National Semiconductor

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 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). 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 μA max. Also, a thermal limit circuit is included to protect the device from overload conditions.

Features

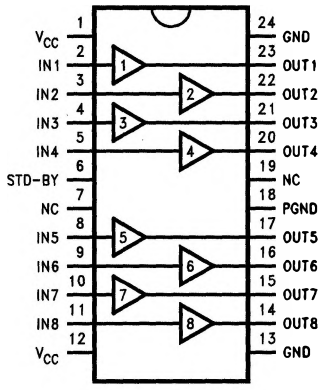
- High Output Current:
  - High Speed Buffers — 250 mA min
  - Low Power Buffers — 150 mA min
- Slew Rate:
  - High Speed Buffers — 1.7 V/μs
  - Low Power Buffers — 0.85V/μs
- Settling Time, C_L = 0.1 μF — 16 μs max
- Wide Input/Output Range — 0.1V to V_{CC} − 0.1V min
- Supply Voltage Range — 5V to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

Applications

- AMLCD voltage buffering
- Multi-voltage buffering

Connection Diagram

24-Pin SO



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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 (θ_{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 = 0Ω.

Symbol	Parameter	Conditions	Typ (Note 5)	LMC6008 Limit (Note 6)	Units
SR	Slew Rate	Buffers 1, 3, 5, 7 (Note 3)		1.70	V/μs min
		Buffers 2, 4, 6, 8 (Note 3)		0.85	V/μs min
t_S	Settling Time	(Notes 3, 7)		16	μs max
t_{ON}	Standby Response Time ON			10	μs max
t_{OFF}	Standby Response Time OFF			10	μs max
PBW	Power Bandwidth	V_O = 10 V_{PP} for Hi-Speed V_O = 5 V_{PP} for Lo-Speed (Note 3)		45	KHz min
C_L	Load Capacitance			0.1	μF 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 kΩ in series with 100 pF.

Note 3: The Load is a series connection of a 0.1 μF capacitor and a 1Ω resistor.

Note 4: The maximum power dissipation is a function of $T_{J(max)}$, θ_{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 θ_{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 μs.

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.