



TS27M4C, TS27M4I, TS27M4M

Precision low power CMOS quad operational amplifiers

Features

- Low power consumption: 150 $\mu\text{A}/\text{op}$
- Output voltage can swing to ground
- Excellent phase margin on capacitive loads
- Unity gain stable
- Two input offset voltage selections

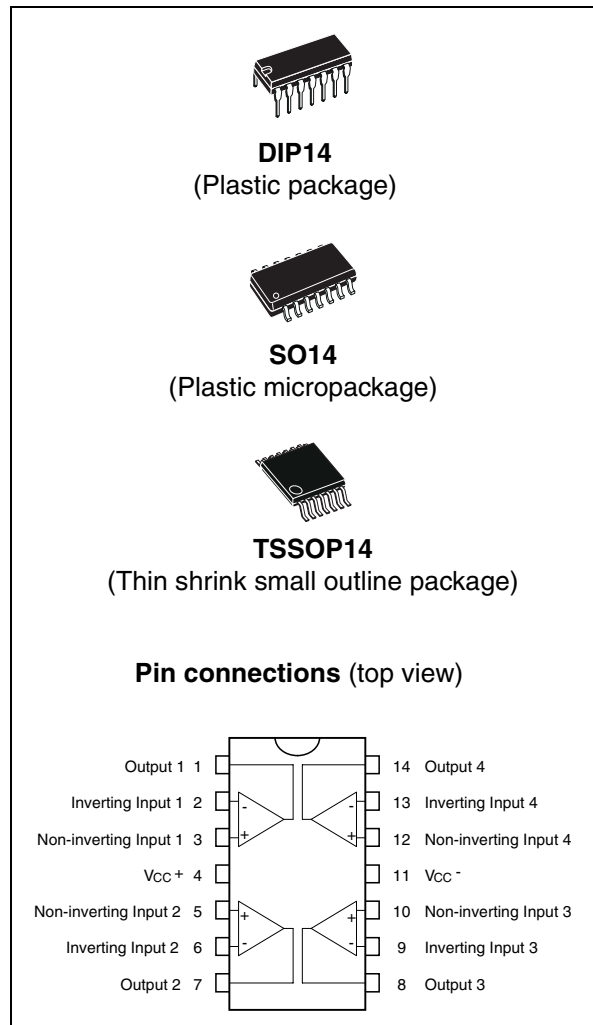
Description

These devices 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 thus offering the best consumption-speed ratio for your application:

- $I_{CC} = 10 \mu\text{A}/\text{amp}$: TS27L4 (very low power)
- $I_{CC} = 150 \mu\text{A}/\text{amp}$: TS27M4 (low power)
- $I_{CC} = 1 \text{ mA}/\text{amp}$: 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 currents drift with temperature (see [Figure 4 on page 7](#)).



1 Circuit schematics

Figure 1. Block diagram

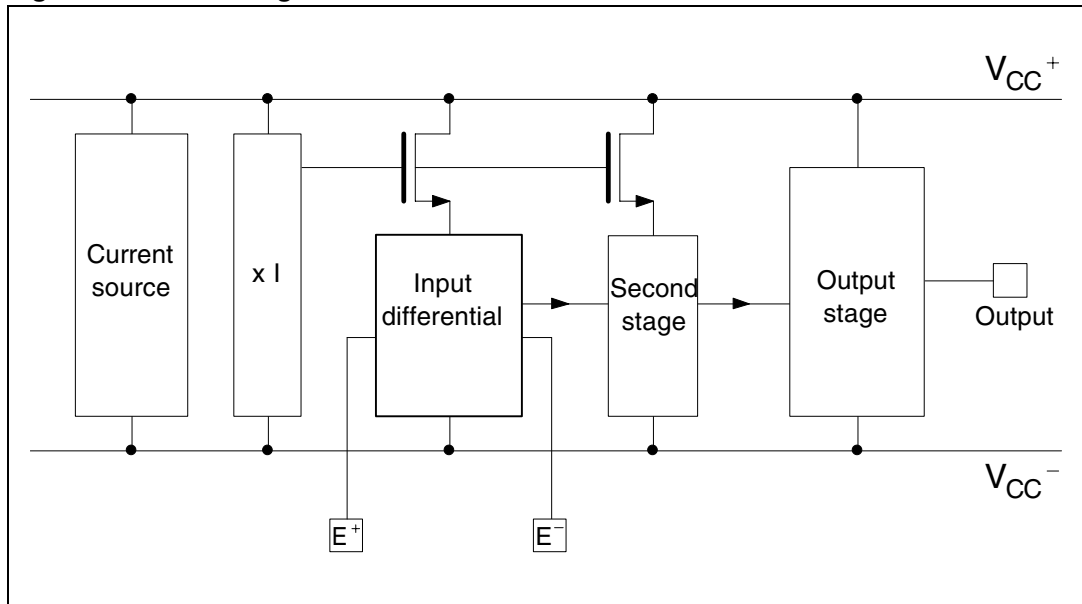
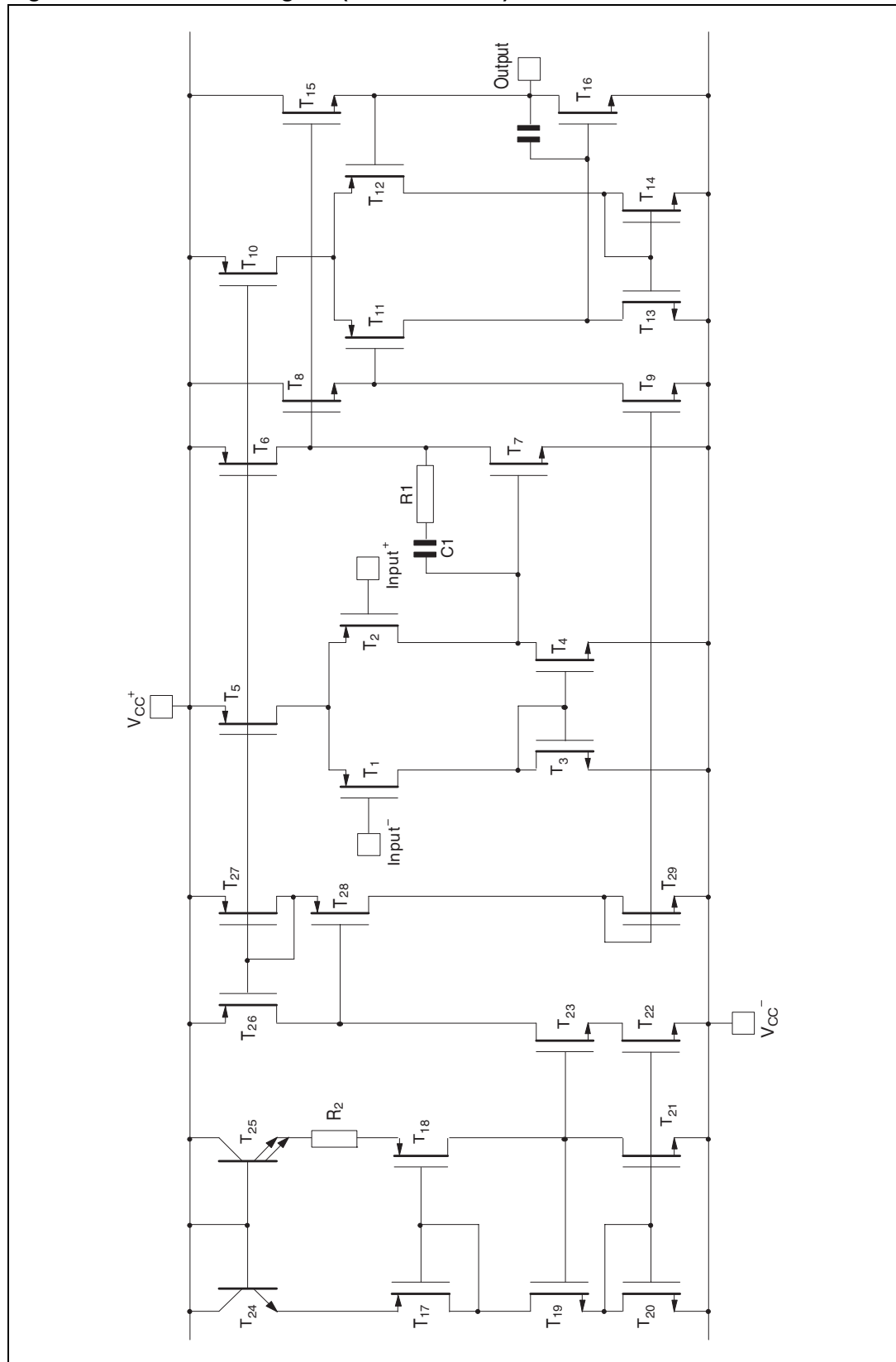


Figure 2. Schematic diagram (for 1/4 TS27M4)



2 Absolute maximum ratings and operating conditions

Table 1. Absolute maximum ratings (AMR)

| Symbol | Parameter | TS27M4C/AC | TS27M4I/AI | TS27M4M/AM | 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_{oper} | Operating free-air temperature range | 0 to +70 | -40 to +125 | -55 to +125 | °C |
| T_{stg} | Storage temperature range | -65 to +150 | | | °C |
| R_{thja} | Thermal resistance junction to ambient ⁽⁴⁾ | | | | °C/W |
| | SO-14 | 105 | | | |
| | TSSOP14 | 100 | | | |
| R_{thjc} | Thermal resistance junction to case ⁽⁴⁾ | | | | °C/W |
| | SO-14 | 31 | | | |
| | TSSOP14 | 32 | | | |
| 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 1.5kΩ 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 < 5Ω). 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 | Value | Unit |
|-----------|---------------------------------|----------------------|------|
| V_{CC+} | Supply voltage | 3 to 16 | V |
| V_{icm} | Common mode input voltage range | 0 to $V_{CC+} - 1.5$ | V |

3 Electrical characteristics

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

| Symbol | Parameter | TS27M4C/AC | | | TS27M4I/AI TS27M4M/AM | | | Unit |
|------------|---|------------|------------|------------|--------------------------|------------|------------|------------------------------|
| | | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| V_{io} | Input offset voltage $V_O = 1.4\text{V}$, $V_{ic} = 0\text{V}$ TS27M4C/I/M TS27M4AC/AI/AM $T_{min} \leq T_{amb} \leq T_{max}$ TS27M4C/I/M TS27M4AC/AI/AM | | 1.1 0.9 | 10 5 | | 1.1 0.9 | 10 5 | mV |
| DV_{io} | Input offset voltage drift | | 2 | | | 2 | | $\mu\text{V}/^\circ\text{C}$ |
| I_{io} | Input offset current note ⁽¹⁾ $V_{ic} = 5\text{V}$, $V_O = 5\text{V}$ $T_{min} \leq T_{amb} \leq T_{max}$ | | 1 | 100 | | 1 | 200 | pA |
| I_{ib} | Input bias current ⁽¹⁾ $V_{ic} = 5\text{V}$, $V_O = 5\text{V}$ $T_{min} \leq T_{amb} \leq T_{max}$ | | 1 | 150 | | 1 | 300 | pA |
| V_{OH} | High level output voltage $V_{id} = 100\text{mV}$, $R_L = 100\text{k}\Omega$ $T_{min} \leq T_{amb} \leq T_{max}$ | 8.7 8.6 | 8.9 | | 8.7 8.5 | 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 6V $T_{min} \leq T_{amb} \leq T_{max}$ | 30 20 | 50 | | 30 10 | 50 | | V/mV |
| GBP | Gain bandwidth product $A_v = 40\text{dB}$, $R_L = 100\text{k}\Omega$, $C_L = 100\text{pF}$, $f_{in} = 100\text{kHz}$ | | 1 | | | 1 | | MHz |
| CMR | Common mode rejection ratio $V_{ic} = 1\text{V}$ to 7.4V , $V_o = 1.4\text{V}$ | 65 | 80 | | 65 | 80 | | dB |
| SVR | Supply voltage rejection ratio $V_{CC^+} = 5\text{V}$ to 10V , $V_o = 1.4\text{V}$ | 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 | 200 250 | | 150 | 200 300 | μA |
| I_o | Output short-circuit current $V_o = 0\text{V}$, $V_{id} = 100\text{mV}$ | | 60 | | | 60 | | mA |
| I_{sink} | Output sink current $V_o = V_{CC}$, $V_{id} = -100\text{mV}$ | | 45 | | | 45 | | mA |
| SR | Slew rate at unity gain $R_L = 100\text{k}\Omega$, $C_L = 100\text{pF}$, $V_i = 3$ to 7V | | 0.6 | | | 0.6 | | V/ μs |

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

| Symbol | Parameter | TS27M4C/AC | | | TS27M4I/AI TS27M4M/AM | | | Unit |
|-----------------|--|------------|------|------|--------------------------|------|------|--------------------------------------|
| | | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| ϕ_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 include unavoidable inaccuracies of the industrial tests.

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

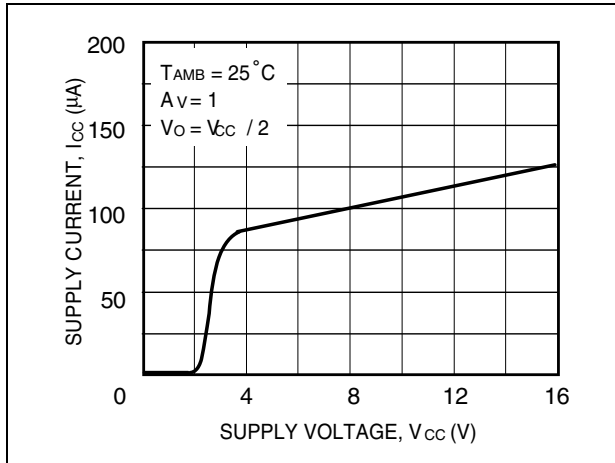


Figure 4. Input bias current versus free air temperature

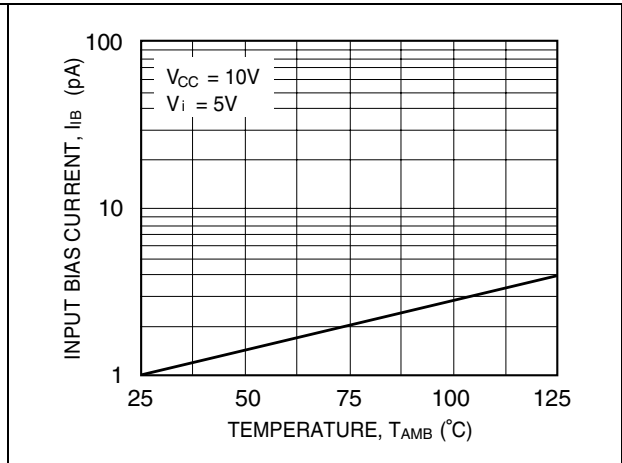


Figure 5. High level output voltage versus high level output current

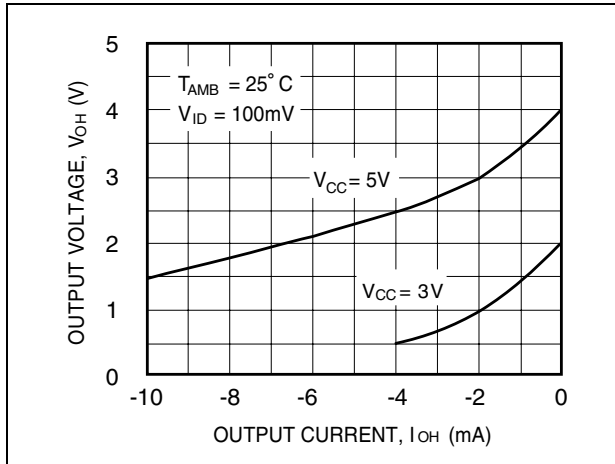


Figure 6. High level output voltage versus high level output current

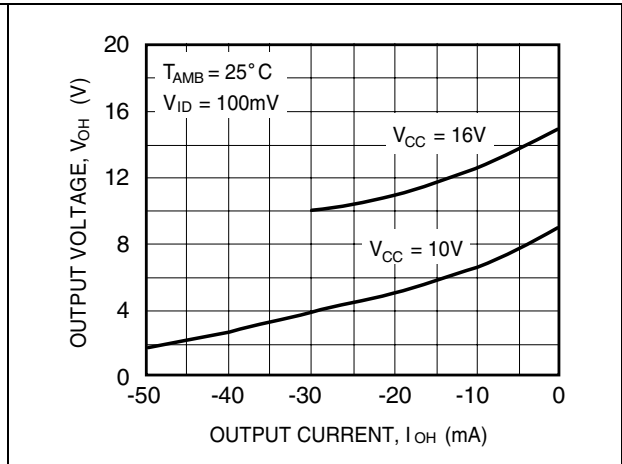


Figure 7. Low level output voltage versus low level output current

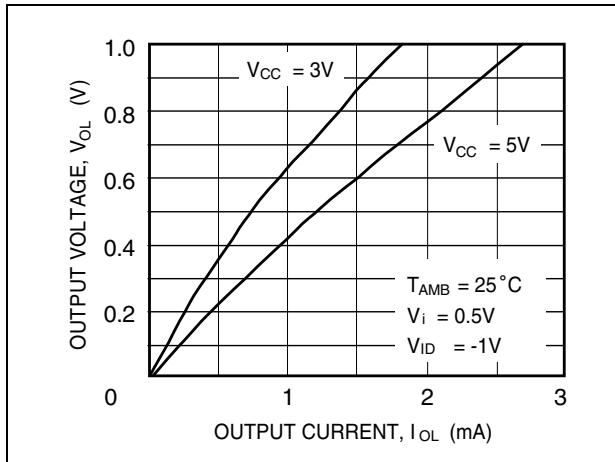


Figure 8. Low level output voltage versus low level output current

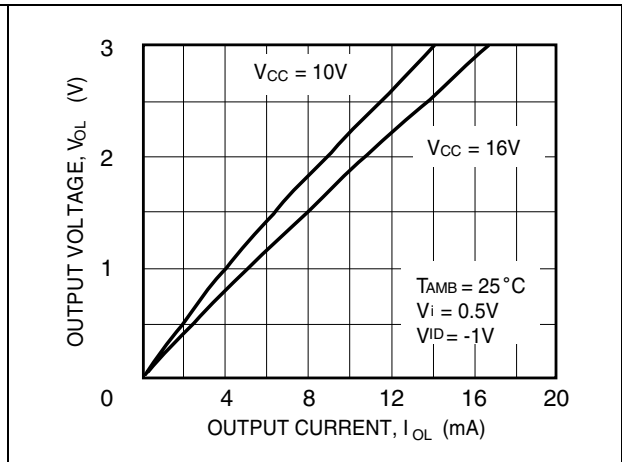


Figure 9. Open loop frequency response and phase shift

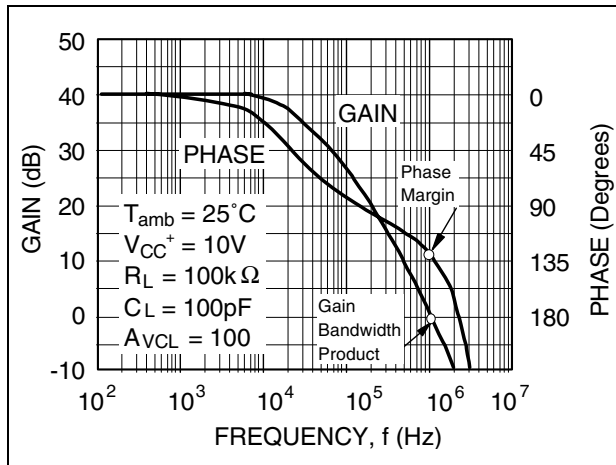


Figure 10. Gain bandwidth product versus supply voltage

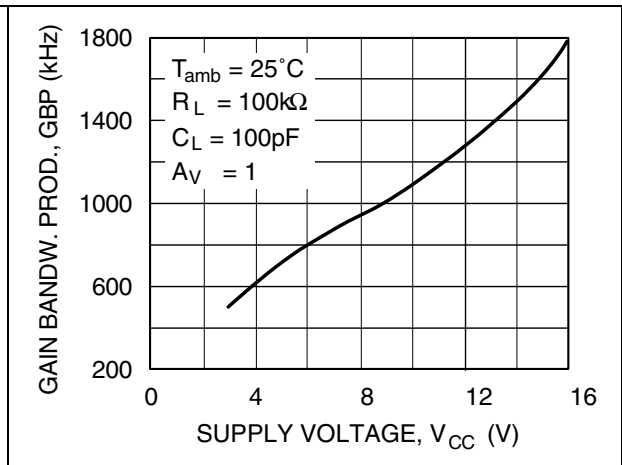


Figure 11. Phase margin versus supply voltage

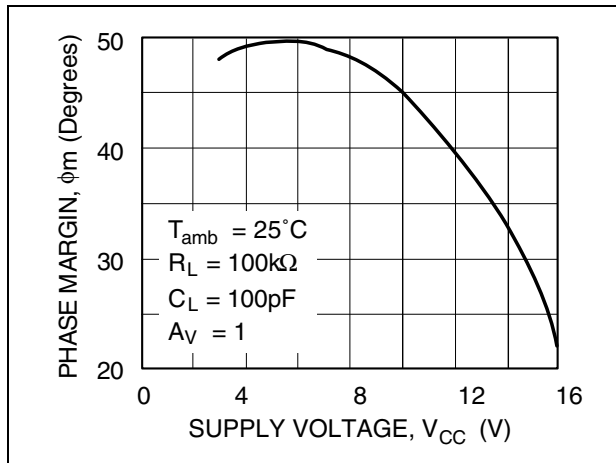


Figure 12. Phase margin versus capacitive load

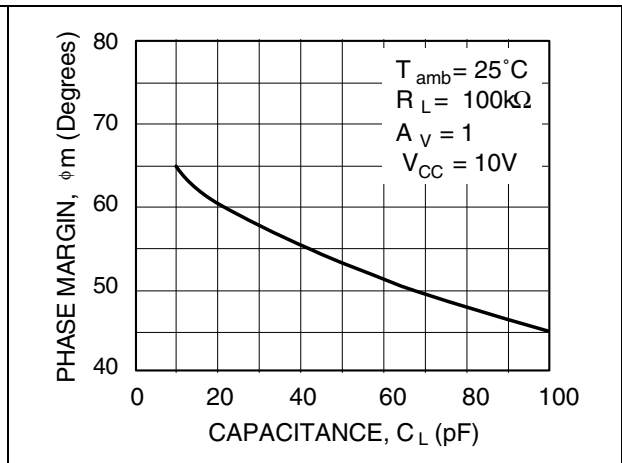


Figure 13. Slew rate versus supply voltage

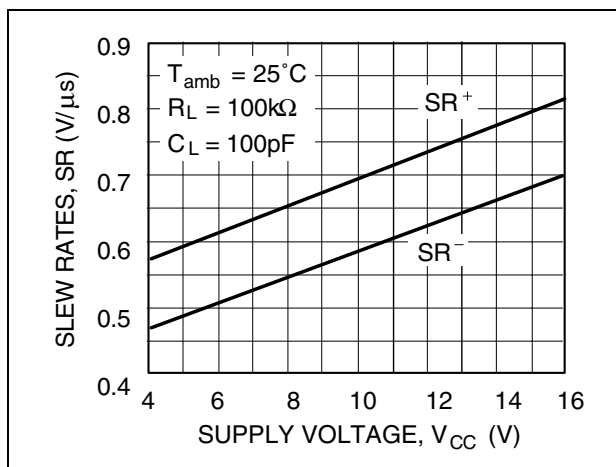
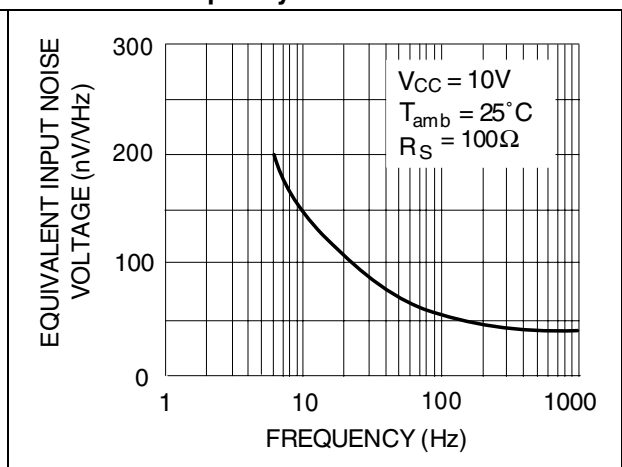


Figure 14. Input voltage noise versus frequency



4 Package information

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.

4.1 DIP14 package information

Figure 15. DIP14 package mechanical drawing

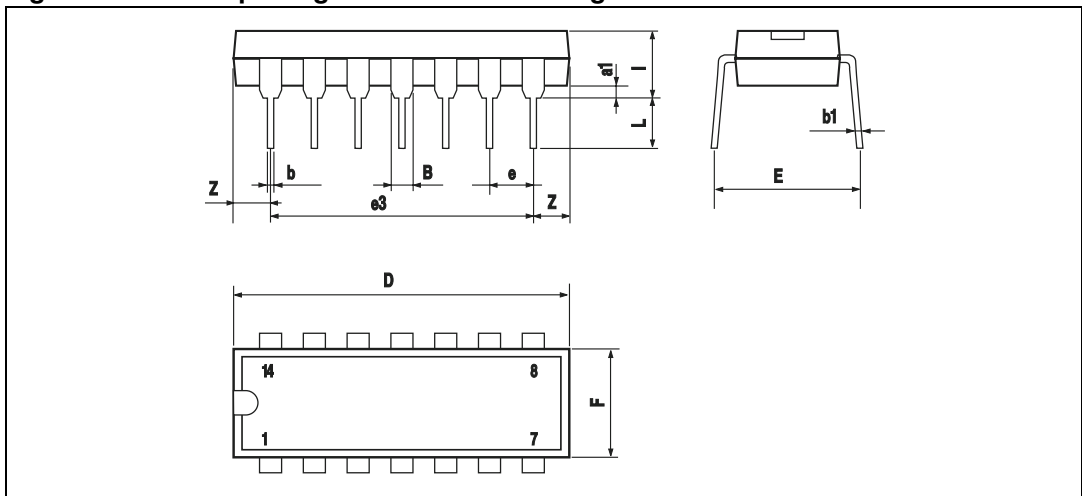


Table 4. DIP14 package mechanical data

| Ref. | Millimeters | | | Inches | | |
|------|-------------|-------|------|--------|-------|-------|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| a1 | 0.51 | | | 0.020 | | |
| B | 1.39 | | 1.65 | 0.055 | | 0.065 |
| b | | 0.5 | | | 0.020 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 20 | | | 0.787 |
| E | | 8.5 | | | 0.335 | |
| e | | 2.54 | | | 0.100 | |
| e3 | | 15.24 | | | 0.600 | |
| F | | | 7.1 | | | 0.280 |
| I | | | 5.1 | | | 0.201 |
| L | | 3.3 | | | 0.130 | |
| Z | 1.27 | | 2.54 | 0.050 | | 0.100 |

4.2 SO-14 package information

Figure 16. SO-14 package mechanical drawing

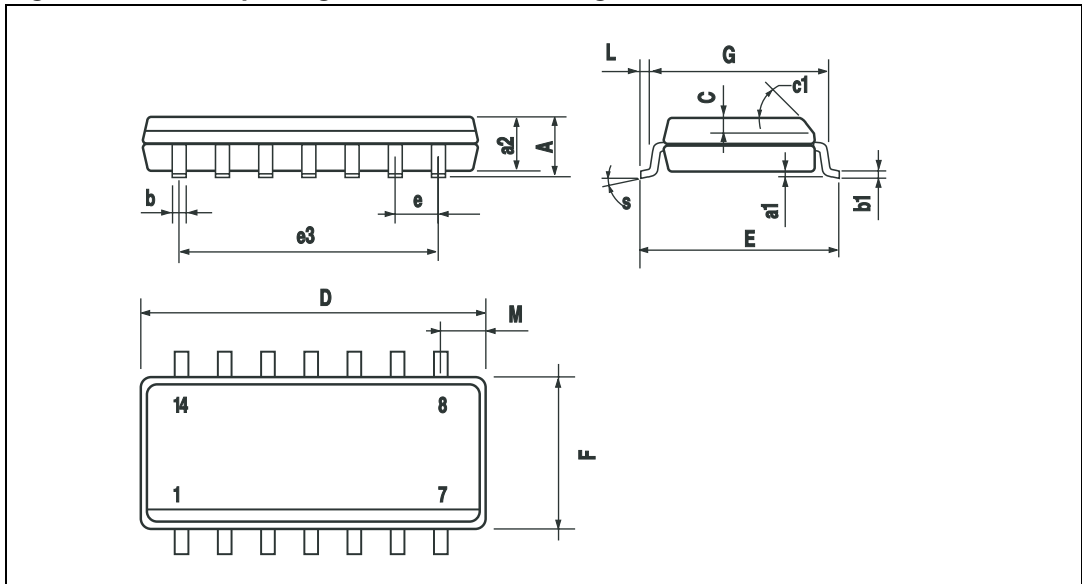


Table 5. SO-14 package mechanical data

| Ref. | Dimensions | | | | | |
|------|-------------|------|------|--------|-------|-------|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.2 | 0.003 | | 0.007 |
| a2 | | | 1.65 | | | 0.064 |
| b | 0.35 | | 0.46 | 0.013 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007 | | 0.010 |
| C | | 0.5 | | | 0.019 | |
| c1 | 45° (typ.) | | | | | |
| D | 8.55 | | 8.75 | 0.336 | | 0.344 |
| E | 5.8 | | 6.2 | 0.228 | | 0.244 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 7.62 | | | 0.300 | |
| F | 3.8 | | 4.0 | 0.149 | | 0.157 |
| G | 4.6 | | 5.3 | 0.181 | | 0.208 |
| L | 0.5 | | 1.27 | 0.019 | | 0.050 |
| M | | | 0.68 | | | 0.026 |
| S | 8° (max.) | | | | | |

4.3 TSSOP14 package information

Figure 17. TSSOP14 package mechanical drawing

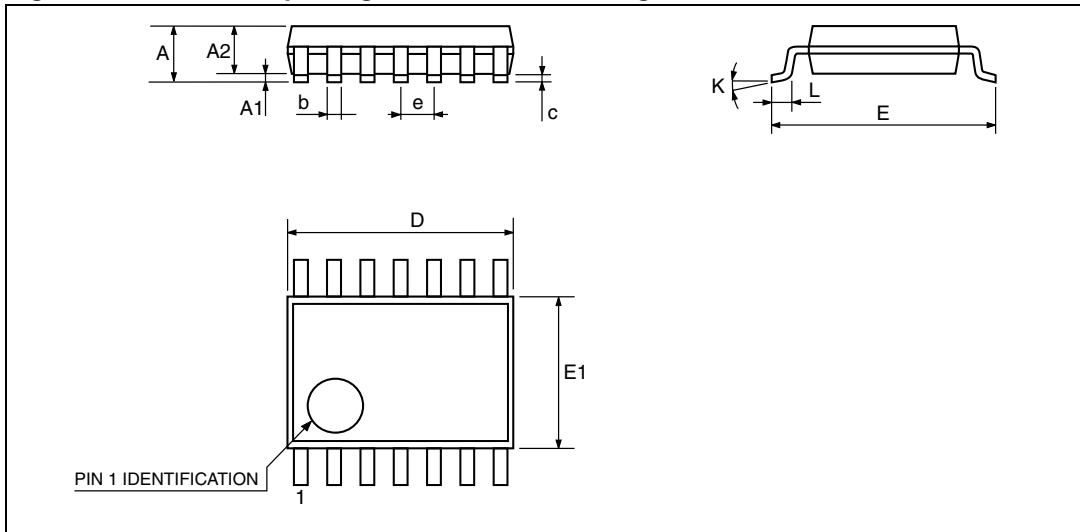


Figure 18. TSSOP14 package mechanical data

| Ref. | Dimensions | | | | | |
|------|-------------|----------|------|--------|------------|--------|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 1.2 | | | 0.047 |
| A1 | 0.05 | | 0.15 | 0.002 | 0.004 | 0.006 |
| A2 | 0.8 | 1 | 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 | 4.9 | 5 | 5.1 | 0.193 | 0.197 | 0.201 |
| E | 6.2 | 6.4 | 6.6 | 0.244 | 0.252 | 0.260 |
| E1 | 4.3 | 4.4 | 4.48 | 0.169 | 0.173 | 0.176 |
| e | | 0.65 BSC | | | 0.0256 BSC | |
| K | 0° | | 8° | 0° | | 8° |
| L1 | 0.45 | 0.60 | 0.75 | 0.018 | 0.024 | 0.030 |

5 Ordering information

Table 6. Order codes

| Order code | Temperature range | Package | Packing | Marking |
|-------------------------|-------------------|---------|------------------------|-----------------|
| TS27M4CD TS27M4CDT | 0°C, +70°C | SO-14 | Tube or Tape & reel | 27M4C |
| TS27M4ACD TS27M4ACDT | | | | 27M4AC |
| TS27M4CN TS27M4ACN | | DIP14 | Tube | TS27M4CN |
| | | | | TS27M4ACN |
| TS27M4CPT TS27M4ACPT | | TSSOP14 | Tape & reel | 27M4C 27M4AC |
| TS27M4ID TS27M4IDT | -40°C, +125°C | SO-14 | Tube or Tape & reel | 27M4I |
| TS27M4AID TS27M4AIDT | | | | 27M4AI |
| TS27M4IN TS27M4AIN | | DIP14 | Tube | TS27M4IN |
| | | | | TS27M4AIN |
| TS27M4IPT TS27M4AIPT | | TSSOP14 | Tape & reel | 27M4I 27M4AI |
| TS27M4MD TS27M4MDT | -55°C, +125°C | SO-14 | Tube or Tape & reel | 27M4M |
| TS27M4AM TS27M4AMDT | | | | 27M4AM |
| TS27M4MN TS27M4AMN | | DIP14 | Tube | TS27M4MN |
| | | | | TS27M4AMN |
| TS27M4MPT TS27M4AMPT | | TSSOP14 | Tape & reel | 27M4M 27M4AM |

6 Revision history

Table 7. Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 07-Jan-2001 | 1 | Initial release. |
| 08-Sep-2008 | 2 | Removed TS27M4B version of device. Added R_{thja} , R_{thjc} , and ESD parameters in Table 1: Absolute maximum ratings (AMR) . Expanded Table 6: Order codes . Updated document format. |

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2008 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com