

# C# application controls simple ADC

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This Design Idea describes a simple and low-cost ADC that you control using the serial port of a PC running Windows XP/Vista. The hardware comprises Microchip's (www.microchip.com) 12-bit SAR (successive-approximation-register) MCP3201 ADC, which attaches to the serial port of the PC through the RTS, CTS, and DTR lines (Figure 1).

The circuit uses an SPI (serial-peripheral-interface)-compatible interface to communicate with the MCP3201. The

MAX232 chip transforms the RS-232 levels into TTL-compatible levels that the MCP3201 converter requires to operate. The analog signal comes through the IN+ pin of the MCP3201. The output digital stream of bytes on the D<sub>OUT</sub> pin goes through the CTS line to the serial port of the PC. The RTS line of the serial port provides clock pulses that go through the CLK pin of the converter. Each separate bit appears on D<sub>OUT</sub> on the falling edge of CLK, and the application should latch the bit on

the rising edge of the clock pulse.

The DTR line produces the  $\overline{CS}$  signal that frames the conversion process. The  $\overline{CS}$  signal must be low while the conversion is in progress (Figure 2).

The meaningful bits, with MSB first, appear on D<sub>OUT</sub> after the third CLK pulse

goes low. It implies that, if you miss the first three data bits, the software would programmatically realize it. The software that controls the device is written in free Microsoft (www.microsoft.com) Visual C# 2008 Express Edition. It uses a built-in SerialPort component that allows you to get full control over the serial port of the PC. You implement the software as a simple console application containing Listing 1, which is available with the Web version of this Design Idea at www.edn.com/081030di1. The program is uncomplicated, so you can easily modify it. For instance, you could send the data from ADC over the Internet or pass it into Microsoft Excel or Microsoft Access for further processing.

You can improve the simplified circuit in Figure 1 for higher accuracy by placing a lowpass filter in the analog-signal chain. You should also always use a bypass capacitor with the MCP3201. Place a capacitor with a recommended value of 1  $\mu$ F as close as possible to the device's pin. You can also replace the MCP3201 with a similar SAR ADC that works with an SPI-compatible interface. For instance, you may use an LTC1286 or an LTC1297 device from Linear Technology (www.linear.com). If you plan to use a different ADC, you must

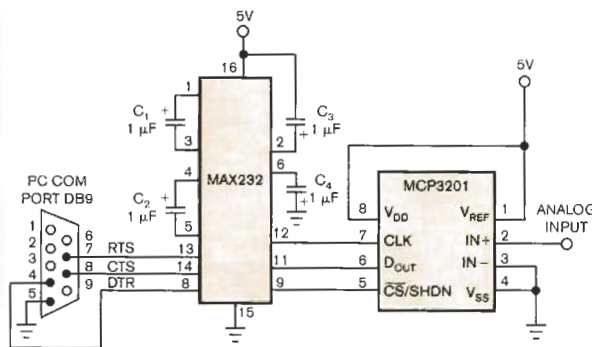


Figure 1 This simple, low-cost ADC comprises a 12-bit SAR ADC, which attaches to the serial port of the PC through the RTS, CTS, and DTR lines.

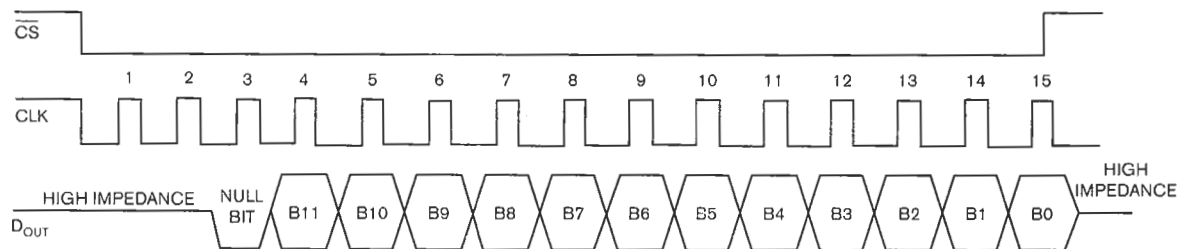


Figure 2 The DTR line produces the  $\overline{CS}$  signal that frames the conversion process. The  $\overline{CS}$  signal must be low while the conversion is in progress.

make some changes in the hardware and software. The changes necessary to the hardware are obvious, and you may need to change the software

source code of the application to correct the *for (...)* loop statement according to the timing diagram of the selected part. **EDN**

## Perform bitwise operation in Excel spreadsheets

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Microsoft's (www.microsoft.com) Excel helps engineers with calculus and graphics to solve problems. But engineers often have to perform bitwise operations, too. **Figure 1** shows the bitwise operations' tables. The bitwise functions work for decimal values. If you need to use hexadecimal or binary values, you must use the Dec2Bin and Dec2Hex functions to convert all the decimal values for the desired format.

To install the add-in bitwise functions, you can download the ins.xla file from the Web version of this De-

sign Idea at [www.edn.com/081030di2](http://www.edn.com/081030di2). In Excel, go to Tools, then Add-Ins, and then Browser. Find the downloaded add-in xla file and click OK. Now, Excel can run the bitwise functions.

You can also download some examples from the EDN Web site at [www.edn.com/081030di2](http://www.edn.com/081030di2) (**Reference 1**). **EDN**

### REFERENCE

1 Kagan, Aubrey, *Excel by Example: A Microsoft Excel Cookbook for Electronics Engineers*, Newnes Elsevier, 2004, ISBN 0-7506-7756-2.

AND	RESULT
0 0	0
1 0	0
0 1	0
1 1	1

OR	RESULT
0 0	0
1 0	1
0 1	1
1 1	1

XOR	RESULT
0 0	0
1 0	1
0 1	1
1 1	0

NOT	RESULT
0	255
1	254

SHIFT RIGHT		RESULT
BINARY	SHIFTED	BINARY
11010010	6	00000011
SHIFT LEFT		RESULT
BINARY	SHIFTED	BINARY
01100100	2	10010000

Figure 1 With the help of some new add-in functions, you can perform these bitwise operations in Excel.

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