

# DESIGN NOTES

## Op Amp, Comparator and Reference IC Provides Micropower Monitoring Capability – Design Note 190

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### Introduction

The LTC<sup>®</sup>1541 combines a micropower amplifier, comparator and 1.2V reference in an 8-pin package. The part operates from a single 2.5V to 12.6V supply with typical supply current of 5 $\mu$ A. Both op amp and comparator feature a common mode input voltage range that extends from the negative supply to within 1.3V of the positive supply. The op amp output stage swings from rail-to-rail. Figure 1 lists additional features along with a block diagram of the device. The part's attributes suggest low power monitoring applications and two such circuits are presented here.

### Pilot Light Flame Detector with Low-Battery Lockout

Figure 2 shows a pilot light flame detector with low-battery lockout. The amplifier ("A"), running open loop, compares a small portion of the reference with the thermocouple-

generated voltage. When the thermocouple is hot, the amplifier's output swings high, biasing Q1 on. Hysteresis, provided by the 10M resistor, ensures clean transitions, while the diodes clamp static generated voltages to the rails. The 100k–2.2 $\mu$ F RC filters the signal to the amplifier.

The comparator ("C") monitors the battery voltage via the 2M–1M divider and compares it to the 1.2V reference. A battery voltage above 3.6V holds C's output high, biasing Q2 on and maintaining the small potential at A's negative input. When the battery voltage drops too low, C goes low, signaling a low-battery condition. Simultaneously, Q2 goes off, causing A's negative input to move to 1.2V. This biases A low, shutting off Q1. The low outputs alert downstream circuitry to shut down gas flow.

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SUPPLY RANGE: 2.5V TO 12.6V  
 $I_{\text{QUIESCENT}}$ : 5 $\mu$ A  
 OP AMP  $V_{\text{OS}}$ : 700 $\mu$ V  
 COMPARATOR  $V_{\text{OS}}$ : 1mV  
 COMPARATOR HYSTERESIS:  $\pm$ 3mV  
 COMMON MODE RANGE: 0V TO ( $V_{\text{SUPPLY}} - 1.3$ V)  
 INPUT BIAS CURRENT: 1nA MAX, 10pA (25 $^{\circ}$ C) TYP  
 REFERENCE: 1.2V  $\pm$ 0.4%

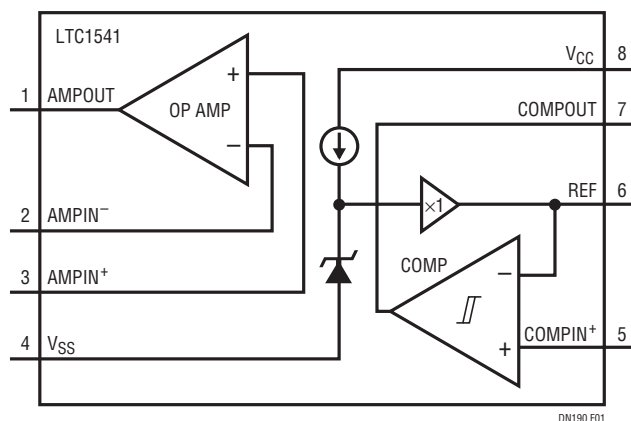
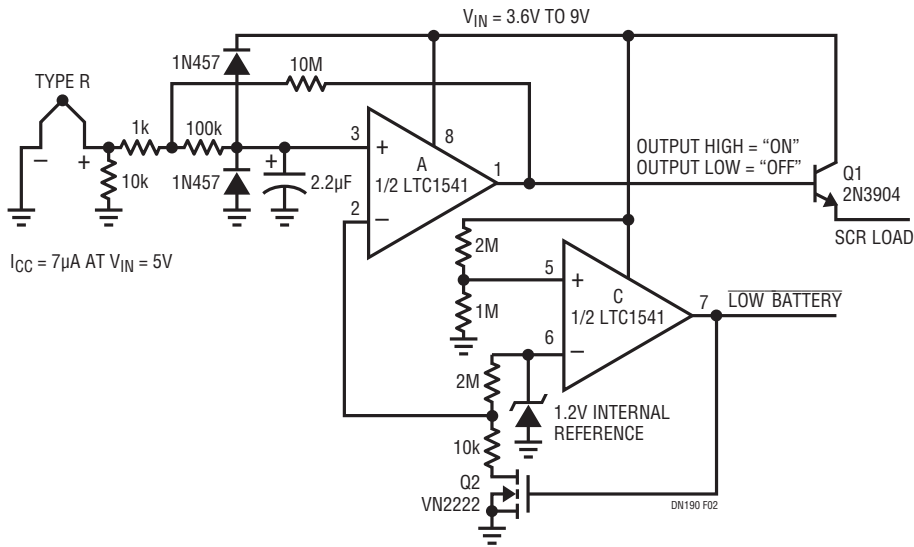


Figure 1. LTC1541 Block Diagram and Features of the Micropower Op Amp, Comparator and Reference

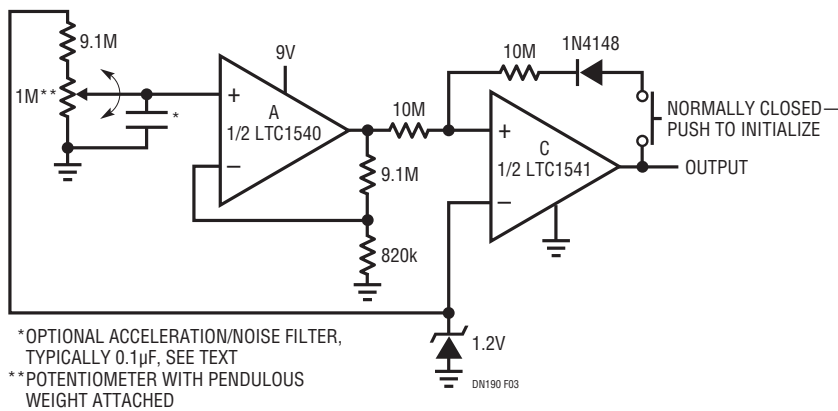


**Figure 2. Pilot Light Flame Detector with Low-Battery Lockout**

**Tip-Acceleration Detector for Shipping Containers**

Figure 3's circuit is a tip-acceleration detector for shipping containers. It detects if a shipping container has been subjected to excessive tipping or acceleration and retains the detected output. The sensitivity and frequency response are adjustable. A potentiometer with a small pendulous mass biases the amplifier ("A"), operating at a gain of 12. Normally, A's output is below C's trip point and circuit output is low. Any tip-acceleration event that causes A's output to swing

beyond 1.2V will trip C high. Positive feedback around C will latch it in this high state, alerting the receiving party that the shipped goods have been mishandled. Sensitivity is variable with potentiometer mechanical or electrical biasing or A's gain. Bandwidth is settable by selection of the capacitor at A's input. The circuit is prepared for use by applying power and pushing the button in C's output.



\*OPTIONAL ACCELERATION/NOISE FILTER, TYPICALLY 0.1µF, SEE TEXT  
 \*\*POTENTIOMETER WITH PENDULOUS WEIGHT ATTACHED

**Figure 3. Tip-Acceleration Detector for Shipping Containers Retains Output if Triggered. Sensitivity is Adjustable Via Amplifier Feedback Values. Capacitor Sets Acceleraton Response Bandwidth**

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