1.2MHz, Over-The-Top Micropower, Rail-to-Rail Input and Output Op Amp in SOT-23

September 1999

FEATURES

- **Operates with Inputs Above V+**
- **Rail-to-Rail Input and Output**
- **Micropower: 300μA Supply Current Max**
- Small SOT-23 Package
- Gain Bandwidth product: 1.2MHz
- Slew Rate: 0.45V/μs
- Low Input Offset Voltage: 800μV Max
- Single Supply Input Range: 0V to 18V
- High Output Current: 18mA Min
- Specified on 3V, 5V and ±5V Supplies
- Output Shutdown on 6-Lead Version
- Reverse Battery Protection to 18V
- High Voltage Gain: 1500V/mV

APPLICATIONS

- Battery- or Solar-Powered Systems
- Portable Instrumentation
- Sensor Conditioning
- Supply Current Sensing
- Battery Monitoring
- MUX Amplifiers
- 4mA to 20mA Transmitters

DESCRIPTION

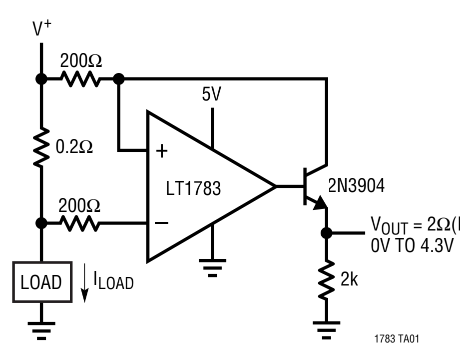
The LT®1783 is a 1.2MHz op amp available in the small SOT-23 package that operates on all single and split supplies with a total voltage of 2.5V to 18V. The amplifier draws less than 300μA of quiescent current and has reverse battery protection, drawing no current for reverse supply up to 18V.

The input range of the LT1783 includes ground, and a unique feature of this device is its ability of Over-The-Top™ operation with either or both of its inputs above the positive rail. The inputs handle 18V both differential and common mode, independent of supply voltage. The input stage incorporates phase reversal protection to prevent false outputs from occurring even when the inputs are 9V below the negative supply.

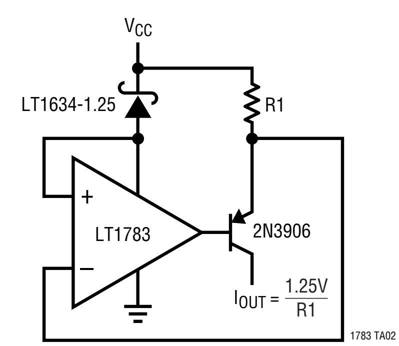
The LT1783 can drive loads up to 18mA and still maintain rail-to-rail capability. A shutdown feature on the 6-lead version can disable the part, making the output high impedance and reducing quiescent current to 5μA. The LT1783 op amp is available in the 5- and 6-lead SOT-23 packages. For applications requiring lower power, refer to the LT1782.

TYPICAL APPLICATION

Positive Supply Rail Current Sense



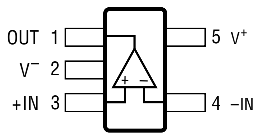
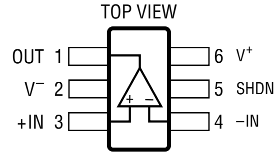
Current Source



ABSOLUTE MAXIMUM RATINGS (Note 1)

Total Supply Voltage (V^+ to V^-) 18V
Input Differential Voltage 18V
Input Pin Voltage to V^- .... +24V/–10V
Shutdown Pin Voltage Above V^- 18V
Shutdown Pin Current .... ±10mA
Output Short-Circuit Duration (Note 2) .... Continuous
Operating Temperature Range .... 0°C to 70°C
Specified Temperature Range .... 0°C to 70°C
Junction Temperature .... 150°C
Storage Temperature Range .... –65°C to 150°C
Lead Temperature (Soldering, 10 sec) .... 300°C

PACKAGE/ORDER INFORMATION

	ORDER PART NUMBER		ORDER PART NUMBER
TOP VIEW  S5 PACKAGE 5-LEAD PLASTIC SOT-23 T_{JMAX} = 150°C, θ_{JA} = 250°C/W	LT1783CS5	TOP VIEW  S6 PACKAGE 6-LEAD PLASTIC SOT-23 T_{JMAX} = 150°C, θ_{JA} = 230°C/W	LT1783CS6
	S5 PART MARKING		S6 PART MARKING
	LTLF		LTIU

Consult factory for Industrial and Military grade parts.

ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the specified temperature range, otherwise specifications are T_A = 25°C. V_S = 3V, 0V; V_S = 5V, 0V, V_{CM} = V_{OUT} = half supply, for the 6-lead part V_{PIN5} = 0V, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	T_A = 25°C			400	800	µV
		0°C ≤ T_A ≤ 70°C	●			950	µV
	Input Offset Voltage Drift (Note 7)	0°C ≤ T_A ≤ 70°C	●		2	5	µV/°C
I_{OS}	Input Offset Current		●		4	8	nA
		V_{CM} = 18V (Note 3)	●			7	µA
I_B	Input Bias Current		●		40	80	nA
		V_{CM} = 18V (Note 3)	●		35	60	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			20		$nV/\sqrt{Hz}$
i_n	Input Noise Current Density	f = 1kHz			0.14		$pA/\sqrt{Hz}$
R_{IN}	Input Resistance	Differential		0.65	1.3		MΩ
		Common Mode, V_{CM} = 0V to 18V		0.3	0.5		MΩ
C_{IN}	Input Capacitance				5		pF
	Input Voltage Range		●	0		18	V
CMRR	Common Mode Rejection Ratio (Note 3)	V_{CM} = 0V to V_{CC} – 1V	●	90	100		dB
		V_{CM} = 0V to 18V (Note 6)	●	68	80		dB
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 = 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

ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the specified temperature range, otherwise specifications are T_A = 25°C. V_S = 3V, 0V; V_S = 5V, 0V, V_{CM} = V_{OUT} = half supply, for the 6-lead part V_{PIN5} = 0V, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{OL}	Output Voltage Swing LOW	No Load	●		3	8	mV
		I_{SINK} = 5mA	●		200	400	mV
		V_S = 5V, I_{SINK} = 10mA	●		330	600	mV
V_{OH}	Output Voltage Swing HIGH	V_S = 3V, No Load	●	2.91	2.94		V
		V_S = 3V, I_{SOURCE} = 5mA	●	2.6	2.8		V
		V_S = 5V, No Load	●	4.91	4.94		V
		V_S = 5V, I_{SOURCE} = 10mA	●	4.5	4.74		V
I_{SC}	Short-Circuit Current (Note 2)	V_S = 3V, Short to GND		5	10		mA
		V_S = 3V, Short to V_{CC}		15	30		mA
		V_S = 5V, Short to GND		15	30		mA
		V_S = 5V, Short to V_{CC}		20	40		mA
PSRR	Power Supply Rejection Ratio	V_S = 3V to 12.5V, V_{CM} = V_O = 1V	●	90	100		dB
	Minimum Supply Voltage		●		2.5	2.7	V
	Reverse Supply Voltage	I_S = –100µA	●	18			V
I_S	Supply Current				220	300	µA
	(Note 4)		●			350	µA
	Supply Current, SHDN	V_{PIN5} = 2V, No Load (Note 8)	●		5	18	µA
I_{SHDN}	Shutdown Pin Current	V_{PIN5} = 0.3V, No load (Note 8)	●		0.5		nA
		V_{PIN5} = 2V, No Load (Note 8)	●		2	8	µA
	Shutdown Output Leakage Current	V_{PIN5} = 2V, No Load (Note 8)	●		0.05	1	µA
	Maximum Shutdown Pin Current	V_{PIN5} = 18V, No Load (Note 8)	●		10	30	µA
V_L	Shutdown Pin Input Low Voltage	(Note 8)	●			0.3	V
V_H	Shutdown Pin Input High Voltage	(Note 8)	●	2.2			V
t_{ON}	Turn-On Time	V_{PIN5} = 5V to 0V, R_L = 10k (Note 8)			25		µs
t_{OFF}	Turn-Off Time	V_{PIN5} = 0V to 5V, R_L = 10k (Note 8)			3		µs
GBW	Gain Bandwidth Product	f = 5kHz		750	1250		kHz
	(Note 3)	0°C ≤ T_A ≤ 70°C	●	600			kHz
SR	Slew Rate	A_V = –1, R_L = ∞		0.24	0.42		V/µs
	(Note 5)	0°C ≤ T_A ≤ 70°C	●	0.21			V/µs

V_S = ±5V, V_{CM} = 0V, V_{OUT} = 0V, for the 6-lead part V_{SHDN} = V^-

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	T_A = 25°C			500	900	µV
		0°C ≤ T_A ≤ 70°C	●			1050	µV
	Input Offset Voltage Drift (Note 7)	0°C ≤ T_A ≤ 70°C	●		2	5	µV/°C
I_{OS}	Input Offset Current		●		4	8	nA
I_B	Input Bias Current		●		40	80	nA
	Input Noise Voltage	0.1Hz to 10Hz			1		$µV_{P-P}$
e_n	Input Noise Voltage Density	f = 1kHz			20		nV/√Hz
i_n	Input Noise Current Density	f = 1kHz			0.14		pA/√Hz

ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range, otherwise specifications are T_A = 25°C. V_S = ±5V, V_{CM} = 0V, V_{OUT} = 0V, for the 6-lead part V_{SHDN} = V^-, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
R_{IN}	Input Resistance	Differential Common Mode, V_{CM} = −5V to 13V	● ●	0.65 0.3	1.3 0.5		MΩ MΩ
C_{IN}	Input Capacitance				5		pF
	Input Voltage Range		●	−5		13	V
CMRR	Common Mode Rejection Ratio	V_{CM} = −5V to 13V	●	68	80		dB
A_{VOL}	Large-Signal Voltage Gain	V_O = ±4V, R_L= 10k 0°C ≤ T_A ≤ 70°C	 ●	70 50	160		V/mV V/mV
V_{OL}	Output Voltage Swing LOW	No Load I_{SINK} = 5mA I_{SINK} = 10mA	● ● ●		−4.997 −4.8 −4.67	−4.992 −4.6 −4.4	V V V
V_{OH}	Output Voltage Swing HIGH	No Load I_{SOURCE} = 5mA I_{SOURCE} = 10mA	● ● ●	4.91 4.6 4.5	4.94 4.8 4.74		V V V
I_{SC}	Short-Circuit Current (Note 2)	Short to GND 0°C ≤ T_A ≤ 70°C	 ●	18 15	30		mA mA
PSRR	Power Supply Rejection Ratio	V_S = ±1.5V to ±9V	●	90	100		dB
I_S	Supply Current		 ●		250	325 375	µA µA
	Supply Current, SHDN	V_{PIN5} = −3V, V_S = ±5V, No Load (Note 8)	●		6	20	µA
I_{SHDN}	Shutdown Pin Current	V_{PIN5} = −4.7V, V_S = ±5V, No load (Note 8) V_{PIN5} = −3V, V_S = ±5V, No Load (Note 8)	● ●		0.5 2	 8	nA µA
	Maximum Shutdown Pin Current	V_{PIN5} = 9V, V_S = ±9V (Note 8)	●		10	30	µA
	Shutdown Output Leakage Current	V_{PIN5} = −7V, V_S = ±9V, No Load (Note 8)	●		0.05	1	µA
V_L	Shutdown Pin Input Low Voltage	V_S = ±5V (Note 8)	●			−4.7	V
V_H	Shutdown Pin Input High Voltage	V_S = ±5V (Note 8)	●	−2.8			V
t_{ON}	Turn-On Time	V_{PIN5} = 0V to −5V, R_L = 10k (Note 8)	●		25		µs
t_{OFF}	Turn-Off Time	V_{PIN5} = −5V to 0V, R_L = 10k (Note 8)	●		3		µs
GBW	Gain Bandwidth Product	f = 5kHz 0°C ≤ T_A ≤ 70°C	 ●	800 700	1300		kHz kHz
SR	Slew Rate	A_V = −1, R_L = ∞, V_O = ±4V, Measured at V_O = ±2V 0°C ≤ T_A ≤ 70°C	 ●	0.26 0.23	0.45		V/µs V/µs

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

Note 2: A heat sink may be required to keep the junction temperature below absolute maximum.

Note 3: V_S = 5V limits are guaranteed by correlation to V_S = 3V and V_S = ±5V or V_S = ±9V tests.

Note 4: V_S = 3V limits are guaranteed by correlation to V_S = 5V and V_S = ±5V or V_S = ±9V tests.

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

Note 6: This specification implies a typical input offset voltage of 1.8mV at V_{CM} = 18V and a maximum input offset voltage of 7.2mV at V_{CM} = 18V.

Note 7: This parameter is not 100% tested.

Note 8: Specifications apply to 6-lead SOT-23 with shutdown.

Linear Technology Corporation
1630 McCarthy Blvd., Milpitas, CA 95035-7417
(408)432-1900•FAX: (408) 434-0507•www.linear-tech.com

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