



[Maxim](#) > [Design Support](#) > [Technical Documents](#) > [Application Notes](#) > [Measurement Circuits](#) > APP 4409

Keywords: Universal Serial Bus, USB, analog-digital converter, ADC, multichannel ADC, 16-bit measurements

#### APPLICATION NOTE 4409

# USB Carries 16-Bit Voltage Measurements

Jun 23, 2009

*Abstract: This application note presents a simple circuit that combines an ADC with a small USB module to make an 8-channel, 16-bit measuring system. The MAX1168 ADC is featured.*

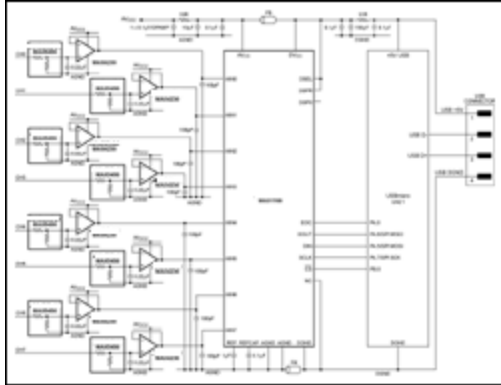
USB is now the interface of choice for connecting to personal computers. Available on all modern PCs, USB has a standard connector and provides +5V at up to 100mA for peripheral devices.

The **Figure 1** circuit combines the [MAX1168](#) 16-bit ADC with a small USB module (the USBMicro U421) to make a simple 8-channel, 16-bit measurement system.

Based on a Cypress™ CY7C63743 controller, the U421 provides up to 16 I/O lines with an option to use some of those lines as an SPI™ port. As a human interface device (HID), it transfers up to 800Bps. The SPI clock rate can be set at 62.5kHz, 500kHz, 1MHz, or 2MHz. Firmware on the U421 allows generic access to SPI read-and-write devices. Because the U421 includes additional pins as generic I/O, it can use them as slave-select lines for addressing multiple SPI devices. One such line controls the MAX1168 chip-select input.

The MAX1168 is a low-power, 16-bit ADC with eight input channels and an SPI interface. It operates from a single +5V supply and includes a 4.096V reference and clock oscillator. It can convert individual channels, execute multiple conversions on one channel, or scan the channels sequentially, storing the data on-chip.

The ADC's sample and hold must charge its 45pF hold capacitor and acquire the input voltage in 3μs; it must be driven by a fast amplifier. The [MAX4230](#) amplifier was chosen for the design because it has a 10MHz bandwidth, 2V/μS slew rate, rail-to-rail inputs and outputs, and operates from a single +5V rail (down to 2.7V). It is available in dual and quad versions. Its bias current (50pA, typ) allows a significant input impedance without affecting accuracy. To provide scaling (1/11 for the 10:1 resistor-divider) and protection from input overvoltage, Figure 1 includes the MAX5490 100kΩ precision-matched resistor-divider at the input of each buffer amplifier. That configuration allows a maximum readable input of 45V, with resolution just under 1mV (687.5μV). In this design 5V power is taken from the USB port, with some additional filtering to reduce noise.



[More detailed image](#) (PDF, 248kB)

Figure 1. This simple data-acquisition system provides eight channels of 16-bit data over a USB interface.

The evaluation software was written in Visual Basic.Net (Standard), and commands to the U421 are provided through a DLL file (USBm.dll). The demo program sets the MAX1168 to scan all eight channels and display the results. When you run the program a form appears (**Figure 2**) that lets you set the reference voltage (to allow for the input divider), set the scan time, and select any of the eight channels for plotting on the screen. Evaluation software is available for download at: [www.maximintegrated.com/MAX1168DI](http://www.maximintegrated.com/MAX1168DI).

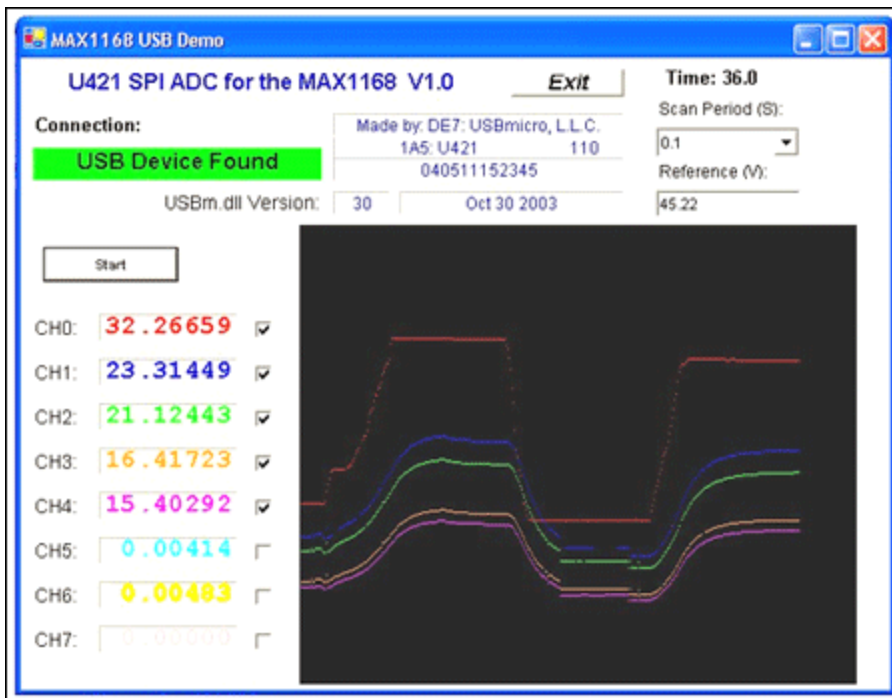


Figure 2. Software for the Figure 1 system lets you set the operating parameters and observe selected channels.

Thanks to Robert Severson of USBmicro ([usbmicro.com](http://usbmicro.com)) for his help with the interface.

This design idea appeared in the May 25, 2006 issue of EDN magazine.

Cypress is a registered trademark of Cypress Semiconductor Corporation.

#### Related Parts

<a href="#">MAX1168</a>	Multichannel, 16-Bit, 200ksps Analog-to-Digital Converters	<a href="#">Free Samples</a>
<a href="#">MAX4230</a>	High-Output-Drive, 10MHz, 10V/ $\mu$ s, Rail-to-Rail I/O Op Amps with Shutdown in SC70	<a href="#">Free Samples</a>

#### More Information

For Technical Support: <http://www.maximintegrated.com/support>

For Samples: <http://www.maximintegrated.com/samples>

Other Questions and Comments: <http://www.maximintegrated.com/contact>

Application Note 4409: <http://www.maximintegrated.com/an4409>

APPLICATION NOTE 4409, AN4409, AN 4409, APP4409, Appnote4409, Appnote 4409

© 2013 Maxim Integrated Products, Inc.

Additional Legal Notices: <http://www.maximintegrated.com/legal>