LINEAR TECHNOLOGY

DESIGN NOTES

Dual Micropower Comparator with Integrated 400mV Reference Simplifies Monitor and Control Functions – Design Note 321

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Introduction

The LT®6700 dual comparator incorporates features to reduce part count in space-critical designs, including a trimmed on-chip 400mV bandgap derived reference and internal hysteresis mechanisms. The LT6700 also features low voltage micropower single supply operation (1.4V to 18V, 7µA typical) and Over-The-Top® I/O capability to maximize versatility and provide solutions especially useful in portable battery-powered applications. The outputs are open collector to permit logical wire-AND functionality, and can drive relatively heavy loads (up to 40mA) such as relays or LED indicators.

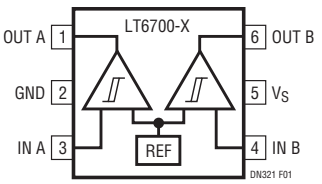
The LT6700 supports a wide range of design configurations, but still offers a minimum pin count package (ThinSOT™, 6-lead). This is made possible by offering the LT6700 in three different versions, each with a different input configuration. The LT6700-1 provides the designer with one inverting and one noninverting input, especially useful in window detection functions; the LT6700-2 provides two inverting inputs; and the LT6700-3 offers two noninverting inputs. The internal reference is connected to one of the inputs of each comparator section, as shown in Figure 1, and the remaining two connections are brought out for signal sensing by the user.

"Gas Gauge" Battery Monitor

It is easy to create a simple and accurate battery monitor using the LT6700, thanks to the accurate internal reference (±2% over temperature). Figure 2 shows an implementation of a 2-threshold "alkaline-cell" battery monitor. For the resistor values shown, the Pin 1 output goes low when the pack voltage falls below 2V (1V per cell) which corresponds to about 30% capacity remaining. The Pin 6 output goes low as well at 1.6V (0.8V per cell) as the battery pack reaches its rated end-of-life voltage. The number of threshold points may easily be increased by extending the resistor-divider chain and using additional comparators.

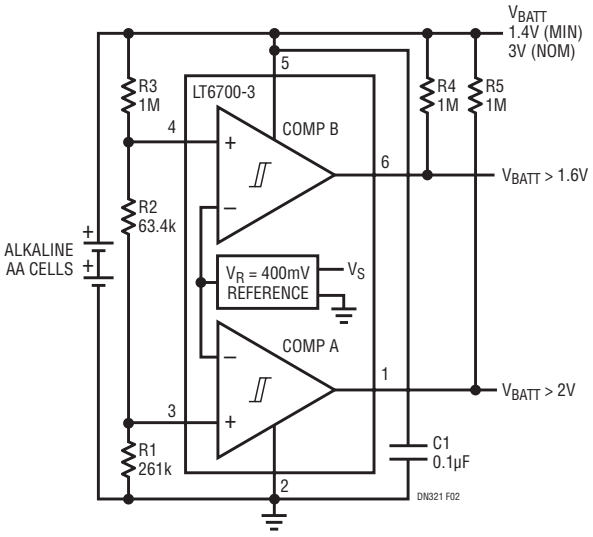
Simple Window-Function Status Monitor

The LT6700-1 lends itself nicely to window comparison applications, where the output wire-AND feature can be exploited. Figure 3 shows a 48V power bus monitor that provides an optoisolated alarm indication when voltage limits are exceeded. The micropower operation of the circuit allows it to derive operating power directly from the monitored voltage using simple Zener diode techniques.



THREE AVAILABLE INPUT POLARITY OPTIONS:
LT6700-1 INVERTING (B) AND NONINVERTING (A)
LT6700-2 BOTH (A AND B) INVERTING
LT6700-3 BOTH (A AND B) NONINVERTING

Figure 1. Pin Functions of the LT6700 Family



MONITOR CONSUMES ~10A
HYSTERESIS IS APPROXIMATELY
2% OF TRIP VOLTAGE

Figure 2. Micropower "Gas Gauge" Battery Monitor

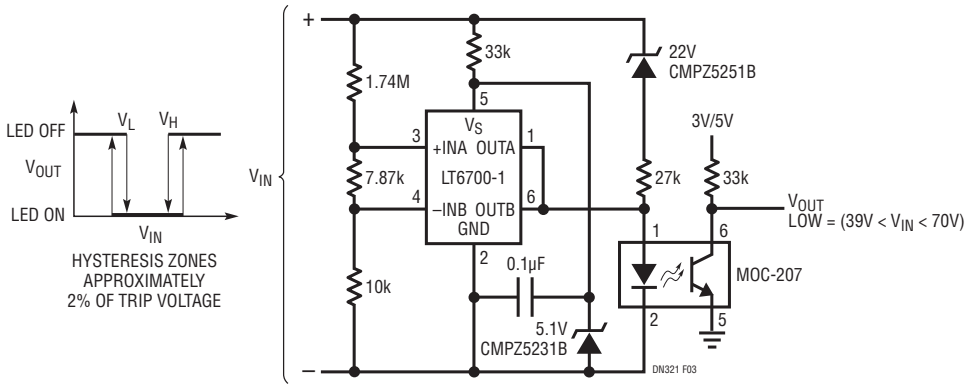


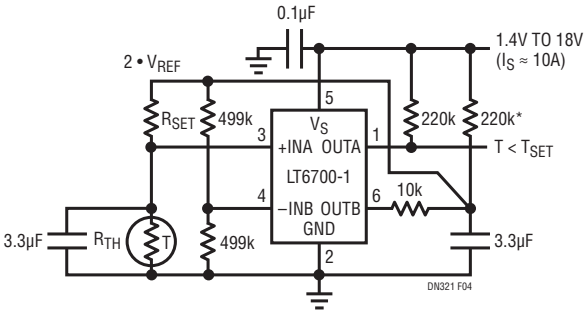
Figure 3. 48V Power Bus Status Monitor

During bus operation within the normal voltage range, neither comparator output is active, so the LED is on and the alarm output is low (alarm clear). If the bus voltage deviates sufficiently, then one of the comparators shunts away the LED drive resulting in assertion of the alarm. Notice that any failure mode that causes an open connection to the photo-transistor or prevents the LED from operating (i.e., other open-circuit conditions), produces a fail-safe alarm indication at the destination logic input. The ability of the LT6700 to operate down to very low voltage assures correct alarm indication even during deep sags in bus potential (the 22V Zener further eliminates the possibility of false-fault indication during a bus power-down transition by disabling the LED).

Micropower Thermostat/Temperature Alarm

Though the 400mV reference is not directly available to the circuit designer, an inverting comparator section can be used to scale an external voltage in proportion to the reference by implementing a simple "bang-bang" servo. This technique is shown in Figure 4, where the multiplier is set to two by an equal-resistor feedback path. The inverting comparator steers current to hold the voltage on a capacitor such that the feedback "bangs" between the input hysteresis points. The LT6700 hysteresis is nominally 6.5mV so this circuit has about $13mV_{P-P}$ ripple on the servo capacitor.

The other comparator section actually performs the alarm decision which is simply based on the imbalance of a resistor half-bridge. In this circuit, the thermistor resistance is balanced against a known resistor, so the temperature threshold is established easily by selecting



RTH = 1M (e.g., YSI 44015, 1.00MΩ AT 25°C)
RSET = RTH AT TSET
*RESISTANCE MAY REQUIRE OPTIMIZATION FOR OPERATION OVER INTENDED RTH AND VSUPPLY RANGES
HYSTERESIS ZONE ≈ 0.4°C

Figure 4. Micropower Thermostat/Temperature Alarm

R_{SET} from the thermistor table for the temperature of interest. Since the resistance varies about –4.4%/°C for the thermistor shown, the temperature hysteresis of the output signal is about 0.4°C, suitable for most environmental control applications. The capacitor in parallel with the thermistor filters away the ripple of the reference multiplier circuit. The micropower consumption of this circuit permits over two years of continuous operation from a common 3V coin-cell (i.e., CR2032).

Conclusion

The LT6700 provides compact, micropower solutions for threshold-based status and control functions. The extra-wide supply range and Over-The-Top features offer performance ideal for portable, battery-powered products as well as industrial applications.

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