TS27L4

Very low power precision CMOS quad operational amplifiers

Features

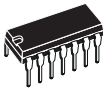
- Very low power consumption: 10 µA/op
- Output voltage can swing to ground
- Excellent phase margin on capacitive loads
- Unity gain stable
- Two input offset voltage selections

Description

The TS27L4 series are low-cost, low-power quad operational amplifiers designed to operate with single or dual supplies. These operational amplifiers use the ST silicon gate CMOS process allowing an excellent consumption-speed ratio. These series are ideally suited for low consumption applications.

Three power consumptions are available enabling the best consumption-speed ratio:
I_{CC} = 10 µA/amp: TS27L4 (very low power),
I_{CC} = 150 µA/amp: TS27M4 (low power),
I_{CC} = 1 mA/amp: TS274 (standard).

These CMOS amplifiers offer very high input impedance and extremely low input currents. The major advantage versus JFET devices is the very low input current drift with temperature (see *Figure 4*).

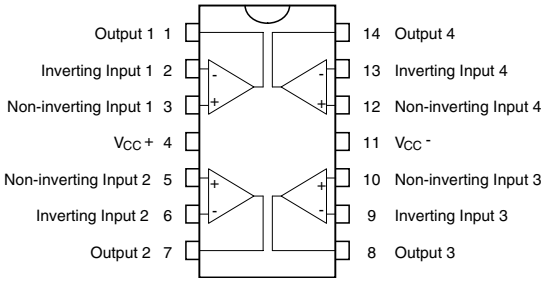


DIP14
(Plastic package)

SO-14
(Plastic micropackage)

TSSOP14
(Thin shrink small outline package)

Pin connections (top view)



1 Circuit schematics

Figure 1. Internal block diagram

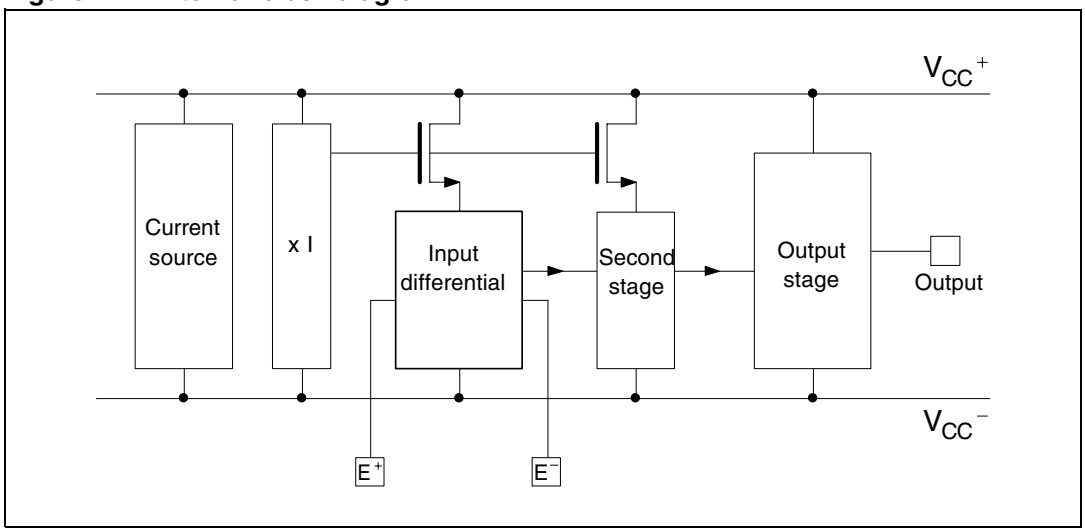
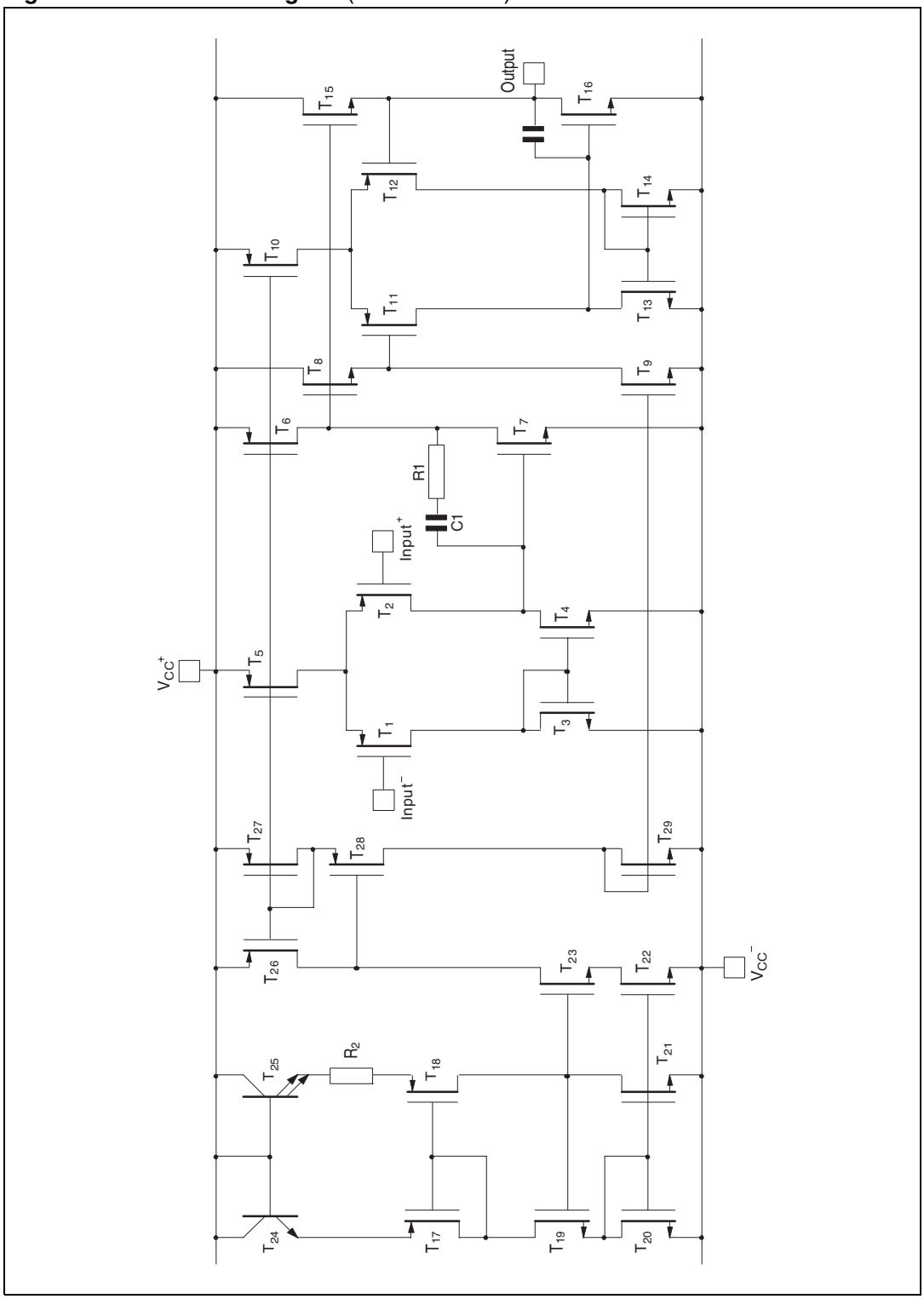


Figure 2. Schematic diagram (for 1/4 TS27L4)



2 Absolute maximum ratings and operating conditions

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC+}	Supply voltage (1)	18	V
V_{id}	Differential input voltage (2)	±18	V
V_{in}	Input voltage (3)	-0.3 to 18	V
I_o	Output current for $V_{CC}^+ \geq 15V$	±30	mA
I_{in}	Input current	±5	mA
T_{stg}	Storage temperature range	-65 to +150	°C
R_{thja}	Thermal resistance junction to ambient(4) SO-14 TSSOP14 DIP14	 105 100 80	°C/W
R_{thjc}	Thermal resistance junction to case(4) SO-14 TSSOP14 DIP14	 31 32 33	°C/W
ESD	HBM: human body model(5)	1	kV
	MM: machine model(6)	100	V
	CDM: charged device model(7)	1.5	kV

1. All 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 the input and the output voltages must never exceed the magnitude of the positive supply voltage.
4. Short-circuits can cause excessive heating and destructive dissipation. Values are typical.
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 the ground through only one pin. This is done for all pins.

Table 2. Operating conditions

Symbol	Parameter	TS27L4C	TS27L4I	Unit
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	°C

3 Electrical characteristics

Table 3. V_{CC}^+ = +10 V, V_{CC}^- = 0 V, T_{amb} = +25° C (unless otherwise specified)

Symbol	Parameter	TS27L4C/AC			TS27L4I/AI			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
V_{io}	Input offset voltage V_o = 1.4V, V_{ic} = 0V TS27L4 TS27L4A $T_{min} \le T_{amb} \le T_{max}$ TS27L4 TS27L4A		 1.1 0.9	 10 5 12 6.5		 1.1 0.9	 10 5 12 6.5	mV
DV_{io}	Input offset voltage drift		2			2		µV/°C
I_{io}	Input offset current (1) V_{ic} = 5V, V_O = 5V $T_{min} \le T_{amb} \le T_{max}$		1	 100		1	 200	pA
I_{ib}	Input bias current (1) V_{ic} = 5V, V_O = 5V $T_{min} \le T_{amb} \le T_{max}$		1	 150		1	 300	pA
V_{OH}	High level output voltage V_{id} = 100mV, R_L = 1MΩ $T_{min} \le T_{amb} \le T_{max}$	8.8 8.7	9		8.8 8.6	9		V
V_{OL}	Low level output voltage V_{id} = -100mV			50			50	mV
A_{vd}	Large signal voltage gain V_{iC} = 5V, R_L = 1MΩ, V_o = 1V to 6V $T_{min} \le T_{amb} \le T_{max}$	60 45	100		60 40	100		V/mV
GBP	Gain bandwidth product A_v = 40dB, R_L = 1MΩ, C_L = 100pF, f_{in} = 100kHz		0.1			0.1		MHz
CMR	Common mode rejection ratio V_{iC} = 1V to 7.4V, V_o = 1.4V	65	80		65	80		dB
SVR	Supply voltage rejection ratio V_{CC}^+ = 5V to 10V, V_o = 1.4V	60	80		60	80		dB
I_{CC}	Supply current (per amplifier) A_v = 1, no load, V_o = 5V $T_{min} \le T_{amb} \le T_{max}$		10	15 17		10	15 18	µA
I_o	Output short circuit current V_o = 0V, V_{id} = 100mV		60			60		mA
I_{sink}	Output sink current V_o = V_{CC}, V_{id} = -100mV		45			45		mA
SR	Slew rate at unity gain R_L = 1MΩ, C_L = 100pF, V_i = 3 to 7V		0.04			0.04		V/µs

Table 3. V_{CC}^+ = +10 V, V_{CC}^- = 0 V, T_{amb} = +25° C (unless otherwise specified) (continued)

Symbol	Parameter	TS27L4C/AC			TS27L4I/AI			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
ϕm	Phase margin at unity gain A_v = 40dB, R_L = 1MΩ, C_L = 100pF		45			45		Degrees
K_{ov}	Overshoot factor		30			30		%
e_n	Equivalent input noise voltage f = 1kHz, R_s = 100Ω		68			68		$\frac{nV}{\sqrt{Hz}}$
V_{o1}/V_{o2}	Channel separation		120			120		dB

1. Maximum values include unavoidable inaccuracies of the industrial tests.

4 Typical characteristics

Figure 3. Supply current (each amplifier) versus supply voltage

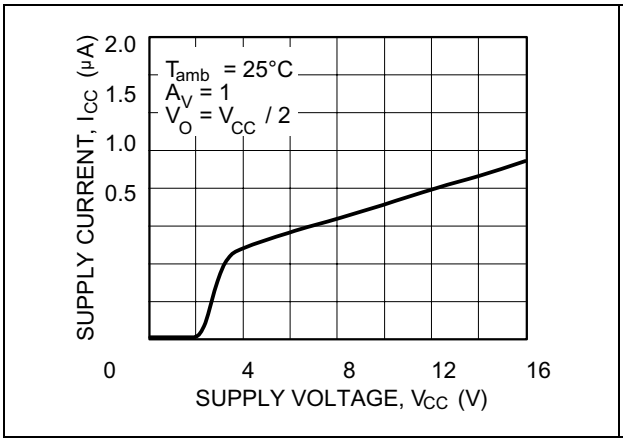


Figure 4. Input bias current versus free air temperature

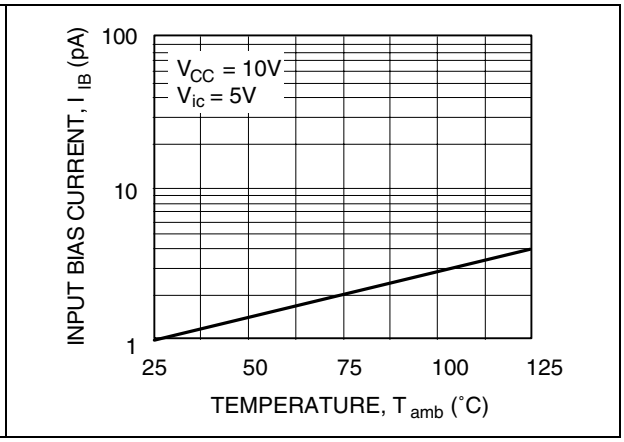


Figure 5. High level output voltage versus high level output current

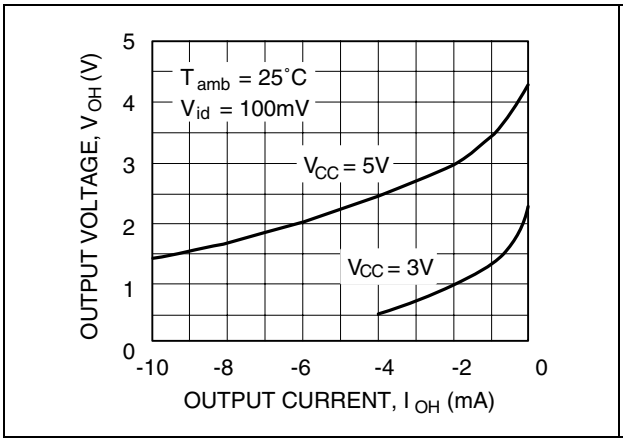


Figure 6. High level output voltage versus high level output current

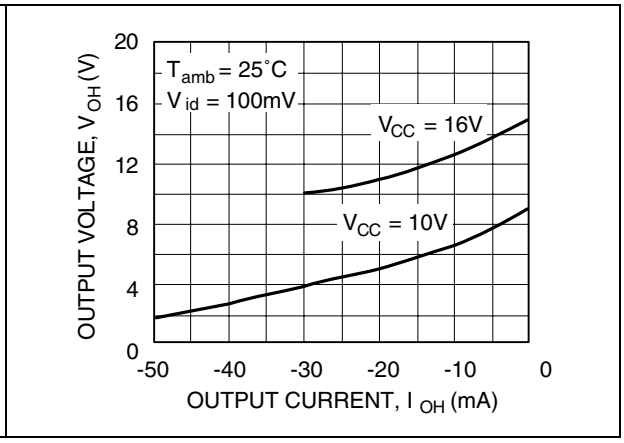


Figure 7. Low level output voltage versus low level output current

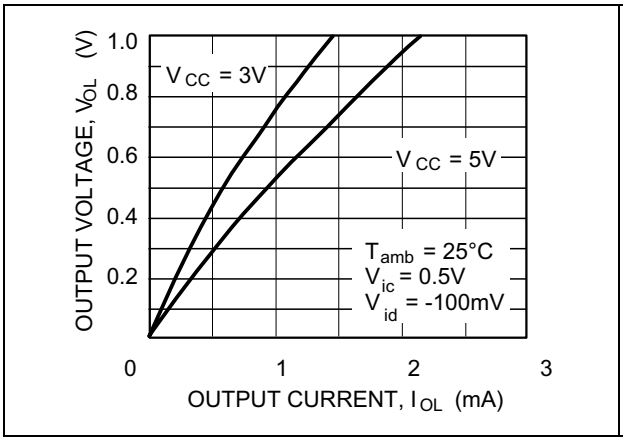


Figure 8. Low level output voltage versus low level output current

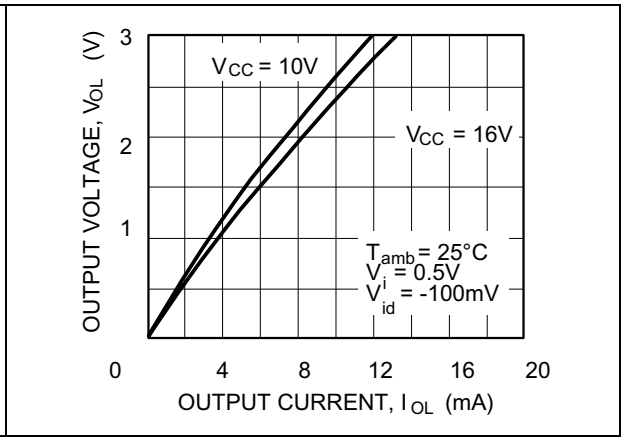


Figure 9. Open loop frequency response and phase shift

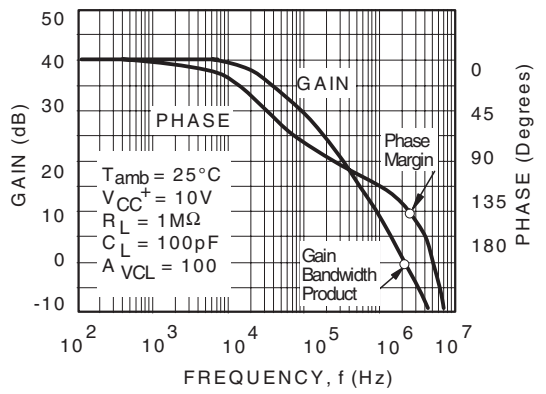


Figure 10. Gain bandwidth product versus supply voltage

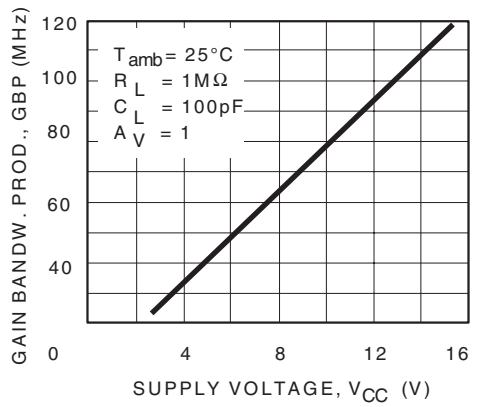


Figure 11. Phase margin versus supply voltage

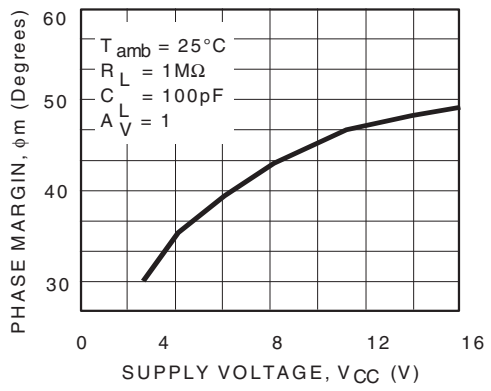


Figure 12. Phase margin versus capacitive load

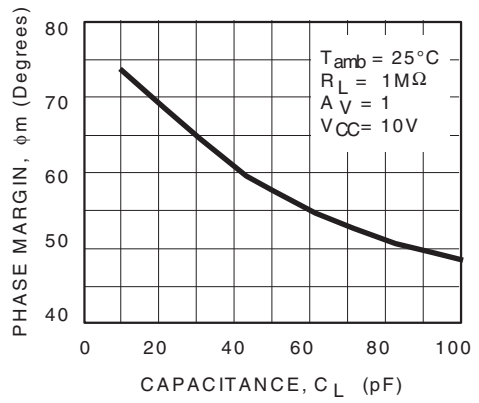


Figure 13. Slew rate versus supply voltage

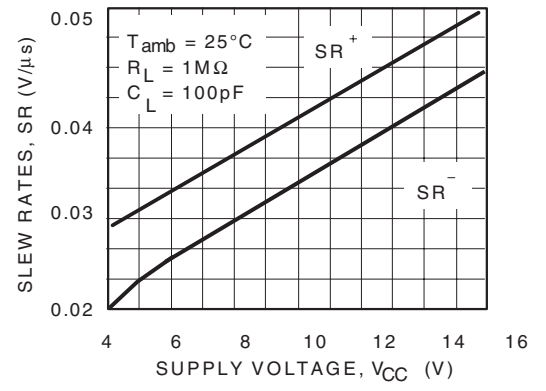
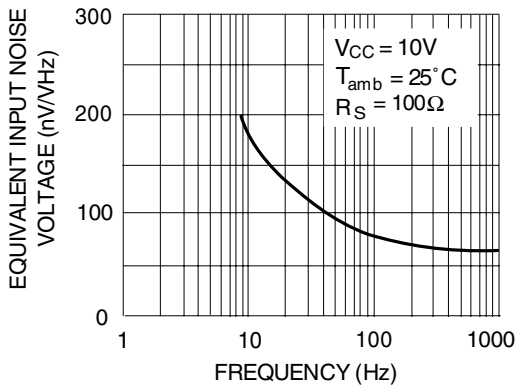


Figure 14. Input voltage noise versus frequency



5 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.

5.1 DIP14 package information

Figure 15. DIP14 package mechanical drawing

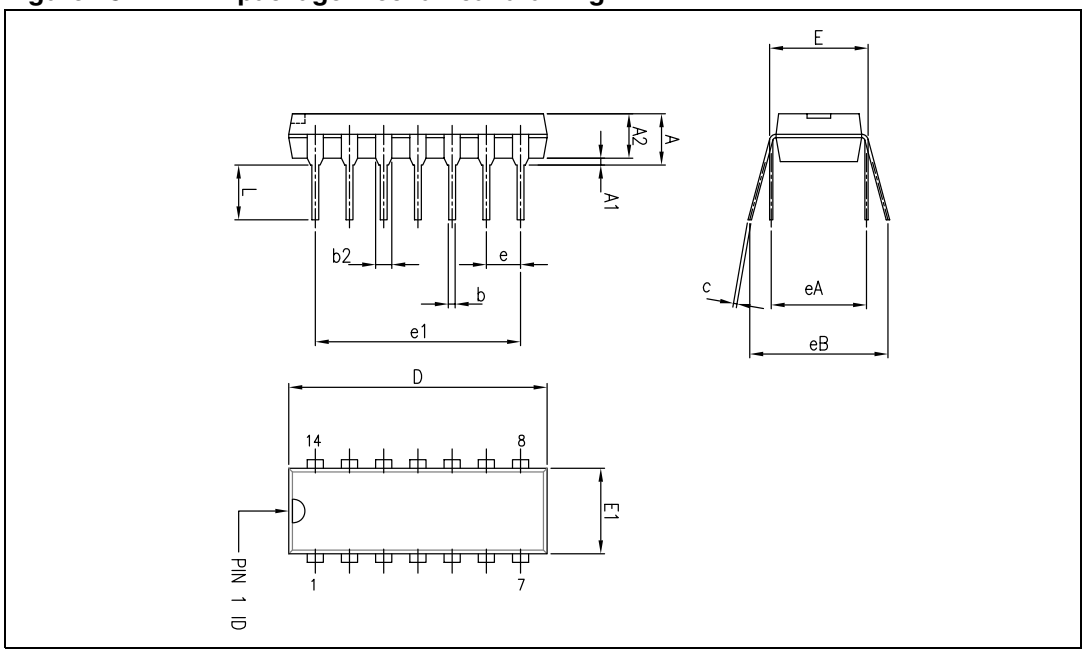


Table 4. DIP14 package mechanical data

Dimensions						
Ref.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			5.33			0.21
A1	0.38			0.015		
A2	2.92	3.30	4.95	0.11	0.13	0.19
b	0.36	0.46	0.56	0.014	0.018	0.022
b2	1.14	1.52	1.78	0.04	0.06	0.07
c	0.20	0.25	0.36	0.007	0.009	0.01
D	18.67	19.05	19.69	0.73	0.75	0.77
E	7.62	7.87	8.26	0.30	0.31	0.32
E1	6.10	6.35	7.11	0.24	0.25	0.28
e		2.54			0.10	
e1		15.24			0.60	
eA		7.62			0.30	
eB			10.92			0.43
L	2.92	3.30	3.81	0.11	0.13	0.15

5.2 SO-14 package information

Figure 16. SO-14 package mechanical drawing

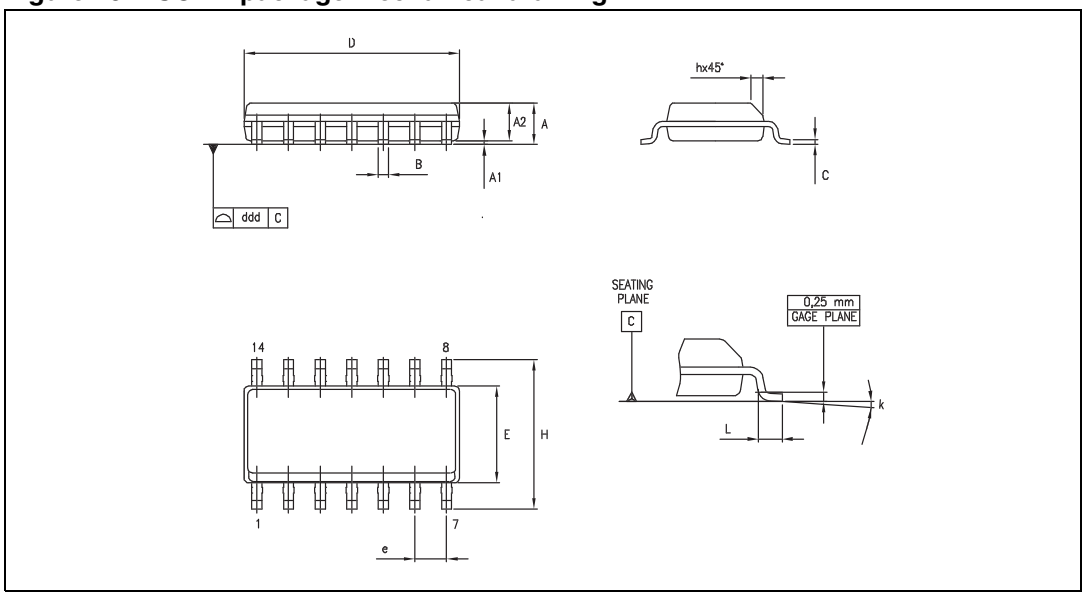


Table 5. SO-14 package mechanical data

Dimensions						
Ref.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	1.35		1.75	0.05		0.068
A1	0.10		0.25	0.004		0.009
A2	1.10		1.65	0.04		0.06
B	0.33		0.51	0.01		0.02
C	0.19		0.25	0.007		0.009
D	8.55		8.75	0.33		0.34
E	3.80		4.0	0.15		0.15
e		1.27			0.05	
H	5.80		6.20	0.22		0.24
h	0.25		0.50	0.009		0.02
L	0.40		1.27	0.015		0.05
k	8° (max.)					
ddd			0.10			0.004

5.3 TSSOP14 package information

Figure 17. TSSOP14 package mechanical drawing

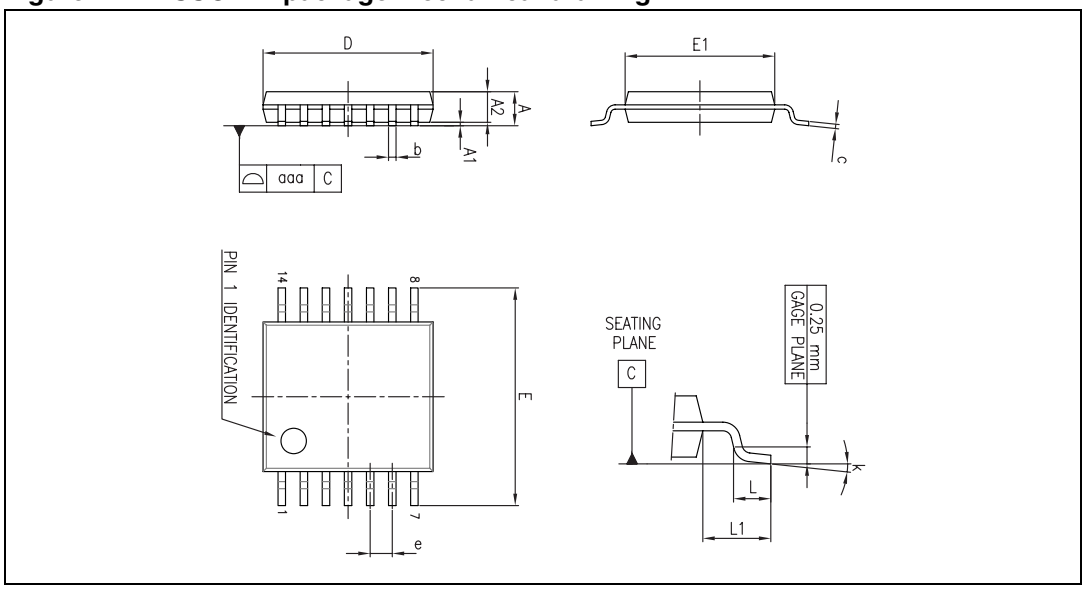


Table 6. TSSOP14 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.047
A1	0.05		0.15	0.002	0.004	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		0.0089
D	4.90	5.00	5.10	0.193	0.197	0.201
E	6.20	6.40	6.60	0.244	0.252	0.260
E1	4.30	4.40	4.50	0.169	0.173	0.176
e		0.65			0.0256	
L	0.45	0.60	0.75	0.018	0.024	0.030
L1		1.00			0.039	
k	0°		8°	0°		8°
aaa			0.10			0.004

6 Ordering information

Table 7. Order codes

Order code	Temperature range	Package	Packing	Marking
TS27L4CD TS27L4CDT	0°C, +70°C	SO-14	Tube or Tape & reel	27L4C
TS27L4ACD TS27L4ACDT				27L4AC
TS27L4CN TS27L4ACN		DIP14	Tube	TS27L4CN
				TS27L4ACN
TS27L4CPT TS27L4ACPT		TSSOP14	Tape & reel	27L4C
				27L4AC
TS27L4ID TS27L4IDT	-40°C, +125°C	SO-14	Tube or Tape & reel	27L4I
TS27L4AID TS27L4AIDT				27L4AI
TS27L4IN TS27L4AIN		DIP14	Tube	TS27L4IN
				TS27L4AIN
TS27L4IPT TS27L4AIPT		TSSOP14	Tape & reel	27L4I
				27L4AI

7 Revision history

Table 8. Document revision history

Date	Revision	Changes
11-Nov-2001	1	Initial release.
08-Sep-2008	2	Removed TS27L4B version of device. Added R_{thja}, R_{thjc}, and ESD parameters in *Table 1: Absolute maximum ratings*. Expanded *Table 7: Order codes*. Updated document format.
02-Mar-2009	3	Removed TS27L4*M* from *Table 7: Order codes*. Updated package mechanical drawings and data in *Chapter 5: Package information*.

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