

# 180MHz, 350V/ $\mu$ s Rail-to-Rail Input and Output Low Distortion Op Amp

January 2000

## FEATURES

- **-3dB Bandwidth: 320MHz,  $A_V = 1$**
- **Gain-Bandwidth Product: 180MHz,  $A_V \geq 10$**
- **Slew Rate: 350V/ $\mu$ s**
- **Wide Supply Range: 2.5V to 12.6V**
- **Large Output Current: 85mA**
- **Low Distortion, 5MHz: -90dBc**
- Input Common Mode Range Includes Both Rails
- Output Swings Rail-to-Rail
- Input Offset Voltage, Rail-to-Rail: 2.5mV Max
- Common Mode Rejection: 89dB Typ
- Power Supply Rejection: 87dB Typ
- Open-Loop Gain: 100V/mV Typ
- Shutdown Pin
- 8-Pin SO-8 Package
- Operating Temperature Range -40°C to 85°C

## APPLICATIONS

- Active Filters
- Rail-to-Rail Buffer Amplifiers
- Driving A/D Converters
- Low Voltage Signal Processing
- Video Line Driver

## DESCRIPTION


The LT<sup>®</sup>1809 is a low distortion rail-to-rail input and output op amp with a 350V/ $\mu$ s slew rate. The amplifier has a -3dB bandwidth of 320MHz at unity-gain, a gain-bandwidth product of 180MHz ( $A_V \geq 10$ ) and an 85mA output current to fit the needs of low voltage, high performance signal conditioning systems.

The LT1809 has an input range that includes both supply rails and an output that swings within 20mV of either supply rail to maximize the signal dynamic range in low supply applications.

The LT1809 has very low distortion (-90dBc) up to 5MHz that allows it to be used in high performance data acquisition systems.

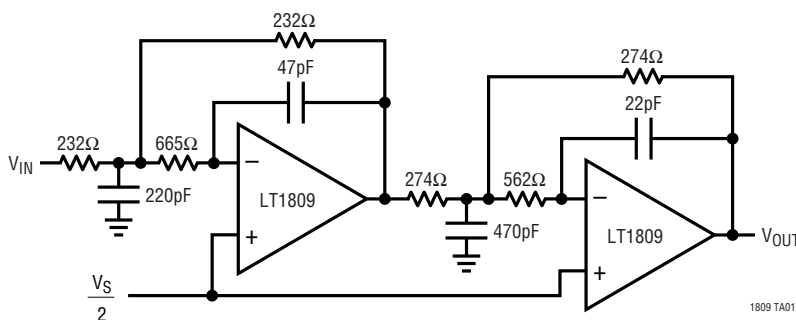
The LT1809 maintains its performance for supplies from 2.5V to 12.6V and is specified at 3V, 5V and  $\pm 5$ V supplies. The inputs can be driven beyond the supplies without damage or phase reversal of the output.

The LT1809 is available in the 8-pin SO package with the standard op amp pinout. This device can be used as a plug-in replacement for many op amps to improve input/output range and performance.

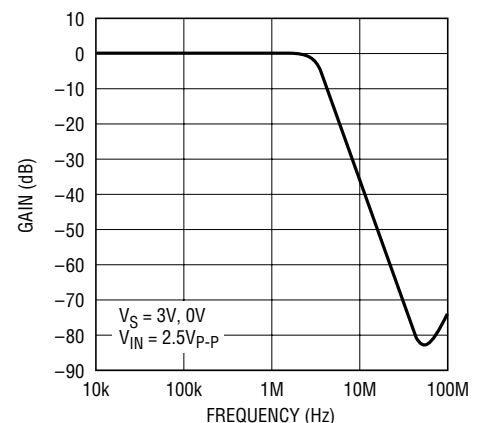
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## TYPICAL APPLICATION

Single 3V Supply, 4MHz, 4th Order Butterworth Filter



Filter Frequency Response



## ABSOLUTE MAXIMUM RATINGS

(Note 1)

Total Supply Voltage ( $V^+$ to $V^-$ ) .....	12.6V
Input Voltage (Note 2) .....	$\pm V_S$
Input Current (Note 2) .....	$\pm 10\text{mA}$
Output Short-Circuit Duration (Note 3) .....	Indefinite
Operating Temperature Range (Note 4) ..	$-40^\circ\text{C}$ to $85^\circ\text{C}$
Specified Temperature Range (Note 5) ...	$-40^\circ\text{C}$ to $85^\circ\text{C}$
Junction Temperature .....	$150^\circ\text{C}$
Storage Temperature Range .....	$-65^\circ\text{C}$ to $150^\circ\text{C}$
Lead Temperature (Soldering, 10 sec) .....	$300^\circ\text{C}$

## PACKAGE/ORDER INFORMATION

<p>TOP VIEW</p> <p>SHDN 1 8 NC</p> <p>-IN 2 7 V+</p> <p>+IN 3 6 OUT</p> <p>V- 4 5 NC</p> <p>S8 PACKAGE 8-LEAD PLASTIC SO</p> <p><math>T_{j\text{MAX}} = 150^\circ\text{C}</math>, <math>\theta_{\text{JA}} = 190^\circ\text{C/W}</math></p>	ORDER PART NUMBER
	LT1809CS8 LT1809IS8
	S8 PART MARKING
	1809 1809I

Consult factory for Military grade parts.

## ELECTRICAL CHARACTERISTICS

$T_A = 25^\circ\text{C}$ .  $V_S = 5\text{V}$ ,  $0\text{V}$ ;  $V_S = 3\text{V}$ ,  $0\text{V}$ ;  $V_{\text{SHDN}} = \text{open}$ ;  $V_{\text{CM}} = V_{\text{OUT}} = \text{half supply unless otherwise noted}$ .

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
$V_{\text{OS}}$	Input Offset Voltage	$V_{\text{CM}} = V^+$		0.6	2.5	mV
		$V_{\text{CM}} = V^-$		0.6	2.5	mV
$\Delta V_{\text{OS}}$	Input Offset Shift	$V_{\text{CM}} = V^-$ to $V^+$		0.3	1.75	mV
$I_B$	Input Bias Current	$V_{\text{CM}} = V^+$		1.8	8	$\mu\text{A}$
		$V_{\text{CM}} = V^-$	-27.5	-13		$\mu\text{A}$
$\Delta I_B$	Input Bias Current Shift	$V_{\text{CM}} = V^-$ to $V^+$		11.8	35.5	$\mu\text{A}$
$I_{\text{OS}}$	Input Offset Current	$V_{\text{CM}} = V^+$		0.05	1.2	$\mu\text{A}$
		$V_{\text{CM}} = V^-$		0.2	4	$\mu\text{A}$
$\Delta I_{\text{OS}}$	Input Offset Current Shift	$V_{\text{CM}} = V^-$ to $V^+$		0.25	5.2	$\mu\text{A}$
$e_n$	Input Noise Voltage Density	$f = 10\text{kHz}$		16		$\text{nV}/\sqrt{\text{Hz}}$
$i_n$	Input Noise Current Density	$f = 10\text{kHz}$		5		$\text{pA}/\sqrt{\text{Hz}}$
$C_{\text{IN}}$	Input Capacitance			2		pF
$A_{\text{VOL}}$	Large-Signal Voltage Gain	$V_S = 5\text{V}$ , $V_O = 0.5\text{V}$ to $4.5\text{V}$ , $R_L = 1\text{k}$	35	90		V/mV
		$V_S = 5\text{V}$ , $V_O = 1\text{V}$ to $4\text{V}$ , $R_L = 100\Omega$	4.5	10		V/mV
		$V_S = 3\text{V}$ , $V_O = 0.5\text{V}$ to $2.5\text{V}$ , $R_L = 1\text{k}$	22	42		V/mV
CMRR	Common Mode Rejection Ratio	$V_S = 5\text{V}$ , $V_{\text{CM}} = V^-$ to $V^+$	69	82		dB
		$V_S = 3\text{V}$ , $V_{\text{CM}} = V^-$ to $V^+$	64	78		dB
	Input Common Mode Range		$V^-$		$V^+$	V
PSRR	Power Supply Rejection Ratio	$V_S = 2.5\text{V}$ to $10\text{V}$ , $V_{\text{CM}} = 0\text{V}$	73	87		dB
		Minimum Supply Voltage (Note 6)		2.3	2.5	V

## ELECTRICAL CHARACTERISTICS

$T_A = 25^\circ\text{C}$ .  $V_S = 5\text{V}, 0\text{V}$ ;  $V_S = 3\text{V}, 0\text{V}$ ;  $V_{\text{SHDN}} = \text{open}$ ;  $V_{\text{CM}} = V_{\text{OUT}} = \text{half supply unless otherwise noted}$ .

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
$V_{\text{OL}}$	Output Voltage Swing LOW (Note 7)	No Load		6	20	mV
		$I_{\text{SINK}} = 5\text{mA}$		40	80	mV
		$I_{\text{SINK}} = 25\text{mA}$		150	300	mV
$V_{\text{OH}}$	Output Voltage Swing HIGH (Note 7)	No Load		17	40	mV
		$I_{\text{SOURCE}} = 5\text{mA}$		80	160	mV
		$I_{\text{SOURCE}} = 25\text{mA}$		300	500	mV
$I_{\text{SC}}$	Short-Circuit Current	$V_S = 5\text{V}$	$\pm 50$	$\pm 85$		mA
		$V_S = 3\text{V}$	$\pm 40$	$\pm 70$		mA
$I_S$	Supply Current			12.5	17	mA
	Disable Supply Current	$V_S = 5\text{V}, V_{\text{SHDN}} = 0\text{V}$ $V_S = 3\text{V}, V_{\text{SHDN}} = 0\text{V}$		0.55 0.31	0.8 0.5	mA mA
GBW	Gain-Bandwidth Product	Frequency = 2MHz		160		MHz
SR	Slew Rate	$V_S = 5\text{V}, A_V = -1, R_L = 1\text{k}, V_O = 4\text{V}_{\text{P-P}}$		300		V/ $\mu\text{s}$
THD	Total Harmonic Distortion	$V_S = 5\text{V}, A_V = 1, R_L = 1\text{k}, V_O = 2\text{V}_{\text{P-P}}, f_C = 5\text{MHz}$		-86		dB
$t_S$	Settling Time	0.01%, $V_S = 5\text{V}, V_{\text{STEP}} = 2\text{V}, A_V = 1, R_L = 1\text{k}$		40		ns
$\Delta G$	Differential Gain (NTSC)	$V_S = 5\text{V}, A_V = 2, R_L = 150\Omega$		0.015		%
$\Delta\theta$	Differential Phase (NTSC)			0.05		%

The ● denotes the specifications which apply over the  $0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$  temperature range.  $V_S = 5\text{V}, 0\text{V}$ ;  $V_S = 3\text{V}, 0\text{V}$ ;  $V_{\text{SHDN}} = \text{open}$ ;  $V_{\text{CM}} = V_{\text{OUT}} = \text{half supply unless otherwise noted}$ .

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
$V_{\text{OS}}$	Input Offset Voltage	$V_{\text{CM}} = V^+$	●	1	3	mV
		$V_{\text{CM}} = V^-$	●	1	3	mV
$V_{\text{OS TC}}$	Input Offset Voltage Drift (Note 8)	$V_{\text{CM}} = V^+$	●	9	25	$\mu\text{V}/^\circ\text{C}$
		$V_{\text{CM}} = V^-$	●	9	25	$\mu\text{V}/^\circ\text{C}$
$\Delta V_{\text{OS}}$	Input Offset Voltage Shift	$V_{\text{CM}} = V^- \text{ to } V^+$	●	0.5	2	mV
$I_B$	Input Bias Current	$V_{\text{CM}} = V^+ - 0.1\text{V}$	●	2	10	$\mu\text{A}$
		$V_{\text{CM}} = V^- + 0.2\text{V}$	●	-30	-14	$\mu\text{A}$
$\Delta I_B$	Input Bias Current Shift	$V_{\text{CM}} = V^- + 0.2\text{V} \text{ to } V^+ - 0.1\text{V}$	●	12	40	$\mu\text{A}$
$I_{\text{OS}}$	Input Offset Current	$V_{\text{CM}} = V^+ - 0.1\text{V}$	●	0.05	1.5	$\mu\text{A}$
		$V_{\text{CM}} = V^- + 0.2\text{V}$	●	0.40	4.5	$\mu\text{A}$
$\Delta I_{\text{OS}}$	Input Offset Current Shift	$V_{\text{CM}} = V^- + 0.2\text{V} \text{ to } V^+ - 0.1\text{V}$	●	0.45	6	$\mu\text{A}$
$A_{\text{VOL}}$	Large-Signal Voltage Gain	$V_S = 5\text{V}, V_O = 0.5\text{V} \text{ to } 4.5\text{V}, R_L = 1\text{k}$	●	25	80	V/mV
		$V_S = 5\text{V}, V_O = 1\text{V} \text{ to } 4\text{V}, R_L = 100\Omega$	●	3.5	8.5	V/mV
		$V_S = 3\text{V}, V_O = 0.5\text{V} \text{ to } 2.5\text{V}, R_L = 1\text{k}$	●	16	40	V/mV
CMRR	Common Mode Rejection Ratio	$V_S = 5\text{V}, V_{\text{CM}} = V^- \text{ to } V^+$	●	67.5	80	dB
		$V_S = 3\text{V}, V_{\text{CM}} = V^- \text{ to } V^+$	●	63.5	75	dB
	Input Common Mode Range		●	$V^-$	$V^+$	V
PSRR	Power Supply Rejection Ratio	$V_S = 2.5\text{V} \text{ to } 10\text{V}, V_{\text{CM}} = 0\text{V}$	●	71	83	dB
	Minimum Supply Voltage (Note 6)		●	2.3	2.5	V
$V_{\text{OL}}$	Output Voltage Swing LOW (Note 7)	No Load	●	8	25	mV
		$I_{\text{SINK}} = 5\text{mA}$	●	40	80	mV
		$I_{\text{SINK}} = 25\text{mA}$	●	160	320	mV

## ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$  temperature range.  $V_S = 5\text{V}, 0\text{V}; V_S = 3\text{V}, 0\text{V}; V_{\overline{\text{SHDN}}} = \text{open}; V_{\text{CM}} = V_{\text{OUT}} = \text{half supply unless otherwise noted.}$

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
$V_{\text{OH}}$	Output Voltage Swing HIGH (Note 7)	No Load	●	50	100	mV
		$I_{\text{SOURCE}} = 5\text{mA}$	●	110	220	mV
		$I_{\text{SOURCE}} = 25\text{mA}$	●	340	600	mV
$I_{\text{SC}}$	Short-Circuit Current	$V_S = 5\text{V}$	●	$\pm 45$	$\pm 75$	mA
		$V_S = 3\text{V}$	●	$\pm 35$	$\pm 65$	mA
$I_S$	Supply Current		●	15	20	mA
	Disable Supply Current	$V_S = 5\text{V}, V_{\overline{\text{SHDN}}} = 0\text{V}$ $V_S = 3\text{V}, V_{\overline{\text{SHDN}}} = 0\text{V}$	●	0.58	1	mA
GBW	Gain-Bandwidth Product		●	145		MHz
SR	Slew Rate	$V_S = 5\text{V}, A_V = -1, R_L = 1\text{k}, V_O = 4V_{\text{P-P}}$	●	250		$V/\mu\text{s}$

The ● denotes the specifications which apply over the  $-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$  temperature range.  $V_S = 5\text{V}, 0\text{V}; V_S = 3\text{V}, 0\text{V}; V_{\overline{\text{SHDN}}} = \text{open}; V_{\text{CM}} = V_{\text{OUT}} = \text{half supply unless otherwise noted. (Note 5)}$

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
$V_{\text{os}}$	Input Offset Voltage	$V_{\text{CM}} = V^+$	●	1	3.5	mV
		$V_{\text{CM}} = V^-$	●	1	3.5	mV
$V_{\text{os TC}}$	Input Offset Voltage Drift (Note 8)	$V_{\text{CM}} = V^+$	●	9	25	$\mu\text{V}/^{\circ}\text{C}$
		$V_{\text{CM}} = V^-$	●	9	25	$\mu\text{V}/^{\circ}\text{C}$
$\Delta V_{\text{os}}$	Input Offset Voltage Shift	$V_{\text{CM}} = V^-$	●	0.5	2.25	mV
$I_B$	Input Bias Current	$V_{\text{CM}} = V^+ - 0.1\text{V}$	●	2	12	$\mu\text{A}$
		$V_{\text{CM}} = V^- + 0.2\text{V}$	●	-35	-17	$\mu\text{A}$
$\Delta I_B$	Input Bias Current Shift	$V_{\text{CM}} = V^- + 0.2\text{V to } V^+ - 0.1\text{V}$	●	14	47	$\mu\text{A}$
$I_{\text{OS}}$	Input Offset Current	$V_{\text{CM}} = V^+ - 0.1\text{V}$	●	0.08	2	$\mu\text{A}$
		$V_{\text{CM}} = V^- + 0.2\text{V}$	●	0.5	6	$\mu\text{A}$
$\Delta I_{\text{OS}}$	Input Offset Current Shift	$V_{\text{CM}} = V^- + 0.2\text{V to } V^+ - 0.1\text{V}$	●	0.58	7.5	$\mu\text{A}$
$A_{\text{VOL}}$	Large-Signal Voltage Gain	$V_S = 5\text{V}, V_O = 0.5\text{V to } 4.5\text{V}, R_L = 1\text{k}$	●	20	60	$\text{V/mV}$
		$V_S = 5\text{V}, V_O = 1\text{V to } 4\text{V}, R_L = 100\Omega$	●	2.5	7	$\text{V/mV}$
		$V_S = 3\text{V}, V_O = 0.5\text{V to } 2.5\text{V}, R_L = 1\text{k}$	●	12	35	$\text{V/mV}$
CMRR	Common Mode Rejection Ratio	$V_S = 5\text{V}, V_{\text{CM}} = V^- \text{ to } V^+$	●	66.5	80	dB
		$V_S = 3\text{V}, V_{\text{CM}} = V^- \text{ to } V^+$	●	62.5	75.5	dB
	Input Common Mode Range		●	$V^-$	$V^+$	V
PSRR	Power Supply Rejection Ratio	$V_S = 2.5\text{V to } 10\text{V}, V_{\text{CM}} = 0\text{V}$	●	71	83.5	dB
	Minimum Supply Voltage (Note 6)		●	2.3	2.5	V
$V_{\text{OL}}$	Output Voltage Swing LOW (Note 7)	No Load	●	8	30	mV
		$I_{\text{SINK}} = 5\text{mA}$	●	45	90	mV
		$I_{\text{SINK}} = 25\text{mA}$	●	170	340	mV
$V_{\text{OH}}$	Output Voltage Swing HIGH (Note 7)	No Load	●	55	120	mV
		$I_{\text{SOURCE}} = 5\text{mA}$	●	110	230	mV
		$I_{\text{SOURCE}} = 25\text{mA}$	●	350	620	mV
$I_{\text{SC}}$	Short-Circuit Current	$V_S = 5\text{V}$	●	$\pm 35$	$\pm 70$	mA
		$V_S = 3\text{V}$	●	$\pm 30$	$\pm 60$	mA
$I_S$	Supply Current		●	15	21	mA
	Disable Supply Current	$V_S = 5\text{V}, V_{\overline{\text{SHDN}}} = 0\text{V}$ $V_S = 3\text{V}, V_{\overline{\text{SHDN}}} = 0\text{V}$	●	0.58	1.1	mA
			●	0.35	0.85	mA

## ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the  $-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$  temperature range.  $V_S = 5\text{V}$ ,  $0\text{V}$ ;  $V_S = 3\text{V}$ ,  $0\text{V}$ ;  $V_{\overline{\text{SHDN}}} = \text{open}$ ;  $V_{\text{CM}} = V_{\text{OUT}} = \text{half supply unless otherwise noted. (Note 5)}$

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
GBW	Gain-Bandwidth Product	Frequency = 2MHz	●	140		MHz
SR	Slew Rate	$V_S = 5\text{V}$ , $A_V = -1$ , $R_L = 1\text{k}$ , $V_O = 4V_{\text{P-P}}$	●	180		V/ $\mu\text{s}$

$T_A = 25^{\circ}\text{C}$ .  $V_S = \pm 5\text{V}$ ,  $V_{\overline{\text{SHDN}}} = \text{open}$ ,  $V_{\text{CM}} = 0\text{V}$ ,  $V_{\text{OUT}} = 0\text{V}$  unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
$V_{\text{OS}}$	Input Offset Voltage	$V_{\text{CM}} = V^+$ $V_{\text{CM}} = V^-$		0.8 0.8	3 3	mV mV
$\Delta V_{\text{OS}}$	Input Offset Voltage Shift	$V_{\text{CM}} = V^-$ to $V^+$		0.35	2	mV
$I_{\text{B}}$	Input Bias Current	$V_{\text{CM}} = V^+$ $V_{\text{CM}} = V^-$	-30	2 -12.5	10	$\mu\text{A}$ $\mu\text{A}$
$\Delta I_{\text{B}}$	Input Bias Current Shift	$V_{\text{CM}} = V^-$ to $V^+$		13.5	42.5	$\mu\text{A}$
$I_{\text{OS}}$	Input Offset Current	$V_{\text{CM}} = V^+$ $V_{\text{CM}} = V^-$		0.05 0.4	2 5	$\mu\text{A}$ $\mu\text{A}$
$\Delta I_{\text{OS}}$	Input Offset Current Shift	$V_{\text{CM}} = V^-$ to $V^+$		0.45	7	$\mu\text{A}$
$e_{\text{n}}$	Input Noise Voltage Density	$f = 10\text{kHz}$		16		$\text{nV}/\sqrt{\text{Hz}}$
$i_{\text{n}}$	Input Noise Current Density	$f = 10\text{kHz}$		5		$\text{pA}/\sqrt{\text{Hz}}$
$C_{\text{in}}$	Input Capacitance	$f = 100\text{kHz}$		2		pF
$A_{\text{VOL}}$	Large-Signal Voltage Gain	$V_O = -4\text{V}$ to $4\text{V}$ , $R_L = 1\text{k}$ $V_O = -2.5\text{V}$ to $2.5\text{V}$ , $R_L = 100\Omega$	45 5	100 12		V/mV V/mV
CMRR	Common Mode Rejection Ratio	$V_{\text{CM}} = V^-$ to $V^+$	73	89		dB
	Input Common Mode Range		$V^-$		$V^+$	V
PSRR	Power Supply Rejection Ratio	$V^+ = 2.5\text{V}$ to $10\text{V}$ , $V^- = 0\text{V}$	73	87		dB
$V_{\text{OL}}$	Output Voltage Swing LOW (Note 7)	No Load $I_{\text{SINK}} = 5\text{mA}$ $I_{\text{SINK}} = 25\text{mA}$		8 46 170	30 100 350	mV mV mV
$V_{\text{OH}}$	Output Voltage Swing HIGH (Note 7)	No Load $I_{\text{SOURCE}} = 5\text{mA}$ $I_{\text{SOURCE}} = 25\text{mA}$		30 90 310	60 200 600	mV mV mV
$I_{\text{SC}}$	Short-Circuit Current		$\pm 60$	$\pm 85$		mA
$I_{\text{S}}$	Supply Current			15	20	mA
	Disable Supply Current	$V_{\overline{\text{SHDN}}} = 0\text{V}$		0.6	0.9	mA
GBW	Gain-Bandwidth Product	Frequency = 2MHz	120	180		MHz
SR	Slew Rate	$A_V = -1$ , $R_L = 1\text{k}$ , $V_O = \pm 4\text{V}$ , Measure at $V_O = \pm 3\text{V}$	175	350		V/ $\mu\text{s}$
HD	Total Harmonic Distortion	$A_V = 1$ , $R_L = 1\text{k}$ , $V_O = 2V_{\text{P-P}}$ , $f_C = 5\text{MHz}$		-90		dB
$t_{\text{S}}$	Settling Time	0.01%, $V_{\text{STEP}} = 5\text{V}$ , $A_V = 1$ , $R_L = 1\text{k}$		60		nS
$\Delta G$	Differential Gain (NTSC)	$A_V = 2$ , $R_L = 150$		0.01		%
$\Delta\theta$	Differential Phase (NTSC)			0.01		%

## ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$  temperature range.  $V_S = \pm 5\text{V}$ ,  $V_{\overline{\text{SHDN}}} = \text{open}$ ,  $V_{\text{CM}} = 0\text{V}$ ,  $V_{\text{OUT}} = 0\text{V}$  unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
$V_{\text{OS}}$	Input Offset Voltage	$V_{\text{CM}} = V^+$	●	1	3.25	mV
		$V_{\text{CM}} = V^-$	●	1	3.25	mV
$V_{\text{OS TC}}$	Input Offset Voltage Drift (Note 8)	$V_{\text{CM}} = V^+$	●	10	25	$\mu\text{V}/^{\circ}\text{C}$
		$V_{\text{CM}} = V^-$	●	10	25	$\mu\text{V}/^{\circ}\text{C}$
$\Delta V_{\text{OS}}$	Input Offset Voltage Shift	$V_{\text{CM}} = V^-$ to $V^+$	●	0.5	2.15	mV
$I_{\text{B}}$	Input Bias Current	$V_{\text{CM}} = V^+ - 0.1\text{V}$	●	2.5	12.5	$\mu\text{A}$
		$V_{\text{CM}} = V^- + 0.2\text{V}$	●	-37.5	-15	$\mu\text{A}$
$\Delta I_{\text{B}}$	Input Bias Current Shift	$V_{\text{CM}} = V^- + 0.2\text{V}$ to $V^+ - 0.1\text{V}$	●	14	50	$\mu\text{A}$
$I_{\text{OS}}$	Input Offset Current	$V_{\text{CM}} = V^+ - 0.1\text{V}$	●	0.06	2.25	$\mu\text{A}$
		$V_{\text{CM}} = V^- + 0.2\text{V}$	●	0.5	6	$\mu\text{A}$
$\Delta I_{\text{OS}}$	Input Offset Current Shift	$V_{\text{CM}} = V^- + 0.2\text{V}$ to $V^+ - 0.1\text{V}$	●	0.56	8.25	$\mu\text{A}$
$A_{\text{VOL}}$	Large-Signal Voltage Gain	$V_{\text{O}} = -4\text{V}$ to $4\text{V}$ , $R_{\text{L}} = 1\text{k}$	●	35	90	V/mV
		$V_{\text{O}} = -2.5\text{V}$ to $2.5\text{V}$ , $R_{\text{L}} = 100\Omega$	●	4	10	V/mV
CMRR	Common Mode Rejection Ratio	$V_{\text{CM}} = V^-$ to $V^+$	●	73.5	86	dB
	Input Common Mode Range		●	$V^-$	$V^+$	V
PSRR	Power Supply Rejection Ratio	$V^+ = 2.5\text{V}$ to $10\text{V}$ , $V^- = 0\text{V}$	●	71	83	dB
$V_{\text{OL}}$	Output Voltage Swing LOW (Note 7)	No Load	●	10	40	mV
		$I_{\text{SINK}} = 5\text{mA}$	●	45	100	mV
		$I_{\text{SINK}} = 25\text{mA}$	●	185	370	mV
$V_{\text{OH}}$	Output Voltage Swing HIGH (Note 7)	No Load	●	60	120	mV
		$I_{\text{SOURCE}} = 5\text{mA}$	●	110	220	mV
		$I_{\text{SOURCE}} = 25\text{mA}$	●	360	625	mV
$I_{\text{SC}}$	Short-Circuit Current		●	$\pm 50$	$\pm 75$	mA
$I_{\text{S}}$	Supply Current		●	17.5	25	mA
	Disable Supply Current	$V_{\overline{\text{SHDN}}} = 0\text{V}$	●	0.6	1.1	mA
GBW	Gain-Bandwidth Product	Frequency = 2MHz	●	100	170	MHz
SR	Slew Rate	$A_{\text{V}} = -1$ , $R_{\text{L}} = 1\text{k}$ , $V_{\text{O}} = \pm 4\text{V}$ , Measure at $V_{\text{O}} = \pm 3\text{V}$	●	150	300	V/ $\mu\text{s}$

The ● denotes the specifications which apply over the  $-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$  temperature range.  $V_S = \pm 5\text{V}$ ,  $V_{\overline{\text{SHDN}}} = \text{open}$ ,  $V_{\text{CM}} = 0\text{V}$ ,  $V_{\text{OUT}} = 0\text{V}$  unless otherwise noted. (Note 5)

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
$V_{\text{OS}}$	Input Offset Voltage	$V_{\text{CM}} = V^+$	●	1	3.75	mV
		$V_{\text{CM}} = V^-$	●	1	3.75	mV
$V_{\text{OS TC}}$	Input Offset Voltage Drift (Note 8)	$V_{\text{CM}} = V^+$	●	10	25	$\mu\text{V}/^{\circ}\text{C}$
		$V_{\text{CM}} = V^-$	●	10	25	$\mu\text{V}/^{\circ}\text{C}$
$\Delta V_{\text{OS}}$	Input Offset Voltage Shift	$V_{\text{CM}} = V^-$ to $V^+$	●	0.5	2.5	mV
$I_{\text{B}}$	Input Bias Current	$V_{\text{CM}} = V^+ - 0.1\text{V}$	●	2.8	14	$\mu\text{A}$
		$V_{\text{CM}} = V^- + 0.2\text{V}$	●	-45	-17	$\mu\text{A}$
$\Delta I_{\text{B}}$	Input Bias Current Shift	$V_{\text{CM}} = V^- + 0.2\text{V}$ to $V^+ - 0.1\text{V}$	●	19.8	59	$\mu\text{A}$

## ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the  $-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$  temperature range.  $V_S = \pm 5\text{V}$ ,  $V_{\text{SHDN}} = \text{open}$ ,  $V_{\text{CM}} = 0\text{V}$ ,  $V_{\text{OUT}} = 0\text{V}$  unless otherwise noted. (Note 3)

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
$I_{\text{OS}}$	Input Offset Current	$V_{\text{CM}} = V^+ - 0.1\text{V}$	●	0.08	2.5	$\mu\text{A}$
		$V_{\text{CM}} = V^- + 0.2\text{V}$	●	0.6	8	$\mu\text{A}$
$\Delta I_{\text{OS}}$	Input Offset Current Shift	$V_{\text{CM}} = V^- + 0.2\text{V}$ to $V^+ - 0.1\text{V}$	●	0.68	10.5	$\mu\text{A}$
$A_{\text{VOL}}$	Large-Signal Voltage Gain	$V_0 = -4\text{V}$ to $4\text{V}$ , $R_L = 1\text{k}$	●	25	80	$\text{V/mV}$
		$V_0 = -2.5\text{V}$ to $2.5\text{V}$ , $R_L = 100\Omega$	●	3	10	$\text{V/mV}$
CMRR	Common Mode Rejection Ratio	$V_{\text{CM}} = V^-$ to $V^+$	●	72	86	dB
	Input Common Mode Range		●	$V^-$	$V^+$	V
PSRR	Power Supply Rejection Ratio	$V^+ = 2.5\text{V}$ to $10\text{V}$ , $V^- = 0\text{V}$	●	71	83.5	dB
$V_{\text{OL}}$	Output Voltage Swing LOW (Note 7)	No Load	●	10	45	mV
		$I_{\text{SINK}} = 5\text{mA}$	●	50	100	mV
		$I_{\text{SINK}} = 25\text{mA}$	●	200	400	mV
$V_{\text{OH}}$	Output Voltage Swing HIGH (Note 7)	No Load	●	70	140	mV
		$I_{\text{SOURCE}} = 5\text{mA}$	●	115	240	mV
		$I_{\text{SOURCE}} = 25\text{mA}$	●	360	650	mV
$I_{\text{SC}}$	Short-Circuit Current		●	$\pm 40$	$\pm 75$	mA
$I_S$	Supply Current		●	19	25	mA
	Disable Supply Current	$V_{\text{SHDN}} = 0\text{V}$	●	0.65	1.15	mA
GBW	Gain-Bandwidth Product	Frequency = 2MHz	●	90	160	MHz
SR	Slew Rate	$A_V = -1$ , $R_L = 1\text{k}$ , $V_0 = \pm 4\text{V}$ , Measure at $V_0 = \pm 2\text{V}$	●	110	220	$\text{V}/\mu\text{s}$

**Note 1:** Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

**Note 2:** The inputs are protected by back-to-back diodes. If the differential input voltage exceeds 1.4V, the input current should be limited to less than 10mA.

**Note 3:** A heat sink may be required to keep the junction temperature below the absolute maximum rating when the output is shorted indefinitely.

**Note 4:** The LT1809C/LT1809I are guaranteed functional over the operating temperature range of  $-40^{\circ}\text{C}$  and  $85^{\circ}\text{C}$ .

**Note 5:** The LT1809C is guaranteed to meet specified performance from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ . The LT1809C is designed, characterized and expected to meet specified performance from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$  but is not tested or QA sampled at these temperatures. The LT1809I is guaranteed to meet specified performance from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

**Note 6:** Minimum supply voltage is guaranteed by power supply rejection ratio test.

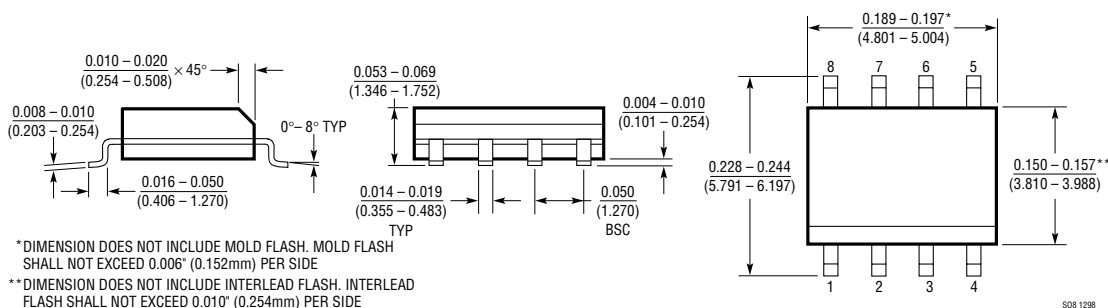
**Note 7:** Output voltage swings are measured between the output and power supply rails.

**Note 8:** This parameter is not 100% tested.

## PACKAGE DESCRIPTION

Dimensions in inches (millimeters) unless otherwise noted.

**S8 Package**  
**8-Lead Plastic Small Outline (Narrow 0.150)**  
 (LTC DWG # 05-08-1610)



## TYPICAL APPLICATION

### Single Supply Video Line Driver

The LT1809 is a wideband rail-to-rail op amp with high output current that allows it to drive video signals in low supply applications. Figure 1 depicts a single supply video line driver with AC coupling to minimize the quiescent power dissipation. Resistors R1 and R2 are used to level-shift the input and output to provide the largest signal swing. The gain of two is set up with R3 and R4 to restore the signal at  $V_{OUT}$  which is attenuated by 6dB due to the

matching of the  $75\Omega$  line with the back-terminated resistor, R5. The back termination will eliminate any reflection of the signal that comes from the load. The input termination resistor,  $R_T$ , is optional—it is used only if matching of the incoming line is necessary. The values of C1, C2 and C3 are selected to minimize the droop of the luminance signal. In some less stringent requirements, the value of capacitors could be reduced.

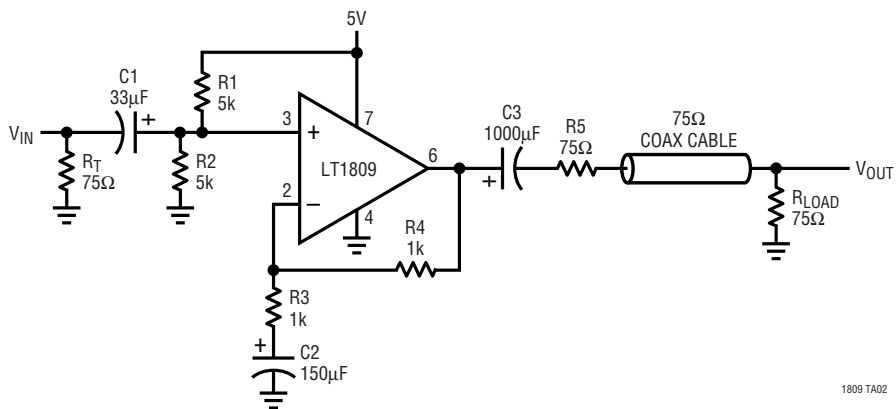


Figure 1. Single Supply Video Line Driver

1809 TA02

## RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1632/LT1633	Dual/Quad 45MHz, 45V/ $\mu$ s Rail-to-Rail Input and Output Op Amps	High DC Accuracy, 1.35mV $V_{OS(MAX)}$ , 70mA Output Current, Max Supply Current 5.2mA per Amplifier
LT1630/LT1631	Dual/Quad 30MHz, 10V/ $\mu$ s Rail-to-Rail Input and Output Op Amps	High DC Accuracy, 525 $\mu$ V $V_{OS(MAX)}$ , 70mA Output Current, Max Supply Current 4.4mA per Amplifier
LT1215/LT1216	Dual/Quad 23MHz, 50V/ $\mu$ s Single Supply Precision Op Amps	Input Common Mode Includes Ground, 450 $\mu$ V $V_{OS(MAX)}$ , 6 $\mu$ V/ $^{\circ}$ C Max Drift, Max Supply Current 6.6mA per Amplifier