

DESIGN NOTES

SOT-23 Micropower, Rail-to-Rail Op Amps Operate with Inputs Above the Positive Supply – Design Note 221

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Introduction

The only SOT-23 op amps featuring Over-The-Top™ operation—the ability to operate with either or both inputs above the positive rail—are the 55µA LT®1782 and the 300µA LT1783. This feature is important in many current-sensing applications, where the inputs are required to operate at or above the supply. The wide supply voltage range, from 2.7V to 18V, gives the LT1782/LT1783 broad appeal as general purpose amplifiers, while the guaranteed offset voltage of 950µV over temperature is the lowest of any SOT-23 op amp. There is even a shutdown feature for ultralow supply current applications.

Tough General Purpose Op Amps

The LT1782/LT1783 SOT-23 op amps are ideal for general purpose applications that demand excellent performance. These SOT-23 op amps are specified at input common mode voltages as high as 18V, independent of the supply voltage, making them ideal for applications with a wide input range requirement and/or unusual input conditions. In applications that require more bandwidth than the 200kHz LT1782, the LT1783's six-fold increase in supply current gives it six times more bandwidth and slew rate. The parts are available in two pinouts, a 6-lead version with a shutdown feature that reduces supply current to only 5µA, and a standard pinout 5-lead version. Table 1 summarizes the performance of these new op amps.

Table 1. LT1782/LT1783 SOT-23 Guaranteed Performance, $V_S = 3V/0V$ or $5V/0V$, $T_A = 25^\circ C$

PARAMETER	LT1782	LT1783
Supply Voltage Range	2.7V to 18V	2.7V to 18V
Supply Current (Max)	55µA	300µA
Input Offset Voltage (Max)	800µV	800µV
Input Bias Current (Max)	15nA	80nA
Input Bias Current, $V^+ = 0V$ (Typ)	0.1nA	0.1nA
Input Offset Current (Max)	2nA	8nA
Open-Loop Gain, $R_L = 10k$ (Min)	200V/mV	200V/mV
PSRR (Min)	90dB	90dB
CMRR (Min)	90dB	90dB
Common Mode Range	0V to 18V	0V to 18V
Output Swing Low, $(V_O - V^-)$	8mV	8mV
Output Swing High, $(V^+ - V_O)$	90mV	90mV
Slew Rate (Typ)	0.07V/µs	0.42V/µs
Gain Bandwidth Product (Typ)	200kHz	1.25MHz

Tough Op Amps

The LT1782/LT1783 are tough op amps that can be exposed to a variety of extreme conditions without being damaged (Figure 1). The amplifiers have reverse-battery protection up to 18V. The input pin voltage can extend to 10V below V^- or 24V above V^- without damaging the

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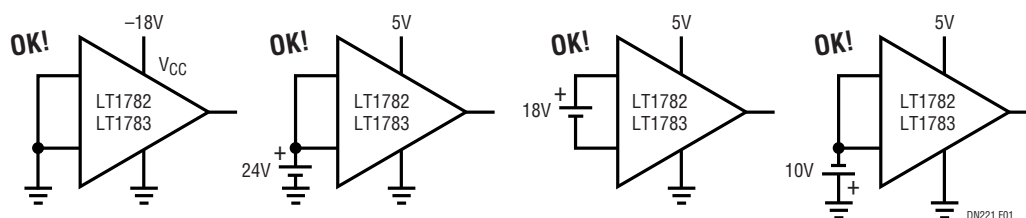


Figure 1. Tough Op Amps

device. The maximum input differential voltage is 18V, regardless of the supply voltage. All of these features combine to make the LT1782/LT1783 “one tough SOT-23.”

Read All of the Specs

Common factors that keep most SOT-23 parts from being general purpose amplifiers include low supply voltage range, high input offset voltage, low open-loop voltage gain and poor output stage performance.

The LT1782/LT1783 amplifiers operate on all single and split supplies with a total voltage of 2.7V to 18V. They are stable with capacitive loads up to 500pF under all load conditions. The minimum output current is $\pm 18\text{mA}$ and the unloaded output swing is guaranteed within 8mV of ground and 90mV of the positive rail.

A common problem encountered with other op amps in many applications is that as the output approaches the rail or ground, the gain degrades. The data sheet typically claims the output can swing to within a few millivolts of the rail, but the input overdrive required to achieve this can be quite high. This not the case with the LT1782/LT1783; a few millivolts of input overdrive is enough to swing the outputs to their guaranteed value. Figure 2 shows the typical output saturation voltage vs input overdrive.

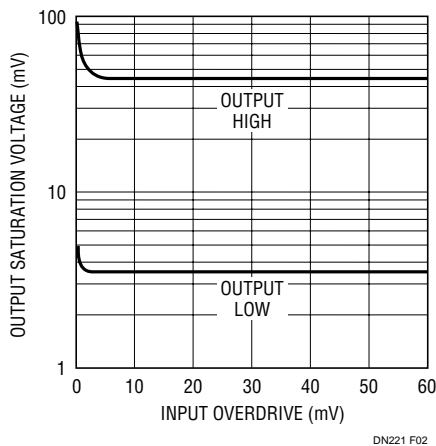


Figure 2. Output Saturation Voltage vs Input Overdrive

Over-The-Top Applications

The circuit of Figure 3 uses the Over-the-Top capabilities of the LT1783. The 0.2Ω resistor senses the load current while the op amp and NPN transistor form a closed loop, making the collector current of Q1 proportional to the load current. The 2k load resistor converts the current into a voltage. The positive supply rail, V_{BAT} , is not limited to the 5V supply of the op amp and could be as high as 18V. The LT1783 draws no current through the inputs when it is powered down, extending the battery life.

The circuit of Figure 4 uses the LT1782 in conjunction with the LT1634 micropower shunt reference. The supply current of the op amp also biases the reference. The drop across resistor R1 is fixed at 1.25V generating an output current equal to $1.25\text{V}/R1$. Notice that noninverting input is tied to the V_{CC} pin of the op amp.

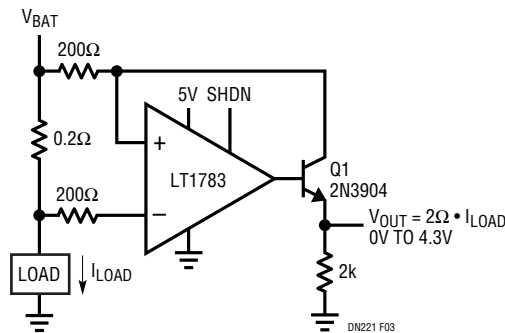


Figure 3. Positive Supply Rail Current Sense

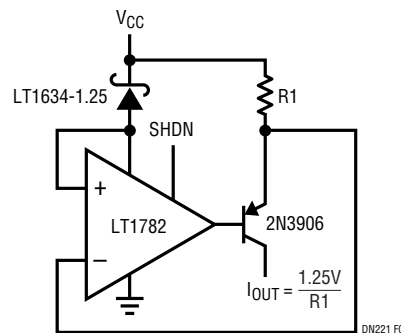


Figure 4. Current Source

Data Sheet Download

<http://www.linear-tech.com/go/dnLT1782>
<http://www.linear-tech.com/go/dnLT1783>

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