ElectrodeSense

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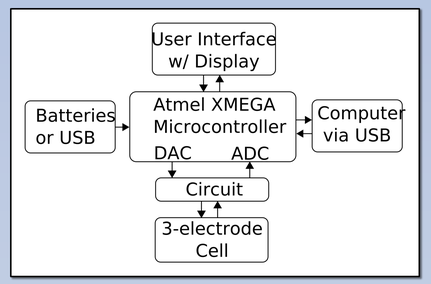
Abstract

The device is a battery powered, hand-held potentiostat which controls a three electrode cell. Programmable hardware and a user interface allow the device to be used with a wide array of biosensors. Some current and future applications of biosensors involve drug concentration detection and monitoring for both health care and law enforcement applications. Basic results are shown on the device's display, while more detailed results can be downloaded to a computer.



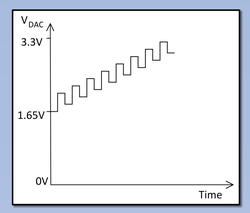
Specifications/Challenges

Section	Parameter		Min	Typical	Max	Unit
Cell Reference Potential	Frequency		1		200	Hz
	Range		-500		500	mV
		Accuracy	-50		50	mV
		Precision	-0.5		0.5	mV
Cell Current	Range		-10		10	uA
		Accuracy	-1		1	uA
		Precision	-20		20	nA
	Range		-1		1	uA
		Accuracy	-100		100	nA
		Precision	-5		5	nA
Power Supply	Input Voltage		2		3	V
	Output Voltage			3.3		V
	Supply Current		4		10	mA
	Efficiency			90		%
	Battery Life (each AA, 2000mA hr @ 1.5V)		180		450	hrs

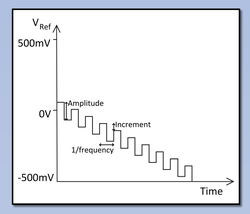
Challenges:

-Operating with currents on nanoampere scale
-Designing a device versatile enough for various operating ranges
-Protection against cell damage
-Making device easily usable and affordable

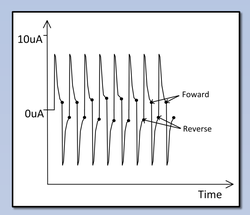
Execution



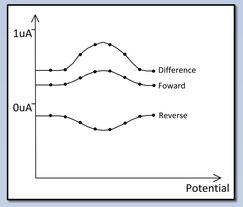
The microcontroller is programmed to use the DAC to produce a staircase potential sweep.



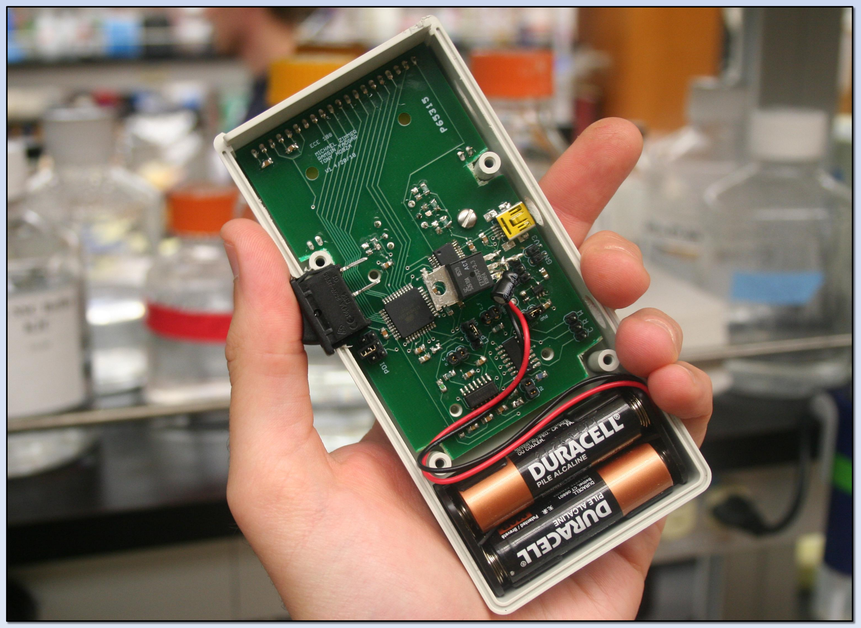
The staircase potential sweep is scaled to produce the desired waveform to apply to the 3 electrode cell.



The resulting current across the cell is measured by the ADC. The current at the end of each potential change is measured.



The difference between the forward and reverse current is calculated. Changes in peak height can used to detect concentrations.



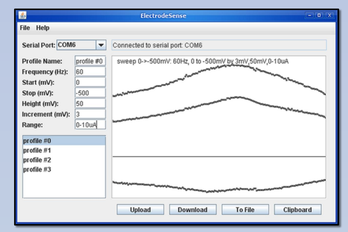
Results/Conclusions

- The device meets all accuracy and precision specifications for both current operating ranges with a dummy cell.

- Data can be easily recorded and analyzed on the computer via USB connection.

- Preliminary results indicate ability to detect concentration changes with some 3 electrode cells.

- Affordable and easy to use



Graphical User Interface allows for configuration and data extraction

Above: *Enclosure with LCD display and 4-directional switch for user interface*
Left: *Internal Circuitry*