National Semiconductor

April 1996

# LMC6008
# 8 Channel Buffer

## General Description

The LMC6008 octal buffer is designed specifically to buffer the multi-level voltages going to the inputs of the integrated circuits. The LMC6008 AC characteristics, including settling time, are specified for a capacitive load of 0.1 μF for this reason.

The LMC6008 contains 4 high-speed buffers and 4 low-power buffers. The high-speed buffers can provide an output current of at least 250 mA (minimum), and the low-power buffers can provide at least 150 mA (minimum). By including the 2 types of buffers, the LMC6008 is able to provide this function while consuming a supply current of only 6.5 mA (maximum). The buffers are a rail-to-rail design, which typically swing to within 30 mV of either supply.

The LMC6008 also contains a standby function which puts the buffer into a high-impedance mode. The supply current in the standby mode is a low 500 μA max. Also, a thermal limit circuit is included to protect the device from overload conditions.

## Features

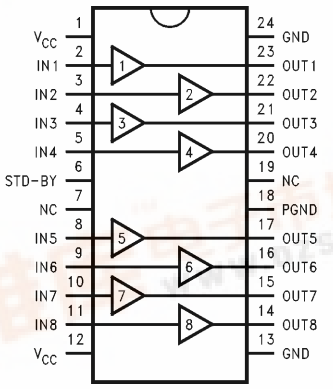
- High Output Current:
  - High Speed Buffers 250 mA min
  - Low Power Buffers 150 mA min
- Slew Rate:
  - High Speed Buffers 1.7 V/μs
  - Low Power Buffers 0.85V/μs
- Settling Time, $C_L$ = 0.1 μF 16 μs max
- Wide Input/Output Range 0.1V to $V_{CC}$ − 0.1V min
- Supply Voltage Range 5V to 16V
- Supply Current 6.5 mA max
- Standby Mode Current 500 μA

## Applications

- AMLCD voltage buffering
- Multi-voltage buffering

## Connection Diagram

**24-Pin SO**




TL/H/12321–1

**Top View**

**Note:** Buffers 1, 3, 5 and 7 are High Speed and Buffers 2, 4, 6 and 8 are Low Speed.

## Ordering Information

| Package | Temperature Range −40°C to +85°C | NSC Drawing | Transport Media |
|---|---|---|---|
| 24-Pin Surface Mount | LMC6008IM | M24B | Rail |
| | LMC6008IMX | M24B | Tape & Reel |

## Absolute Maximum Ratings (Note 1)

**If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.**

| | |
|---|---|
| ESD Tolerance (Note 2) | 2000V |
| Voltage at Input Pin | $V^+ + 0.4V$, $V^- - 0.4V$ |
| Voltage at Output Pin | $V^+ + 0.4V$, $V^- - 0.4V$ |
| Supply Voltage ($V^+ - V^-$) | 16V |
| Lead Temperature (soldering, 10 sec.) | 260°C |
| Storage Temperature Range | −55°C to +150°C |
| Junction Temperature (Note 4) | 150°C |
| Power Dissipation (Note 4) | Internally Limited |

## Operating Ratings (Note 1)

| | |
|---|---|
| Supply Voltage | $4.5V \le V^+ \le 16V$ |
| Temperature Range | −20°C to +100°C |
| Thermal Resistance ($\theta_{JA}$) | |
| M Package, 24-Pin Surface Mount | 50°C/W |

## DC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for $T_J = 25°C$, $V_{CC} = 14.5V$ and $R_L = 0$.

| Symbol | Parameter | Conditions | Typ (Note 5) | LMC6008 Limit (Note 6) | Units |
|---|---|---|---|---|---|
| $V_{OS}$ | Input Offset Voltage | $R_S = 10\ k\Omega$ | | 25 | mV max |
| $A_V$ | $V_O = 10\ V_{PP}$ | | | 0.985 | V/V |
| $I_B$ | Input Bias Current | | | 300 | nA max |
| $I_{LP}$ | Peak Load Current | Hi Speed Buffers $V_O = 13\ V_{PP}$ | | −250 | mA max |
| | | | | +250 | mA min |
| $I_{LP}$ | Peak Load Current | Lo Speed Buffers $V_O = 13\ V_{PP}$ | | −150 | mA max |
| | | | | +150 | mA min |
| $V_{ERR}$ | Output Voltage Difference (Note 9) | | 35 | | mV max |
| $V_{IH}$ | Standby Logic HIgh Voltage | | | 3.30 | V min |
| $V_{IL}$ | $I_{STANDBY}$ Logic Low Voltage | | | 1.80 | V max |
| $I_{IH}$ | Standby High Input Current | | | 1.0 | μA max |
| $I_{IL}$ | Standby Low Input Current | | | 1.0 | μA max |
| $I_{O\ (STD-BY)}$ | Output Leakage Current | $V_{STD-BY}$ = High | | 5 | μA max |
| $I_{CC}$ | Supply Current | $V_{IL}$ = Low, $V_{IN} = 7.25V$ | | 6.5 | mA max |
| $I_{STD-BY}$ | Standby Current | $V_{STD-BY}$ = High | | 500 | μA max |
| PSRR | Power Supply Rejection Ratio | $5V < V_{CC} < 14.5V$ | | 55 | dB min |
| $V_O$ | Voltage Output Swing | | | 0.1 | V min |
| | | | | $V_{CC} - 0.1$ | V max |

## AC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for $T_J = 25°C$, $V_{CC} = 14.5V$ and $R_L = 0\Omega$.

| Symbol | Parameter | Conditions | Typ (Note 5) | LMC6008 Limit (Note 6) | Units |
|---|---|---|---|---|---|
| SR | Slew Rate | Buffers 1, 3, 5, 7 (Note 3) | | 1.70 | V/$\mu$s min |
| | | Buffers 2, 4, 6, 8 (Note 3) | | 0.85 | V/$\mu$s min |
| $t_S$ | Settling Time | (Notes 3, 7) | | 16 | $\mu$s max |
| $t_{ON}$ | Standby Response Time ON | | | 10 | $\mu$s max |
| $t_{OFF}$ | Standby Response Time OFF | | | 10 | $\mu$s max |
| PBW | Power Bandwidth | $V_O = 10\ V_{PP}$ for Hi-Speed<br>$V_O = 5\ V_{PP}$ for Lo-Speed<br>(Note 3) | | 45 | KHz min |
| $C_L$ | Load Capacitance | | | 0.1 | $\mu$F max |

**Note 1:** Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating ratings indicate conditions for which the device is intended to be functional, but specific performance is not guaranteed. For guaranteed specifications and the test conditions, see the Electrical Characteristics.

**Note 2:** Human body model, 1.5 k$\Omega$ in series with 100 pF.

**Note 3:** The Load is a series connection of a 0.1 $\mu$F capacitor and a 1$\Omega$ resistor.

**Note 4:** The maximum power dissipation is a function of $T_{J(max)}$, $\theta_{JA}$, and $T_A$. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(max)} - T_A)/\theta_{JA}$, where the junction-to-ambient thermal resistance $\theta_{JA} = 50°C/W$. If the maximum allowable power dissipation is exceeded, the thermal limit circuit will limit the die temperature to approximately 160°C. All numbers apply for packages soldered directly into a PC board.

**Note 5:** Typical Values represent the most likely parametric norm.

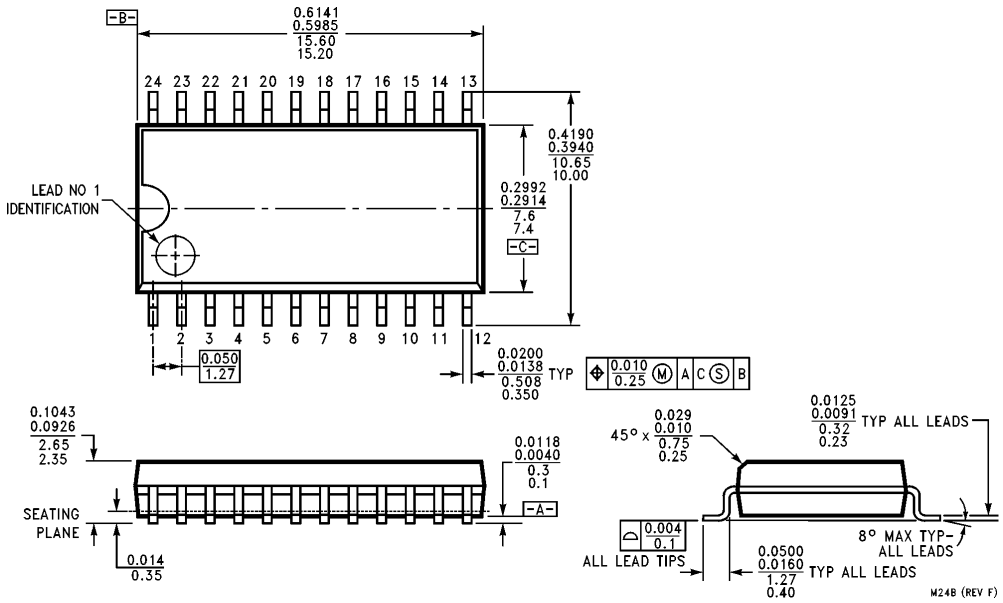
**Note 6:** All limits are guaranteed by testing or statistical analysis.

**Note 7:** The settling time is measured from the input transition to a point 50 mV of the final value, for both rising and falling transitions. The input swing is 0.5V to 13.5V for buffers 1, 3, 5, 7 and 3.75V to 10.25V for buffers 2, 4, 6, 8. Input rise time should be less than 1 $\mu$s.

**Note 8:** High-Speed Buffers are 1, 3, 5, 7 and Low-Speed Buffers are 2, 4, 6, 8.

**Note 9:** Output Voltage Difference is the difference between the highest and lowest buffer output voltage when all buffer inputs are at identical voltages.

## Physical Dimensions inches (millimeters) unless otherwise noted




**24-Lead (3.00″ Wide) Small Outline Molded Package (M)**
**Order Number LMC6008IM or LMC6008IMX**
**NS Package Number M24B**

**LIFE SUPPORT POLICY**

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

**National Semiconductor Corporation**
1111 West Bardin Road
Arlington, TX 76017
Tel: 1(800) 272-9959
Fax: 1(800) 737-7018

http://www.national.com

**National Semiconductor Europe**
Fax: +49 (0) 180-530 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 180-530 85 85
English Tel: +49 (0) 180-532 78 32
Français Tel: +49 (0) 180-532 93 58
Italiano Tel: +49 (0) 180-534 16 80

**National Semiconductor Hong Kong Ltd.**
13th Floor, Straight Block,
Ocean Centre, 5 Canton Rd.
Tsimshatsui, Kowloon
Hong Kong
Tel: (852) 2737-1600
Fax: (852) 2736-9960

**National Semiconductor Japan Ltd.**
Tel: 81-043-299-2308
Fax: 81-043-299-2408