LT1783

1.25MHz, Over-The-Top Micropower, Rail-to-Rail Input and Output Op Amp in SOT-23

FEATURES

- **Operates with Inputs Above V⁺**
- **Rail-to-Rail Input and Output**
- **Micropower: 300µA Supply Current Max**
- Operating Temperature Range: –40°C to 125°C
- Low Profile (1mm) ThinSOT™ Package
- Gain Bandwidth product: 1.25MHz
- Slew Rate: 0.42V/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

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

DESCRIPTION

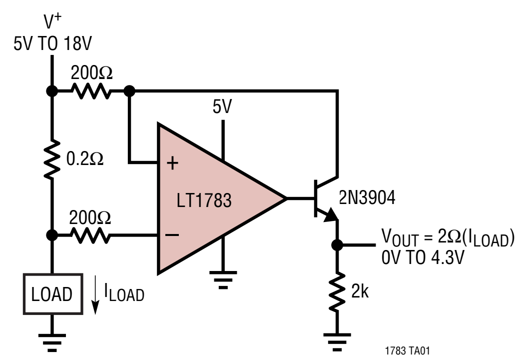
The LT®1783 is a 1.25MHz op amp available in the small SOT-23 package that operates on all single and split supplies with a total voltage of 2.5V to 18V. The amplifier draws less than 300µA of quiescent current and has reverse battery protection, drawing negligible current for reverse supply voltages up to 18V.

The input range of the LT1783 includes ground, and a unique feature of this device is its Over-The-Top™ operation capabilitity 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.

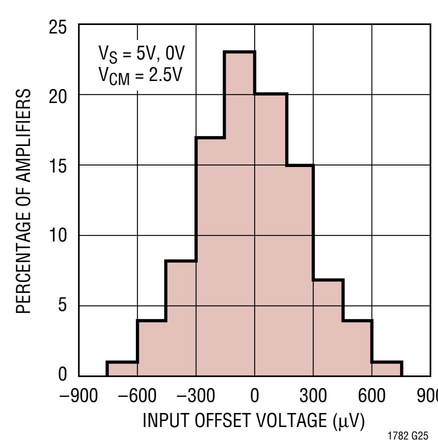
The LT1783 can drive loads up to 18mA and still maintain rail-to-rail capability. A shutdown feature on the 6-lead version can disable the part, making the output high impedance and reducing quiescent current to 5µA. The LT1783 op amp is available in the 5- and 6-lead SOT-23 packages. For applications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

TYPICAL APPLICATION

Positive Supply Rail Current Sense



Distribution of Input Offset Voltage



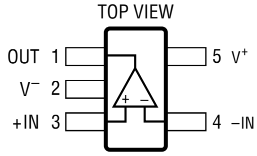
ABSOLUTE MAXIMUM RATINGS (Note 1)

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) .... Indefinite
Operating Temperature Range (Note 3)
LT1783C .... –40°C to 85°C
LT1783I .... –40°C to 85°C
LT1783H .... –40°C to 125°C

Specified Temperature Range (Note 4)
LT1783C .... –40°C to 85°C
LT1783I .... –40°C to 85°C
LT1783H .... –40°C to 125°C
Junction Temperature .... 150°C
Storage Temperature Range .... –65°C to 150°C
Lead Temperature (Soldering, 10 sec) .... 300°C

PACKAGE/ORDER INFORMATION

TOP VIEW

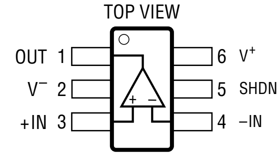


S5 PACKAGE
5-LEAD PLASTIC SOT-23

T_{JMAX} = 150°C, θ_{JA} = 250°C/W

ORDER PART NUMBER	S5 PART MARKING
LT1783CS5	LTLF
LT1783IS5	LTLG
LT1783HS5	LTXR

TOP VIEW



S6 PACKAGE
6-LEAD PLASTIC SOT-23

T_{JMAX} = 150°C, θ_{JA} = 230°C/W

ORDER PART NUMBER	S6 PART MARKING
LT1783CS6	LTIU
LT1783IS6	LTIV
LT1783HS6	LTXS

Consult factory for parts specified with wider operating temperature ranges.

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, pulse power tested unless otherwise specified. (Note 4)

SYMBOL	PARAMETER	CONDITIONS		LT1783C/LT1783I MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	T_A = 25°C 0°C ≤ T_A ≤ 70°C –40°C ≤ T_A ≤ 85°C	 ● ●		400	800 950 1100	µV µV µV
	Input Offset Voltage Drift (Note 9)		●		2	5	µV/°C
I_{OS}	Input Offset Current	 V_{CM} = 18V (Note 5)	● ●		4	8 7	nA µA
I_B	Input Bias Current	 V_{CM} = 18V (Note 5) SHDN or V_S = 0V, V_{CM} = 0V to 18V	● ●		45 35 0.1	80 60	nA µA nA
	Input Bias Current Drift		●		0.06		nA/°C
	Input Noise Voltage	0.1Hz to 10Hz			0.6		$µV_{P-P}$
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 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, pulse power tested unless otherwise specified. (Note 4)

SYMBOL	PARAMETER	CONDITIONS		LT1783C/LT1783I MIN	TYP	MAX	UNITS
R_{IN}	Input Resistance	Differential	●	0.65	1.3		MΩ
		Common Mode, V_{CM} = 0V to (V_{CC} – 1V)			1		GΩ
		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 5)	V_{CM} = 0V to V_{CC} – 1V	●	90	100		dB
		V_{CM} = 0V to 18V (Note 8)	●	68	80		dB
PSRR	Power Supply Rejection Ratio	V_S = 3V to 12.5V, V_{CM} = V_O = 1V	●	90	100		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 = 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	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
	Minimum Supply Voltage		●		2.5	2.7	V
	Reverse Supply Voltage	I_S = –100µA	●	18			V
I_S	Supply Current (Note 6)				210	300	µA
		0°C ≤ T_A ≤ 70°C	●			350	µA
		–40°C ≤ T_A ≤ 85°C	●			375	µA
	Supply Current, SHDN	V_{PIN5} = 2V, No Load (Note 10)	●		5	18	µA
I_{SHDN}	Shutdown Pin Current	V_{PIN5} = 0.3V, No Load (Note 10)	●		0.5		nA
		V_{PIN5} = 2V, No Load (Note 10)	●		2	8	µA
		V_{PIN5} = 5V, No Load (Note 10)			5		µA
	Shutdown Output Leakage Current	V_{PIN5} = 2V, No Load (Note 10)	●		0.05	1	µA
	Maximum Shutdown Pin Current	V_{PIN5} = 18V, No Load (Note 10)	●		10	30	µA
V_L	Shutdown Pin Input Low Voltage	(Note 10)	●			0.3	V
V_H	Shutdown Pin Input High Voltage	(Note 10)	●	2			V
t_{ON}	Turn-On Time	V_{PIN5} = 5V to 0V, R_L = 10k (Note 10)			25		µs
t_{OFF}	Turn-Off Time	V_{PIN5} = 0V to 5V, R_L = 10k (Note 10)			3		µs
GBW	Gain Bandwidth Product (Note 5)	f = 5kHz		750	1250		kHz
		0°C ≤ T_A ≤ 70°C	●	600			kHz
		–40°C ≤ T_A ≤ 85°C	●	550			kHz

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, pulse power tested unless otherwise specified. (Note 4)

SYMBOL	PARAMETER	CONDITIONS		LT1783C/LT1783I MIN	TYP	MAX	UNITS
SR	Slew Rate (Note 7)	A_V = –1, R_L = ∞		0.24	0.42		V/µs
		0°C ≤ T_A ≤ 70°C	●	0.21			V/µs
		–40°C ≤ T_A ≤ 85°C	●	0.019			V/µs
FPBW	Full-Power Bandwidth (Note 11)	V_{OUT} = $2V_{P-P}$			66		kHz
t_S	Settling Time	V_S = 5V, ΔV_{OUT} = 2V to 0.1%, A_V = –1			12		µs
THD	Distortion	V_S = 3V, V_O = $2V_{P-P}$, A_V = 1, R_L = 10k, f = 1kHz			0.001		%

The ● denotes specifications which apply over the specified temperature range, otherwise specifications are T_A = 25°C. V_S = ±5V, V_{CM} = 0V, V_{OUT} = 0V, for the 6-lead part V_{PIN5} = $V^–$, pulse power tested unless otherwise specified. (Note 4)

SYMBOL	PARAMETER	CONDITIONS		LT1783C/LT1783I MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	T_A = 25°C			500	900	µV
		0°C ≤ T_A ≤ 70°C	●			1050	µV
		–40°C ≤ T_A ≤ 85°C	●			1200	µV
	Input Offset Voltage Drift (Note 9)		●		2	5	µV/°C
I_{OS}	Input Offset Current		●		4	8	nA
I_B	Input Bias Current		●		40	80	nA
	Input Bias Current Drift		●		0.06		nA/°C
	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
R_{IN}	Input Resistance	Differential	●	0.65	1.3		MΩ
		Common Mode, V_{CM} = –5V to 13V	●	0.3	0.5		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		70	160		V/mV
		0°C ≤ T_A ≤ 70°C	●	50			V/mV
		–40°C ≤ T_A ≤ 85°C	●	40			V/mV
V_{OL}	Output Voltage Swing LOW	No Load	●		–4.997	–4.992	V
		I_{SINK} = 5mA	●		–4.8	–4.6	V
		I_{SINK} = 10mA	●		–4.67	–4.4	V
V_{OH}	Output Voltage Swing HIGH	No Load	●	4.91	4.94		V
		I_{SOURCE} = 5mA	●	4.6	4.8		V
		I_{SOURCE} = 10mA	●	4.5	4.74		V
I_{SC}	Short-Circuit Current (Note 2)	Short to GND		18	30		mA
		0°C ≤ T_A ≤ 70°C	●	15			mA
PSRR	Power Supply Rejection Ratio	V_S = ±1.5V to ±9V	●	90	100		dB
I_S	Supply Current				230	325	µA
		0°C ≤ T_A ≤ 70°C	●			375	µA
		–40°C ≤ T_A ≤ 85°C	●			400	µA
	Supply Current, SHDN	V_{PIN5} = –3V, V_S = ±5V, No Load (Note 10)	●		6	20	µA
I_{SHDN}	Shutdown Pin Current	V_{PIN5} = –4.7V, V_S = ±5V, No Load (Note 10)	●		0.5		nA
		V_{PIN5} = –3V, V_S = ±5V, No Load (Note 10)	●		2	8	µA

ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the specified temperature range, otherwise specifications are T_A = 25°C. V_S = ±5V, V_{CM} = 0V, V_{OUT} = 0V, for the 6-lead part V_{PIN5} = V^-, pulse power tested unless otherwise specified. (Note 4)

SYMBOL	PARAMETER	CONDITIONS		LT1783C/LT1783I MIN	 TYP	 MAX	UNITS
	Maximum Shutdown Pin Current	V_{PIN5} = 9V, V_S = ±9V (Note 10)	●		10	30	μA
	Shutdown Output Leakage Current	V_{PIN5} = –7V, V_S = ±9V, No Load (Note 10)	●		0.05	1	μA
V_L	Shutdown Pin Input Low Voltage	V_S = ±5V (Note 10)	●			–4.7	V
V_H	Shutdown Pin Input High Voltage	V_S = ±5V (Note 10)	●	–2.8			V
t_{ON}	Turn-On Time	V_{PIN5} = 0V to –5V, R_L = 10k (Note 10)	●		25		μs
t_{OFF}	Turn-Off Time	V_{PIN5} = –5V to 0V, R_L = 10k (Note 10)	●		3		μs
GBW	Gain Bandwidth Product	f = 5kHz 0°C ≤ T_A ≤ 70°C –40°C ≤ T_A ≤ 85°C	 ● ●	800 700 625	1300		kHz kHz kHz
SR	Slew Rate	A_V = –1, R_L = ∞, V_O = ±4V, Measured at V_O = ±2V 0°C ≤ T_A ≤ 70°C –40°C ≤ T_A ≤ 85°C	 ● ●	0.26 0.23 0.21	0.45		V/μs V/μs V/μs
FPBW	Full-Power Bandwidth (Note 11)	V_{OUT} = 8V_{P-P}			18		kHz
t_S	Settling Time	ΔV_{OUT} = 4V to 0.1%, A_V = 1			10		μs

The ● denotes specifications which apply over the full operating temperature range of –40°C ≤ T_A ≤ 125°C. V_S = 3V, 0V; V_S = 5V, 0V; V_{CM} = V_{OUT} = half supply, for the 6-lead part V_{PIN5} = 0V, pulse power tested unless otherwise specified. (Note 4)

SYMBOL	PARAMETER	CONDITIONS		LT1783H MIN	 TYP	 MAX	UNITS
V_{OS}	Input Offset Voltage		 ●		400	850 3	μV mV
	Input Offset Voltage Drift (Note 9)		●			15	μV/°C
I_{OS}	Input Offset Current	 V_{CM} = 18V (Note 5)	● ●			15 10	nA μA
I_B	Input Bias Current	 V_{CM} = 18V (Note 5)	● ●			150 150	nA μA
	Input Voltage Range		●	0.3		18	V
CMRR	Common Mode Rejection Ratio	V_{CM} = 0.3V to V_{CC} – 1V V_{CM} = 0.3V to 18V	● ●	76 60			dB dB
A_{VOL}	Large-Signal Voltage Gain	V_S = 3V, V_O = 500mV to 2.5V, R_L = 10k	 ●	200 50	1500		V/mV V/mV
		V_S = 5V, V_O = 500mV to 4.5V, R_L = 10k	 ●	400 100	1500		V/mV V/mV
V_{OL}	Output Voltage Swing LOW	No Load I_{SINK} = 5mA V_S = 5V, I_{SINK} = 10mA	● ● ●			15 800 1200	mV mV mV
V_{OH}	Output Voltage Swing HIGH	V_S = 3V, No Load V_S = 3V, I_{SOURCE} = 5mA	● ●	2.85 2.30			V V
		V_S = 5V, No Load V_S = 5V, I_{SOURCE} = 10mA	● ●	4.85 4			V V
PSRR	Power Supply Rejection Ratio	V_S = 3V to 12.5V, V_{CM} = V_O = 1V	●	80			dB
	Minimum Supply Voltage		●	2.7			V
	Reverse Supply Voltage	I_S = –100μA	●	18			V

ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range of –40°C ≤ T_A ≤ 125°C. V_S = 3V, 0V; V_S = 5V, 0V; V_{CM} = V_{OUT} = half supply, for the 6-lead part V_{PIN5} = 0V, pulse power tested unless otherwise specified. (Note 4)

SYMBOL	PARAMETER	CONDITIONS		LT1783H MIN	TYP	MAX	UNITS
I_S	Supply Current		 ●		210	300 600	µA µA
	Supply Current, SHDN	V_{PIN5} = 2V, No Load (Note 10)	●			25	µA
I_{SHDN}	Shutdown Pin Current	V_{PIN5} = 0.3V, No Load (Note 10) V_{PIN5} = 2V, No Load (Note 10)	● ●		0.5	 12	nA µA
	Output Leakage Current	V_{PIN5} = 2V, No Load (Note 10)	●			2.5	µA
	Maximum Shutdown Pin Current	V_{PIN5} = 18V, No Load (Note 10)	●			40	µA
GBW	Gain Bandwidth Product	f = 5kHz (Note 5)	 ●	750 400	1250		kHz kHz
SR	Slew Rate	A_V = –1, R_L = ∞ (Note 7)	 ●	0.24 0.12	0.42		V/µs V/µs

The ● denotes specifications which apply over the full operating temperature range of –40°C ≤ T_A ≤ 125°C. V_S = ±5V, V_{CM} = 0V, V_{OUT} = 0V, V_{SHDN} = V^-, T_A = –40°C to 125°C, for the 6-lead part V_{PIN5} = V^-, pulse power tested unless otherwise specified. (Note 4)

SYMBOL	PARAMETER	CONDITIONS		LT1783H MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage		 ●		500	950 3.1	µV mV
	Input Offset Voltage Drift (Note 9)		●			15	µV/°C
I_{OS}	Input Offset Current		●			15	nA
I_B	Input Bias Current		●			150	nA
CMRR	Common Mode Rejection Ratio	V_{CM} = –4.7V to 13V	●	60			dB
A_{VOL}	Large-Signal Voltage Gain	V_O = ±4V, R_L = 10k	 ●	70 10	160		V/mV V/mV
V_O	Output Voltage Swing	No Load I_{OUT} = ±5mA I_{OUT} = ±10mA	● ● ●	±4.85 ±4.20 ±3.80			V V V
PSRR	Power Supply Rejection Ratio	V_S = ±1.5V to ±9V	●	80			dB
	Minimum Supply Voltage		●	±1.35			V
I_S	Supply Current		 ●		230	325 650	µA µA
	Supply Current, SHDN	V_{PIN5} = –3V, V_S = ±5V, No Load (Note 10)	●			25	µA
I_{SHDN}	Shutdown Pin Current	V_{PIN5} = –4.7V, V_S = ±5V, No Load (Note 10) V_{PIN5} = –3V, V_S = ±5V, No Load (Note 10)	● ●		0.5	 12	nA µA
	Maximum Shutdown Pin Current	V_{PIN5} = 9V, V_S = ±9V (Note 10)	●			45	µA
	Output Leakage Current	V_{PIN5} = –7V, V_S = ±9V, No Load	●			3	µA
V_L	Shutdown Pin Input Low Voltage	V_S = ±5V	●			–4.7	V
V_H	Shutdown Pin Input High Voltage	V_S = ±5V	●	–2.8			V
GBW	Gain Bandwidth Product	f = 5kHz	 ●	800 425	1300		kHz kHz
SR	Slew Rate	A_V = –1, R_L = ∞, V_O = 4V Measured at V_O = ±2V	 ●	0.26 0.14	0.45		V/µs V/µs

ELECTRICAL CHARACTERISTICS

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: The LT1783C and LT1873I are guaranteed functional over the operating temperature range of –40°C to 85°C. The LT1783H is guaranteed functional over the operating temperature range of –40°C to 125°C.

Note 4: The LT1783C is guaranteed to meet specified performance from 0°C to 70°C. The LT1783C is designed, characterized and expected to meet specified performance from –40°C to 85°C but is not tested or QA sampled at these temperatures. The LT1783I is guaranteed to meet specified performance from –40°C to 85°C. The LT1783H is guaranteed to meet specified performance from –40°C to 125°C.

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

Note 6: V_S = 3V limits are guaranteed by correlation to V_S = 5V and V_S = ±5V or V_S = ±9V tests.

Note 7: Guaranteed by correlation to slew rate at V_S = ±5V, and GBW at V_S = 3V and V_S = ±5V tests.

Note 8: 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.

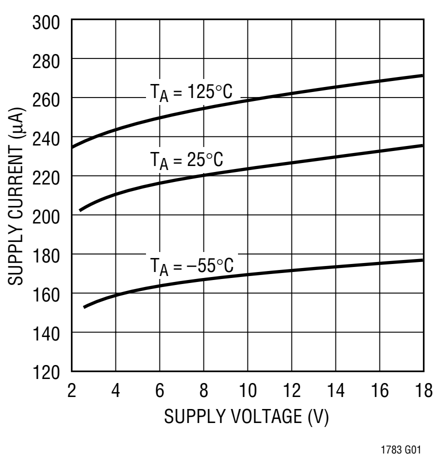
Note 9: This parameter is not 100% tested.

Note 10: Specifications apply to 6-lead SOT-23 with shutdown.

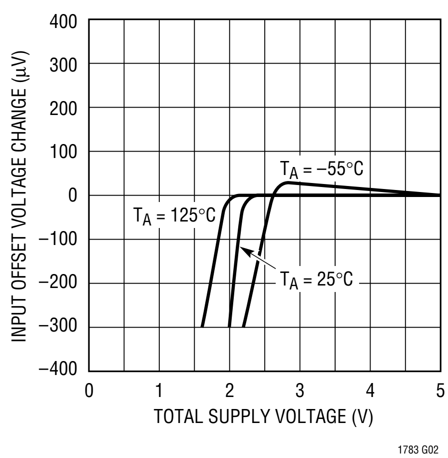
Note 11: Full-power bandwidth is calculated from the slew rate. FPBW = SR/2πV_P.

TYPICAL PERFORMANCE CHARACTERISTICS

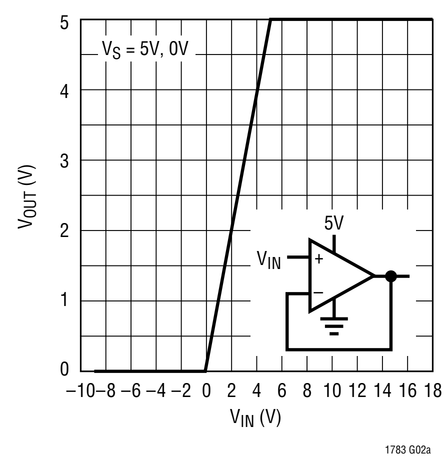
Supply Current vs Supply Voltage



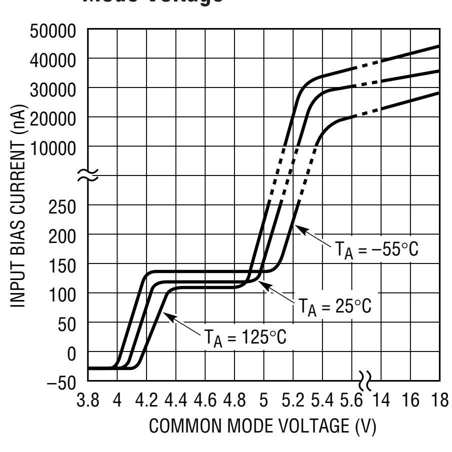
Minimum Supply Voltage



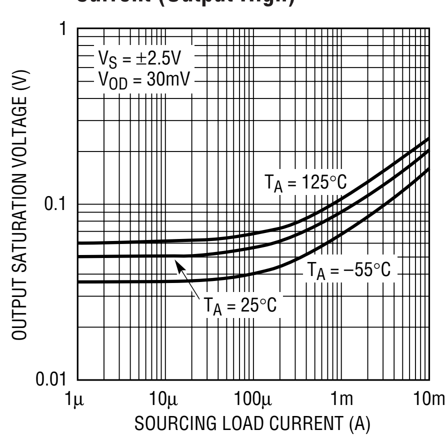
Output Voltage vs Large Input Voltage



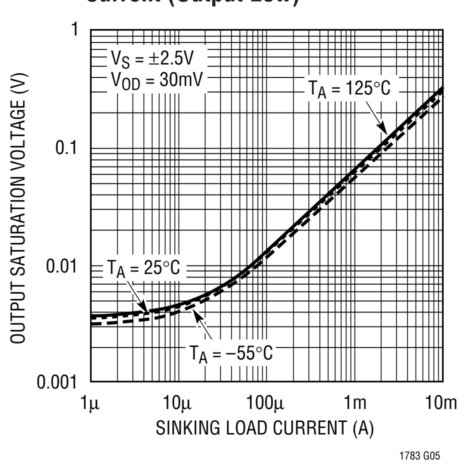
Input Bias Current vs Common Mode Voltage



Output Saturation Voltage vs Load Current (Output High)

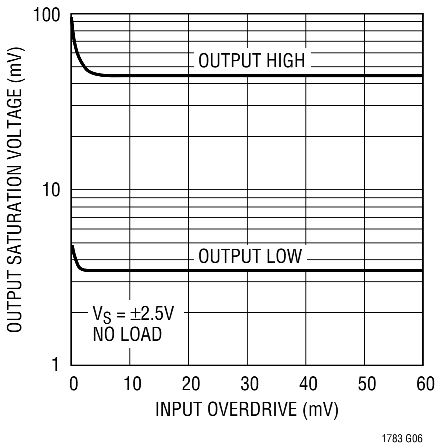


Output Saturation Voltage vs Load Current (Output Low)

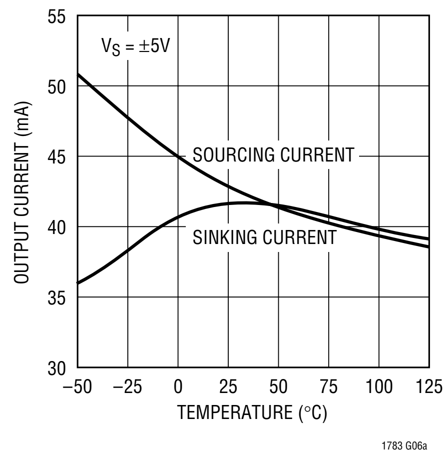


TYPICAL PERFORMANCE CHARACTERISTICS

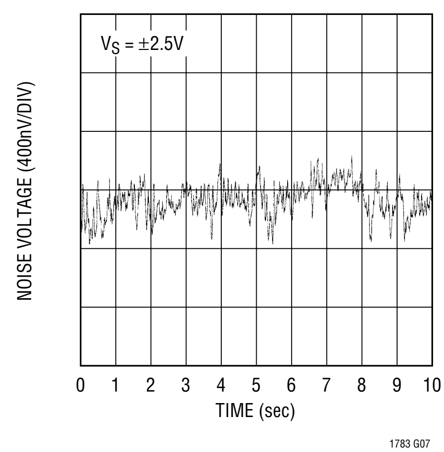
Output Saturation Voltage vs Input Overdrive



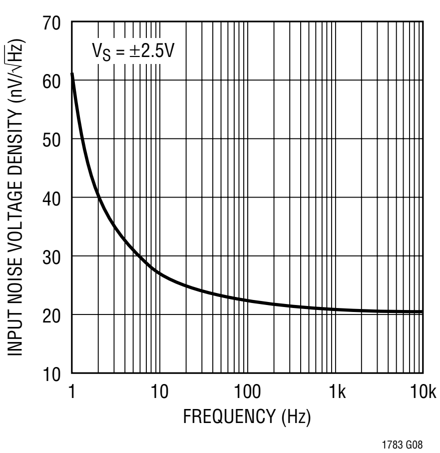
Output Short-Circuit Current vs Temperature



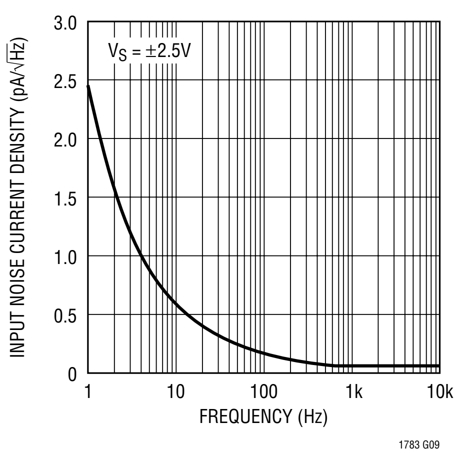
0.1Hz to 10Hz Noise Voltage



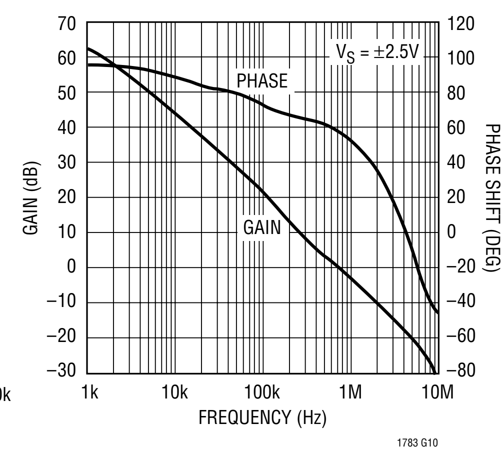
Noise Voltage Density vs Frequency



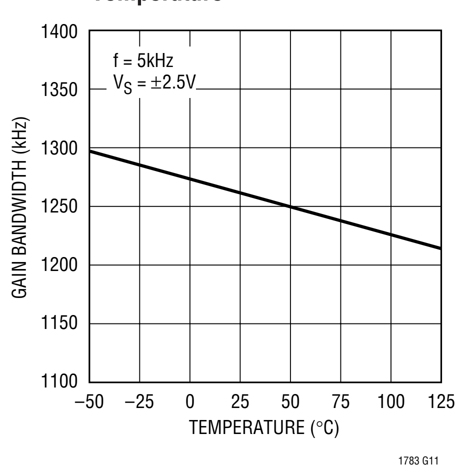
Input Noise Current vs Frequency



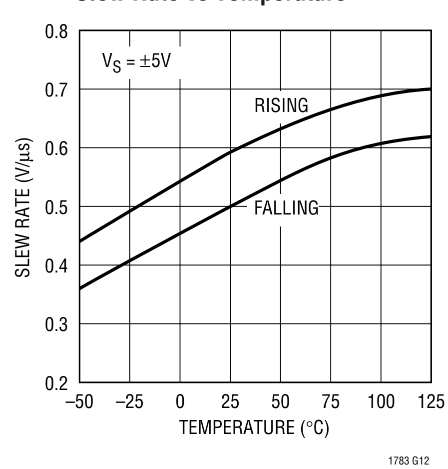
Gain and Phase Shift vs Frequency



Gain Bandwidth Product vs Temperature

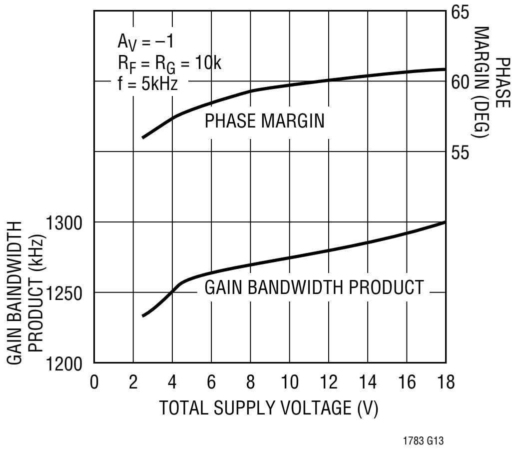


Slew Rate vs Temperature

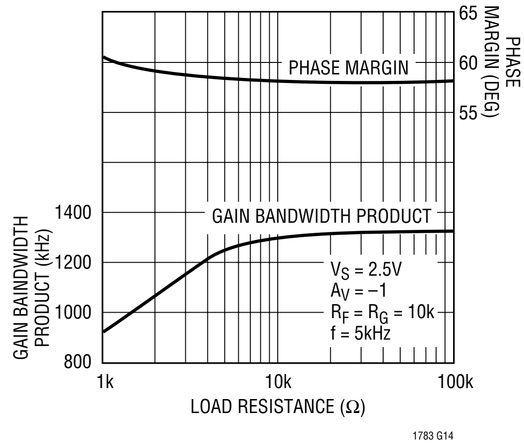


TYPICAL PERFORMANCE CHARACTERISTICS

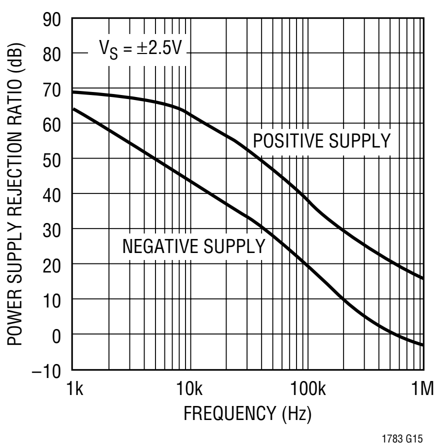
Gain Bandwidth Product and Phase Margin vs Supply Voltage



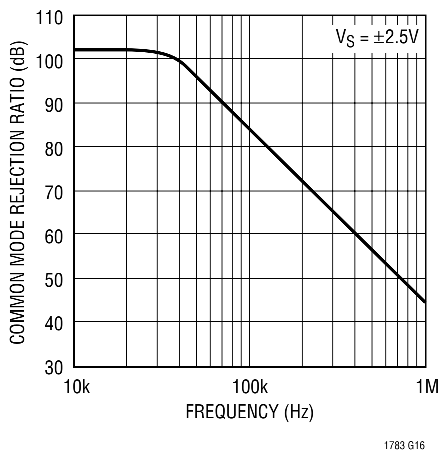
Gain Bandwidth and Phase Margin vs Load Resistance



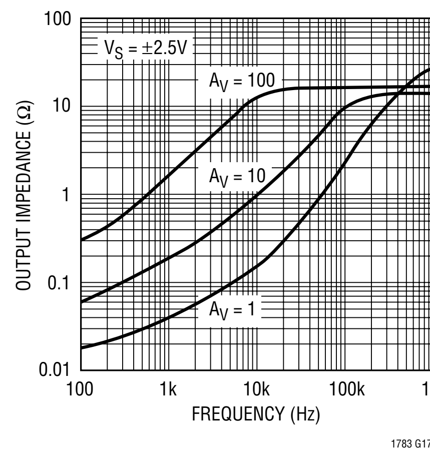
PSRR vs Frequency



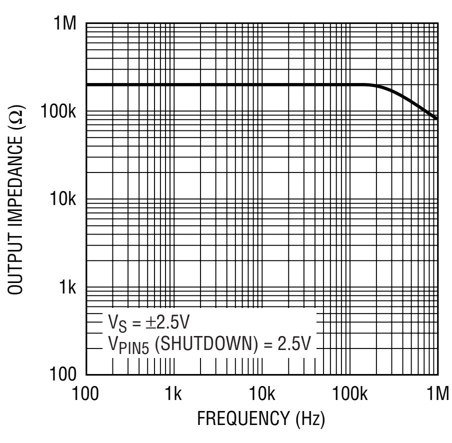
CMRR vs Frequency



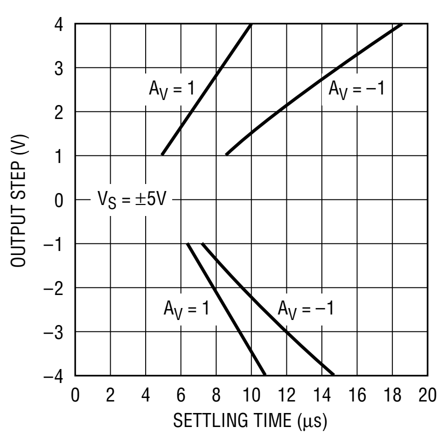
Output Impedance vs Frequency



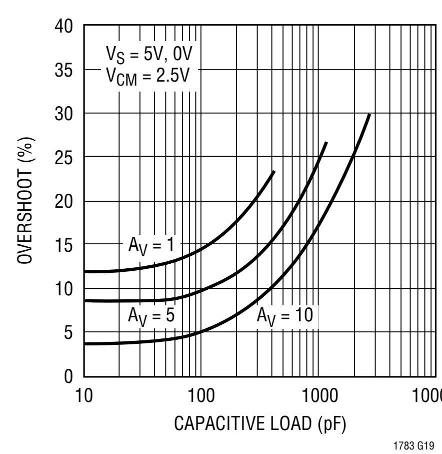
Disabled Output Impedance vs Frequency (Note 8)



Settling Time to 0.1% vs Output Step

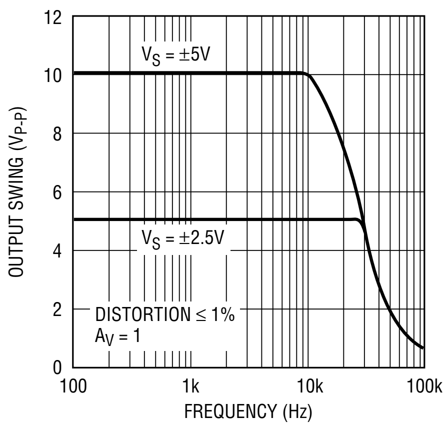


Capacitive Load Handling Overshoot vs Capacitive Load



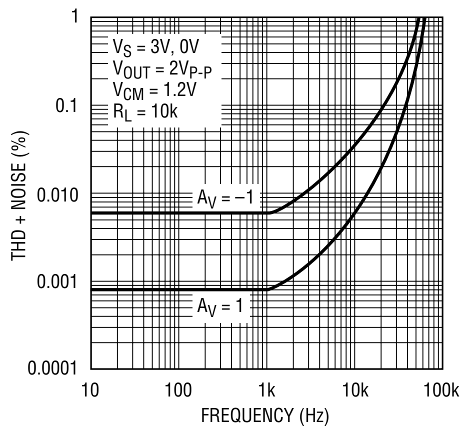
TYPICAL PERFORMANCE CHARACTERISTICS

Undistorted Output Swing vs Frequency



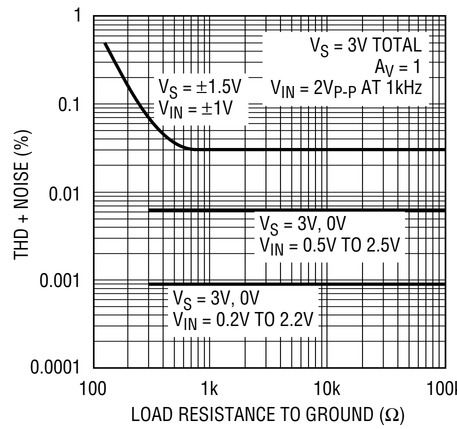
1783 G20

Total Harmonic Distortion + Noise vs Frequency



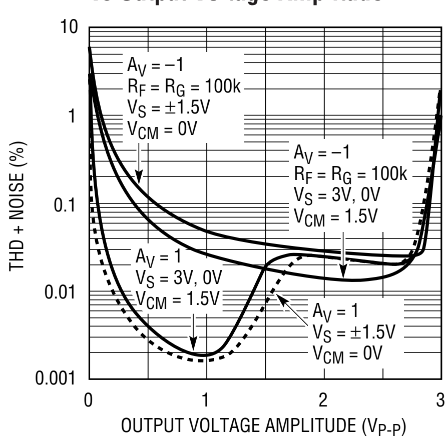
1783 G21

Total Harmonic Distortion + Noise vs Load Resistance



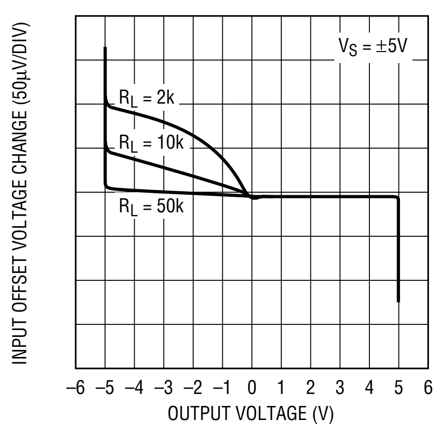
1783 G22

Total Harmonic Distortion + Noise vs Output Voltage Amplitude



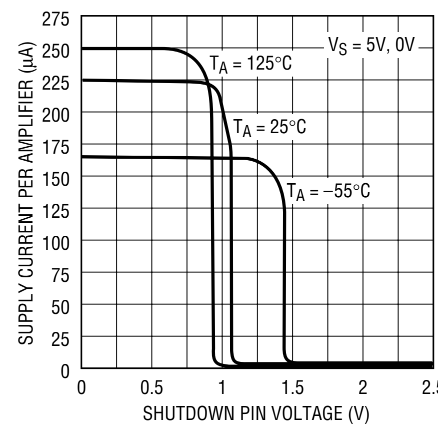
1783 G23

Open-Loop Gain



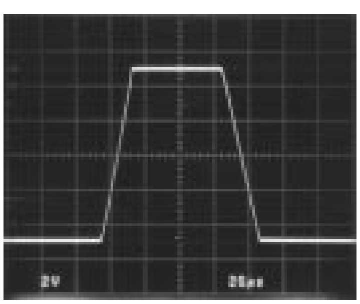
1783 G24

Supply Current vs SHDN Pin Voltage



1783 G25

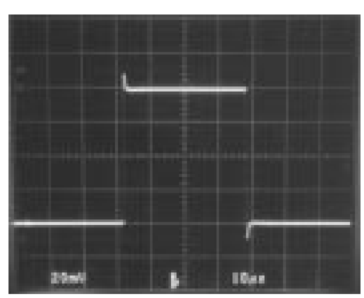
Large-Signal Response



$V_S = \pm5V$
$A_V = 1$
$C_L = 15pF$

1783 G26

Small-Signal Response



$V_S = \pm5V$
$A_V = 1$
$C_L = 15pF$

1783 G27

APPLICATIONS INFORMATION

Supply Voltage

The positive supply pin of the LT1783 should be bypassed with a small capacitor (typically 0.1µF) within an inch of the pin. When driving heavy loads, an additional 4.7µF electrolytic capacitor should be used. When using split supplies, the same is true for the negative supply pin.

The LT1783 is protected against reverse battery voltages up to 18V. In the event a reverse battery condition occurs, the supply current is less than 1nA.

Inputs

The LT1783 has two input stages, NPN and PNP (see the Simplified Schematic), resulting in three distinct operating regions as shown in the Input Bias Current vs Common Mode typical performance curve.

For input voltages about 0.8V or more below V^+, the PNP input stage is active and the input bias current is typically –40nA. When the input common mode voltage is within 0.5V of the positive rail, the NPN stage is operating and the input bias current is typically 80nA. Increases in temperature will cause the voltage at which operation switches from the PNP input stage to the NPN input stage to move towards V^+. The input offset voltage of the NPN stage is untrimmed and is typically 1.8mV.

A Schottky diode in the collector of the input transistors, along with special geometries for these NPN transistors, allow the LT1783 to operate with either or both of its inputs above V^+. At about 0.3V above V^+, the NPN input transistor is fully saturated and the input bias current is typically 30µA at room temperature. The input offset voltage is typically 1.8mV when operating above V^+. The LT1783 will operate with its inputs 18V above V^- regardless of V^+.

The inputs are protected against excursions as much as 10V below V^- by an internal 1k resistor in series with each input and a diode from the input to the negative supply. The input stage of the LT1783 incorporates phase reversal protection to prevent the output from phase reversing for inputs up to 9V below V^-. There are no clamping diodes between the inputs and the maximum differential input voltage is 18V.

Output

The output of the LT1783 can swing to within 60mV of the positive rail with no load and within 3mV of the negative rail with no load. When monitoring input voltages within 60mV of the positive rail or within 3mV of the negative rail, gain should be taken to keep the output from clipping. The LT1783 can sink and source over 30mA at ±5V supplies, sourcing current is reduced to 10mA at 3V total supplies as noted in the Electrical Characteristics.

The LT1783 is internally compensated to drive at least 400pF of capacitance under any output loading conditions. A 0.22µF capacitor in series with a 150Ω resistor between the output and ground will compensate these amplifiers for larger capacitive loads, up to 10,000pF, at all output currents.

Distortion

There are two main contributors to distortion in op amps: output crossover distortion as the output transitions from sourcing to sinking current, and distortion caused by nonlinear common mode rejection. If the op amp is operating inverting, there is no common mode induced distortion. If the op amp is operating in the PNP input stage (input is not within 0.8V of V^+), the CMRR is very good,

APPLICATIONS INFORMATION

typically 100dB. When the LT1783 switches between input stages, there is significant nonlinearity in the CMRR. Lower load resistance increases the output crossover distortion but has no effect on the input stage transition distortion. For lowest distortion, the LT1783 should be operated single supply, with the output always sourcing current and with the input voltage swing between ground and (V^+ – 0.8V). See the Typical Performance Characteristics curves, "Total Harmonic Distortion + Noise vs Output Voltage Amplitude."

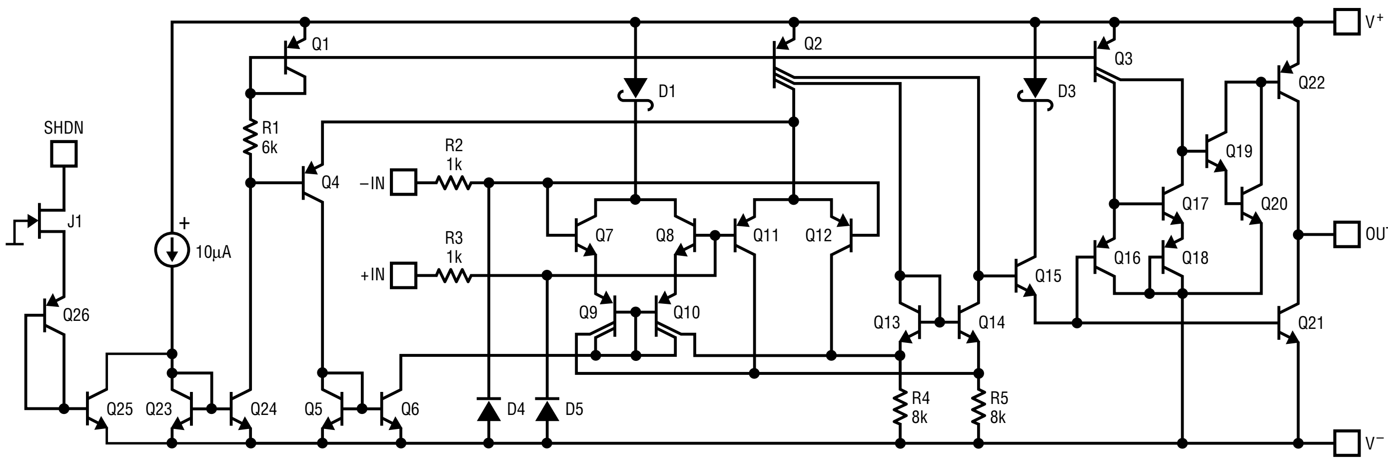
Gain

The open-loop gain is almost independent of load when the output is sourcing current. This optimizes performance in single supply applications where the load is returned to ground. The typical performance curve of open-loop gain for various loads shows the details.

Shutdown

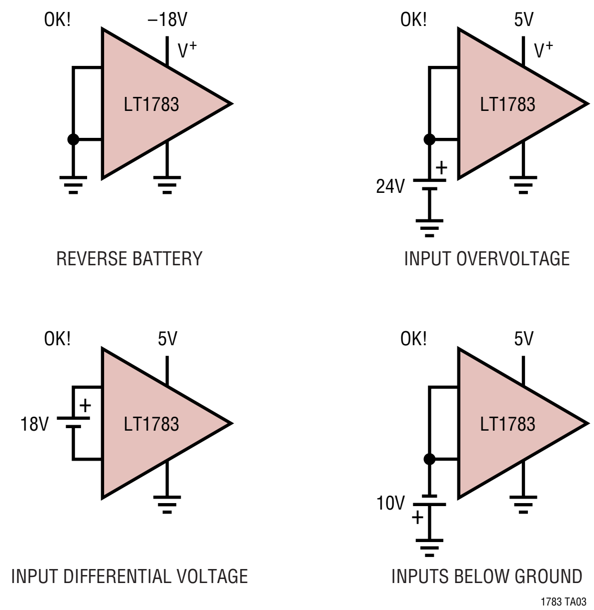
The 6-lead part includes a shutdown feature that disables the part, reducing quiescent current and making the output high impedance. The part can be shut down by bringing the SHDN pin 1.2V or more above V^-. When shut down, the supply current is about 5μA and the output leakage current is less than 1μA ($V^- \le V_{OUT} \le V^+$). In normal operation, the SHDN pin can be tied to V^- or left floating. See the Typical Performance Characteristics curves, "Supply Current vs Shutdown Voltage."

SIMPLIFIED SCHEMATIC



TYPICAL APPLICATION

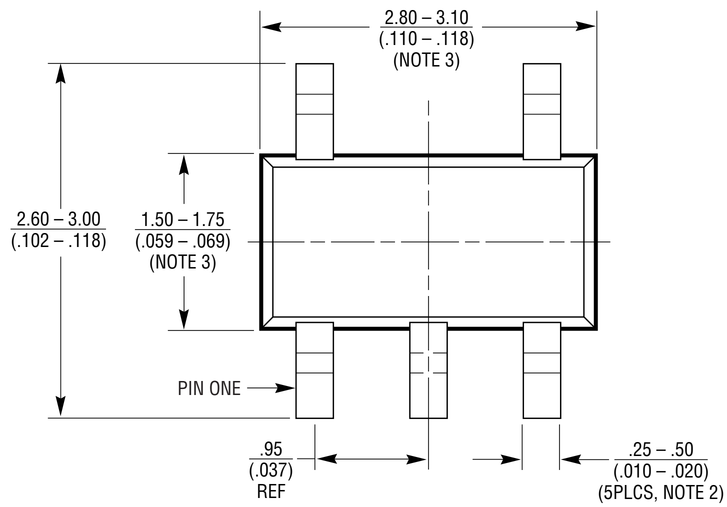
Protected Fault Conditions

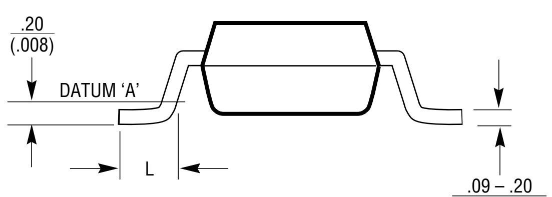


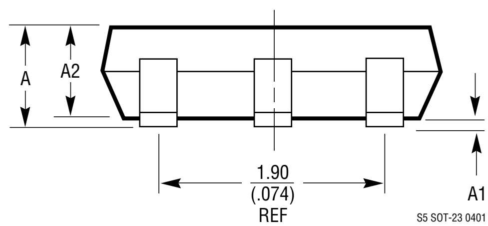
PACKAGE DESCRIPTION

S5 Package
5-Lead Plastic SOT-23
(Reference LTC DWG # 05-08-1633)
(Reference LTC DWG # 05-08-1635)

	SOT-23 (Original)	SOT-23 (ThinSOT)
A	.90 – 1.45 (.035 – .057)	1.00 MAX (.039 MAX)
A1	.00 – .15 (.00 – .006)	.01 – .10 (.0004 – .004)
A2	.90 – 1.30 (.035 – .051)	.80 – .90 (.031 – .035)
L	.35 – .55 (.014 – .021)	.30 – .50 REF (.012 – .019 REF)





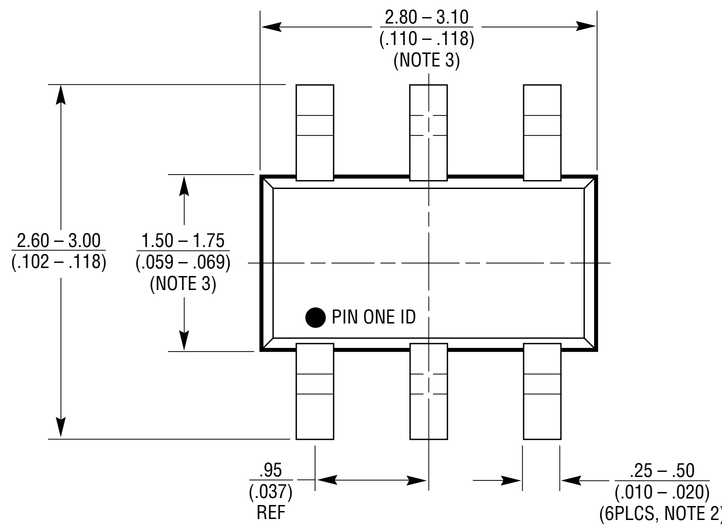


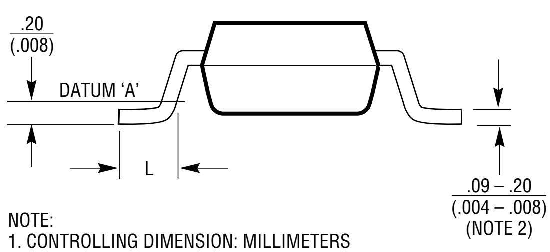
NOTE:
1. CONTROLLING DIMENSION: MILLIMETERS
2. DIMENSIONS ARE IN $\frac{\text{MILLIMETERS}}{\text{(INCHES)}}$
3. DRAWING NOT TO SCALE
4. DIMENSIONS ARE INCLUSIVE OF PLATING
5. DIMENSIONS ARE EXCLUSIVE OF MOLD FLASH AND METAL BURR
6. MOLD FLASH SHALL NOT EXCEED .254mm
7. PACKAGE EIAJ REFERENCE IS:
   SC-74A (EIAJ) FOR ORIGINAL
   JEDEL MO-193 FOR THIN

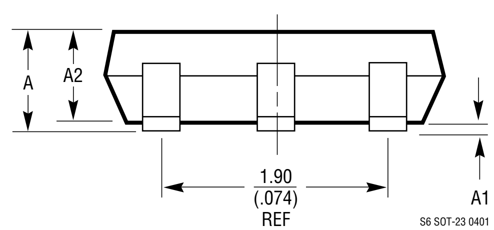
PACKAGE DESCRIPTION

S6 Package
6-Lead Plastic SOT-23
(Reference LTC DWG # 05-08-1634)
(Reference LTC DWG # 05-08-1636)

	SOT-23 (Original)	SOT-23 (ThinSOT)
A	.90 – 1.45 (.035 – .057)	1.00 MAX (.039 MAX)
A1	.00 – 0.15 (.00 – .006)	.01 – .10 (.0004 – .004)
A2	.90 – 1.30 (.035 – .051)	.80 – .90 (.031 – .035)
L	.35 – .55 (.014 – .021)	.30 – .50 REF (.012 – .019 REF)



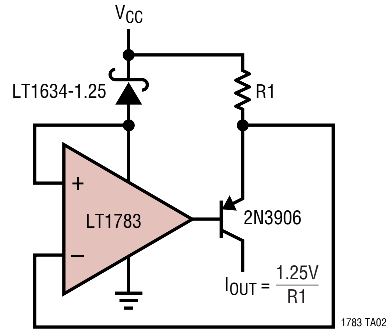




NOTE:
1. CONTROLLING DIMENSION: MILLIMETERS
2. DIMENSIONS ARE IN $\frac{\text{MILLIMETERS}}{\text{(INCHES)}}$
3. DRAWING NOT TO SCALE
4. DIMENSIONS ARE INCLUSIVE OF PLATING
5. DIMENSIONS ARE EXCLUSIVE OF MOLD FLASH AND METAL BURR
6. MOLD FLASH SHALL NOT EXCEED .254mm
7. PACKAGE EIAJ REFERENCE IS:
   SC-74A (EIAJ) FOR ORIGINAL
   JEDEL MO-193 FOR THIN

TYPICAL APPLICATION

Current Source



RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1782	Micropower, Over-The-Top SOT-23 Rail-to-Rail Input and Output Op Amp	SOT-23 Package, Micropower 40µA per Amplifier, Rail-to-Rail Input and Output , 200kHz GBW
LT1490/LT1491	Dual/Quad Over-The-Top Micropower Rail-to-Rail Input and Output Op Amps	Single Supply Input Range: –0.4V to 44V, Micropower 50µA per Amplifier, Rail-to-Rail Input and Output , 200kHz GBW
LT1636	Single Over-The-Top Micropower Rail-to-Rail Input and Output Op Amp	55µA Supply Current, V_{CM} Extends 44V Above V_{EE}, Independent of V_{CC}, MSOP Package, Shutdown Function
LT1638/LT1639	Dual/Quad, 1.2MHz, 0.4V/µs, Over-The-Top Micropower Rail-to-Rail Input and Output Op Amps	170µA Supply Current, Single Supply Input Range: –0.4V to 44V, Rail-to-Rail Input and Output

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