BOT LAB TEST

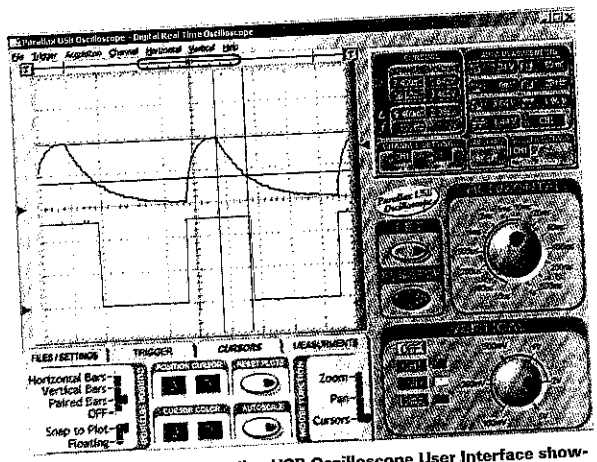
by George Mitsuoka

PARALLAX USB Oscilloscope and Understanding Signals Kit

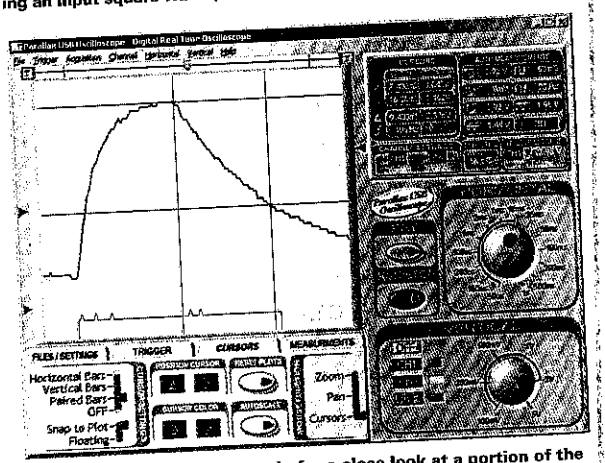
An oscilloscope can be an indispensable tool when building or debugging robot control systems or any circuits with time-varying signals. Having your servos unexpectedly transition to full-throw instead of holding steady at neutral can cause a lot of frustration, but a quick look at the PWM signal with an oscilloscope will immediately tell you if there's really a problem with your servos, or if you've just passed the wrong argument to the PULSOUT function on your BASIC Stamp. And, when you're trying out a new sensor, an oscilloscope can be invaluable in helping you understand the electrical signals your robot controller will have to interpret, and an oscilloscope can also help you verify that the sensor documentation is correct.

Unfortunately, a modern standalone or hand-held oscilloscope can cost hundreds to thousands of dollars and, if you're not experienced with one, can be somewhat intimidating to use. Oscilloscopes typically have countless dials, buttons, and connectors with often cryptic labels or no labels at all, and the manuals often assume that you already know how to use a 'scope. The expense and complexity of using an oscilloscope has made its presence a rarity in hobbyists' workshops.

Well, wait no more. The Parallax USB Oscilloscope at $129 is inexpensive and, when bundled with the Understanding Signals Kit for just $20 more, creates the perfect tool for learning about signals and how to use an oscilloscope effectively. There's no longer any excuse for not having an oscilloscope in your robot lab.



1. Screen shot of the Parallax USB Oscilloscope User Interface showing an input square wave (red) and the output of an RC circuit (blue).



2. The UI allows you to zoom in for a close look at a portion of the signal from image 1 shown above.

USB POWER

The Parallax USB Oscilloscope is a small, portable, two-channel digital sampling oscilloscope that uses a standard Windows PC for its display and user interface. Just load the software and connect the oscilloscope to your PC via any USB port. It is powered by USB so it doesn't need an additional power cord. The Parallax USB Oscilloscope has some features that put older analog oscilloscopes and even some modern digital oscilloscopes to shame. For example, it automatically determines the maximum voltage, minimum voltage, voltage swing, average voltage, RMS voltage, period,

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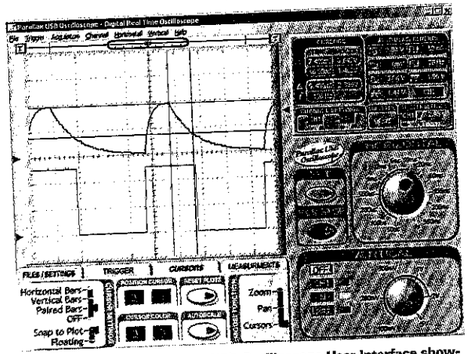

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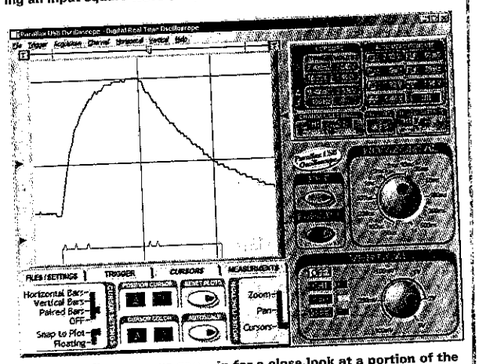

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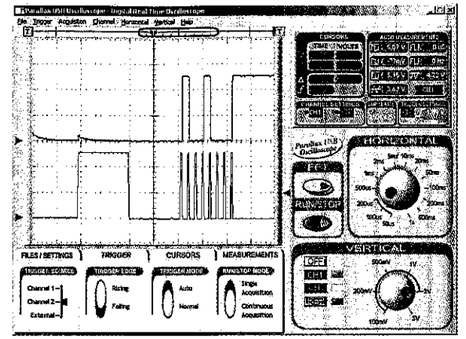
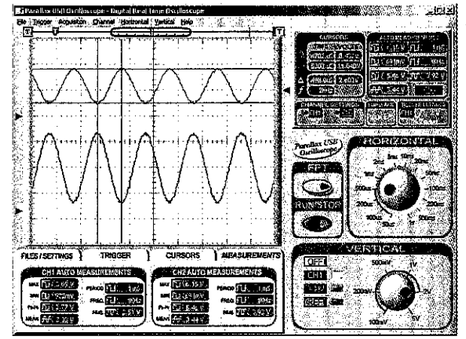
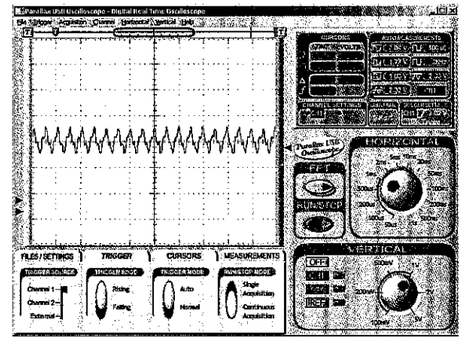
How can the Parallax USB Oscilloscope be so inexpensive when compared to other oscilloscopes? A major reason is that it uses your existing PC for its display and user interface which is not included in the cost. Many standalone digital oscilloscopes are based on a complete PC with added hardware and customized software, so you're paying for the cost of a PC to begin with. Another reason, and it's a big one, is that the Parallax USB Oscilloscope has some significant limitations which make it appropriate for the education and hobby user, but would exclude it from use in many professional markets. The major limitation is a relatively slow maximum sample rate of one million samples per second on one channel, and 500,000 samples per second with two channels. With PC clock speeds exceeding 3GHz and even slow networks running at 10Mbits/second or more, the Parallax USB Oscilloscope would be useless for these high-speed applications. Even the clock and data lines on relatively slow microcontrollers are beyond its sampling capability. That said, the Parallax USB Oscilloscope is still very useful for the often needed testing and debugging of interfaces with sensors, slower communication ports such as serial and infrared, and audio frequency applications.



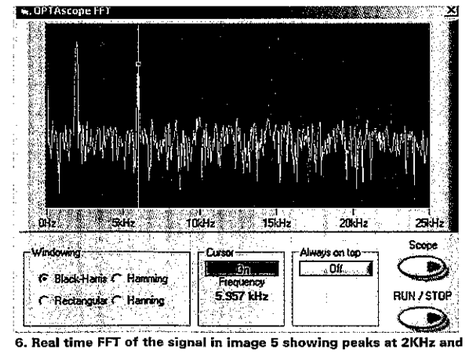
3. The clock (red) and data (blue) lines of a synchronous serial interface.



4. The input (blue) and output (red) signals of an inverting amplifier.



5. Signal composed of two frequencies: 2KHz and 6KHz



6. Real time FFT of the signal in image 5 showing peaks at 2KHz and 6KHz.

GREAT LEARNING TOOL

When combined with the Understanding Signals Kit and a Parallax BASIC Stamp Homework Board or Board of Education, the Parallax USB Oscilloscope is a great learning tool. The Understanding Signals workbook walks you through using the oscilloscope and building and testing many circuits which are common to robotic control systems. By the end of the workbook you will have built, tested, and measured signals on numerous experiments including servo control, sine wave generation, R/C circuits, variable resistors and light detection, synchronous and asynchronous serial communication, IR object detection and remote control, and amplifiers. The workbook and all the parts necessary for the experiments (except the BASIC Stamp board and battery) are included in the Understanding Signals Kit. The workbook is well written and the exercises can be completed in about 20 hours.

Parallax has created a compelling and inexpensive educational package that, after it teaches you how to use it, leaves you with a useful tool for your robot lab. I expect to see Parallax USB Oscilloscopes in robot labs everywhere.

Links

Parallax, www.parallax.com, (888) 512-1024

For more information, please see our source guide on pg. 97.