Experiment 3

Sampling and reconstruction of analog signals

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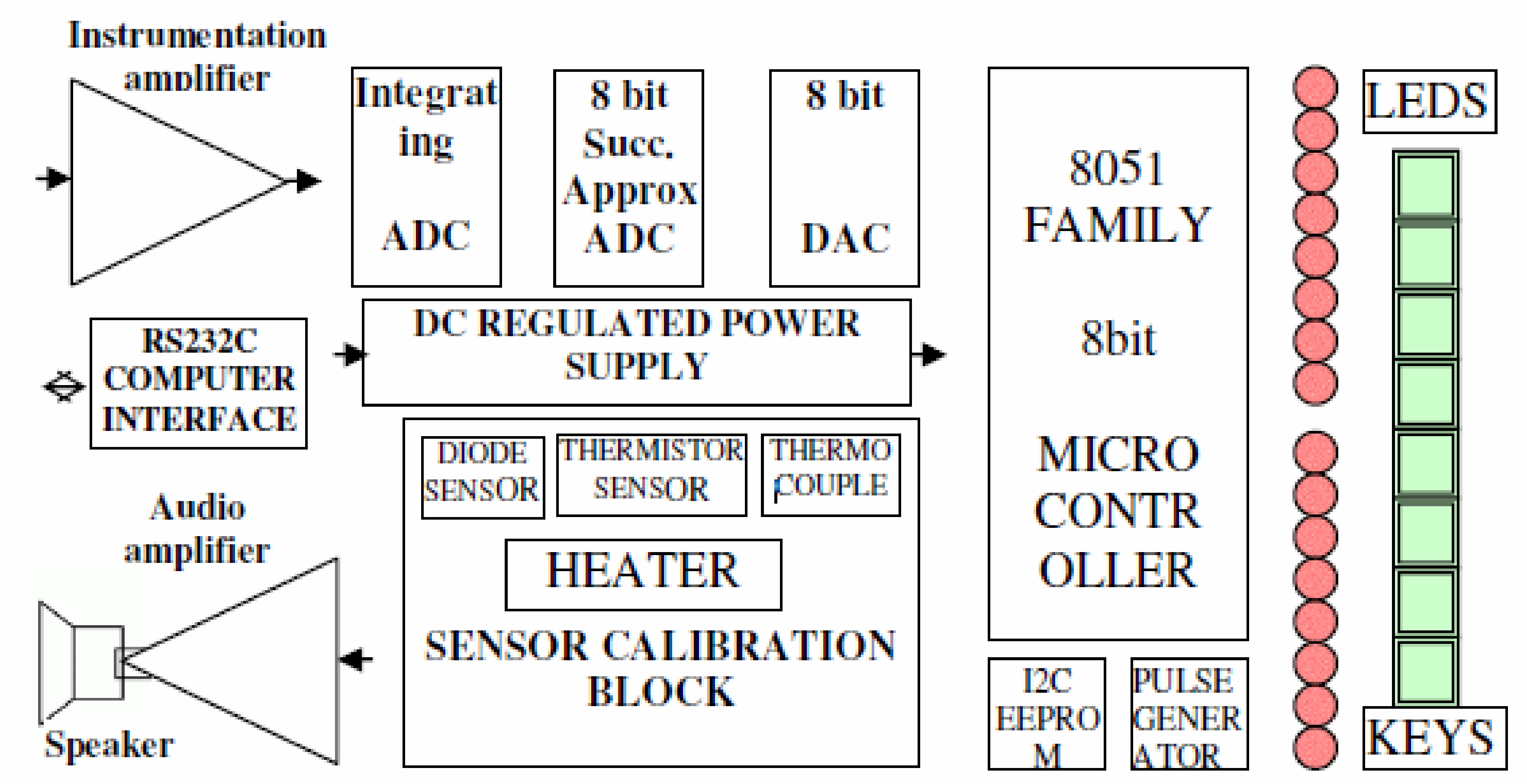
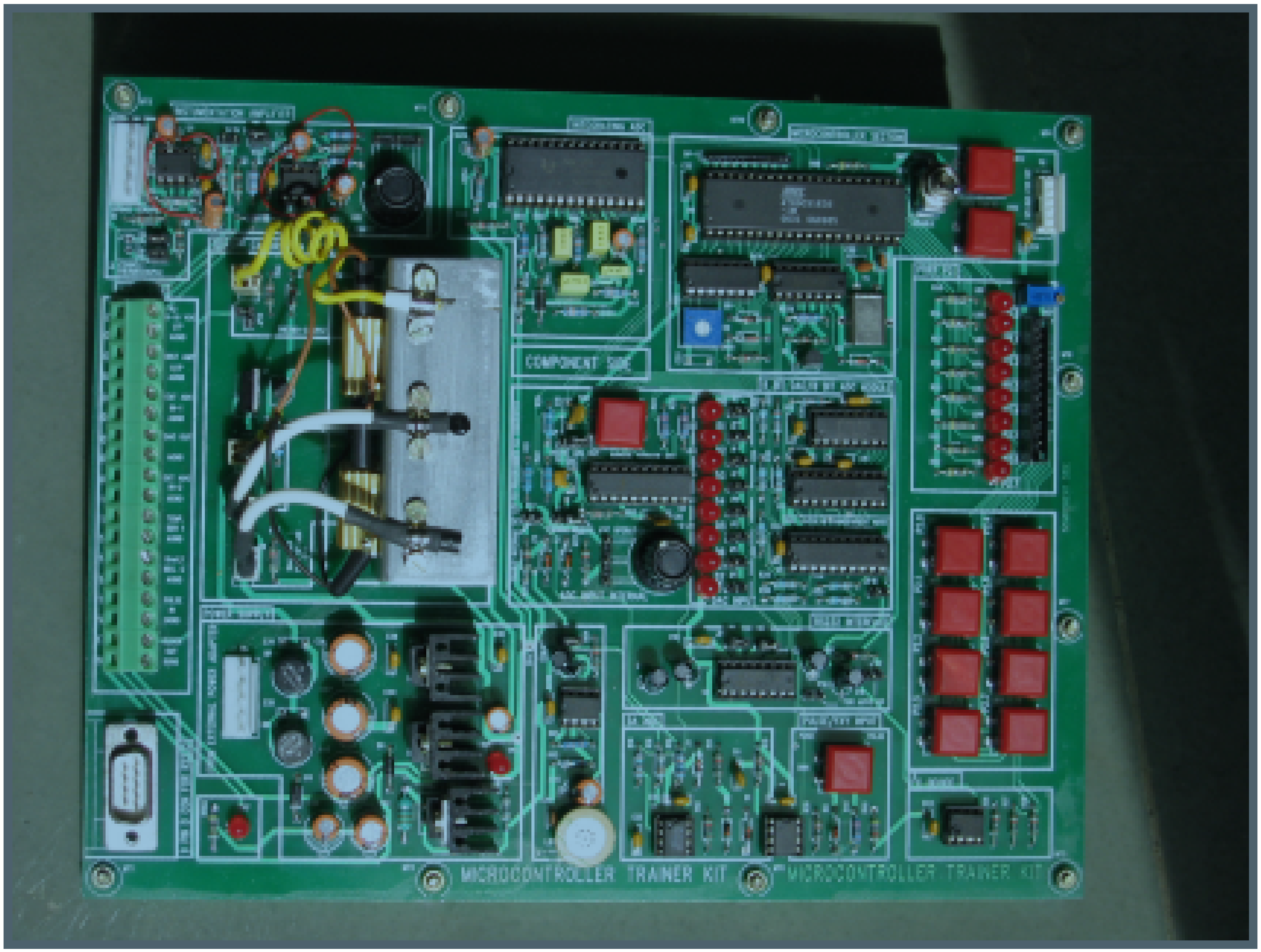
IC211 Kit – Block Schematic



IC211 Kit


COMPONENT SIDE
MICROCONTROLLER TRAINER KIT
MICROCONTROLLER TRAINER KIT

Hardware Features

- One 8-bit DAC with Voltage output
- One 8-bit successive approximation ADC
- One ±20,000 counts integrating ADC with sign
- Instrumentation amplifier with fixed gains of 25X and 100X
- Audio power amplifier with speaker output
- A temperature sensor module with:
  - Calibrated semiconductor diode sensor
  - A negative temp. coeff. (NTC) thermistor
  - Type K thermocouple

Features…contd.

- 8051 8-bit microcontroller with
  - 16 bit counters (3)
  - External interrupts (3)
  - RAM: 1k on chip XRAM; 64k on-chip Flash ROM.
  - ISP programming of CPU through RS232C port
  - I2C EEPROM
  - UART with drivers for RS232C interface

Using IC211 Kit

- Stand-alone mode (without the Microcontroller)
  - Done by putting the ENABLE CPU switch in the DISABLE mode
- Blocks used in stand-alone mode
  - ADC and DAC sections
  - Temp. Sensor section
  - Audio amplifier section
  - Instrumentation amplifier

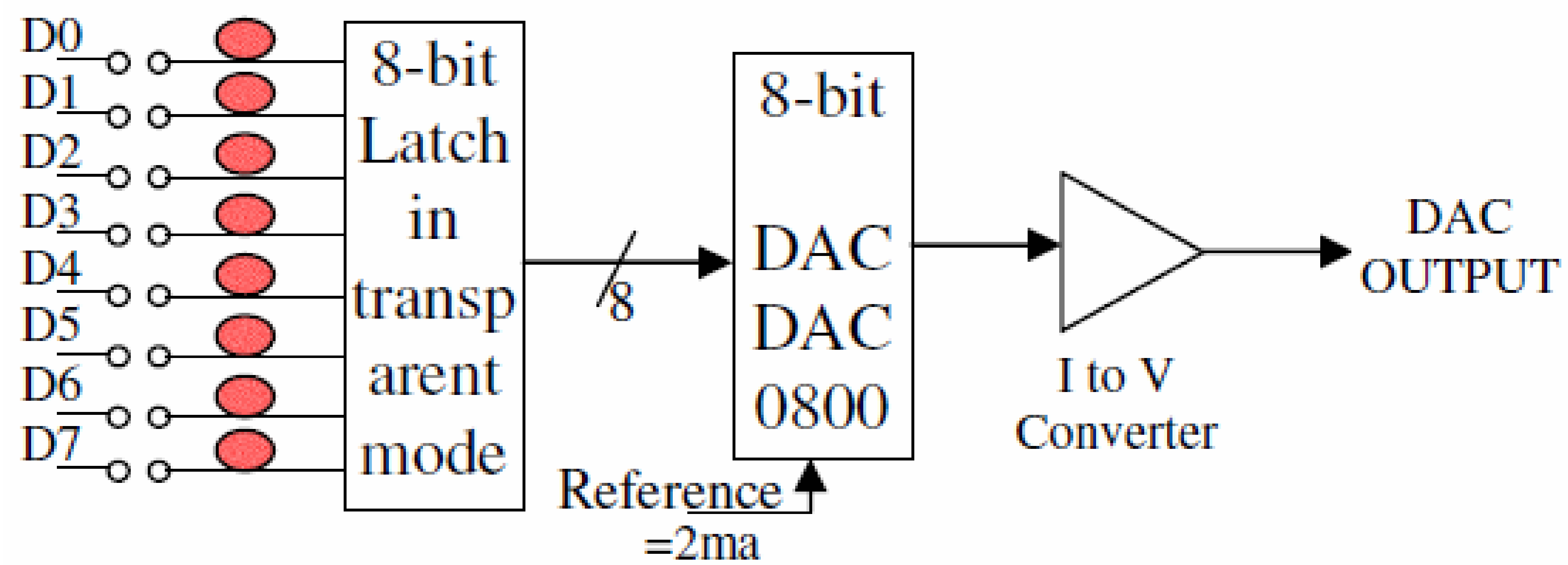
ADC 0804

- 8-bit, successive approximation type
- Conversion time : < 100 µs
- Input voltage range : 0 to 5 V
- Clock frequency : 1.2 MHz (max)

DAC

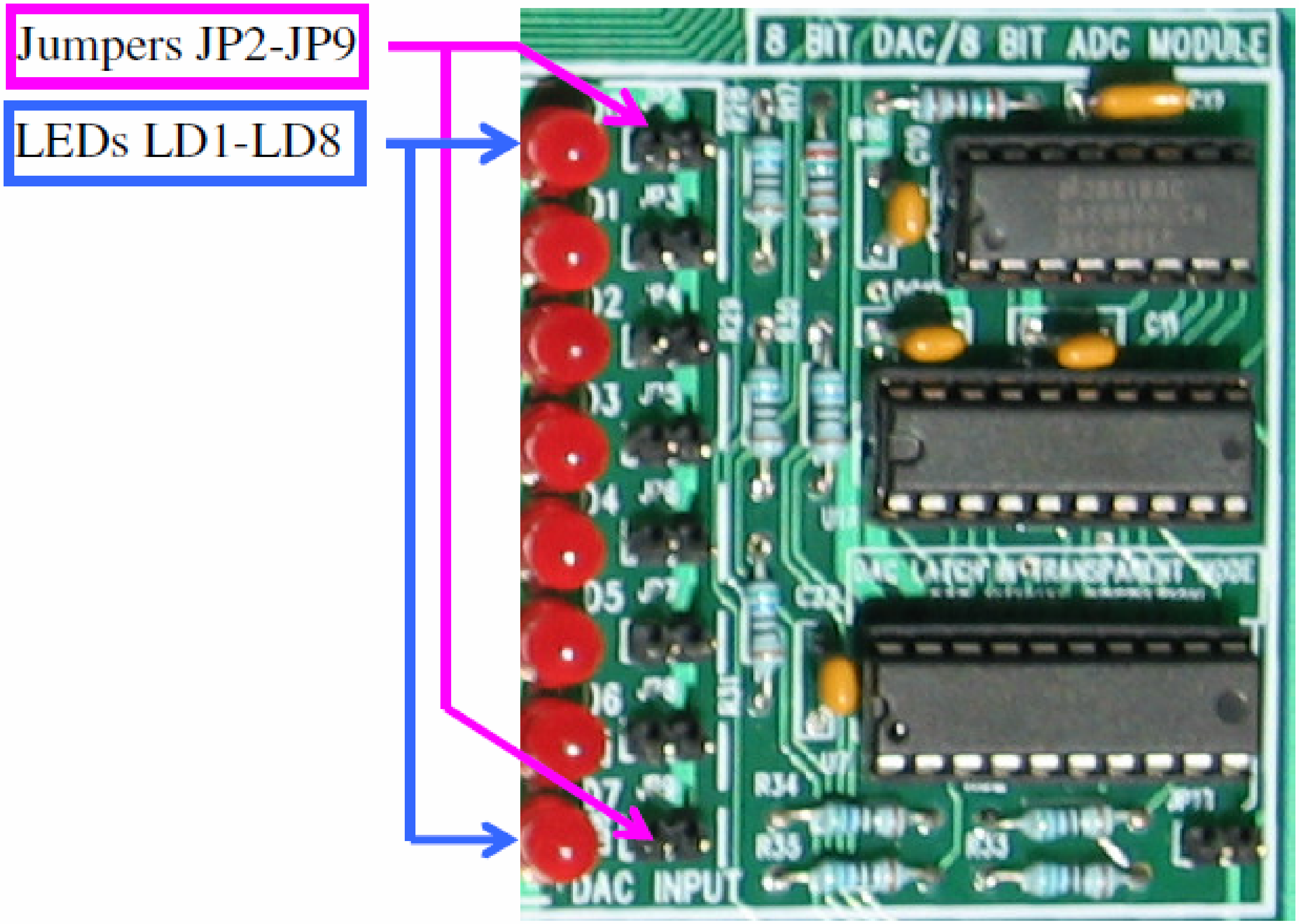
- DAC 0800: High speed 8-bit current output DAC
- Settling output current : 100ns
- Full-scale error : +/- 1 LSB
- Output full scale current: 2 mA
- Current output can be converted into a voltage by putting a resistor or by using a i-v converter.
- voltage range : up to 10 V (typ)

DAC Section



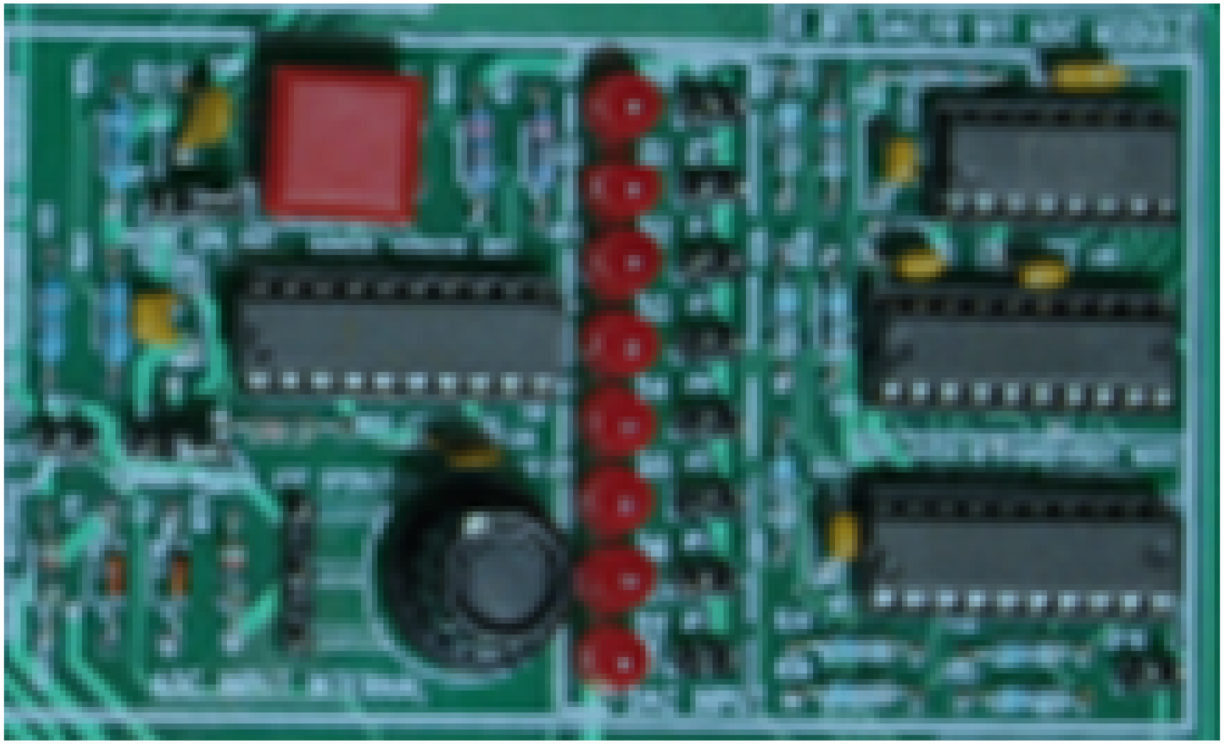
D0
D1
D2
D3
D4
D5
D6
D7
8-bit Latch in transparent mode
8
8-bit DAC DAC 0800
Reference =2ma
I to V Converter
DAC OUTPUT

DAC Section


Jumpers JP2-JP9
LEDs LD1-LD8
8 BIT DAC/8 BIT ADC MODULE
DAC LATCH IN TRANSPARENT MODE
DAC INPUT
R34
R35
R33

ADC and DAC

ADC **DAC**



ADC and DAC Sections

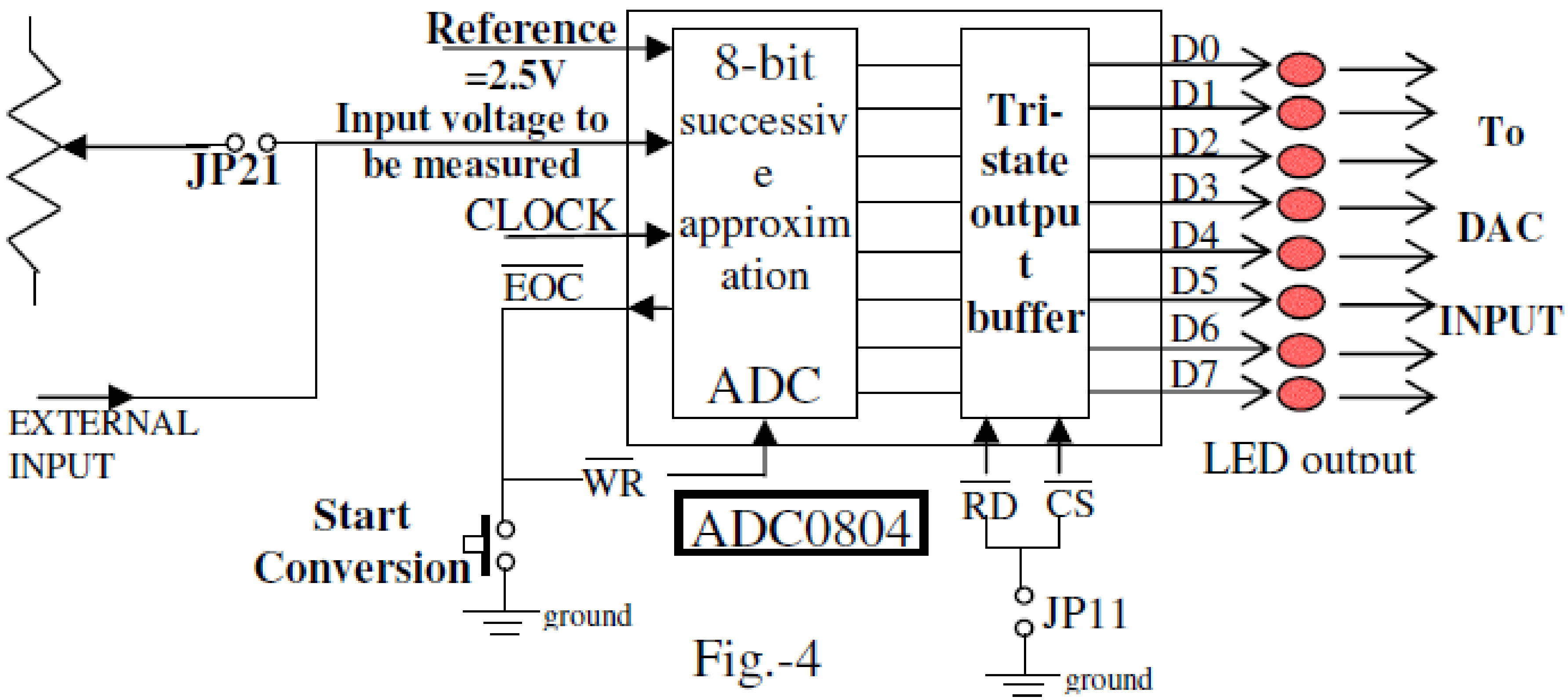


Fig.-4

Experiment: Part A DAC

- Monitoring DAC output voltage using a Digital Multimeter
  - Jumpers JP2 to JP9 (putting any jumper makes that particular bit 0)
  - Put all jumpers (JP2 to JP9) - corresponds to 00000000 (binary); note the reading
  - Remove jumpers one by one and note the reading
  - All jumpers removed - (corresponds to 11111111 (binary) – full scale reading

Experiment: Part B
ADC - with internal DC input

- ADC input options
  - Either internal DC through a potentiometer (0 to 5 V) – Jumpers JP11 and JP21 inserted.

  OR

  - External analog input (through the connector) from a signal source

Part B: ADC with internal DC

- Put jumpers JP11 and JP21 (JP11 routes ADC output to DAC inputs; JP21 is for enabling internal ADC input)
- Remove jumpers J2 to J9 (DAC inputs) so as to observe ADC output through DAC
- Keep potentiometer fully CCW initially,
- Rotate pot clockwise – observe DAC LEDs and measure corresponding ADC input voltage

Part C : Signal Digitization and Reconstruction

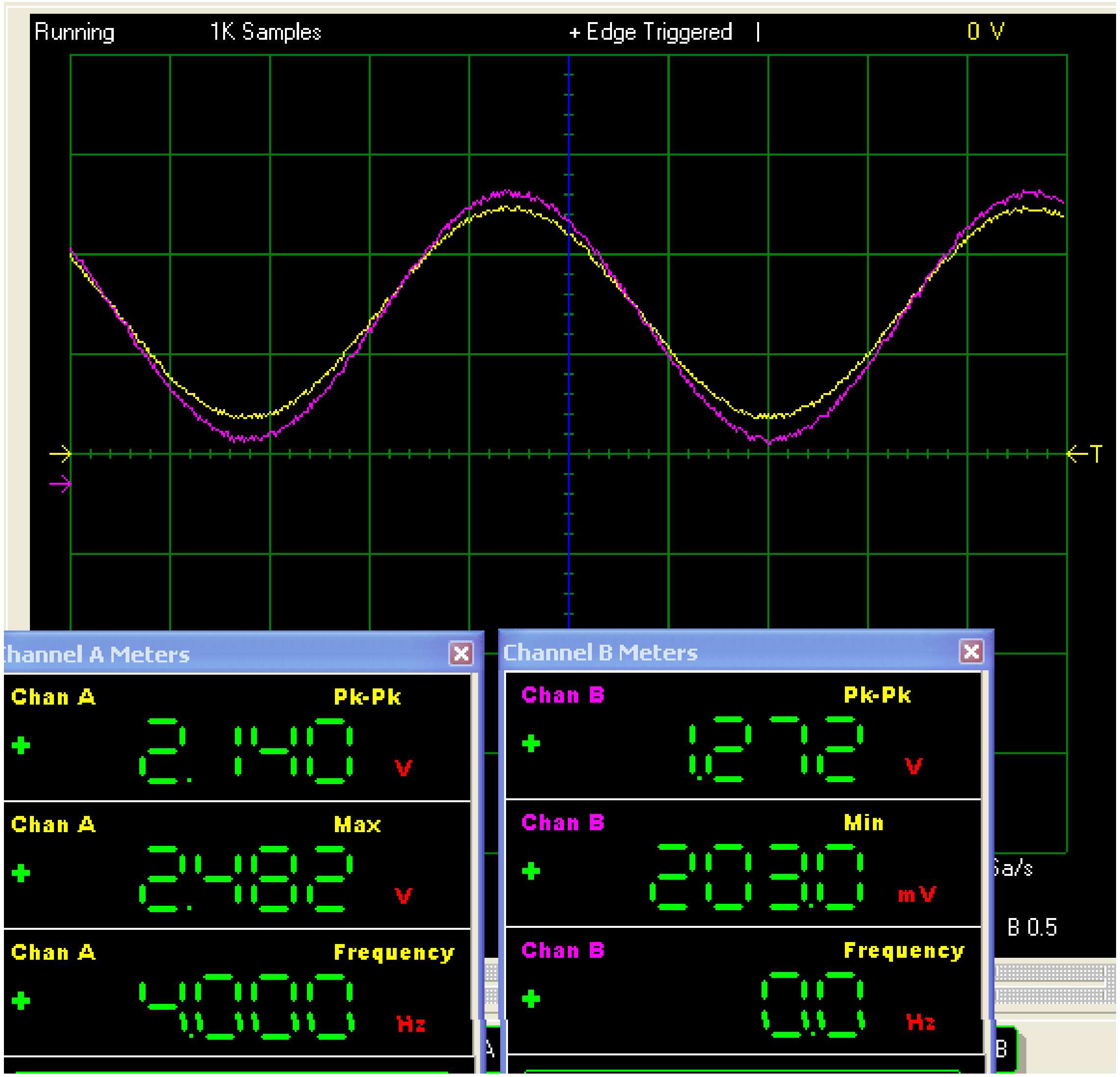
- Remove JP21 (to have ADC input from outside).
- Keep JP11 (ADC outputs routed to DAC inputs)
- Adjust Sig.Gen in PC Scope to give sine wave with 2 Vpk-to-pk, and 1.5V DC offset, i.e signal going from 0.5 to 2.5 V
- ADC input: external Sinusoidal signal (frequency = 10 Hz, from USB Function Gen. output)
- Observe ADC input and DAC output (reconstructed waveform) on the USB Scope.
- Increase frequency of sine wave and observe the reconstructed waveform.

Part C : Signal Digitization and Reconstruction

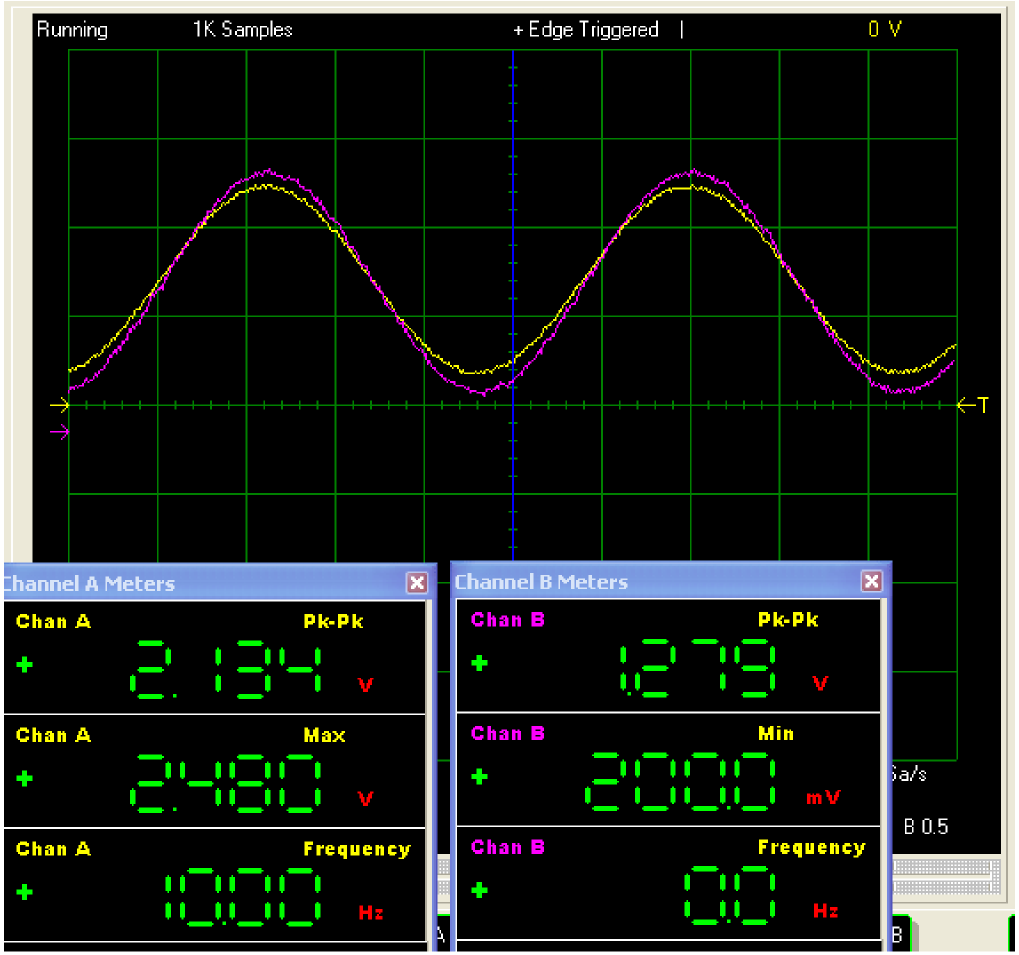
- Screen captures of ADC input and the Reconstructed Signal (at the DAC output)
  - ADC input (Channel A – Yellow)
  - DAC output (Channel B – Purple)
- Chan A Meter – Vpk-pk, Max and Freq

- Chan B Meter - Vpk-pk, and Max (Freq readings - not correct)

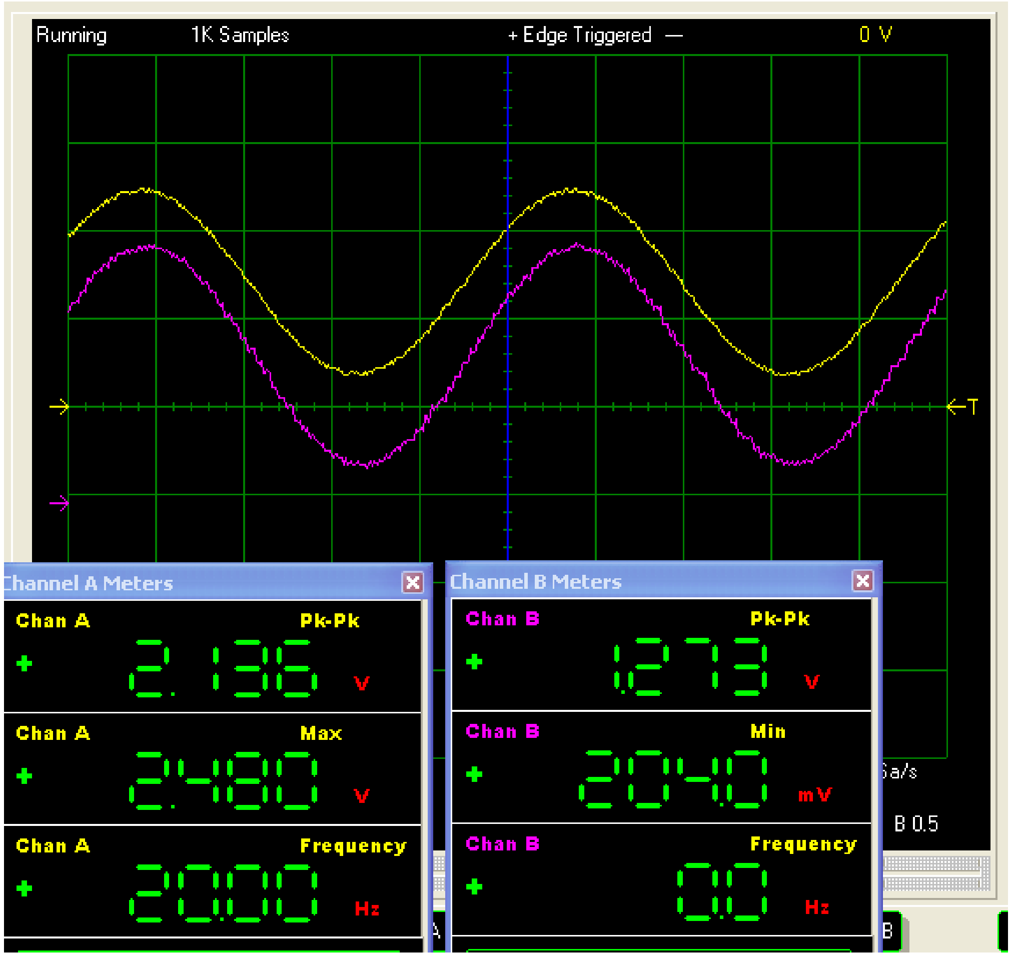
ADC Input and Reconstructed Waveforms (4 Hz)



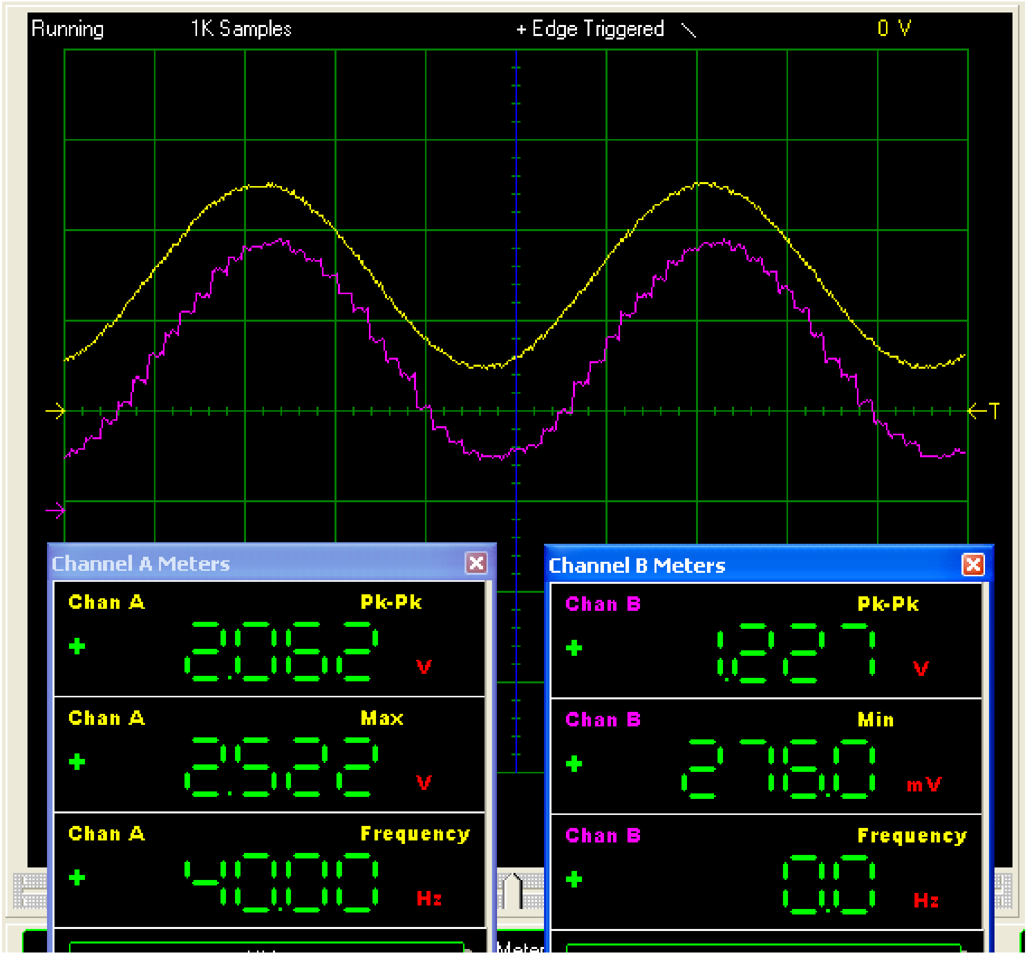
ADC Input and Reconstructed Waveforms (10 Hz)



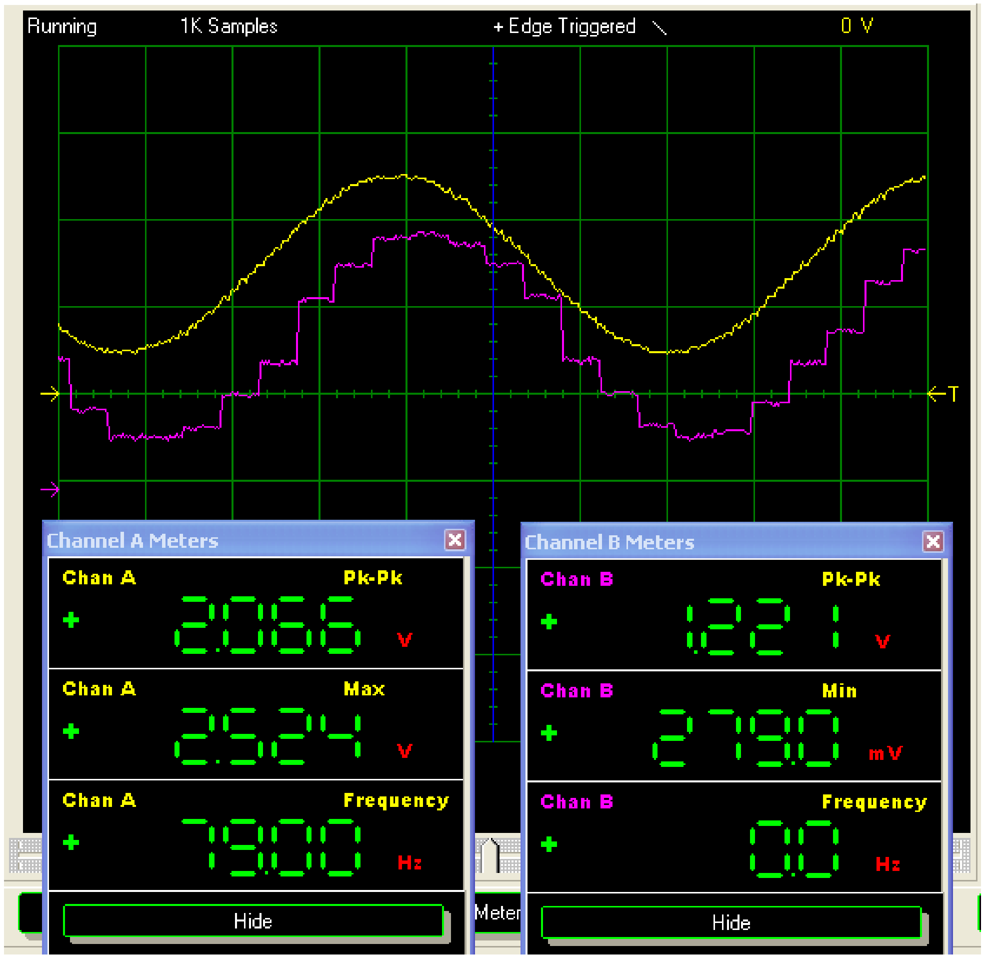
ADC Input and Reconstructed Waveforms (20 Hz)



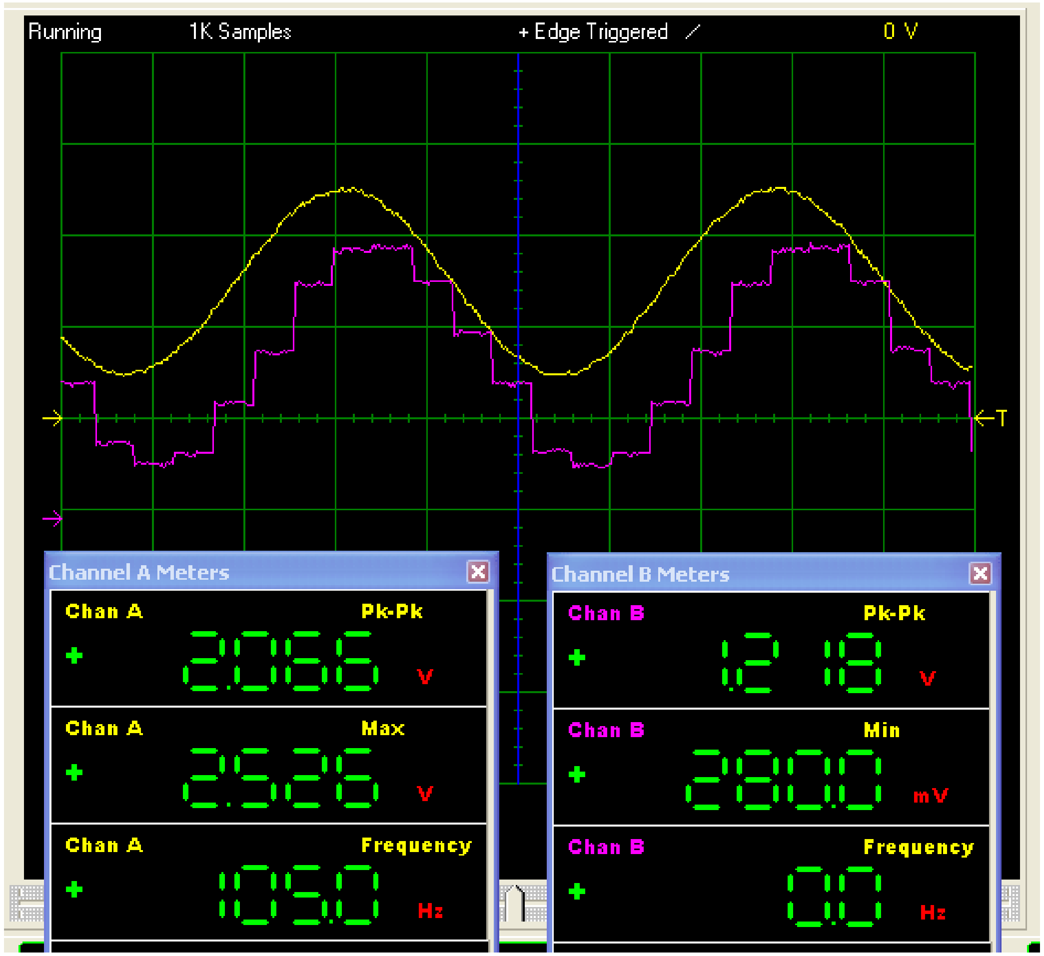
ADC Input and Reconstructed Waveforms (40 Hz)



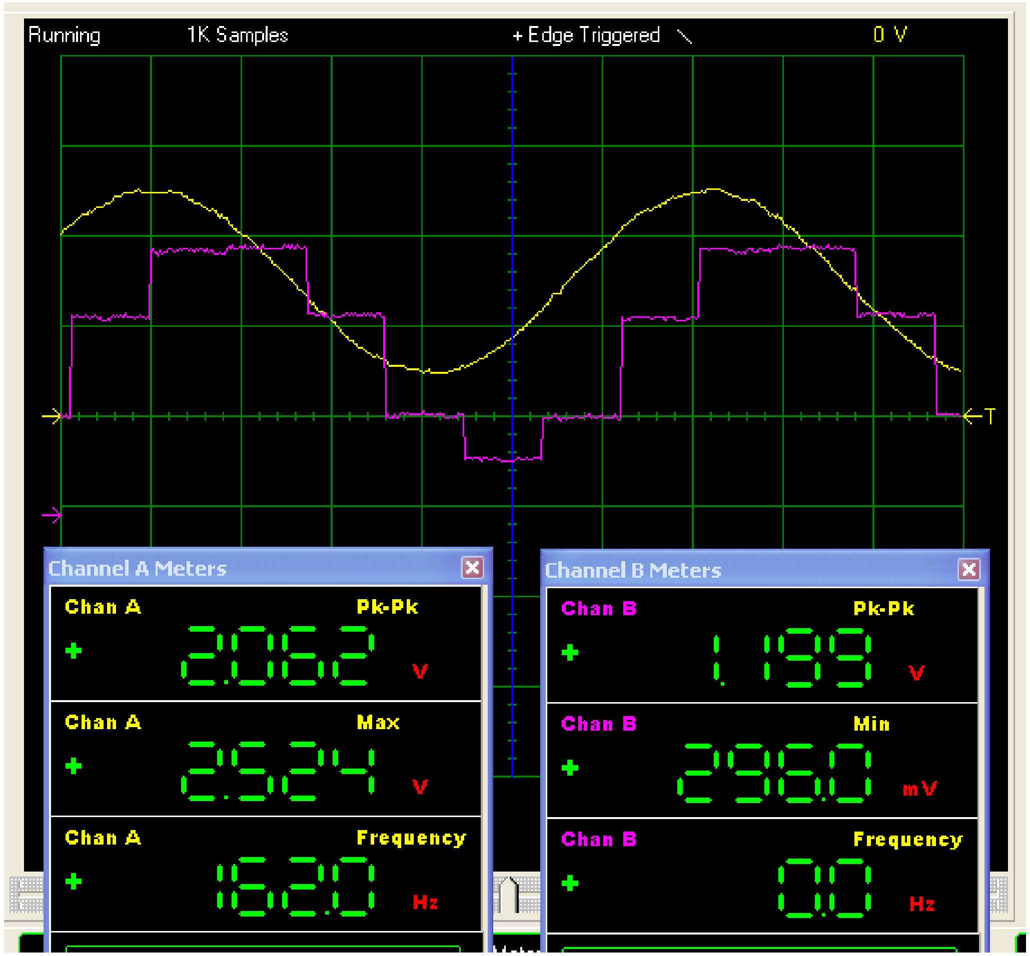
ADC Input and Reconstructed Waveforms (79 Hz)



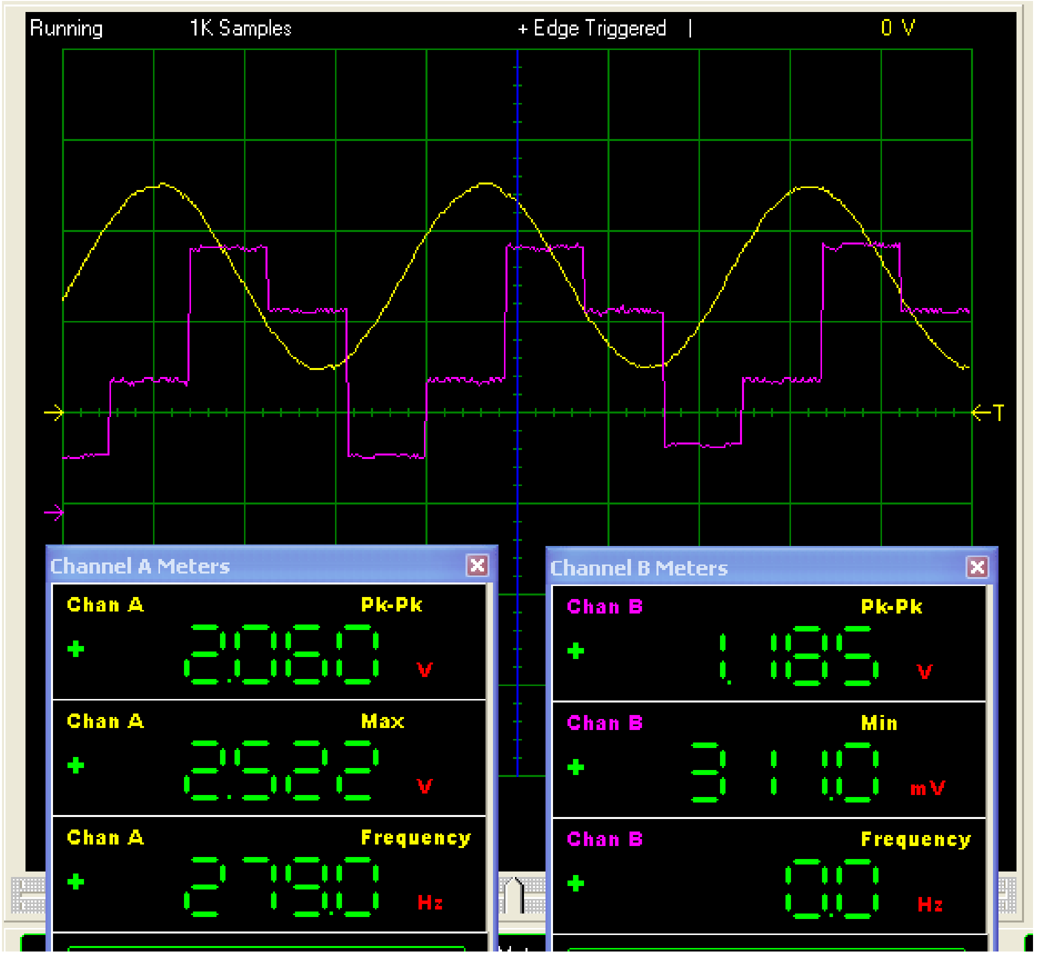
ADC Input and Reconstructed Waveforms (105 Hz)



ADC Input and Reconstructed Waveforms (162 Hz)



ADC Input and Reconstructed Waveforms (279 Hz)



ADC Input and Reconstructed Waveforms (434 Hz)