Dual and Quad Micropower Rail-to-Rail Input and Output Op Amps

April 1996

FEATURES

- **Rail-to-Rail Input and Output**
- **Single Supply Input Range: –0.4V to 44V**
- **Micropower: 50μA/Amplifier Max**
- Specified on 3V, 5V and ±15V Supplies
- High Output Current: 20mA
- Output Drives 5000pF
- Reverse Battery Protection to 18V
- No Supply Sequencing Problems
- High Voltage Gain: 1500V/mV
- High CMRR: 98dB
- No Phase Reversal
- Gain Bandwidth Product: 200kHz

APPLICATIONS

- Battery- or Solar-Powered Systems
  - Portable Instrumentation
  - Sensor Conditioning
- Supply Current Sensing
- Battery Monitoring
- Micropower Active Filters
- 4mA to 20mA Transmitters

DESCRIPTION

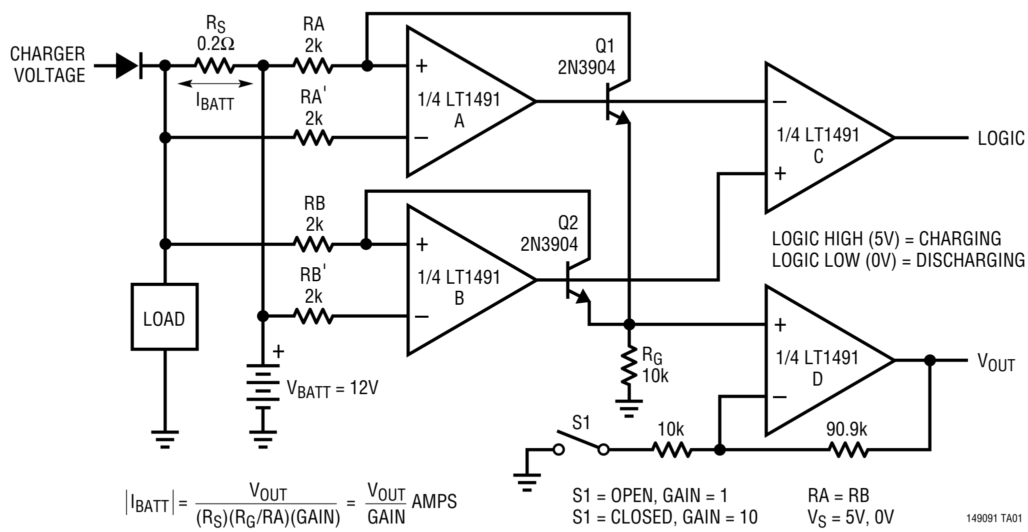
The dual LT®1490 and quad LT1491 op amps operate on all single and split supplies with a total voltage of 2.5V to 44V drawing only 40μA of quiescent current per amplifier. These amplifiers are reverse supply protected; they draw no current for reverse supply up to 18V. The input range of the LT1490/LT1491 includes both supplies and the output swings to both supplies. Unlike most micropower op amps, the LT1490/LT1491 can drive heavy loads; their rail-to-rail outputs drive 20mA. The LT1490/LT1491 are unity-gain stable into all capacitive loads up to 5000pF.

The LT1490/LT1491 have a unique input stage that operates and remains high impedance when above the positive supply. The inputs take 44V both differential and common mode even when operating on a 3V supply. Built-in resistors protect the inputs for faults below the negative supply up to 22V. There is no phase reversal of the output for inputs 5V below V_{EE} or 44V above V_{EE}, independent of V_{CC}.

The LT1490 dual op amp is available in the 8-pin SO and PDIP packages. The quad LT1491 is available in the 14-pin SO and PDIP packages.

TYPICAL APPLICATION

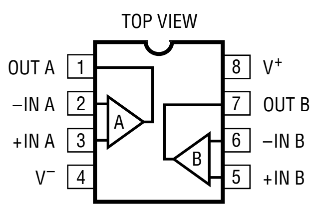
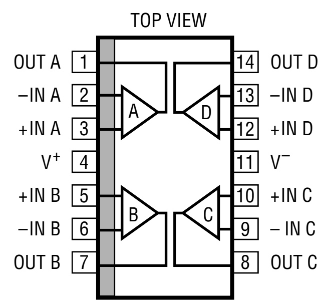
Battery Monitor



ABSOLUTE MAXIMUM RATINGS

Total Supply Voltage (V^+ to V^-) 44V
Input Differential Voltage 44V
Input Current .... ±25mA
Output Short-Circuit Duration (Note 1) ....Continuous
Operating Temperature Range .... −40°C to 85°C
Junction Temperature.. 150°C
Specified Temperature Range................. −40°C to 85°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 LT1490CN8 LT1490CS8 S8 PART MARKING 1490	 N PACKAGE 14-LEAD PDIP S PACKAGE 14-LEAD PLASTIC SO T_{JMAX} = 150°C, θ_{JA} = 110°C/W (N) T_{JMAX} = 150°C, θ_{JA} = 150°C/W (S)	ORDER PART NUMBER Consult Factory for LT1491CN LT1491CS Availability

Consult factory for Industrial and Military grade parts.

ELECTRICAL CHARACTERISTICS

V_S = 3V, 0V; V_S = 5V, 0V; V_{CM} = V_{OUT} = half supply, T_A = 25°C, unless otherwise noted. (Note 2)

SYMBOL	PARAMETER	CONDITIONS		LT1490C MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	N Package			220	800	µV
		0°C ≤ T_A ≤ 70°C	●			1000	µV
		−40°C ≤ T_A ≤ 85°C	●			1100	µV
		S Package			220	950	µV
		0°C ≤ T_A ≤ 70°C	●			1200	µV
		−40°C ≤ T_A ≤ 85°C	●			1300	µV
	Input Offset Voltage Drift	0°C ≤ T_A ≤ 70°C (Note 6)	●		2	4	µV/°C
I_{OS}	Input Offset Current		●		0.2	0.8	nA
		V_{CM} = 44V (Note 3)	●			0.8	µA
I_B	Input Bias Current		●		4	8	nA
		V_{CM} = 44V (Note 3)	●		4	10	µA
		V_S = 0V			0.1		nA
	Input Noise Voltage	0.1Hz to 10Hz			1		μV_{P-P}
e_n	Input Noise Voltage Density	f = 1kHz			50		$nV/\sqrt{Hz}$
i_n	Input Noise Current Density	f = 1kHz			0.03		$pA/\sqrt{Hz}$
R_{IN}	Input Resistance	Differential		6	17		MΩ
		Common Mode, V_{CM} = 0V to 44V		4	11		MΩ
C_{IN}	Input Capacitance				4.6		pF
	Input Voltage Range		●	0		44	V
CMRR	Common Mode Rejection Ratio (Note 3)	V_{CM} = 0V to V_{CC} – 1V	●	84	98		dB
		V_{CM} = 0V to 44V	●	80	98		dB

ELECTRICAL CHARACTERISTICS

V_S = 3V, 0V; V_S = 5V, 0V; V_{CM} = V_{OUT} = half supply, T_A = 25°C, unless otherwise noted. (Note 2)

SYMBOL	PARAMETER	CONDITIONS		LT1490C MIN	TYP	MAX	UNITS
A_{VOL}	Large-Signal Voltage Gain	V_S = 3V, V_O = 500mV to 2.5V, R_L = 10k		200	1500		V/mV
		V_S = 3V, 0°C ≤ T_A ≤ 70°C	●	133			V/mV
		V_S = 3V, −40°C ≤ T_A ≤ 85°C	●	100			V/mV
		V_S = 5V, V_O = 500mV to 4.5V, R_L = 10k		400	1500		V/mV
		V_S = 5V, 0°C ≤ T_A ≤ 70°C	●	250			V/mV
		V_S = 5V, −40°C ≤ T_A ≤ 85°C	●	200			V/mV
V_{OL}	Output Voltage Swing Low	V_S = 3V, No Load	●		22	50	mV
		V_S = 3V, I_{SINK} = 5mA	●		250	450	mV
		V_S = 5V, No Load	●		22	50	mV
		V_S = 5V, I_{SINK} = 5mA	●		250	500	mV
		V_S = 5V, I_{SINK} = 10mA			330	500	mV
V_{OH}	Output Voltage Swing High	V_S = 3V, No Load	●	2.95	2.978		V
		V_S = 3V, I_{SOURCE} = 5mA	●	2.55	2.6		V
		V_S = 5V, No Load	●	4.95	4.978		V
		V_S = 5V, I_{SOURCE} = 10mA	●	4.30	4.6		V
I_{SC}	Short-Circuit Current (Note 1)	V_S = 3V, Short to GND		10	15		mA
		V_S = 3V, Short to V_{CC}		10	30		mA
		V_S = 5V, Short to GND		15	25		mA
		V_S = 5V, Short to V_{CC}		15	30		mA
PSRR	Power Supply Rejection Ratio	V_S = 2.5V to 12.5V, V_{CM} = V_O = 1V	●	86	98		dB
	Reverse Supply Voltage	I_S = −100µA per Amplifier	●	18	27		V
I_S	Supply Current per Amplifier				40	50	µA
	(Note 4)		●			55	µA
GBW	Gain Bandwidth Product	f = 1kHz		110	180		kHz
	(Note 3)	0°C ≤ T_A ≤ 70°C	●	100			kHz
		−40°C ≤ T_A ≤ 85°C	●	90			kHz
SR	Slew Rate	A_V = −1, R_L = ∞		0.035	0.065		V/µs
	(Note 5)	0°C ≤ T_A ≤ 70°C	●	0.031			V/µs
		−40°C ≤ T_A ≤ 85°C	●	0.030			V/µs

V_S = ±15V, V_{CM} = 0V, V_{OUT} = 0V, T_A = 25°C, unless otherwise noted. (Note 2)

SYMBOL	PARAMETER	CONDITIONS		LT1490C MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage				220	1200	µV
		0°C ≤ T_A ≤ 70°C	●			1400	µV
		−40°C ≤ T_A ≤ 85°C	●			1500	µV
	Input Offset Voltage Drift	0°C ≤ T_A ≤ 70°C (Note 6)	●		3	6	µV/°C
I_{OS}	Input Offset Current		●		0.2	0.8	nA
I_B	Input Bias Current		●		4	8	nA
	Input Noise Voltage	0.1Hz to 10Hz			1		$µV_{P-P}$
e_n	Input Noise Voltage Density	f = 1kHz			50		$nV/\sqrt{Hz}$
i_n	Input Noise Current Density	f = 1kHz			0.03		$pA/\sqrt{Hz}$
R_{IN}	Input Resistance	Differential		6	17		MΩ
		Common Mode, V_{CM} = −15V to 14V			15000		MΩ
C_{IN}	Input Capacitance				4.6		pF
	Input Voltage Range		●	−15		29	V
CMRR	Common Mode Rejection Ratio	V_{CM} = −15V to 29V	●	80	98		dB

ELECTRICAL CHARACTERISTICS

V_S = ±15V, V_{CM} = 0V, V_{OUT} = 0V, T_A = 25°C, unless otherwise noted. (Note 2)

SYMBOL	PARAMETER	CONDITIONS		LT1490C MIN	TYP	MAX	UNITS
A_{VOL}	Large-Signal Voltage Gain	V_O = ±14V, R_L = 10k		100	250		V/mV
		0°C ≤ T_A ≤ 70°C	●	75			V/mV
		−40°C ≤ T_A ≤ 85°C	●	50			V/mV
V_O	Output Voltage Swing	No Load	●	±14.9	±14.978		V
		I_{OUT} = ±5mA	●	±14.5	±14.750		V
		I_{OUT} = ±10mA		±14.5	±14.670		V
I_{SC}	Short-Circuit Current (Note 1)	Short to GND		±20	±25		mA
		0°C ≤ T_A ≤ 70°C	●	±15			mA
		−40°C ≤ T_A ≤ 85°C	●	±10			mA
PSRR	Power Supply Rejection Ratio	V_S = ±1.25V to ±22V	●	90	98		dB
I_S	Supply Current per Amplifier				40	70	μA
			●			85	μA
GBW	Gain Bandwidth Product	f = 1kHz		125	200		kHz
		0°C ≤ T_A ≤ 70°C	●	110			kHz
		−40°C ≤ T_A ≤ 85°C	●	100			kHz
SR	Slew Rate	A_V = −1, R_L = ∞, V_O = ±10V, Measure at V_O = ±5V		0.0375	0.07		V/μs
		0°C ≤ T_A ≤ 70°C	●	0.0330			V/μs
		−40°C ≤ T_A ≤ 85°C	●	0.0300			V/μs

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

Note 1: A heat sink may be required to keep the junction temperature below absolute maximum. This depends on the power supply voltage and how many amplifiers are shorted.

Note 2: The LT1490/LT1491 are not tested and are not quality assurance sampled at −40°C and at 85°C.

Note 3: V_S = 5V limits are guaranteed by correlation to V_S = 3V and V_S = ±15V tests.

Note 4: V_S = 3V limits are guaranteed by correlation to V_S = 5V and V_S = ±15V tests.

Note 5: Guaranteed by correlation to slew rate at V_S = ±15V and GBW at V_S = 3V and V_S = ±15V tests.

Note 6: This parameter is not 100% tested.

RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1078/LT1079	Dual/Quad 55μA Max, Single Supply, Precision Op Amps	Input/Output Common Mode Includes Ground, 70μV $V_{OS(MAX)}$ and 2.5μV/°C Drift (Max), 200kHz GBW, 0.07V/μs Slew Rate
LTC1152	Rail-Rail Input, Rail-to-Rail Output, Zero-Drift Amplifier	High DC Accuracy, 10μV $V_{OS(MAX)}$, 100nV/°C, 1MHz GBW, 1V/μs Slew Rate, Supply Current 2.2mA (Max), Single Supply, Can Be Configured for C-Load™ Operation
LT1178/LT1179	Dual/Quad 17μA Max, Single Supply, Precison Op Amps	Input/Output Common Mode Includes Ground, 70μV $V_{OS(MAX)}$ and 4μV/°C Drift (Max), 85kHz GBW, 0.04V/μs Slew Rate
LT1366/LT1367	Dual/Quad Precision, Rail-to-Rail Input and Output Op Amps	475μV $V_{OS(MAX)}$, 500V/mV $A_{VOL(MIN)}$, 400kHz GBW

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