A to D Converters

LTC1292: 12-BIT DATA ACQUISITION CIRCUITS

by Sammy Lum

Temperature-Measurement System

The circuit in Figure 1 shows how a transducer output, such as a platinum RTD bridge, can be digitized with one op amp. This circuit is a modification of that found in Application Note 43.[1] The differential input of the LTC1292 removes the common mode voltage. The LT1006 is used for amplification. The resistor tied between the + input of the LT1006 and the +IN input of the LTC1292 is to compensate for the loading of the bridge by resistor R_S. Full scale can be adjusted by the 500kΩ trim pot and offset can be adjusted by the 100Ω trim pot in series with R_S. A lower R_{PLAT} value than that in AN43 is used here to improve dynamic range. The signal voltage on the +IN pin must not exceed V_{REF}. The differential voltage range is V_{REF} minus approximately 100mV. This is enough range to measure 0°C to 400°C with 0.1°C resolution.

Floating, 12-Bit Data Acquisition System

The circuit in Figure 2 demonstrates how to float the LTC1292 to make a differential measurement. This circuit will digitize a 5V range from 10V to 15V with 12 bits of resolution. The digital I/O has been level translated. The LT1019-5 is used in shunt mode to create the floating analog ground for the LTC1292. The digital I/O lines make use of 4.3V Zeners to clamp the single-transistor inverters. Opto-isolators can also be used. The floating analog ground should be laid out as a ground plane for the LTC1292. The 47µF bypass capacitor should be tied from the V_{CC} pin to the floating ground plane with minimum lead length and placed as close to the device as possible. Likewise, keep the lead length from the GND pin to the floating ground plane at a minimum (a low-profile socket is acceptable).

Differential Temperature Measurement System

The circuit in Figure 3 digitizes the difference in temperature between two locations. The two LM134s are used as temperature sensors. These are ideally suited for remote applications because they are current output devices. This allows long wires to run from the sensor back to the LTC1292 without any degradation to the signal from the sensor. Resistor R_{SET} sets the current to 1µA/°K. The current is converted to a voltage by the resistor R1 connected from V^- to ground. The reference voltage and resistor were selected to give a change of 0.05°C/LSB. The resolution is given by $°C/LSB = V_{REF}/((4096)(1mA)(R1))$. The maximum temperature at each input is 125°C. Note

[1] Williams, Jim, "Bridge Circuits, Marrying Gain and Balance," Application Note 43, Linear Technology Corp.

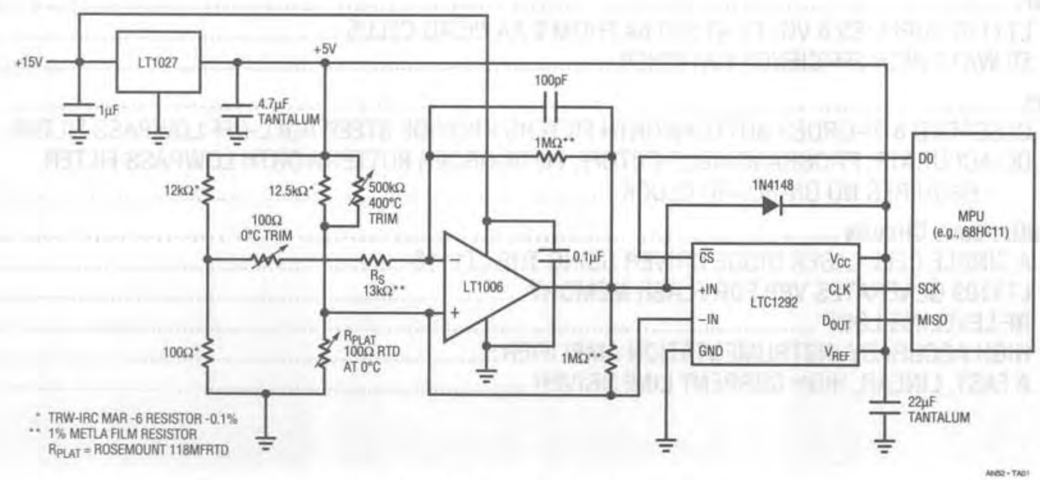

Figure 1. 0° to 400°C Temperature-Measurement System

that if the temperature on the +IN pin is less than the temperature on the –IN pin, the output will be zero. Because the LTC1292 is being driven from a high source impedance, you should limit the CLK frequency to 100kHz or less.

The software code for interfacing the LTC1292 to the Motorola MC68HC11 or the Intel 8051 is found in the LTC1292 data sheet. The code needs to be modified for the circuit in Figure 2 to account for the inversion introduced by the digital level translators.

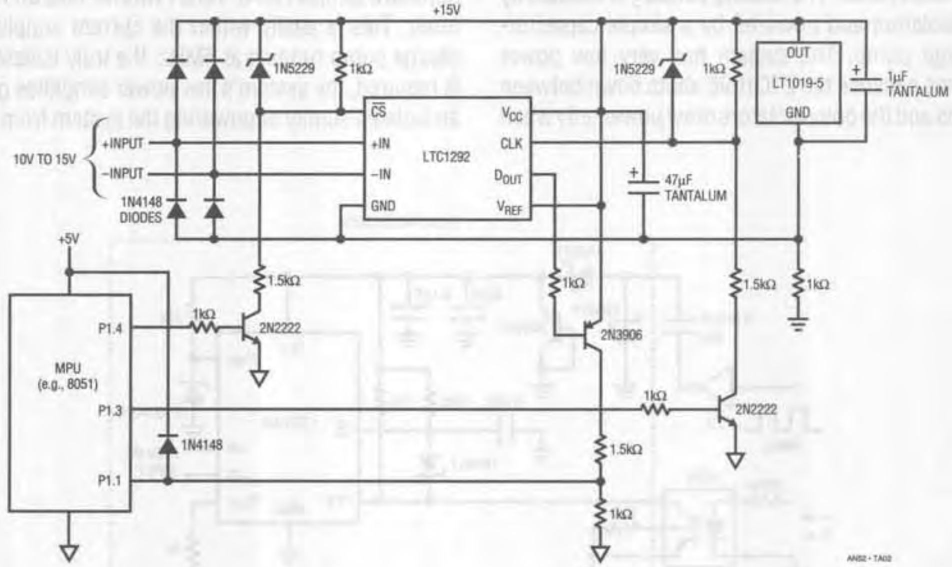

Figure 2. Floating, 12-Bit Data Acquisition System

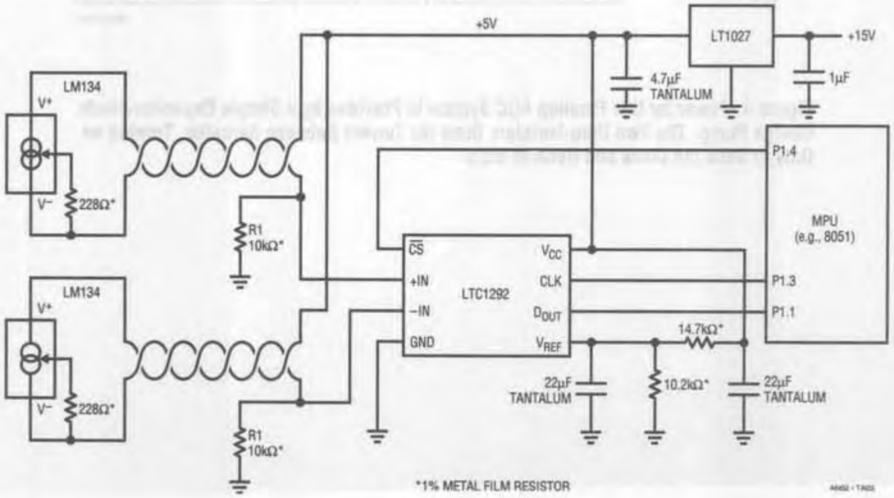

Figure 3. Differential Temperature-Measurement System

MICROPOWER SO8 PACKAGED ADC CIRCUITS

by William Rempfer

Floating 8-Bit Data Acquisition System

Figure 4 shows a floating system that sends data to a grounded host system. The floating circuitry is isolated by two opto-isolators and powered by a simple capacitor-diode charge pump. The system has very low power requirements because the LTC1096 shuts down between conversions and the opto-isolators draw power only when data is being transferred. The system consumes only 50μA at a sample rate of 10Hz (1ms on-time and 99ms off-time). This is easily within the current supplied by the charge pump running at 5MHz. If a truly isolated system is required, the system's low power simplifies generating an isolated supply or powering the system from a battery.

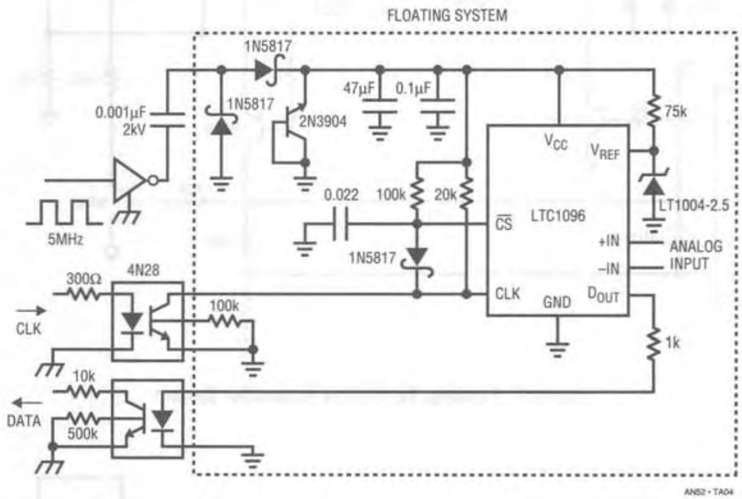

Figure 4. Power for this Floating ADC System is Provided by a Simple Capacitor-Diode Charge Pump. The Two Opto-Isolators Draw No Current Between Samples, Turning on Only to Send the Clock and Receive Data

0°C – 70°C Thermometer

Figure 5 shows a temperature-measurement system. The LTC1096 is connected directly to the low cost silicon temperature sensor. The voltage applied to the V_{REF} pin adjusts the full scale of the ADC to the output range of the sensor. The zero point of the converter is matched to the zero output voltage of the sensor by the voltage on the LTC1096's negative input.

Operating the ADC directly off batteries can eliminate the space taken by a voltage regulator. Connecting the ADC directly to sensors can eliminate op amps and gain stages. The LTC1096/LTC1098 can operate with small, 0.1μF or 0.01μF chip bypass capacitors.

Figure 6 shows the operating sequence of the LTC1096. The converter draws power when the $\overline{CS}$ pin is low and shuts itself down when that pin is high. In systems that convert continuously, the LTC1096/LTC1098 will draw its normal operating power continuously. A 10μs wake up time must be provided to the LTC1096 after each falling $\overline{CS}$.

In systems that have significant time between conversions, lowest power drain will occur with the minimum $\overline{CS}$ low time. Bringing $\overline{CS}$ low, waiting 10μs for the wake up time, transferring data as quickly as possible, and then bringing it back high will result in the lowest current drain.

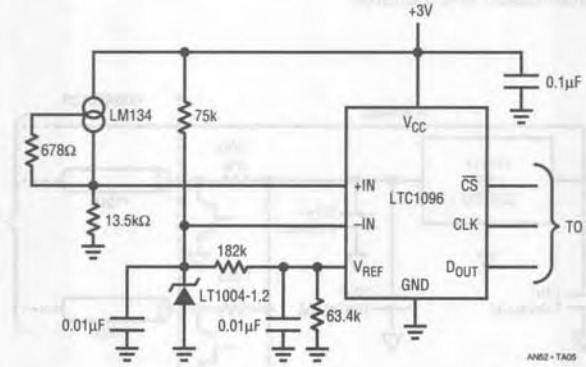

Figure 5. The LTC1096's High-Impedance Input Connects Directly to this Temperature Sensor, Eliminating Signal Conditioning Circuitry in this 0°C–70°C Thermometer

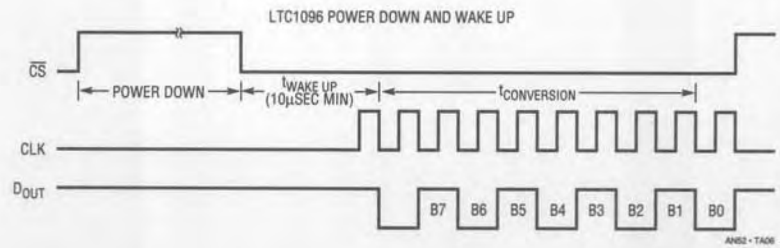

Figure 6. The ADC's Power Consumption Drops to Zero When $\overline{CS}$ Goes High. 10μs After CS Goes Low, the ADC is Ready to Convert. For Minimum Power Consumption Keep $\overline{CS}$ High for as Much Time as Possible Between Conversions