

8-BIT DIGITAL SAMPLING OSCILLOSCOPE

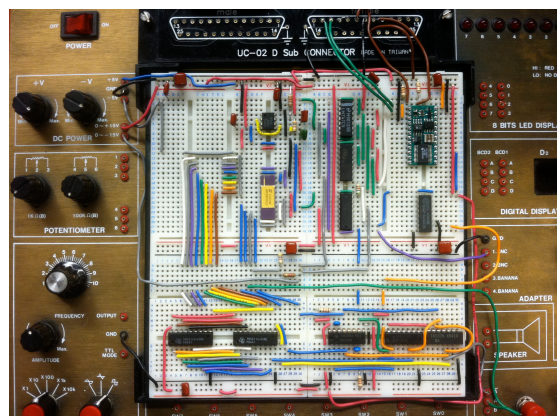
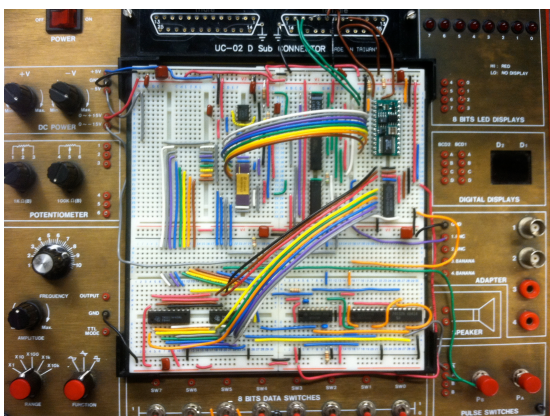
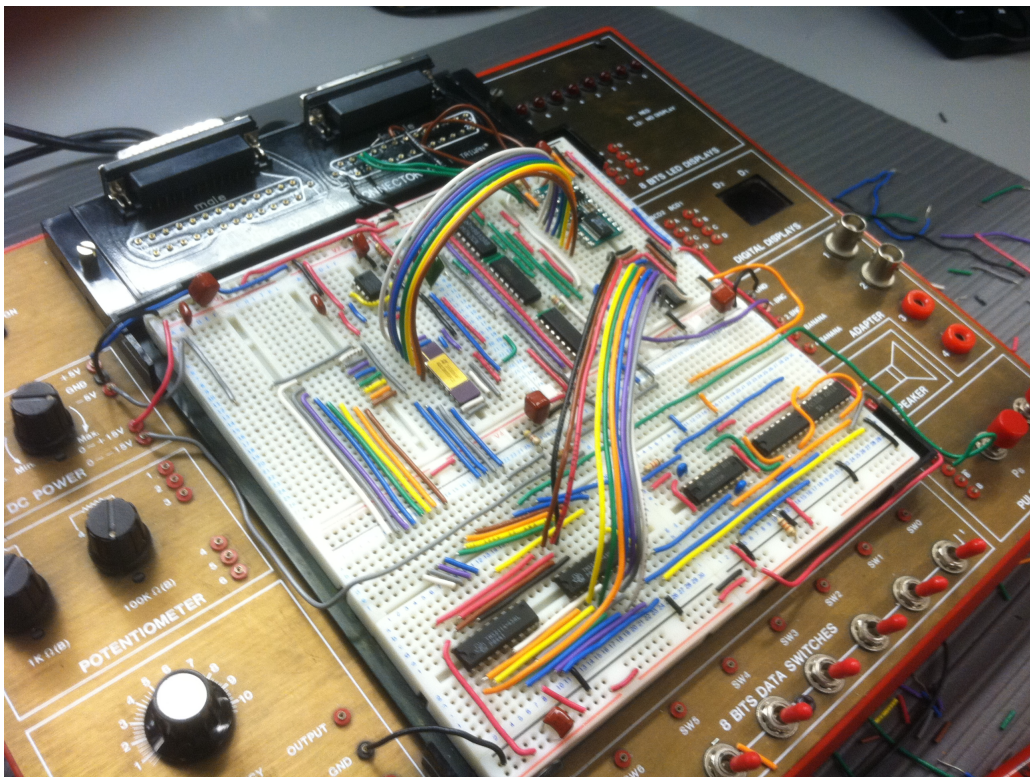
General Description

Presented in this document is an 8-bit digital sampling oscilloscope capable of reading $5 V_{pp}$, 25Hz analog signals; the device is paired with a LabVIEW graphical user interface.

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Parts List

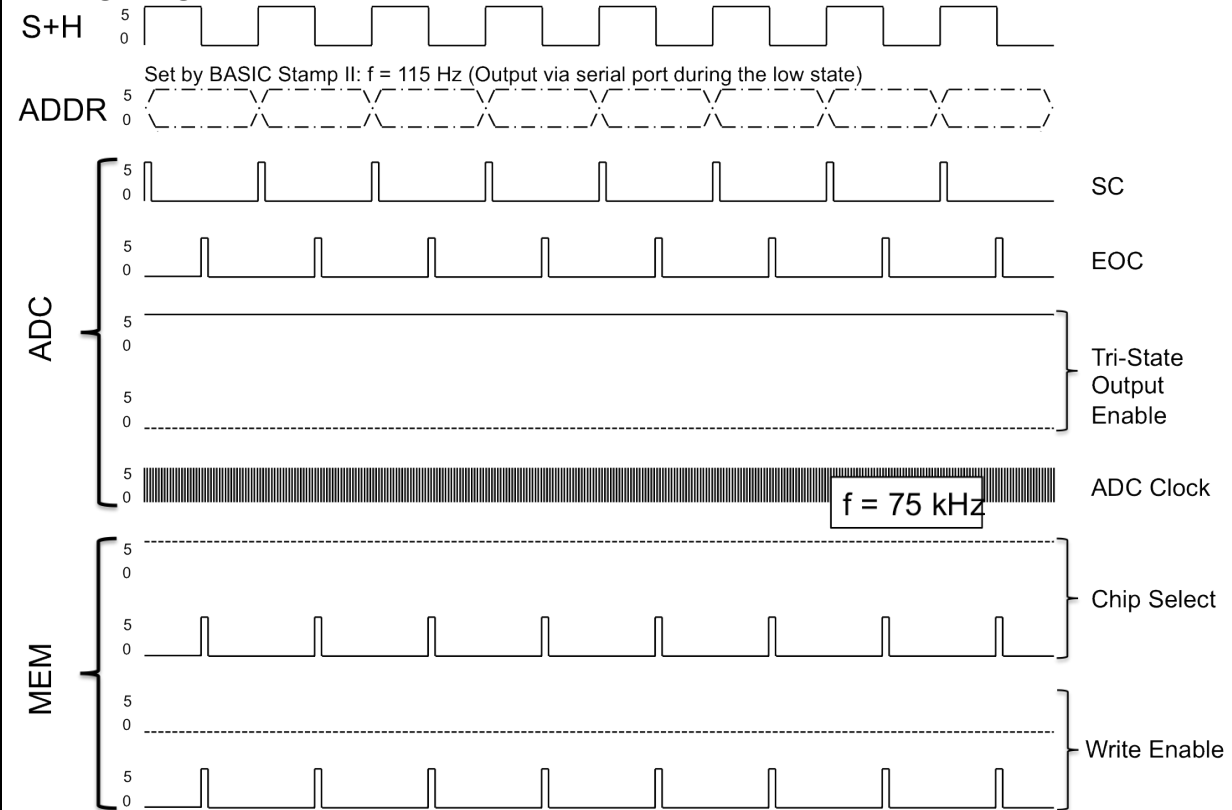
- (1) ADC0800PCD Analog-to-Digital Converter
- (2) TMS2114-45NL Static RAM
- (1 each) 555D Timer, SN74123N Monostable Multivibrator, SN7404N Logical Not, 74S32N Logical Or, 4040BE 12-Bit Counter, LM747CN Operational Amplifier, LM339 Comparator, HCF4016BE Bilateral Switch
- (1) BASIC Stamp II



Schematic Diagram (See Attachement)

Comment: On the left-hand side of the schematic diagram, an alternate representation of the 10-bit digital counter is depicted.

Timing Diagram



Comment: Dotted lines refer to the READ mode, solid lines to WRITE mode.

Electrical Characteristics

Parameters	Values	Units
Supply Voltages (unless noted below)	+5	V
Sample-and-Hold	+/- 15, + 2.5	
Analog-to-Digital Converter	+/- 5, - 12	
BASIC Stamp II	+ 15	
Maximum Input Voltage	5	V_{pp}
Maximum Input Frequency	25	Hz
Clock Speeds		
Analog-to-Digital Converter	75	kHz
Sample-and-Hold	115	Hz

Serial D Sub Connector: Pin 20 is an attention pin that must be grounded when the oscilloscope is operating with LabVIEW. The attention pin is only connected to the BASIC Stamp II for reprogramming purposes.

Operational Information

Powering ON

To power the oscilloscope, first flip the red switch located on the top left of the instrument. An LED in the switch will light when powered on correctly. The instrument will wake up with random data in the memory. Start the LabVIEW software interface by running the virtual instrument (.vi) file [Oscope_MAE511a.vi]. When the virtual instrument runs, the front panel will display the data stored in memory; to record a new signal, please refer to the "Record a Signal" section.

Powering OFF

To power down the instrument, stop the virtual instrument by hitting the large "STOP" button on the front panel. Then exit and quit the software. Toggle the power switch on the top left of the oscilloscope.

Input a Signal

To input a signal to the oscilloscope, make sure the instrument is powered on by referring to "Powering ON" in the user manual. Input the signal via BNC cable to port BNC1 on the instrument. **WARNING: DO NOT EXCEED THE MAXIMUM SIGNAL CHARACTERISTICS (PREVIOUSLY SPECIFIED).**

Limitations on the input signal:

The 5 V_{pp} limitation on the magnitude of the input signal is set by the voltage powering the analog-to-digital converter, any signal above this value will be clipped. The frequency limitation is due to the rate at which the BASIC Stamp II can transmit data to the LabVIEW interface. This rate is 115 Hz; at this rate, a 25 Hz signal has only been sampled four times per cycle, which is not sufficient for an accurate representation of the input signal.

Record a Signal

To record the signal, make sure the instrument is powered on by referring to "Powering ON" in the user manual. Next, make sure there is an input signal by referring to the "Input a Signal" section in the user manual. When the desired signal is being input to the instrument, pressing the switch "P_A" which will start recording to the memory. The oscilloscope samples at 115 Hz, and can capture 1024 memory locations of 8-bit (or 1 byte) information, therefore filling the memory will take about 10 seconds. When the button "P_A" is depressed you will see the contents of the memory playback on LabVIEW front panel.

PBASIC Code

```
' {$STAMP BS2}
' {$PBASIC 2.5}

OUTPUT 8

Main:

IF (IN15 = 1) THEN
  SEROUT 16, 16468, [HEX2 INL]
  PAUSE 1
ENDIF

IF (IN15 = 0) THEN
  HIGH 8
  LOW 8
  SEROUT 16, 16468, [HEX2 INL]
ENDIF

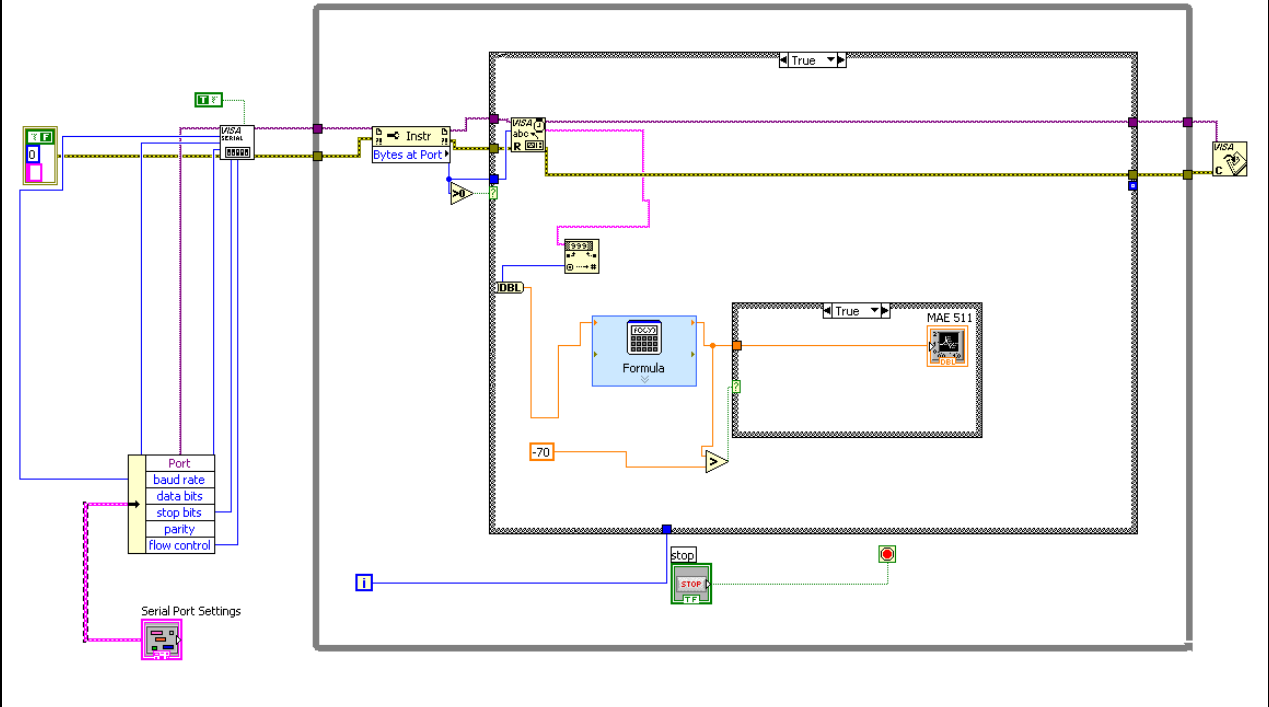
GOTO Main
END
```

Comments: Pin 8 on the BASIC Stamp II is the master sample-and-hold clock. Pin 15 represents the read/write status (high reads from memory, low writes to memory).

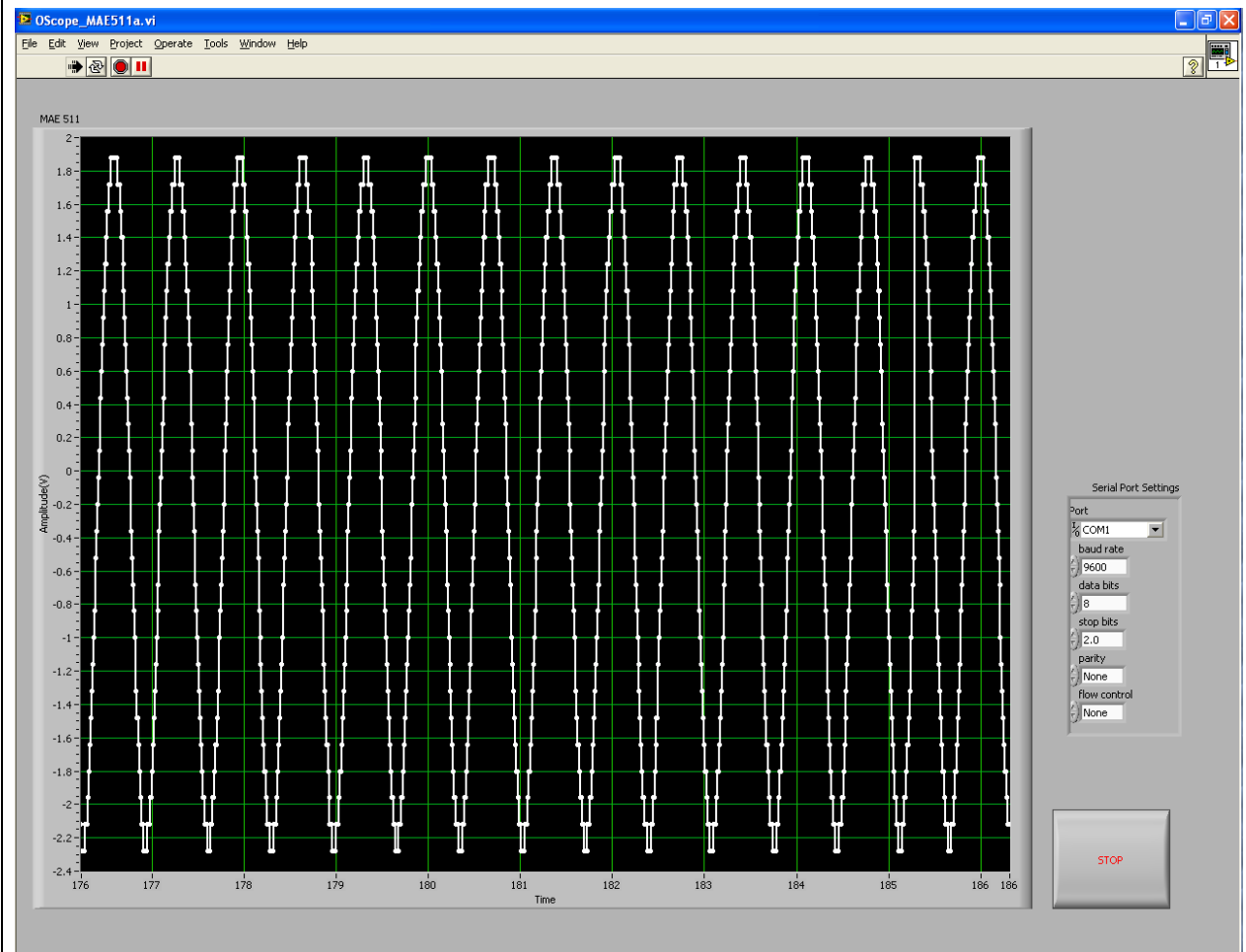
LabVIEW Graphical Schematic

Comments:

- While the LabVIEW program provided in the course reads in ASCII data and converts to a double precision decimal value, this code reads in hexadecimal and converts to double precision decimal.
- The express sub-virtual instrument labeled 'Formula' applies a calibration factor to the voltage range. The calibration factor was calculated using a Tektronix TDS 210 digital real-time oscilloscope.
- The 'Greater?' express comparison function (small triangle with greater-than symbol) checks for and ignores dropped data points.



LabVIEW Front Panel



Shown is a typical waveform on the LabVIEW front panel. Under Serial Port Settings, make sure the correct port is selected for your computer. All other default settings in this box should not be altered!