10MHz, 5V/µs, Dual/Quad Rail-to-Rail Input and Output Precision C-Load Op Amps

December 1996

FEATURES

- **Rail-to-Rail Input and Output**
- **475µV Max V_{OS} from V^+ to V^-**
- **Gain-Bandwidth Product: 10MHz**
- **Slew Rate: 5V/µs**
- **Low Supply Current per Amplifier: 1.7mA**
- Input Offset Current: 50nA Max
- Input Bias Current: 500nA Max
- Open-Loop Gain: 1000V/mV Min
- Low Input Noise Voltage: 12nV/√Hz Typ
- Wide Supply Range: 2.2V to ±15V
- Large Output Drive Current: 30mA
- Stable for Capacitive Loads Up to 10,000pF
- Dual in 8-Pin PDIP and SO Package
- Quad in Narrow 14-Pin SO

APPLICATIONS

- Driving A-to-D Converters
- Active Filters
- Rail-to-Rail Buffer Amplifiers
- Low Voltage Signal Processing
- Battery-Powered Systems

DESCRIPTION

The LT®1498/LT1499 are dual/quad, rail-to-rail input and output precision C-Load™ op amps with a 10MHz gain-bandwidth product and a 5V/µs slew rate.

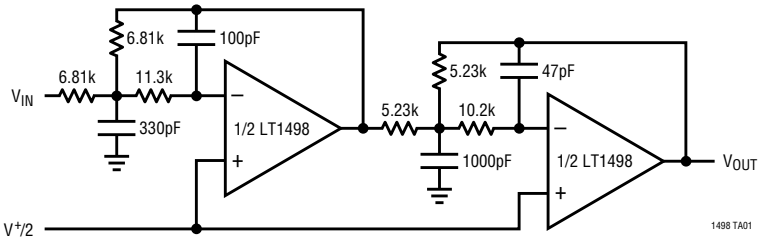
The LT1498/LT1499 are designed to maximize input dynamic range by delivering precision performance over the full supply voltage. Using a patented technique, both input stages of the LT1498/LT1499 are trimmed, one at the negative supply and the other at the positive supply. The resulting guaranteed common mode rejection is much better than other rail-to-rail input op amps. When used as a unity-gain buffer in front of single supply 12-bit A-to-D converters, the LT1498/LT1499 are guaranteed to add less than 1LSB of error even in single 3V supply systems.

With 110dB of supply rejection, the LT1498/LT1499 maintain their performance over a supply range of 2.2V to 36V and are specified for 3V, 5V and ±15V supplies. The inputs can be driven beyond the supplies without damage or phase reversal of the output. These op amps remain stable while driving capacitive loads up to 10,000pF.

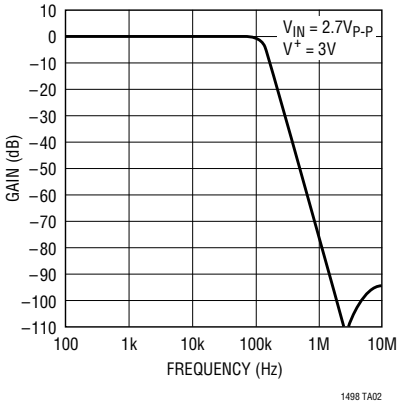
The LT1498 is available with the standard dual op amp configuration in 8-pin PDIP and SO packaging. The LT1499 features the standard quad op amp configuration and is available in a 14-pin plastic SO package. These devices can be used as plug-in replacements for many standard op amps to improve input/output range and precision.

TYPICAL APPLICATION

Single Supply 100kHz 4th Order Butterworth Filter



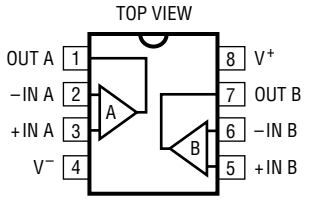
Frequency Response



ABSOLUTE MAXIMUM RATINGS

Total Supply Voltage (V^+ to V^-) 36V
Input Current ..... ±10mA
Output Short-Circuit Duration (Note 1) ..... Continuous
Operating Temperature Range ..... –40°C to 85°C
Specified Temperature Range (Note 3) .... –40°C to 85°C
Junction Temperature ..... 150°C
Storage Temperature Range ..... –65°C to 150°C
Lead Temperature (Soldering, 10 sec) ..... 300°C

PACKAGE/ORDER INFORMATION



N8 PACKAGE
8-LEAD PDIP

S8 PACKAGE
8-LEAD PLASTIC SO

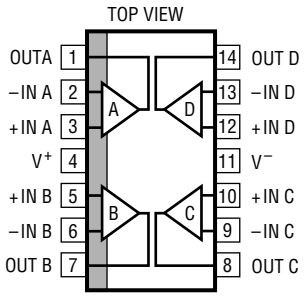
T_{JMAX} = 150°C, θ_{JA} = 130°C/W (N8)
T_{JMAX} = 150°C, θ_{JA} = 190°C/W (S8)

ORDER PART NUMBER

LT1498CN8
LT1498CS8

S8 PART MARKING

1498



S PACKAGE
14-LEAD PLASTIC SO

T_{JMAX} = 150°C, θ_{JA} = 150°C/W

ORDER PART NUMBER

LT1499CS

Consult factory for Military and Industrial grade parts.

ELECTRICAL CHARACTERISTICS

T_A = 25°C, V_S = 5V,0V, V_{CM} = 2.5V, V_{OUT} = 2.5V, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	$V_{CM} = V^+$ $V_{CM} = V^-$			150 150	475 475	µV µV
ΔV_{OS}	Input Offset Voltage Shift Input Offset Voltage Match (Channel-to-Channel)	$V_{CM} = V^-$ to V^+ $V_{CM} = V^+, V^-$ (Note 4)			150 200	425 750	µV µV
I_B	Input Bias Current	$V_{CM} = V^+$ $V_{CM} = V^-$		0 –500	250 –250	500 0	nA nA
ΔI_B	Input Bias Current Shift	$V_{CM} = V^-$ to V^+			500	1000	nA
I_{OS}	Input Offset Current	$V_{CM} = V^+$ $V_{CM} = V^-$			5 5	50 50	nA nA
ΔI_{OS}	Input Offset Current Shift	$V_{CM} = V^-$ to V^+			10	100	nA
	Input Bias Current Match (Channel-to-Channel)	$V_{CM} = V^+$ (Note 4) $V_{CM} = V^-$		0 –100	–10 –10	100 0	nA nA
e_n	Input Noise Voltage Density	f = 1kHz			12		nV/√Hz
i_n	Input Noise Current Density	f = 1kHz			0.3		pA/√Hz
C_{IN}	Input Capacitance				12		pF
A_{VOL}	Large-Signal Voltage Gain	V_O = 75mV to 4.8V, R_L = 10k		600	3800		V/mV
CMRR	Common Mode Rejection Ratio	$V_{CM} = V^-$ to V^+		81	90		dB
	CMRR Match (Channel-to-Channel)	$V_{CM} = V^-$ to V^+ (Note 4)		75	91		dB
PSRR	Power Supply Rejection Ratio	V_S = 2.2V to 12V, $V_{CM} = V_O$ = 0.5V		88	105		dB
	PSRR Match (Channel-to-Channel) (Note 4)	V_S = 2.2V to 12V, $V_{CM} = V_O$ = 0.5V		82	103		dB

ELECTRICAL CHARACTERISTICS

T_A = 25°C, V_S = 5V,0V, V_{CM} = 2.5V, V_{OUT} = 2.5V, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{OL}	Output Voltage Swing (Low) (Note 5)	No Load			14	30	mV
		I_{SINK} = 0.5mA			35	70	mV
		I_{SINK} = 2.5mA			90	200	mV
V_{OH}	Output Voltage Swing (High) (Note 5)	No Load			2.5	10	mV
		I_{SOURCE} = 0.5mA			50	100	mV
		I_{SOURCE} = 2.5mA			140	250	mV
I_{SC}	Short-Circuit Current			±12.5	±24		mA
I_S	Supply Current per Amplifier				1.7	2.2	mA
GBW	Gain-Bandwidth Product				10		MHz

0°C < T_A < 70°C, V_S = 5V, 0V, V_{CM} = 2.5V, V_{OUT} = 2.5V, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	$V_{CM} = V^+$	●		175	650	µV
		$V_{CM} = V^- + 0.1V$	●		175	650	µV
V_{OS} TC	Input Offset Voltage Drift (Note 2)		●		0.5	2.5	µV/°C
		$V_{CM} = V^+$	●		1.5	4.0	µV/°C
ΔV_{OS}	Input Offset Voltage Shift	$V_{CM} = V^- + 0.1V$ to V^+	●		170	600	µV
	Input Offset Voltage Match (Channel-to-Channel)	$V_{CM} = V^- + 0.1V$, V^+ (Note 4)	●		200	900	µV
I_B	Input Bias Current	$V_{CM} = V^+$	●	0	275	600	nA
		$V_{CM} = V^- + 0.1V$	●	–600	–275	0	nA
ΔI_B	Input Bias Current Shift	$V_{CM} = V^- + 0.1V$ to V^+	●		550	1200	nA
I_{OS}	Input Offset Current	$V_{CM} = V^+$	●		10	85	nA
		$V_{CM} = V^- + 0.1V$	●		10	85	nA
ΔI_{OS}	Input Offset Current Shift	$V_{CM} = V^- + 0.1V$ to V^+	●		20	170	nA
	Input Bias Current Match (Channel-to-Channel)	$V_{CM} = V^+$ (Note 4)	●	0	15	170	nA
		$V_{CM} = V^- + 0.1V$	●	–170	–15	0	nA
A_{VOL}	Large-Signal Voltage Gain	V_O = 75mV to 4.8V, R_L = 10k	●	500	2500		V/mV
CMRR	Common Mode Rejection Ratio	$V_{CM} = V^- + 0.1V$ to V^+	●	78	89		dB
	CMRR Match (Channel-to-Channel)	$V_{CM} = V^- + 0.1V$ to V^+ (Note 4)	●	74	90		dB
PSRR	Power Supply Rejection Ratio	V_S = 2.3V to 12V, $V_{CM} = V_O$ = 0.5V	●	86	102		dB
	PSRR Match (Channel-to-Channel) (Note 4)	V_S = 2.3V to 12V, $V_{CM} = V_O$ = 0.5V	●	80	102		dB
V_{OL}	Output Voltage Swing (Low) (Note 5)	No Load	●		17	35	mV
		I_{SINK} = 0.5mA	●		40	80	mV
		I_{SINK} = 2.5mA	●		110	220	mV
V_{OH}	Output Voltage Swing (High) (Note 5)	No Load	●		3.5	15	mV
		I_{SOURCE} = 0.5mA	●		55	120	mV
		I_{SOURCE} = 2.5mA	●		160	300	mV
I_{SC}	Short-Circuit Current		●	±12	±23		mA
I_S	Supply Current per Amplifier		●		1.9	2.6	mA

ELECTRICAL CHARACTERISTICS

$-40°C < T_A < 85°C$, $V_S = 5V, 0V$, $V_{CM} = 2.5V$, $V_{OUT} = 2.5V$, unless otherwise noted. (Note 3)

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	$V_{CM} = V^+$	●		250	750	µV
		$V_{CM} = V^- + 0.1V$	●		250	750	µV
V_{OS} TC	Input Offset Voltage Drift (Note 2)		●		0.5	2.5	µV/°C
		$V_{CM} = V^+$	●		1.5	4.0	µV/°C
ΔV_{OS}	Input Offset Voltage Shift	$V_{CM} = V^- + 0.1V$ to V^+	●		250	650	µV
	Input Offset Voltage Match (Channel-to-Channel)	$V_{CM} = V^- + 0.1V$, V^+ (Note 4)	●		300	1500	µV
I_B	Input Bias Current	$V_{CM} = V^+$	●	0	350	750	nA
		$V_{CM} = V^- + 0.1V$	●	–750	–350	0	nA
ΔI_B	Input Bias Current Shift	$V_{CM} = V^- + 0.1V$ to V^+	●		700	1500	nA
I_{OS}	Input Offset Current	$V_{CM} = V^+$	●		15	90	nA
		$V_{CM} = V^- + 0.1V$	●		15	90	nA
ΔI_{OS}	Input Offset Current Shift	$V_{CM} = V^- + 0.1V$ to V^+	●		30	180	nA
	Input Bias Current Match (Channel-to-Channel)	$V_{CM} = V^+$ (Note 4)	●	0	30	180	nA
		$V_{CM} = V^- + 0.1V$	●	–180	–30	0	nA
A_{VOL}	Large-Signal Voltage Gain	$V_O = 75mV$ to $4.8V$, $R_L = 10k$	●	400	2500		V/mV
CMRR	Common Mode Rejection Ratio	$V_{CM} = V^- + 0.1V$ to V^+	●	77	86		dB
	CMRR Match (Channel-to-Channel)	$V_{CM} = V^- + 0.1V$ to V^+ (Note 4)	●	72	86		dB
PSRR	Power Supply Rejection Ratio	$V_S = 2.5V$ to $12V$, $V_{CM} = V_O = 0.5V$	●	86	100		dB
	PSRR Match (Channel-to-Channel) (Note 4)	$V_S = 2.5V$ to $12V$, $V_{CM} = V_O = 0.5V$	●	80	100		dB
V_{OL}	Output Voltage Swing (Low) (Note 5)	No Load	●		18	40	mV
		$I_{SINK} = 0.5mA$	●		45	80	mV
		$I_{SINK} = 2.5mA$	●		110	220	mV
V_{OH}	Output Voltage Swing (High) (Note 5)	No Load	●		3.5	15	mV
		$I_{SOURCE} = 0.5mA$	●		60	120	mV
		$I_{SOURCE} = 2.5mA$	●		170	300	mV
I_{SC}	Short-Circuit Current		●	±7.5	±15		mA
I_S	Supply Current per Amplifier		●		2.0	2.7	mA

ELECTRICAL CHARACTERISTICS

T_A = 25°C, V_S = 3V, 0V, V_{CM} = 1.5V, V_{OUT} = 1.5V, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	$V_{CM} = V^+$ $V_{CM} = V^-$			150 150	475 475	µV µV
ΔV_{OS}	Input Offset Voltage Shift Input Offset Voltage Match (Channel-to-Channel)	$V_{CM} = V^+$ to V^- $V_{CM} = V^-$, V^+ (Note 4)			150 200	425 750	µV µV
I_B	Input Bias Current	$V_{CM} = V^+$ $V_{CM} = V^-$		0 –500	250 –250	500 0	nA nA
ΔI_B	Input Bias Current Shift	$V_{CM} = V^-$ to V^+			500	1000	nA
I_{OS}	Input Offset Current	$V_{CM} = V^+$ $V_{CM} = V^-$			5 5	50 50	nA nA
ΔI_{OS}	Input Offset Current Shift	$V_{CM} = V^-$ to V^+			10	100	nA
	Input Bias Current Match (Channel-to-Channel)	$V_{CM} = V^+$ (Note 4) $V_{CM} = V^-$		0 –100	10 10	100 0	nA nA
A_{VOL}	Large-Signal Voltage Gain	V_O = 75mV to 2.8V, R_L = 10k		500	2000		V/V
CMRR	Common Mode Rejection Ratio	$V_{CM} = V^-$ to V^+		76	86		dB
	CMRR Match (Channel-to-Channel)	$V_{CM} = V^-$ to V^+ (Note 4)		70	86		dB
V_{OL}	Output Voltage Swing (Low) (Note 5)	No Load I_{SINK} = 0.5mA I_{SINK} = 2.5mA			15 35 90	30 70 200	mV mV mV
V_{OH}	Output Voltage Swing (High) (Note 5)	No Load I_{SOURCE} = 0.5mA I_{SOURCE} = 2.5mA			2.5 50 140	10 100 250	mV mV mV
I_{SC}	Short-Circuit Current			±12	±19		mA
I_S	Supply Current per Amplifier				1.7	2.2	mA

ELECTRICAL CHARACTERISTICS

0°C < T_A < 70°C, V_S = 3V, 0V, V_{CM} = 1.5V, V_{OUT} = 1.5V, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	$V_{CM} = V^+$	●		175	650	µV
		$V_{CM} = V^- + 0.1V$	●		175	650	µV
V_{OS} TC	Input Offset Voltage Drift (Note 2)		●		0.5	2.5	µV/°C
		$V_{CM} = V^+$	●		1.5	4.0	µV/°C
ΔV_{OS}	Input Offset Voltage Shift	$V_{CM} = V^- + 0.1V$ to V^+	●		170	600	µV
	Input Offset Voltage Match (Channel-to-Channel)	$V_{CM} = V^- + 0.1V$, V^+ (Note 4)	●		200	900	µV
I_B	Input Bias Current	$V_{CM} = V^+$	●	0	275	600	nA
		$V_{CM} = V^- + 0.1V$	●	–600	–275	0	nA
ΔI_B	Input Bias Current Shift	$V_{CM} = V^- + 0.1V$ to V^+	●		550	1200	nA
I_{OS}	Input Offset Current	$V_{CM} = V^+$	●		10	85	nA
		$V_{CM} = V^- + 0.1V$	●		10	85	nA
ΔI_{OS}	Input Offset Current Shift	$V_{CM} = V^- + 0.1V$ to V^+	●		20	170	nA
	Input Bias Current Match (Channel-to-Channel)	$V_{CM} = V^+$ (Note 4)	●	0	15	170	nA
		$V_{CM} = V^- + 0.1V$	●	–170	–15	0	nA
A_{VOL}	Large-Signal Voltage Gain	V_O = 75mV to 2.8V, R_L = 10k	●	400	2000		V/mV
CMRR	Common Mode Rejection Ratio	$V_{CM} = V^- + 0.1V$ to V^+	●	73	85		dB
	CMRR Match (Channel-to-Channel)	$V_{CM} = V^- + 0.1V$ to V^+ (Note 4)	●	69	86		dB
V_{OL}	Output Voltage Swing (Low) (Note 5)	No Load	●		17	35	mV
		I_{SINK} = 0.5mA	●		40	80	mV
		I_{SINK} = 2.5mA	●		110	220	mV
V_{OH}	Output Voltage Swing (High) (Note 5)	No Load	●		3.5	15	mV
		I_{SOURCE} = 0.5mA	●		55	120	mV
		I_{SOURCE} = 2.5mA	●		160	300	mV
I_{SC}	Short-Circuit Current		●	±10	±20		mA
I_S	Supply Current per Amplifier		●		1.9	2.6	mA

ELECTRICAL CHARACTERISTICS

$-40°C < T_A < 85°C$, $V_S = 3V, 0V$, $V_{CM} = 1.5V$, $V_{OUT} = 1.5V$, unless otherwise noted. (Note 3)

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	$V_{CM} = V^+$	●		250	750	µV
		$V_{CM} = V^- + 0.1V$	●		250	750	µV
V_{OS} TC	Input Offset Voltage Drift (Note 2)		●		0.5	2.5	µV/°C
		$V_{CM} = V^+$	●		1.5	4.0	µV/°C
ΔV_{OS}	Input Offset Voltage Shift	$V_{CM} = V^- + 0.1V$ to V^+	●		250	650	µV
	Input Offset Voltage Match (Channel-to-Channel)	$V_{CM} = V^- + 0.1V$, V^+ (Note 4)	●		300	1500	µV
I_B	Input Bias Current	$V_{CM} = V^+$	●	0	350	750	nA
		$V_{CM} = V^- + 0.1V$	●	–750	–350	0	nA
ΔI_B	Input Bias Current Shift	$V_{CM} = V^- + 0.1V$ to V^+	●		700	1500	nA
I_{OS}	Input Offset Current	$V_{CM} = V^+$	●		15	90	nA
		$V_{CM} = V^- + 0.1V$	●		15	90	nA
ΔI_{OS}	Input Offset Current Shift	$V_{CM} = V^- + 0.1V$ to V^+	●		30	180	nA
	Input Bias Current Match (Channel-to-Channel)	$V_{CM} = V^+$ (Note 4)	●	0	30	180	nA
		$V_{CM} = V^- + 0.1V$	●	–180	–30	0	nA
A_{VOL}	Large-Signal Voltage Gain	V_O = 75mV to 2.8V, R_L = 10k	●	300	2000		V/mV
CMRR	Common Mode Rejection Ratio	$V_{CM} = V^- + 0.1V$ to V^+	●	73	81		dB
	CMRR Match (Channel-to-Channel)	$V_{CM} = V^- + 0.1V$ to V^+ (Note 4)	●	69	83		dB
V_{OL}	Output Voltage Swing (Low) (Note 5)	No Load	●		18	40	mV
		I_{SINK} = 0.5mA	●		45	80	mV
		I_{SINK} = 2.5mA	●		110	220	mV
V_{OH}	Output Voltage Swing (High) (Note 5)	No Load	●		3.5	15	mV
		I_{SOURCE} = 0.5mA	●		60	120	mV
		I_{SOURCE} = 2.5mA	●		170	300	mV
I_{SC}	Short-Circuit Current		●	±7.5	±15		mA
I_S	Supply Current per Amplifier		●		2.0	2.7	mA

ELECTRICAL CHARACTERISTICS

T_A = 25°C, V_S = ±15V, V_{CM} = 0V, V_{OUT} = 0V, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	$V_{CM} = V^+$ $V_{CM} = V^-$			200 200	800 800	µV µV
ΔV_{OS}	Input Offset Voltage Shift Input Offset Voltage Match (Channel-to-Channel)	$V_{CM} = V^-$ to V^+ $V_{CM} = V^+, V^-$ (Note 4)			150 250	650 1400	µV µV
I_B	Input Bias Current	$V_{CM} = V^+$ $V_{CM} = V^-$		0 –550	250 –250	550 0	nA nA
ΔI_B	Input Bias Current Shift	$V_{CM} = V^-$ to V^+			500	1100	nA
I_{OS}	Input Offset Current	$V_{CM} = V^+$ $V_{CM} = V^-$			6 6	60 60	nA nA
ΔI_{OS}	Input Offset Current Shift	$V_{CM} = V^-$ to V^+			12	120	nA
	Input Bias Current Match (Channel-to-Channel)	$V_{CM} = V^+$ (Note 4) $V_{CM} = V^-$		0 –120	12 –12	120 0	nA nA
A_{VOL}	Large-Signal Voltage Gain	V_O = –14.5V to 14.5V, R_L = 10k V_O = –10V to 10V, R_L = 2k		1000 500	5200 2300		V/mV V/mV
	Channel Separation	V_O = –10V to 10V, R_L = 2k		116	130		dB
SR	Slew Rate	A_V = –1, R_L = Open, V_O = ±10V Measure at V_O = ±5V			5		V/µs
CMRR	Common Mode Rejection Ratio	$V_{CM} = V^-$ to V^+		93	106		dB
	CMRR Match (Channel-to-Channel)	$V_{CM} = V^-$ to V^+ (Note 4)		87	103		dB
PSRR	Power Supply Rejection Ratio	V_S = ±5V to ±15V		89	110		dB
	PSRR Match (Channel-to-Channel)	V_S = ±5V to ±15V (Note 4)		83	105		dB
V_{OL}	Output Voltage Swing (Low) (Note 5)	No Load I_{SINK} = 0.5mA I_{SINK} = 10mA			18 40 230	30 80 500	mV mV mV
V_{OH}	Output Voltage Swing (High) (Note 5)	No Load I_{SOURCE} = 0.5mA I_{SOURCE} = 10mA			2.5 55 420	10 120 800	mV mV mV
I_{SC}	Short-Circuit Current			±15	±30		mA
I_S	Supply Current per Amplifier				1.8	2.5	mA

ELECTRICAL CHARACTERISTICS

0°C < T_A < 70°C, V_S = ±15V, V_{CM} = 0V, V_{OUT} = 0V, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	$V_{CM} = V^+$	●		200	900	µV
		$V_{CM} = V^- + 0.1V$	●		200	900	µV
V_{OS} TC	Input Offset Voltage Drift (Note 2)		●		1.0	3.5	µV/°C
		$V_{CM} = V^+$	●		2.0	5.0	µV/°C
ΔV_{OS}	Input Offset Voltage Shift	$V_{CM} = V^- + 0.1V$ to V^+	●		200	750	µV
	Input Offset Voltage Match (Channel-to-Channel)	$V_{CM} = V^- + 0.1V$, V^+ (Note 4)	●		350	1500	µV
I_B	Input Bias Current	$V_{CM} = V^+$	●	0	300	675	nA
		$V_{CM} = V^- + 0.1V$	●	–675	–300	0	nA
ΔI_B	Input Bias Current Shift	$V_{CM} = V^- + 0.1V$ to V^+	●		600	1350	nA
I_{OS}	Input Offset Current	$V_{CM} = V^+$	●		15	90	nA
		$V_{CM} = V^- + 0.1V$	●		15	90	nA
ΔI_{OS}	Input Offset Current Shift	$V_{CM} = V^- + 0.1V$ to V^+	●		30	180	nA
	Input Bias Current Match (Channel-to-Channel)	$V_{CM} = V^+$ (Note 4)	●	0	20	180	nA
		$V_{CM} = V^- + 0.1V$	●	–180	–20	0	nA
A_{VOL}	Large-Signal Voltage Gain	V_O = –14.5V to 14.5V, R_L = 10k	●	900	5000		V/mV
		V_O = –10V to 10V, R_L = 2k	●	400	2000		V/mV
	Channel Separation	V_O = –10V to 10V, R_L = 2k	●	112	125		dB
CMRR	Common Mode Rejection Ratio	$V_{CM} = V^- + 0.1V$ to V^+	●	92	103		dB
	CMRR Match (Channel-to-Channel)	$V_{CM} = V^- + 0.1V$ to V^+ (Note 4)	●	86	103		dB
PSRR	Power Supply Rejection Ratio	V_S = ±5V to ±15V	●	88	103		dB
	PSRR Match (Channel-to-Channel)	V_S = ±5V to ±15V (Note 4)	●	82	103		dB
V_{OL}	Output Voltage Swing (Low) (Note 5)	No Load	●		18	40	mV
		I_{SINK} = 0.5mA	●		45	90	mV
		I_{SINK} = 10mA	●		270	500	mV
V_{OH}	Output Voltage Swing (High) (Note 5)	No Load	●		3.5	15	mV
		I_{SOURCE} = 0.5mA	●		60	120	mV
		I_{SOURCE} = 10mA	●		480	1000	mV
I_{SC}	Short-Circuit Current		●	±12	±28		mA
I_S	Supply Current per Amplifier		●		1.9	2.8	mA

ELECTRICAL CHARACTERISTICS

$-40°C < T_A < 85°C$, $V_S = \pm 15V$, $V_{CM} = 0V$, $V_{OUT} = 0V$, unless otherwise noted. (Note 3)

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	$V_{CM} = V^+$	●		300	950	µV
		$V_{CM} = V^- + 0.1V$	●		300	950	µV
V_{OS} TC	Input Offset Voltage Drift (Note 2)		●		1.0	3.5	µV/°C
		$V_{CM} = V^+$	●		2.0	5.0	µV/°C
ΔV_{OS}	Input Offset Voltage Shift	$V_{CM} = V^- + 0.1V$ to V^+	●		250	850	µV
	Input Offset Voltage Match (Channel-to-Channel)	$V_{CM} = V^- + 0.1V$, V^+ (Note 4)	●		350	1800	µV
I_B	Input Bias Current	$V_{CM} = V^+$	●	0	350	800	nA
		$V_{CM} = V^- + 0.1V$	●	–800	–350	0	nA
ΔI_B	Input Bias Current Shift	$V_{CM} = V^- + 0.1V$ to V^+	●		700	1600	nA
I_{OS}	Input Offset Current	$V_{CM} = V^+$	●		15	100	nA
		$V_{CM} = V^- + 0.1V$	●		15	100	nA
ΔI_{OS}	Input Offset Current Shift	$V_{CM} = V^- + 0.1V$ to V^+	●		30	200	nA
	Input Bias Current Match (Channel-to-Channel)	$V_{CM} = V^+$ (Note 4)	●	0	20	200	nA
		$V_{CM} = V^- + 0.1V$	●	–200	–20	0	nA
A_{VOL}	Large-Signal Voltage Gain	$V_O = -14.5V$ to $14.5V$, $R_L = 10k$	●	800	5000		V/mV
		$V_O = -10V$ to $10V$, $R_L = 2k$	●	350	2000		V/mV
	Channel Separation	$V_O = -10V$ to $10V$, $R_L = 2k$	●	110	120		dB
CMRR	Common Mode Rejection Ratio	$V_{CM} = V^- + 0.1V$ to V^+	●	90	101		dB
	CMRR Match (Channel-to-Channel)	$V_{CM} = V^- + 0.1V$ to V^+ (Note 4)	●	87	100		dB
PSRR	Power Supply Rejection Ratio	$V_S = \pm 5V$ to $\pm 15V$	●	88	100		dB
	PSRR Match (Channel-to-Channel)	$V_S = \pm 5V$ to $\pm 15V$ (Note 4)	●	82	100		dB
V_{OL}	Output Voltage Swing (Low) (Note 5)	No Load	●		25	50	mV
		$I_{SINK} = 0.5mA$	●		50	100	mV
		$I_{SINK} = 10mA$	●		275	520	mV
V_{OH}	Output Voltage Swing (High) (Note 5)	No Load	●		3.5	15	mV
		$I_{SOURCE} = 0.5mA$	●		65	120	mV
		$I_{SOURCE} = 10mA$	●		500	1000	mV
I_{SC}	Short-Circuit Current		●	±10	±18		mA
I_S	Supply Current per Amplifier		●		2.0	3.0	mA

The ● denotes specifications that apply over the full operating temperature range.

Note 1: A heat sink may be required to keep the junction temperature below the absolute maximum rating when the output is shorted indefinitely.

Note 2: This parameter is not 100% tested.

Note 3: The LT1498/LT1499 are designed, characterized and expected to meet these extended temperature limits, but are not tested at –40°C and 85°C. Guaranteed I grade parts are available, consult factory.

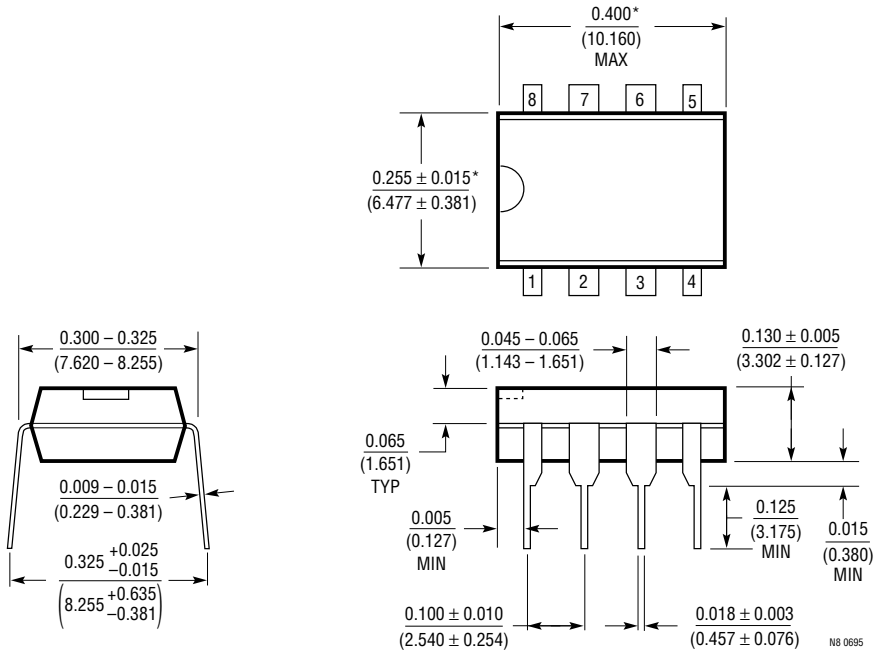
Note 4: Matching parameters are the difference between amplifiers A and D and between B and C on the LT1499; between the two amplifiers on the LT1498.

Note 5: Output voltage swings are measured between the output and power supply rails.

PACKAGE DESCRIPTION

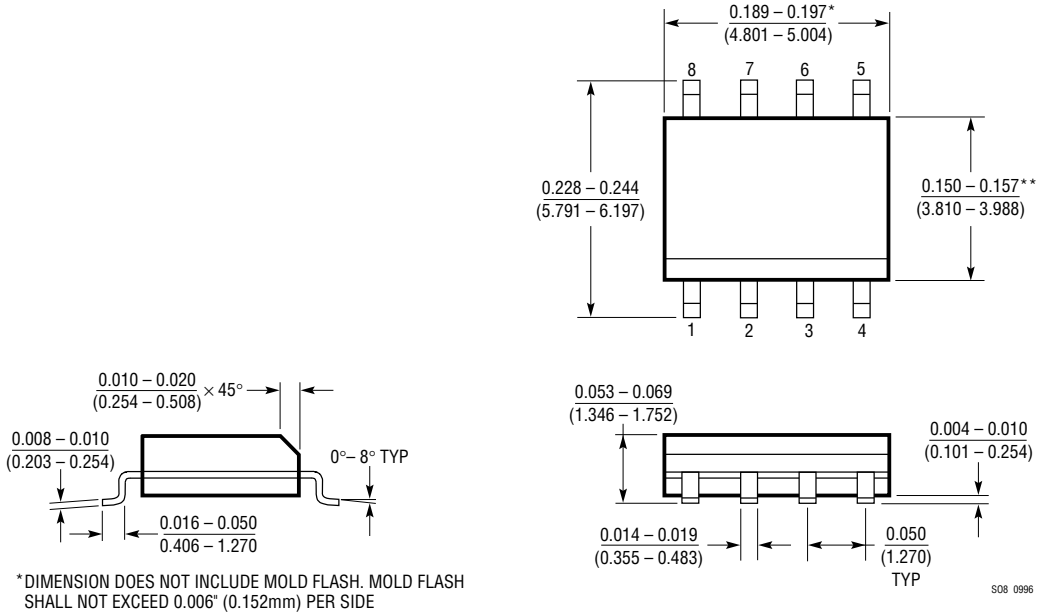
Dimensions in inches (millimeters) unless otherwise noted.

N8 Package
8-Lead PDIP (Narrow 0.300)
(LTC DWG # 05-08-1510)



*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.010 INCH (0.254mm)

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



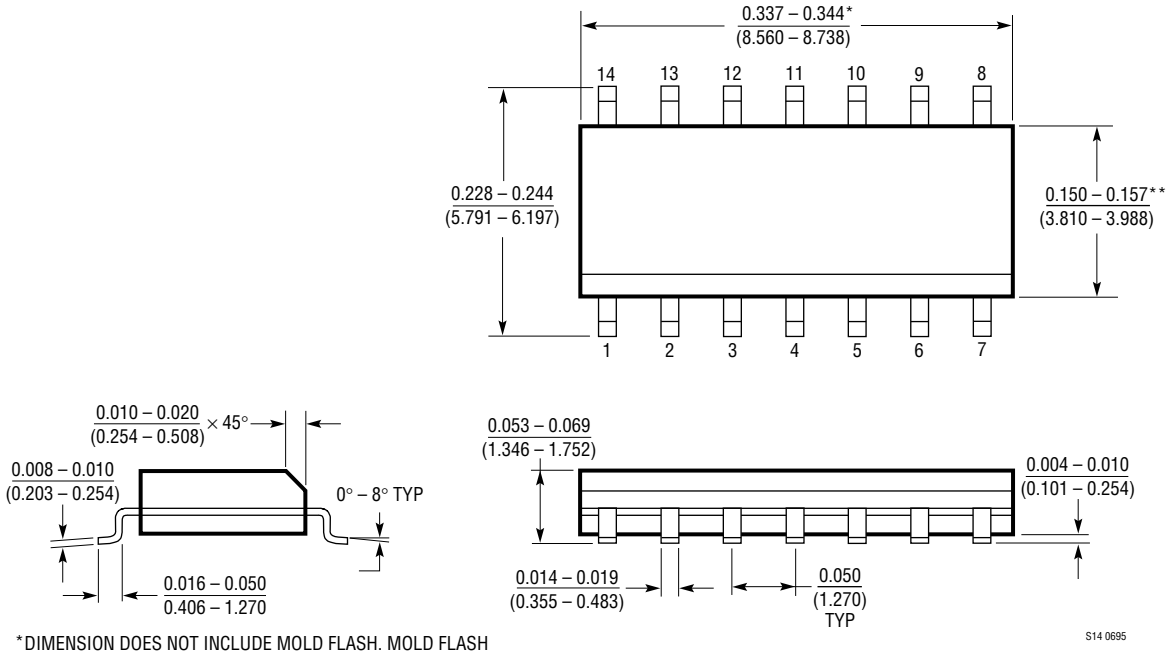
*DIMENSION DOES NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE

**DIMENSION DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010" (0.254mm) PER SIDE

PACKAGE DESCRIPTION

Dimensions in inches (millimeters) unless otherwise noted.

S Package
14-Lead Plastic Small Outline (Narrow 0.150)
(LTC DWG # 05-08-1610)



*DIMENSION DOES NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE

**DIMENSION DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010" (0.254mm) PER SIDE

RELATED PARTS

PART NUMBER	DESCRIPTON	COMMENTS
LTC®1152	Rail-to-Rail Input and Output, Zero-Drift Op Amp	High DC Accuracy, 10µV $V_{OS(MAX)}$, 100nV/°C Drift, 1MHz GBW, 1V/µs Slew Rate, Max Supply Current 2.2mA
LT1211/LT1212	Dual/Quad 14MHz, 7V/µs, Single Supply Precision Op Amps	Input Common Mode Includes Ground, 275µV $V_{OS(MAX)}$, 6µV/°C Max Drift, Max Supply Current 1.8mA per Op Amp
LT1213/LT1214	Dual/Quad 28MHz, 12V/µs, Single Supply Precision Op Amps	Input Common Mode Includes Ground, 275µV $V_{OS(MAX)}$, 6µV/°C Max Drift, Max Supply Current 3.5mA per Op Amp
LT1215/LT1216	Dual/Quad 23MHz, 50V/µs, Single Supply Precision Op Amps	Input Common Mode Includes Ground, 450µV $V_{OS(MAX)}$, Max Supply Current 6.6mA per Op Amp
LT1366/LT1367	Dual/Quad Precision, Rail-to-Rail Input and Output Op Amps	475µV $V_{OS(MAX)}$, 400kHz GBW, 0.13V/µs Slew Rate, Max Supply Current 520µA per Op Amp
LT1490/LT1491	Dual/Quad Micropower, Rail-to-Rail Input and Output Op Amps	Max Supply Current 50µA per Op Amp, 200kHz GBW, 0.07V/µs Slew Rate, Operates with Inputs 44V Above V^+ Independent of V^+

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