V = +1)	5	7		V/µs
GBP	Gain bandwidth product (f = 100 kHz, R_L = 2 kΩ, C_L = 100 pF)	10	15		MHz
B	Unity gain bandwidth (open loop)		9		MHz

Table 3. Electrical characteristics at V_{CC}+ = 15 V, V_{CC}- = -15 V, T_{amb} = 25 °C (unless otherwise specified) (continued)

Symbol	Parameter	Min.	Typ.	Max.	Unit
A_m	Gain margin (R_L = 2 kΩ) C_L = 0 pF C_L = 100 pF		 -11 -6		dB
∅m	Phase margin C_L = 0 pF C_L = 100 pF		 55 30		Degrees
e_n	Equivalent input noise voltage (R_s = 100 Ω, f = 1 kHz)		4.5		$\frac{nV}{\sqrt{Hz}}$
i_n	Equivalent input noise current (f = 1 kHz)		0.5		$\frac{pA}{\sqrt{Hz}}$
THD	Total harmonic distortion R_L = 2 kΩ, f = 20 Hz to 20 kHz, V_o = 3 V_{rms}, A_v = +1		 0.002		%
V_{o1}/V_{o2}	Channel separation (f = 20 Hz to 20 kHz)		120		dB
FPB	Full power bandwidth (V_o = 27 V_{pp}, R_L = 2 kΩ, THD ≤1%)		120		kHz
Z_o	Output impedance (V_o = 0 V, f = 9 MHz)		37		Ω
R_i	Input resistance (V_{ic} = 0 V)		175		kΩ
C_i	Input capacitance (V_{ic} = 0 V)		12		pF

Figure 2. Total supply current vs. supply voltage

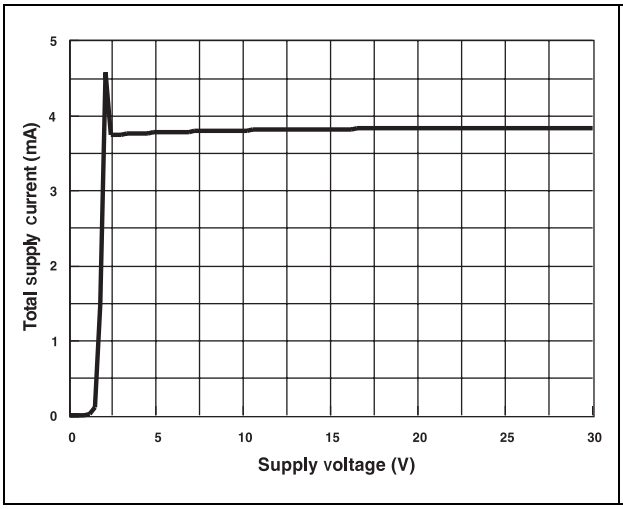


Figure 3. Output short-circuit current vs. output voltage

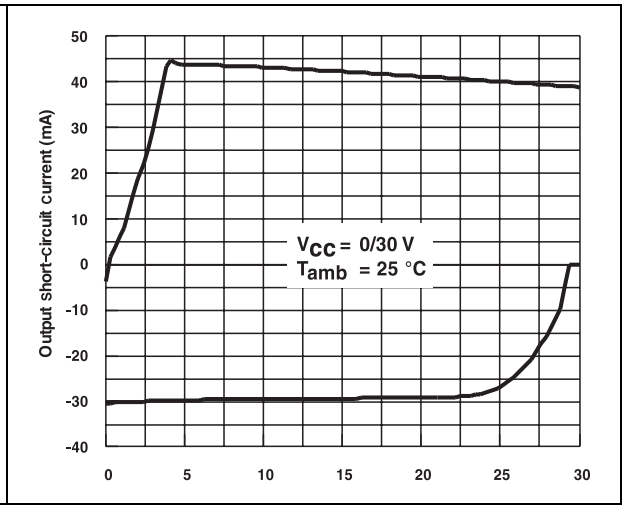


Figure 4. Output voltage vs. supply voltage (V_{id} = ±1 V, R_L = 600 Ω)

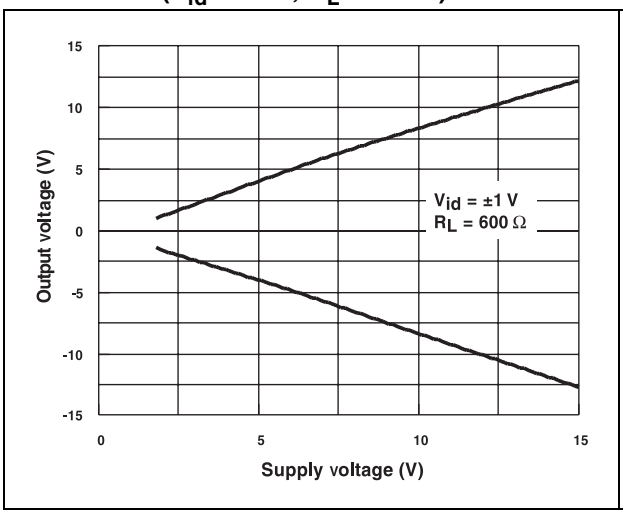


Figure 5. Output voltage vs. supply voltage (V_{id} = ±1 V, R_L = 2 kΩ)

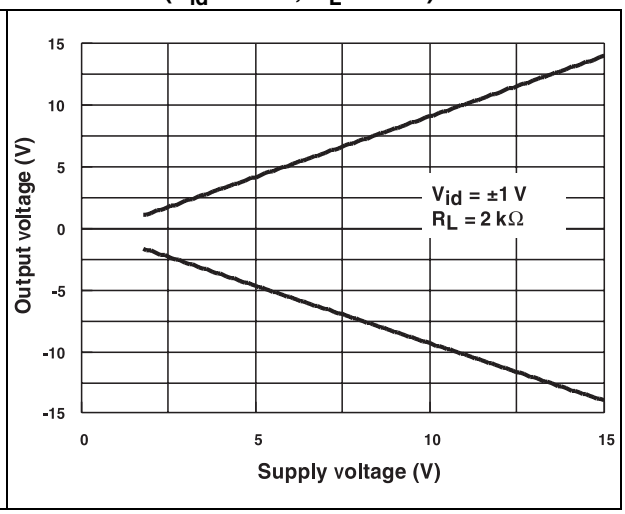


Figure 6. Equivalent input noise voltage vs. frequency

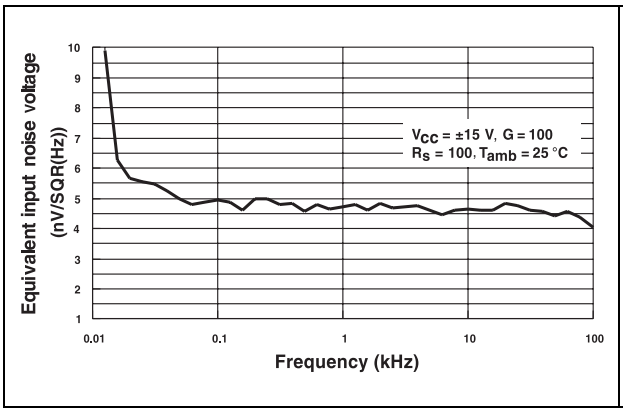


Figure 7. THD + noise vs. frequency

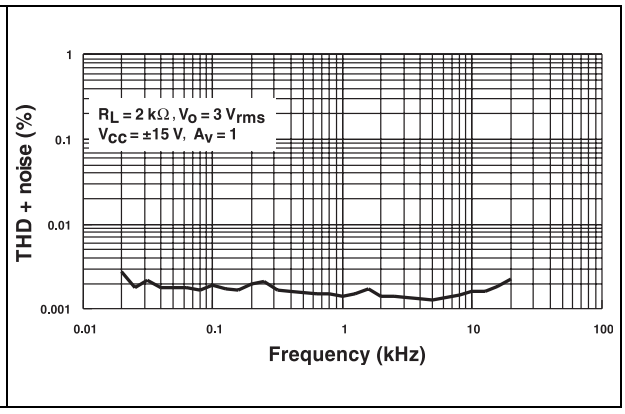


Figure 8. Voltage gain and phase vs. frequency

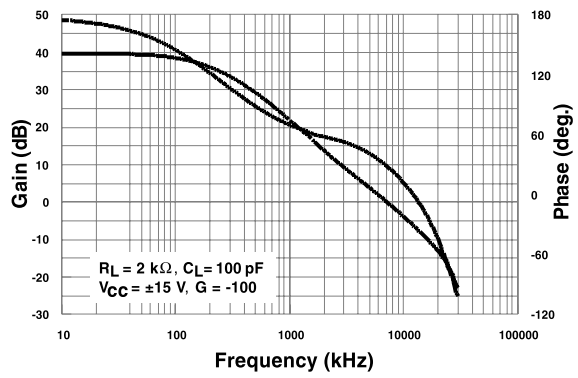
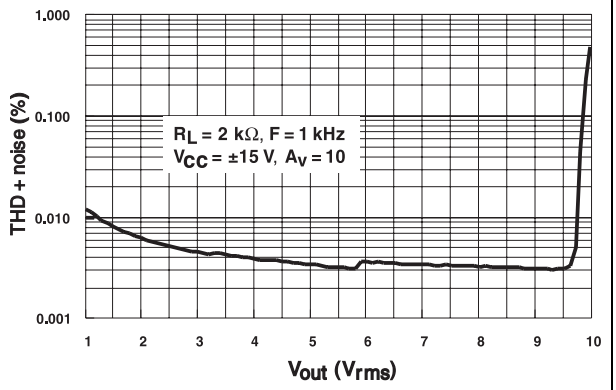


Figure 9. THD + noise vs. V_{out}



4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: *www.st.com*. ECOPACK is an ST trademark.

Figure 10. DIP8 package outline

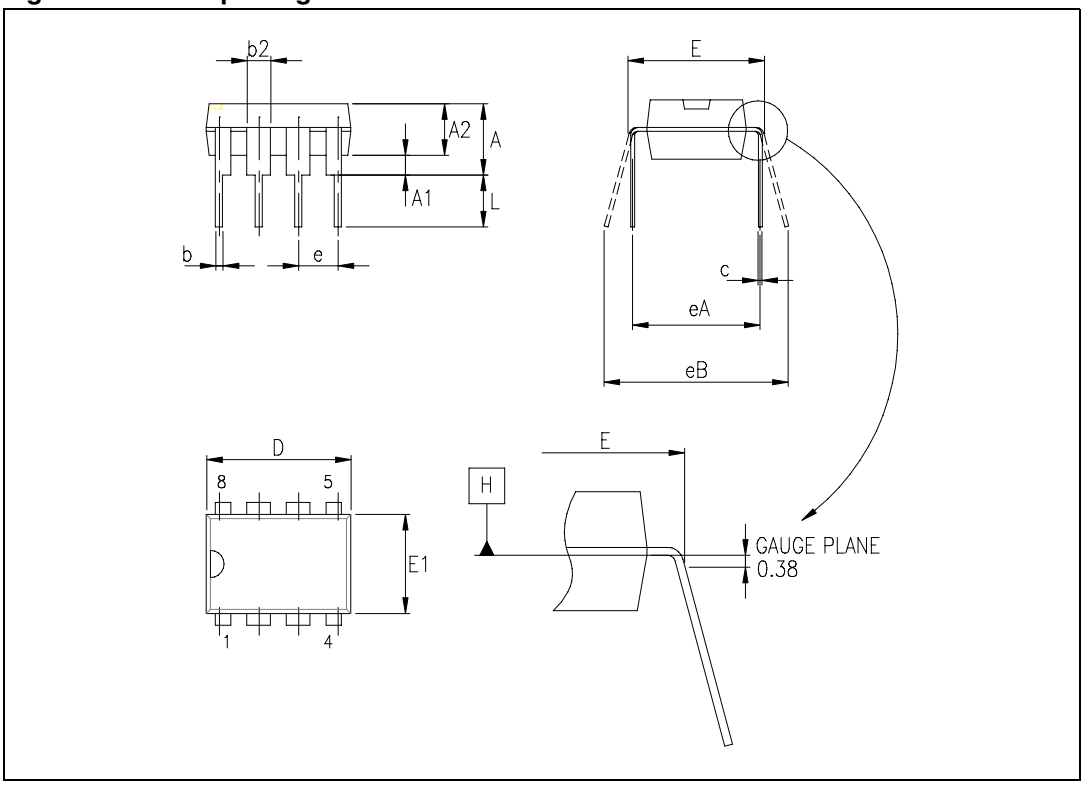


Table 4. DIP8 package mechanical data

Symbol	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			0260
i			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060

Figure 11. SO-8 package outline

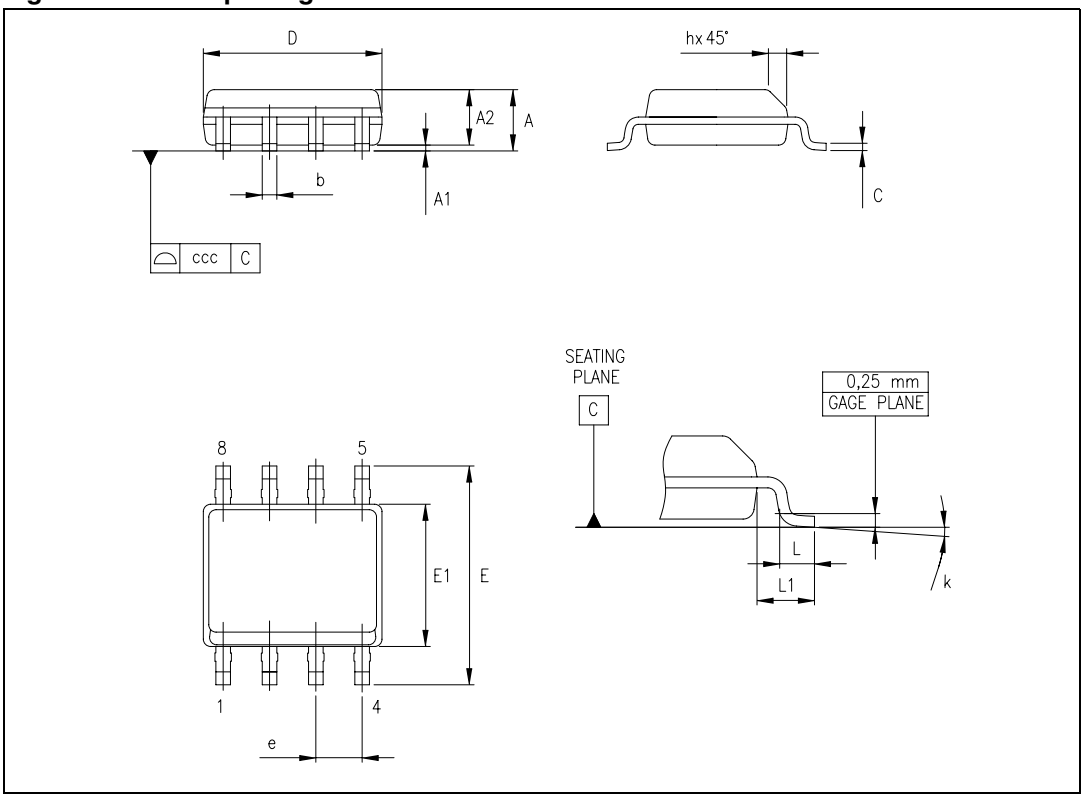


Table 5. SO-8 package mechanical data

Symbol	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
A1	0.10		0.25	0.004		0.010
A2	1.25			0.049		
b	0.28		0.48	0.011		0.019
c	0.17		0.23	0.007		0.010
D	4.80	4.90	5.00	0.189	0.193	0.197
E	5.80	6.00	6.20	0.228	0.236	0.244
E1	3.80	3.90	4.00	0.150	0.154	0.157
e		1.27			0.050	
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
L1		1.04			0.040	
k	1°		8°	1°		8°
ccc			0.10			0.004

5 Ordering information

Table 6. Order codes

Order code	Temperature range	Package	Packing	Marking
TS522ID/DT	-40 to +125 °C	SO-8	Tube/tape and reel	522I
TS522IN	-40 to +125 °C	DIP8	Tube	TS522IN
TS522IYDT(1)	-40 to +125 °C	SO-8 (automotive grade)	Tube/tape and reel	522IY

1. Qualified and characterized according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 and Q 002 or equivalent.

6 Revision history

Table 7. Document revision history

Date	Revision	Changes
01-Nov-2001	1	Initial release.
14-Oct-2008	2	Document reformatted. Added automotive grade order codes in *Table 6: Order codes*. Removed macromodel.
12-Sep-2012	3	Updated *Features* (removed “Macromodel”). Removed TS522IYD order code from *Table 6*. Updated ECOPACK text in *Section 4*. Minor corrections throughout document.

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