

# LMC6008

## 8 Channel Buffer

### General Description

The LMC6008 octal buffer is designed for use in an active matrix liquid-crystal display (AMLCD), specifically to buffer the gray-level voltages going to the inputs of the column driver integrated circuits. In an 8-gray-level (512 color) or 16-gray-level (4096 color) AMLCD, the function of the column drivers is to switch the gray-level voltage inputs to the AMLCD columns. Thus, the voltage buffers must be able to drive the column capacitance of the entire display panel. The LMC6008 AC characteristics, including settling time, are specified for a capacitive load of 0.1  $\mu\text{F}$  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). The high-speed buffers are intended to be used for the highest gray-level voltages (V0, V1, V2, V3 in an 8-gray AMLCD). 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  $\mu\text{A}$  max. Also, a thermal limit circuit is included to protect the device from overload conditions.

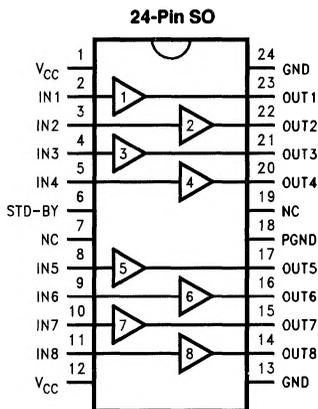
### Features

- High Output Current:
  - High Speed Buffers 250 mA min
  - Low Power Buffers 150 mA min
- Slew Rate:
  - High Speed Buffers 1.7 V/ $\mu\text{s}$
  - Low Power Buffers 0.85V/ $\mu\text{s}$
- Settling Time,  $C_L = 0.1 \mu\text{F}$  16  $\mu\text{s}$  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  $\mu\text{A}$

### Applications

- AMLCD voltage buffering
- Multi-voltage buffering

### Connection Diagram



TL/H/12321-1

**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	LMC6008IM	M24B	Rail
Surface Mount	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	$4.5V \leq V^+ \leq 16V$
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  $T_J = 25^\circ\text{C}$ ,  $V_{CC} = 14.5V$  and  $R_L = 0$ .

Symbol	Parameter	Conditions	Typ (Note 5)	LMC6008 Limit (Note 6)	Units
$V_{OS}$	Input Offset Voltage	$R_S = 10\text{ k}\Omega$		25	mV max
$A_V$	$V_O = 10\text{ V}_{PP}$			0.985	V/V
$I_B$	Input Bias Current			300	nA max
$I_{LP}$	Peak Load Current	Hi Speed Buffers $V_O = 13\text{ V}_{PP}$		-250	mA max
				+250	mA min
$I_{LP}$	Peak Load Current	Lo Speed Buffers $V_O = 13\text{ V}_{PP}$		-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	$\mu\text{A}$ max
$I_{IL}$	Standby Low Input Current			1.0	$\mu\text{A}$ max
$I_{O(STD-BY)}$	Output Leakage Current	$V_{STD-BY} = \text{High}$		5	$\mu\text{A}$ max
$I_{CC}$	Supply Current	$V_{IL} = \text{Low}, V_{IN} = 7.25V$		6.5	mA max
$I_{STD-BY}$	Standby Current	$V_{STD-BY} = \text{High}$		500	$\mu\text{A}$ 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  $T_J = 25^\circ\text{C}$ ,  $V_{CC} = 14.5\text{V}$  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/ $\mu\text{s}$ min
		Buffers 2, 4, 6, 8 (Note 3)		0.85	V/ $\mu\text{s}$ min
$t_S$	Settling Time	(Notes 3, 7)		16	$\mu\text{s}$ max
$t_{ON}$	Standby Response Time ON			10	$\mu\text{s}$ max
$t_{OFF}$	Standby Response Time OFF			10	$\mu\text{s}$ max
PBW	Power Bandwidth	$V_O = 10\text{V}_{PP}$ for Hi-Speed $V_O = 5\text{V}_{PP}$ for Lo-Speed (Note 3)		45	KHz min
$C_L$	Load Capacitance			0.1	$\mu\text{F}$ 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  $\mu\text{F}$  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  $\theta_{JA} = 50^\circ\text{C}/\text{W}$ . If the maximum allowable power dissipation is exceeded, the thermal limit circuit will limit the die temperature to approximately 160 $^\circ\text{C}$ . 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  $\mu\text{s}$ .

**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.