



# TS27M2, TS27M2A, TS27M2B

## Low-power CMOS dual operational amplifiers

### Features

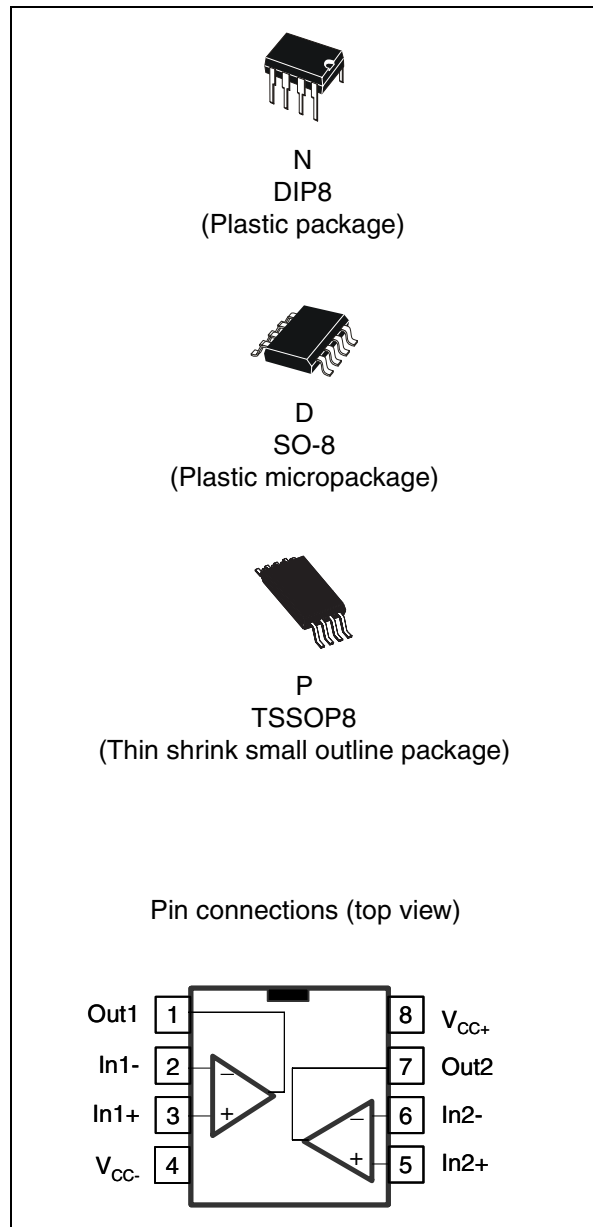
- Wide supply voltage range: 3 to 16 V
- Ultra-low consumption: 150  $\mu\text{A}/\text{op}$  typ
- Output voltage swing to ground
- Excellent phase margin on capacitive load
- Gain bandwidth product: 1 MHz typ
- Vio down to 2 mV max. (B version)

### Description

The TS27x2 series are low-cost and low-power dual operational amplifiers designed to operate with high-voltage single or dual supplies. These operational amplifiers use the ST silicon gate CMOS process, providing an excellent consumption-speed ratio thanks to three different power consumptions, making them ideal for low-consumption applications:

$I_{CC} = 10 \mu\text{A}/\text{amp}$ : TS27L2 (very low power),  
 $I_{CC} = 150 \mu\text{A}/\text{amp}$ : TS27M2 (low power) and  
 $I_{CC} = 1 \text{mA}/\text{amp}$ : TS272 (high speed)

The devices also offer a very high input impedance and extremely low input currents. Their main advantage compared to JFET devices is the very low input current drift with temperature (*Figure 3*).



# 1 Absolute maximum ratings and operating conditions

**Table 1. Absolute maximum ratings**

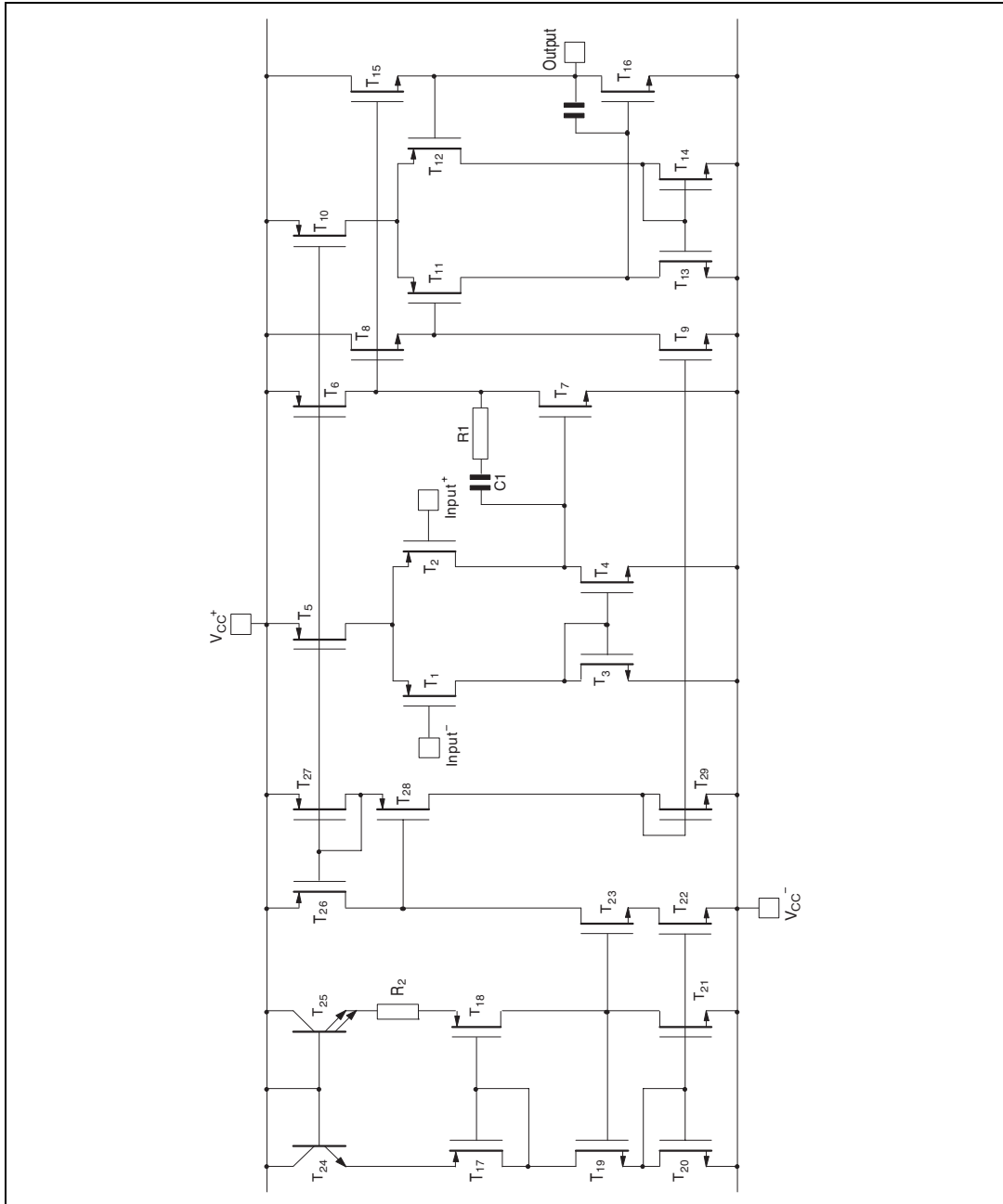
Symbol	Parameter	TS27M2x/Ax/Bx	Unit
$V_{CC}^+$	Supply voltage <sup>(1)</sup>	18	V
$V_{id}$	Differential input voltage <sup>(2)</sup>	$\pm 18$	V
$V_i$	Input voltage <sup>(3)</sup>	-0.3 to 18	V
$I_o$	Output current for $V_{CC}^+ \geq 15V$	$\pm 30$	mA
$I_{in}$	Input current	$\pm 5$	mA
$R_{thja}^{(4)(5)}$	SO-8	125	°C/W
	DIP8	85	
	TSSOP8	120	
$T_{stg}$	Storage temperature range	-65 to +150	°C
$T_j$	Maximum junction temperature	150	°C
ESD	HBM: human body model <sup>(6)</sup>	500	V
	MM: machine model <sup>(7)</sup>	100	V
	CDM: charged device model <sup>(8)</sup>	1.5	kV

- All values, except differential voltage are with respect to network ground terminal.
- Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.
- The magnitude of the input and the output voltages must never exceed the magnitude of the positive supply voltage.
- Short-circuits can cause excessive heating and destructive dissipation.
- $R_{th}$  are typical values.
- Human body model: a 100 pF capacitor is charged to the specified voltage, then discharged through a 1.5 k $\Omega$  resistor between two pins of the device. This is done for all couples of connected pin combinations while the other pins are floating.
- 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  $\Omega$ ). This is done for all couples of connected pin combinations while the other pins are floating.
- Charged device model: all pins and the package are charged together to the specified voltage and then discharged directly to the ground through only one pin. This is done for all pins.

**Table 2. Operating conditions**

Symbol	Parameter	Value			Unit
		TS27M2C/AC/BC	TS27M2I/AI/BI	TS27M2M/AM/BM	
$V_{CC}^+$	Supply voltage	3 to 16			V
$V_{icm}$	Common mode input voltage range	0 to $V_{CC}^+ - 1.5$			V
$T_{oper}$	Operating free air temperature range	0 to +70	-40 to +125	-55 to +125	°C

Figure 1. Simplified schematic diagram (for 1/2 TS27M2)



## 2 Electrical characteristics

**Table 3. Electrical characteristics at  $V_{CC+} = +10\text{ V}$ ,  $V_{CC-} = 0\text{ V}$ ,  $T_{amb} = +25^\circ\text{ C}$  (unless otherwise specified)**

Symbol	Parameter	TS27M2xC			TS27M2xI TS27M2xM			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
<b>DC performance</b>								
$V_{io}$	Input offset voltage $V_O = 1.4\text{ V}$ , $V_{ic} = 0\text{ V}$		1.1	10			10	mV
			0.9	5		1.1	5	
			0.25	2		0.9	2	
	$T_{min} \leq T_{amb} \leq T_{max}$			12		0.25	12	
				6.5			6.5	
			3			3.5		
$DV_{io}$	Input offset voltage drift		2			2		$\mu\text{V}/^\circ\text{C}$
$I_{io}$	Input offset current <sup>(1)</sup> $V_{ic} = 5\text{ V}$ , $V_O = 5\text{ V}$ $T_{min} \leq T_{amb} \leq T_{max}$		1	100		1	200	pA
$I_{ib}$	Input bias current <sup>(1)</sup> $V_{ic} = 5\text{ V}$ , $V_O = 5\text{ V}$ $T_{min} \leq T_{amb} \leq T_{max}$		1	150		1	300	pA
$V_{OH}$	High level output voltage $V_{id} = 100\text{ mV}$ , $R_L = 100\ \Omega$ $T_{min} \leq T_{amb} \leq T_{max}$	8.7	8.9		8.7	8.9		V
$V_{OL}$	Low level output voltage $V_{id} = -100\text{ mV}$			50			50	mV
$A_{vd}$	Large signal voltage gain $V_{ic} = 5\text{ V}$ , $R_L = 100\text{ k}\Omega$ , $V_O = 1\text{ V to }6\text{ V}$ $T_{min} \leq T_{amb} \leq T_{max}$	30	50		30	50		V/mV
		20			10			
CMR	Common mode rejection ratio $V_{ic} = 1\text{ V to }7.4\text{ V}$ , $V_O = 1.4\text{ V}$	65	80		65	80		dB
SVR	Supply voltage rejection ratio $V_{CC+} = 5\text{ V to }10\text{ V}$ , $V_O = 1.4\text{ V}$	60	80		60	80		dB
$I_{CC}$	Supply current (per amplifier) $A_v = 1$ , no load, $V_O = 5\text{ V}$ $T_{min} \leq T_{amb} \leq T_{max}$		150	200		150	200	$\mu\text{A}$
				250			300	
$I_o$	Output short circuit current $V_O = 0\text{ V}$ , $V_{id} = 100\text{ mV}$	45	60			60		mA
$I_{sink}$	Output sink current $V_O = V_{CC}$ , $V_{id} = -100\text{ mV}$	34	45			45		mA

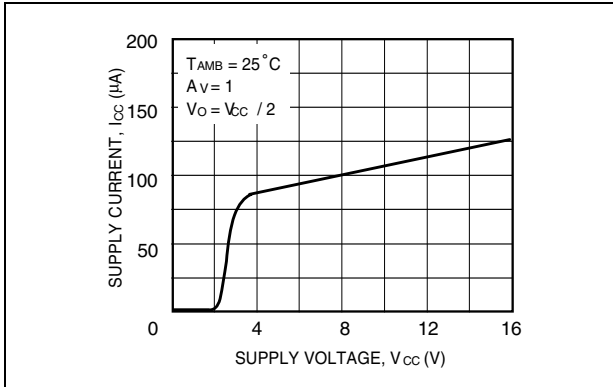
**Table 3. Electrical characteristics at  $V_{CC+} = +10\text{ V}$ ,  $V_{CC-} = 0\text{ V}$ ,  $T_{amb} = +25^\circ\text{ C}$  (unless otherwise specified) (continued)**

Symbol	Parameter	TS27M2xC			TS27M2xI TS27M2xM			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
<b>AC performance</b>								
GBP	Gain bandwidth product $A_v = 40\text{ dB}$ , $R_L = 100\text{ k}\Omega$ , $C_L = 100\text{ pF}$ , $f_{in} = 100\text{ kHz}$	0.5	1		0.5	1		MHz
SR	Slew rate at unity gain $R_L = 100\text{ k}\Omega$ , $C_L = 100\text{ pF}$ , $V_i = 3\text{ to }7\text{ V}$	0.3	0.6		0.3	0.6		V/ $\mu\text{s}$
$\phi_m$	Phase margin at unity gain $A_v = 40\text{ dB}$ , $R_L = 100\text{ k}\Omega$ , $C_L = 100\text{ pF}$		45			45		Degrees
$K_{OV}$	Overshoot factor		30			30		%
$e_n$	Equivalent input noise voltage $f = 1\text{ kHz}$ , $R_s = 100\ \Omega$		38			38		$\frac{\text{nV}}{\sqrt{\text{Hz}}}$
$V_{o1}/V_{o2}$	Channel separation		120			120		dB

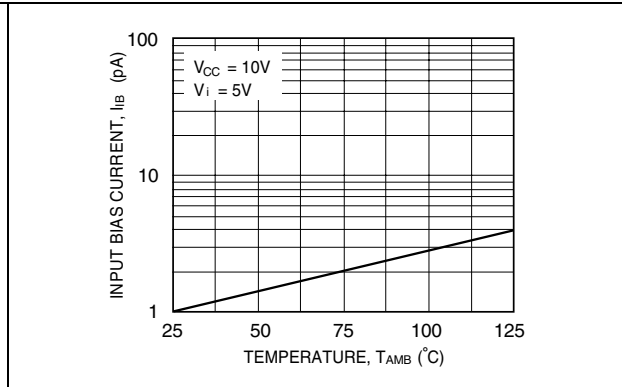
1. Maximum values including unavoidable inaccuracies of industrial tests.

### 3 Typical characteristics

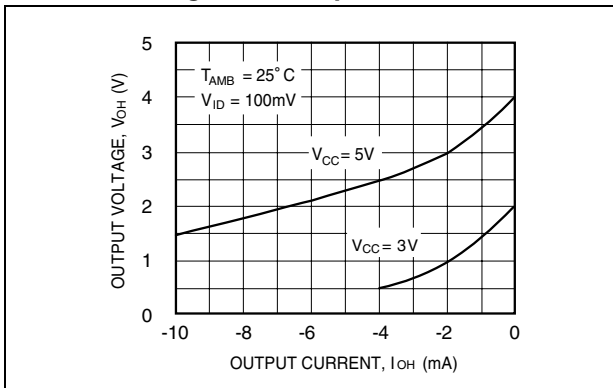
**Figure 2. Supply current (each amplifier) versus supply voltage**



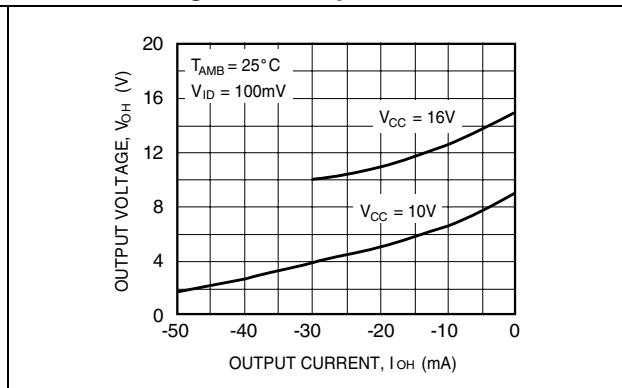
**Figure 3. Input bias current versus free air temperature**



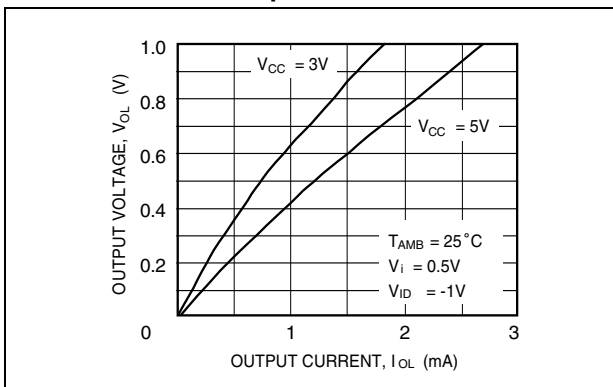
**Figure 4. High level output voltage versus high level output current**



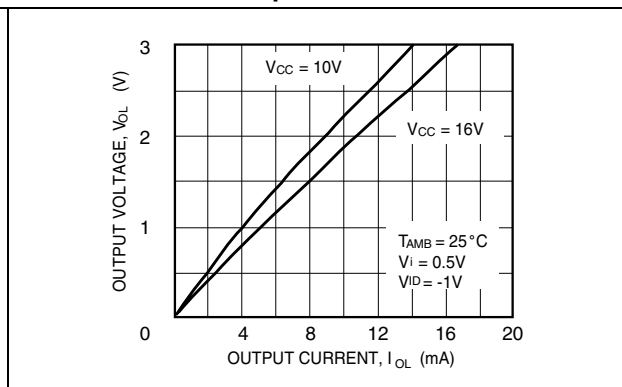
**Figure 5. High level output voltage versus high level output current**



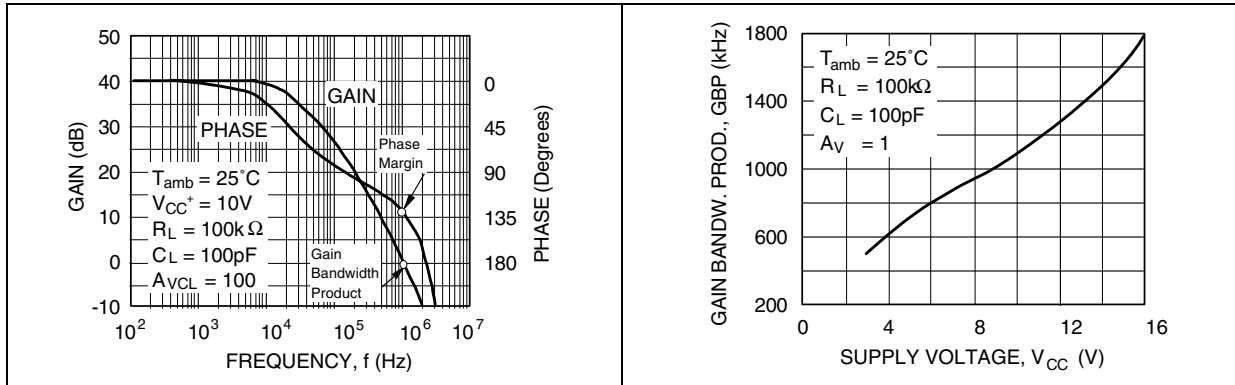
**Figure 6. Low level output voltage versus low level output current**



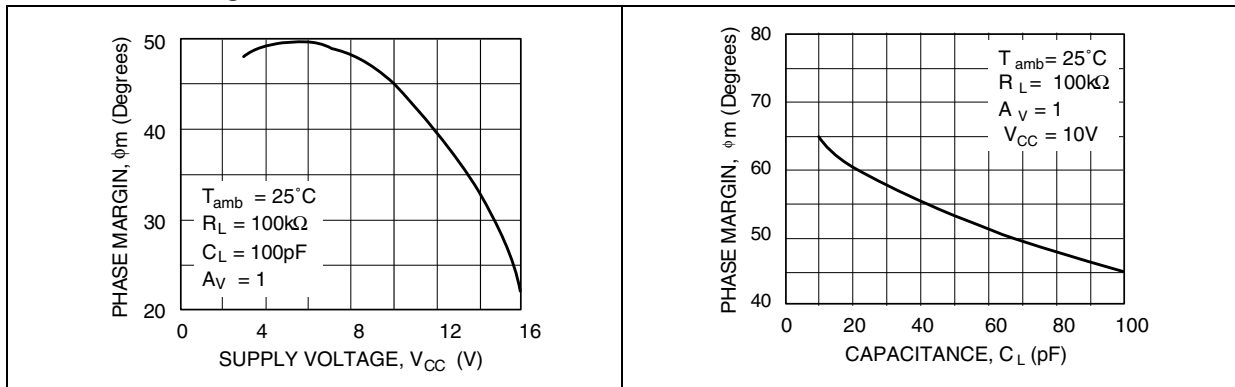
**Figure 7. Low level output voltage versus low level output current**



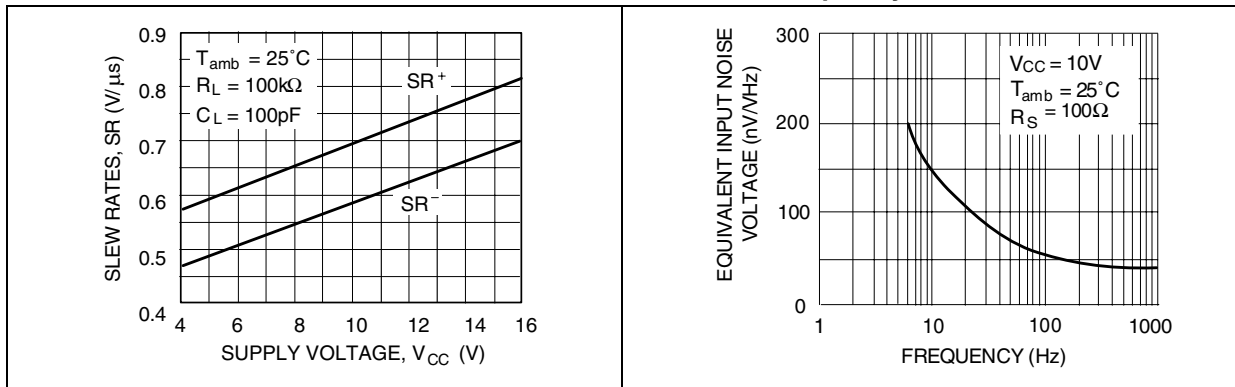
**Figure 8. Open-loop frequency response and phase shift**      **Figure 9. Gain bandwidth product versus supply voltage**



**Figure 10. Phase margin versus supply voltage**      **Figure 11. Phase margin versus capacitive load**



**Figure 12. Slew rate versus supply voltage**      **Figure 13. Input voltage noise versus frequency**



## 4 Package information

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



### 4.1 DIP8 package information

Figure 14. DIP8 package mechanical drawing

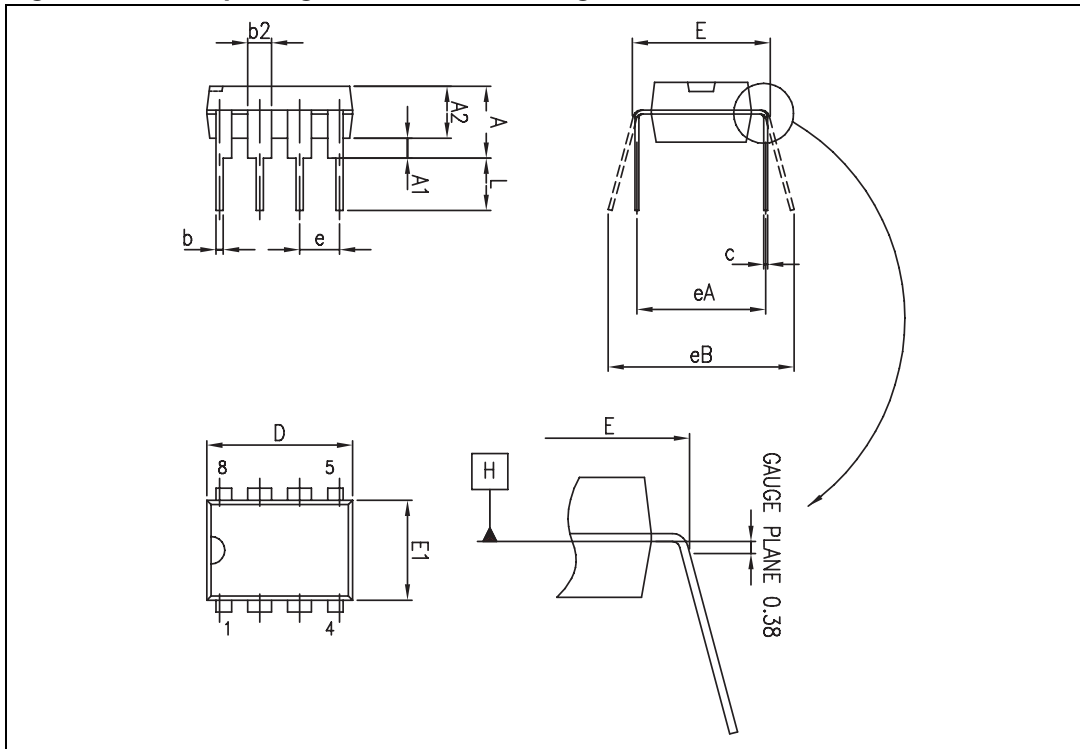


Table 4. DIP8 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			5.33			0.210
A1	0.38			0.015		
A2	2.92	3.30	4.95	0.115	0.130	0.195
b	0.36	0.46	0.56	0.014	0.018	0.022
b2	1.14	1.52	1.78	0.045	0.060	0.070
c	0.20	0.25	0.36	0.008	0.010	0.014
D	9.02	9.27	10.16	0.355	0.365	0.400
E	7.62	7.87	8.26	0.300	0.310	0.325
E1	6.10	6.35	7.11	0.240	0.250	0.280
e		2.54			0.100	
eA		7.62			0.300	
eB			10.92			0.430
L	2.92	3.30	3.81	0.115	0.130	0.150

## 4.2 SO-8 package information

Figure 15. SO-8 package mechanical drawing

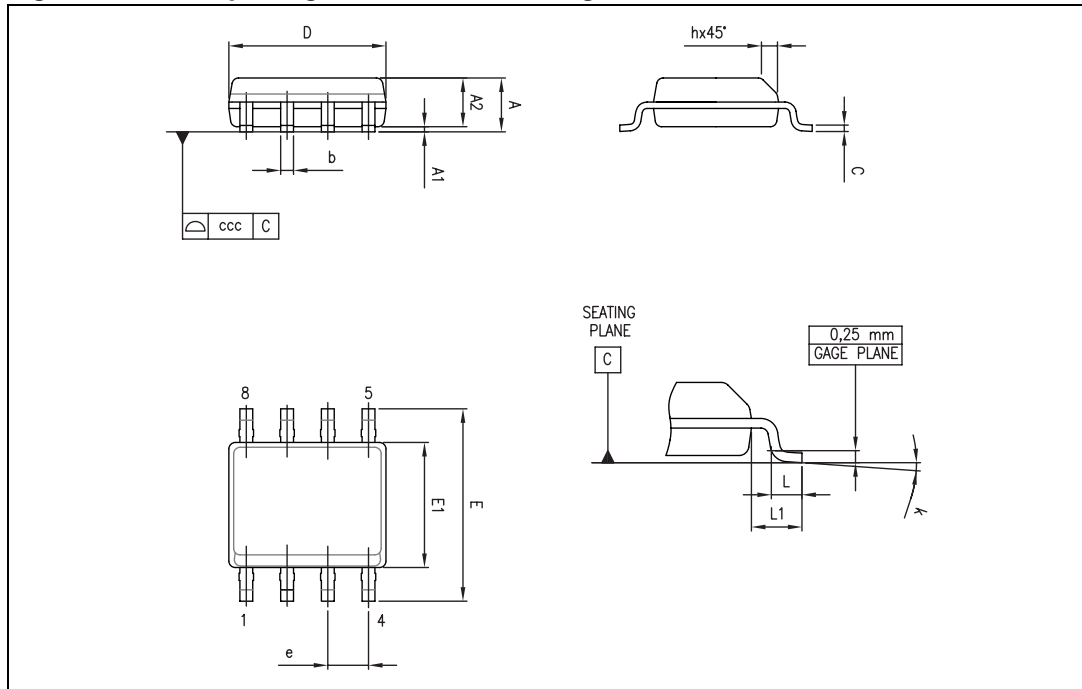


Table 5. SO-8 package mechanical data

Ref.	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

### 4.3 TSSOP8 package information

Figure 16. TSSOP8 package mechanical drawing

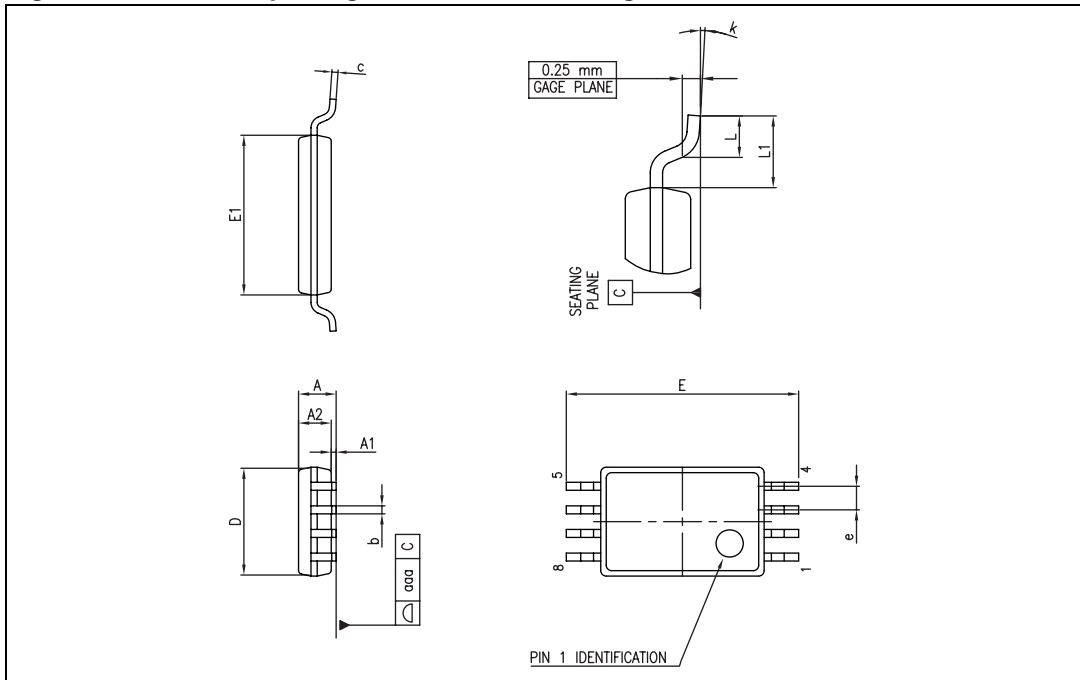


Table 6. TSSOP8 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.047
A1	0.05		0.15	0.002		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.008
D	2.90	3.00	3.10	0.114	0.118	0.122
E	6.20	6.40	6.60	0.244	0.252	0.260
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.0256	
k	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030
L1		1			0.039	
aaa			0.10			0.004

## 5 Ordering information

**Table 7. Order codes**

Part number	Temperature range	Package	Packing	Marking
TS27M2CD TS27M2CDT	0° C to +70° C	SO-8	Tube Tape & reel	27M2C
TS27M2CN		DIP8	Tube	TS27M2CN
TS27M2CPT		TSSOP8	Tube Tape & reel	27M2C
TS27M2ACD TS27M2ACDT		SO-8	Tube Tape & reel	27M2AC
TS27M2ACN		DIP8	Tube	S27M2ACN
TS27M2ACPT		TSSOP8	Tape & reel	2M2AC
TS27M2BCD TS27M2BCDT		SO-8	Tube Tape & reel	27M2BC
TS27M2BCN		DIP8	Tube	S27M2BCN
TS27M2BCPT		TSSOP8	Tape & reel	2M2BC
TS27M2ID TS27M2IDT	-40° C to +125° C	SO-8	Tube Tape & reel	27M2I
TS27M2IN		DIP8	Tube	TS27M2IN
TS27M2IPT		TSSOP8	Tape & reel	27M2I
TS27M2AID TS27M2AIDT		SO-8	Tube Tape & reel	27M2AI
TS27M2AIN		DIP8	Tube	S27M2AIN
TS27M2AIPT		TSSOP8	Tape & reel	2M2AI
TS27M2BID TS27M2BIDT		SO-8	Tube Tape & reel	27M2BI
TS27M2BIN		DIP8	Tube	S27M2BIN
TS27M2BIPT		TSSOP8	Tape & reel	2M2BI

## 6 Revision history

**Table 8. Document revision history**

Date	Revision	Changes
01-Nov-2001	1	Initial release.
18-Aug-2009	2	Updated document format. Added ESD and Rthja information in <a href="#">Table 1: Absolute maximum ratings</a> . Removed block diagram. Added minimum values for Io, GBP and SR parameters in <a href="#">Table 3</a> . Added order codes in <a href="#">Table 7</a> .

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