DESIGN NOTES

Micropower 12-Bit ADCs Shrink Board Space – Design Note 116
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Introduction

The LTC®1286/LTC1298 are serial interfaced, micropower 12-bit analog-to-digital converters. In the realm of 12-bit ADCs they bring a new low in power dissipation and the small size of an SO-8 package to low cost, battery-powered electronic products. These micropower devices consume just 250µA (LTC1286) and 340µA (LTC1298) at full conversion speed and feature autoshutdown.

Many portable and battery-powered systems require internal analog-to-digital conversion. Some, such as pen-based computers, have ADCs at their very cores digitizing the pen screen. Other systems use ADCs more peripherally to monitor voltages or other parameters inside the equipment. Regardless of the use, it has been difficult to obtain small ADCs at power levels and prices that are low enough. The LTC1286/LTC1298 meet these low power dissipation and package size needs.

Micropower and 12-Bits in an SO-8 Package

The LTC1286/LTC1298 are the latest members of the growing family of SO-8 packaged parts (Table 1). As the first of their kind in SO-8 packages, these are improvements to the 8-bit micropower LTC1096/LTC1098 ADCs. The LTC1286/LTC1298 use a successive approximation register (SAR) architecture. Both converters contain sample-and-holds and serial data I/O. The LTC1286 has a fully differential analog input and the LTC1298 has a two input

multiplexer. While running at a full speed conversion rate of 12.5ksps, the LTC1286 consumes only 250µA from a single 5V supply voltage. The device automatically shuts down to 1nA (typ) when not converting. Figure 1 shows how this automatically reduces power at lower sample rates. At a 1ksps conversion rate, the supply current drops to just 20µA (typ). Battery-powered designs will benefit tremendously from this user transparent automatic power dissipation optimization.
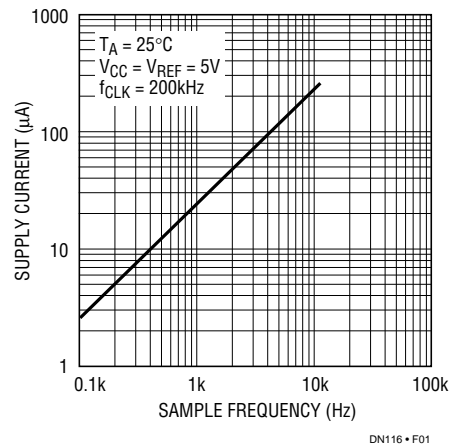

Figure 1. The LTC1286/LTC1298's Autoshutdown Feature Automatically Conserves Power When Operating at Reduced Sample Rates

The DC specifications include an excellent differential linearity error of 0.75LSB (max) and no missing codes. Both are guaranteed over the operating temperature range. Pen screen and other monitoring applications benefit greatly from these tight specifications.

The attractiveness of the LTC1286/LTC1298's small SO-8 design is further enhanced by the use of just one surface mount bypass capacitor (1µF or less). Figure 2 shows a typical connection to a microcontroller's serial port. For ratiometric applications that require no external reference voltage, the LTC1286/LTC1298's reference input is tied to signal source's drive voltage. With their very low supply

Table 1. LTC Micropower 3V and 5V 12-Bit ADCs

DEVICE	POWER DISSIPATION AT 200ksps	SAMP FREQ	S/(N+D) AT NYQUIST	INPUT RANGE	POWER SUPPLY
LTC1285	12µW 3nW*	7.5ksps	72dB	0V to V_{CC}	2.7V to 6V
LTC1286	25µW 5nW*	12.5ksps	71dB	0V to V_{CC}	4.5V to 9V
LTC1288	12µW 3nW*	6.6ksps	72dB	0V to V_{CC}	2.7V to 6V
LTC1298	12µW 5nW*	11.1ksps	71dB	0V to V_{CC}	4.5V to 5.5V

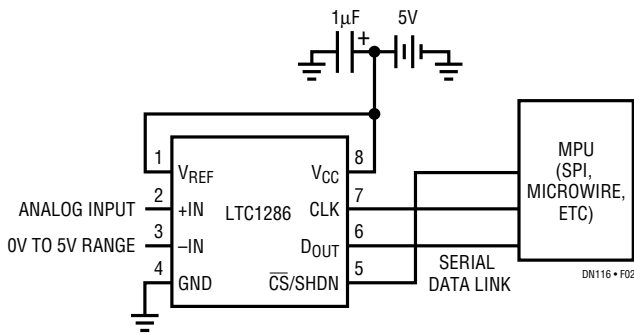*5nW and 3nW power dissipation during shutdown

Figure 2. The No-Glue Serial Interface Simplifies Connection to SPI, QSPI or Microwire Compatible Microcontrollers

current requirements, the ADCs can even be powered directly from an external voltage reference. This eliminates the need for a separate voltage regulator.

The LTC1286/LTC1298 contain everything required except an internal reference (not needed by many applications) keeping systems costs low. The serial interface makes a very space efficient interface and significantly reduces cost of applications requiring isolation. The ADC's high input impedance eliminates the need for buffer amplifiers. All of these features, combined with a very attractive price, make the LTC1286/LTC1298 ideal for new designs.

Resistive Touchscreen Interface

Figure 3 shows the LTC1298 in a 4-wire resistive touch-screen application. Transistor pairs Q1 and Q3, Q2 and Q4 apply 5V and ground to the X axis and Y axis, respectively. The LTC1298 (U1), with its 2-channel multiplexer, digitizes the voltage generated by each axis and transmits the conversion results to the system's processor through a serial interface. RC combinations R1C1, R2C2 and R3C3 form lowpass filters that attenuate noise from possible sources such as the processor clock, switching power supplies and bus signals. Inverter U2A is used to detect screen contact both during a conversion sequence and to trigger its start. Using the single channel LTC1286, 5-wire resistive touchscreens are as easily accommodated.
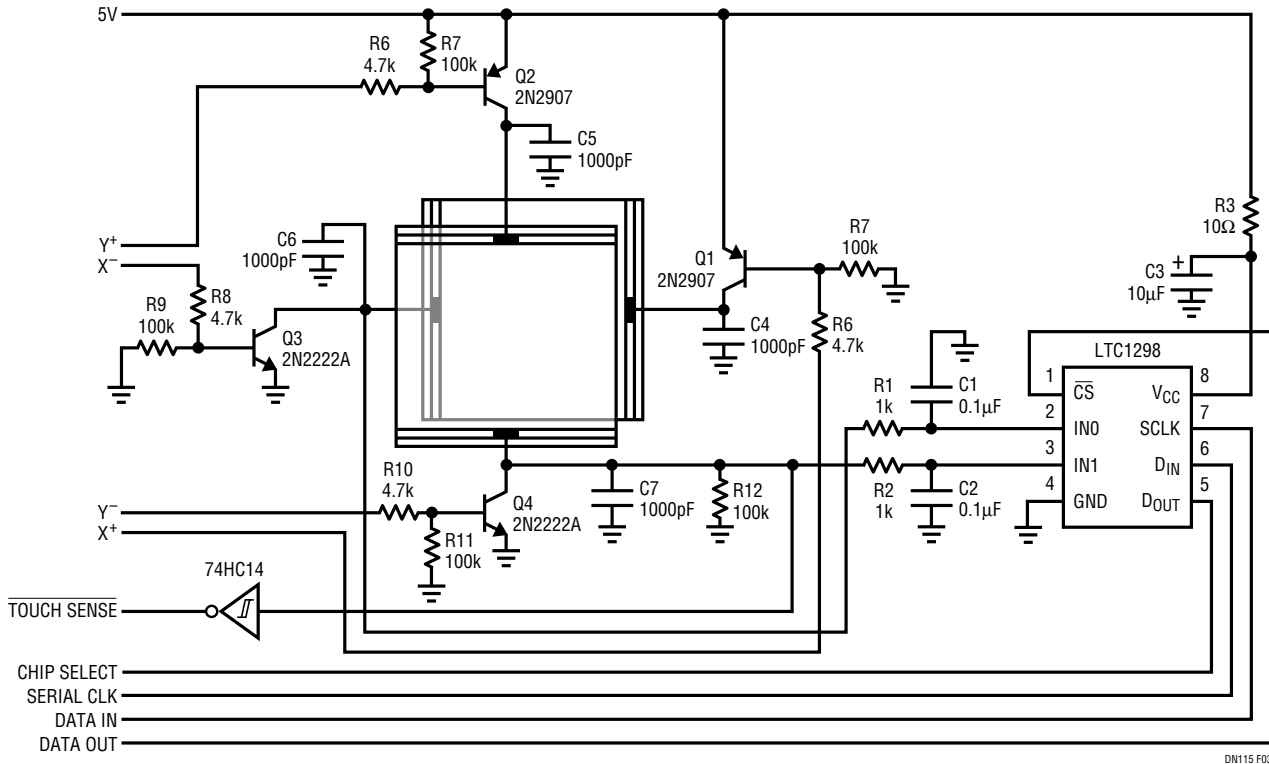

Figure 3. The LTC1298 Digitizes Resistive Touchscreen X and Y Axis Voltages. The ADC's Autoshutdown Feature Helps Maximize Battery Life in Portable Touchscreen Equipment

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