Adaptive Noise Cancellation using the LMS Algorithm (NOISE KILA)

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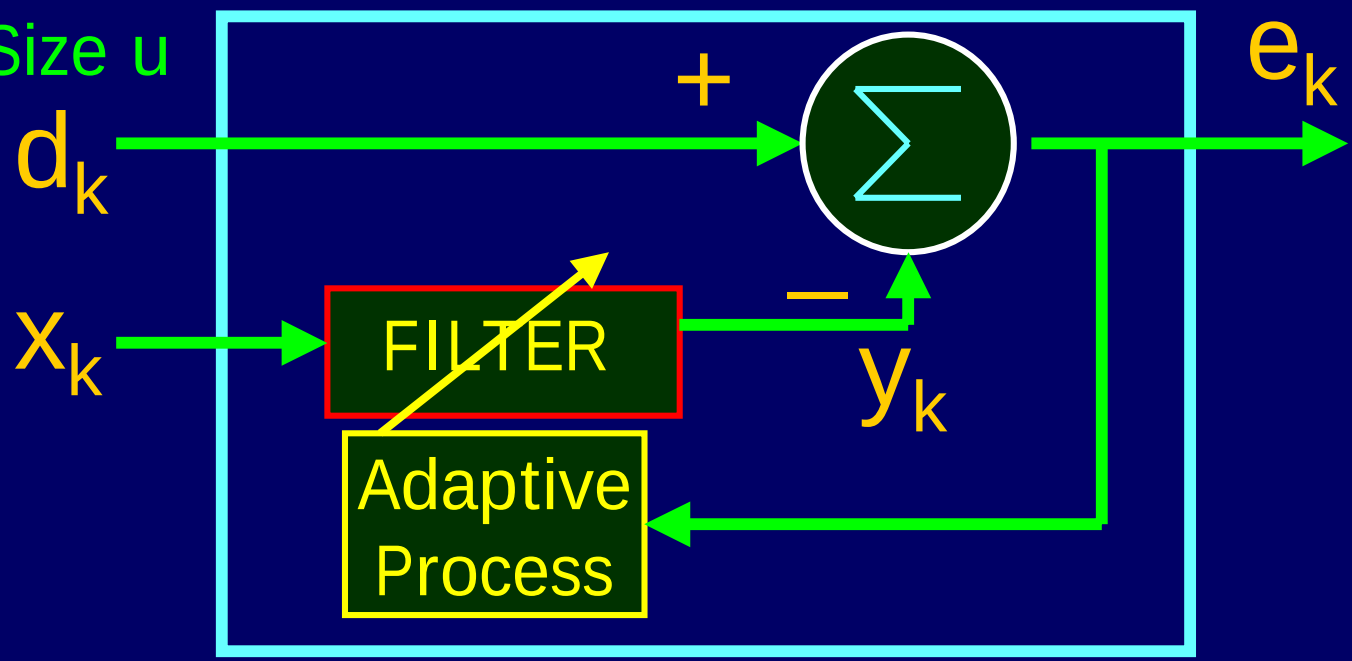
Overview

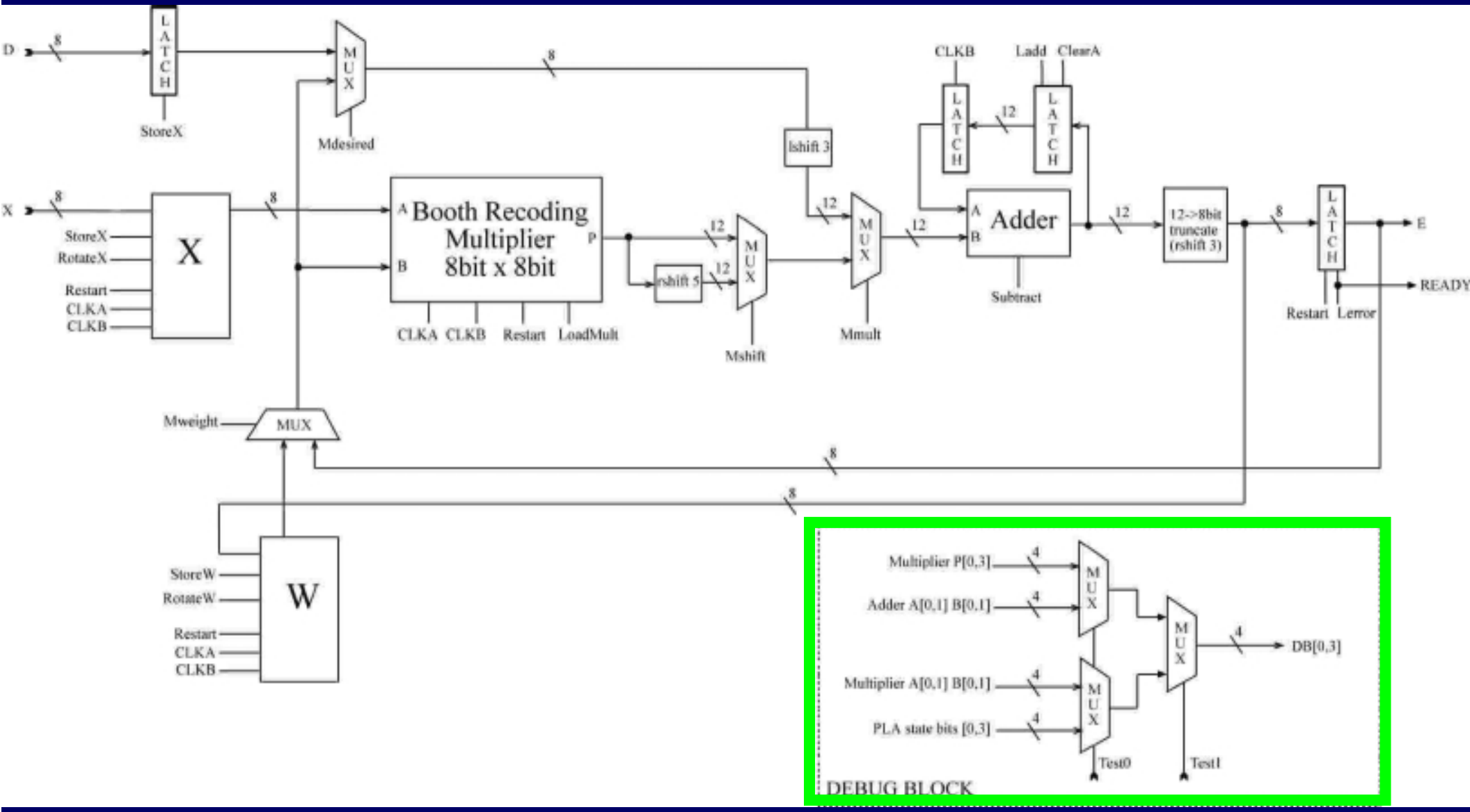
- Functional Description
- Debugging Features of our Chip
- Test Results
- Speed Test Results
- Yield

Functional Description

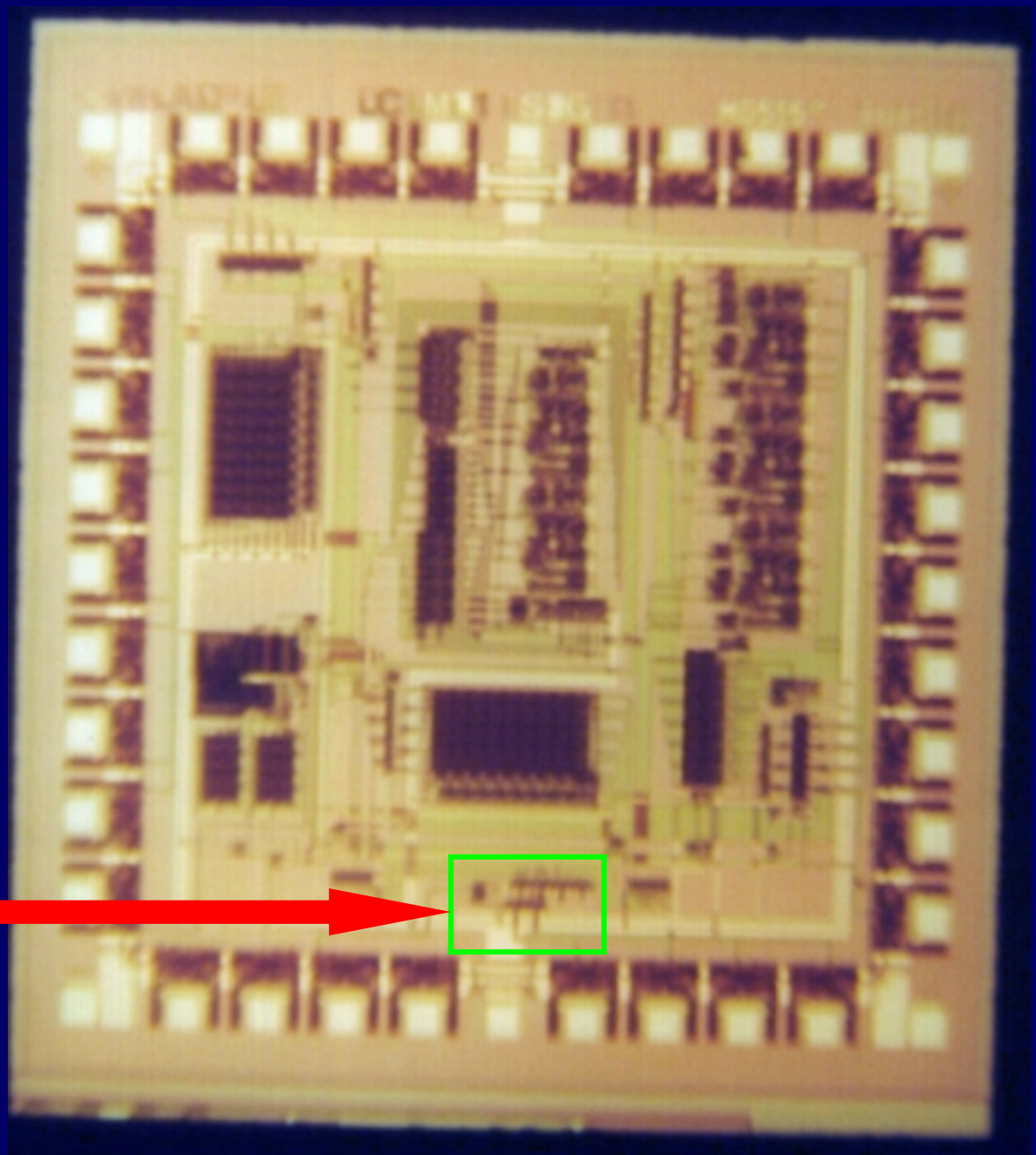
- Filter input x(k) to obtain y(k)
- Error e(k) = Desired Input d(k) – y(k)
  - Used to update filter frequency response
- 8-tap Finite Impulse Response (FIR) Filter
- LMS Algorithm
  - W(k+1) = W(k) + u*2e(k)*x(k)
  - Fixed Step-Size u



Debugging Features of Our Chip



Picture of Chip



Debug Outputs

Test Results

- Simple Testing Runs
- Noise Cancellator Prototype

Limitation w/ OmniLab Testing

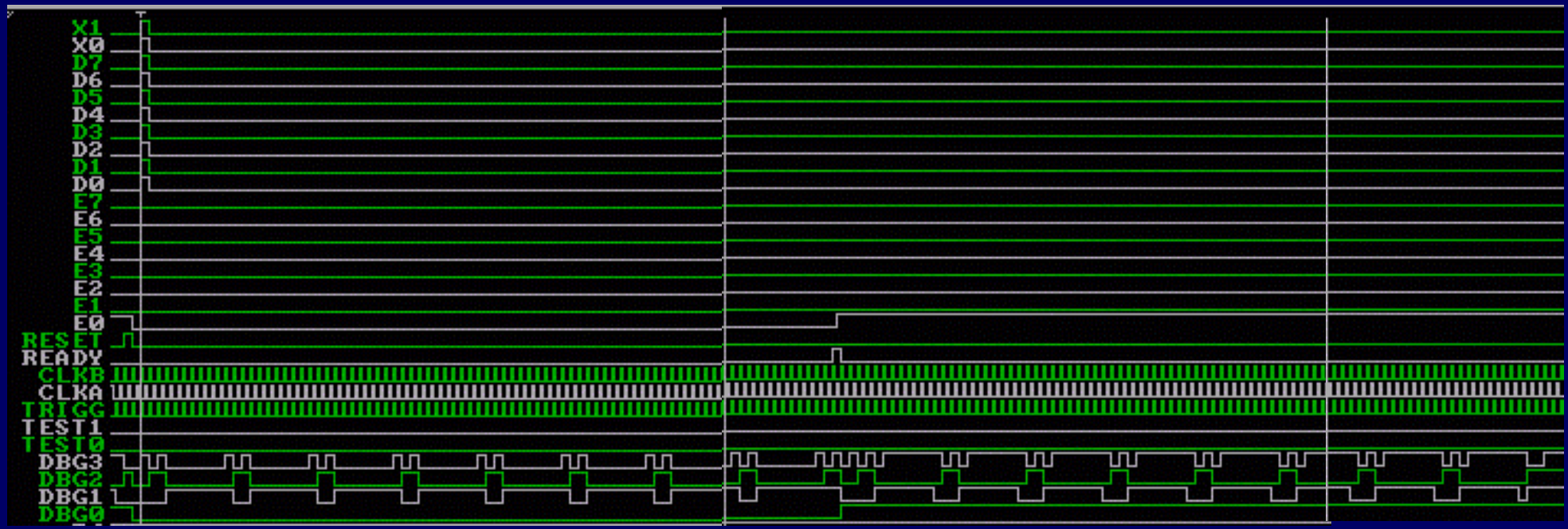
- Only able to debug a MAX of 5 iterations
  - OmniLab has 4096 bit buffer per stimulation
  - Chip needs 175 clock cycles x 4 (2-phase clock)
  - 4096 / 700 = 5 iterations

Simple Testing Run

- 4 Test Vectors (sequentially) for Verification of Functionality
- Used DEBUG outputs to check for internal functionality (4 Different Outputs)
  - State Machine State Bits (4 bits)
  - Multiplier Inputs A (bits 0, 1) and B (bits 0, 1)
  - Multiplier Product Output (bits 0 – 3)
  - Adder Inputs A (bits 0, 1) and B (bits 0, 1)

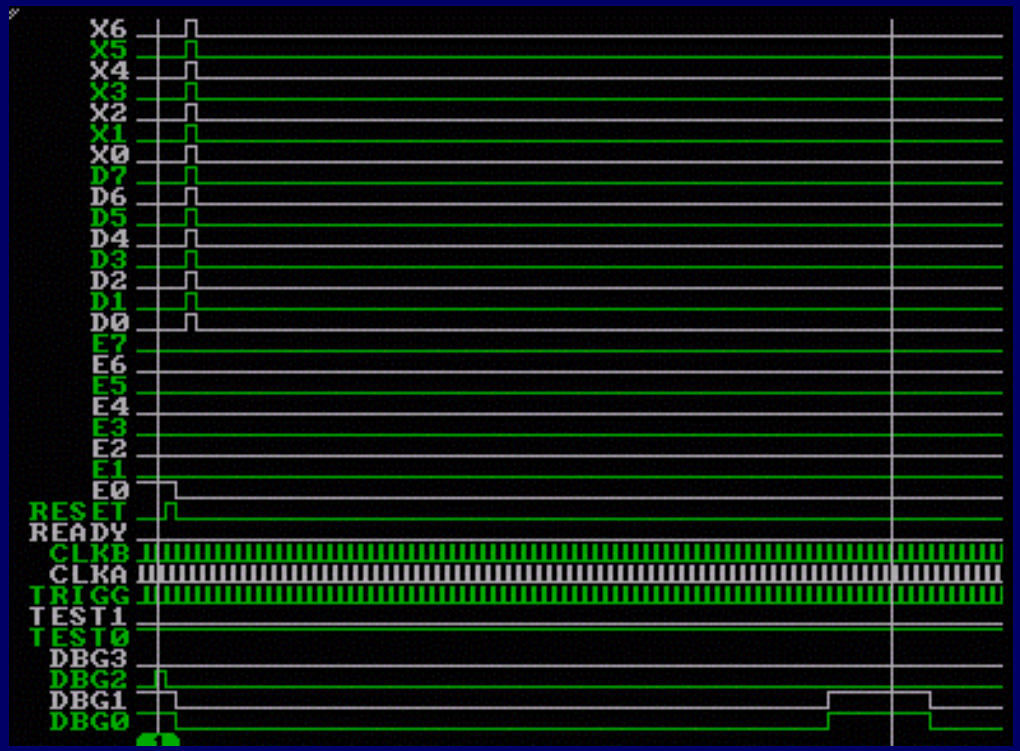
State Machine Bits

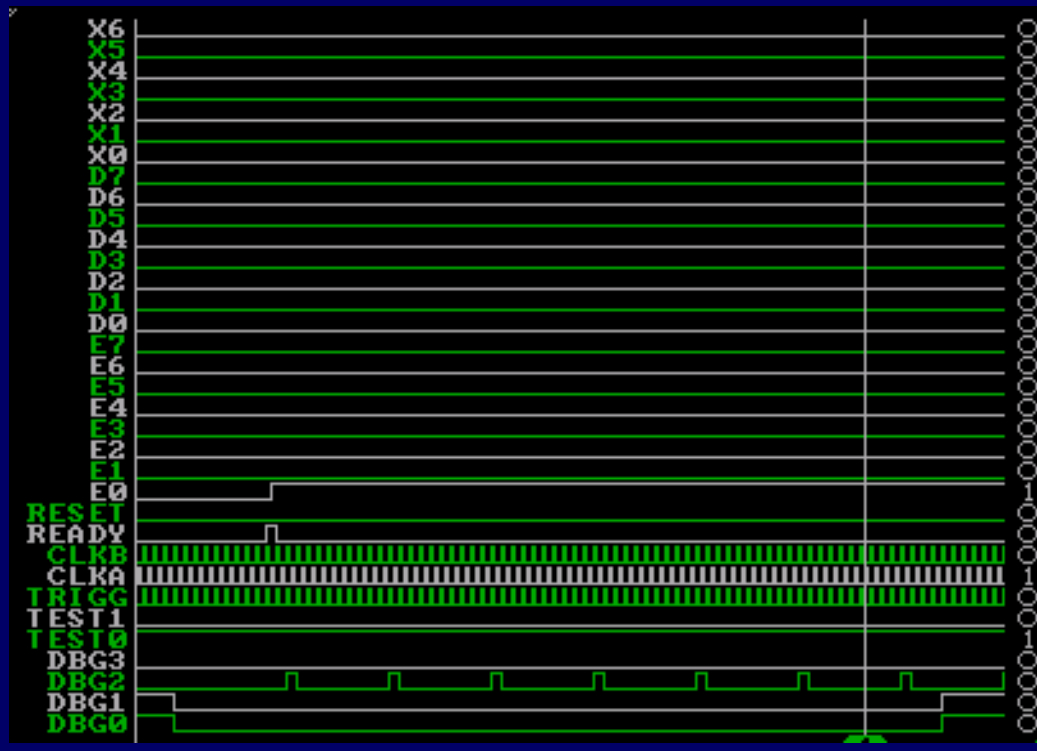
- Chip successfully traverses all states (approx. 180 clock cycles)
  - First Half – Error Calculation
  - Second Half – Filter Tap Weights Update



First Input in Simple Test

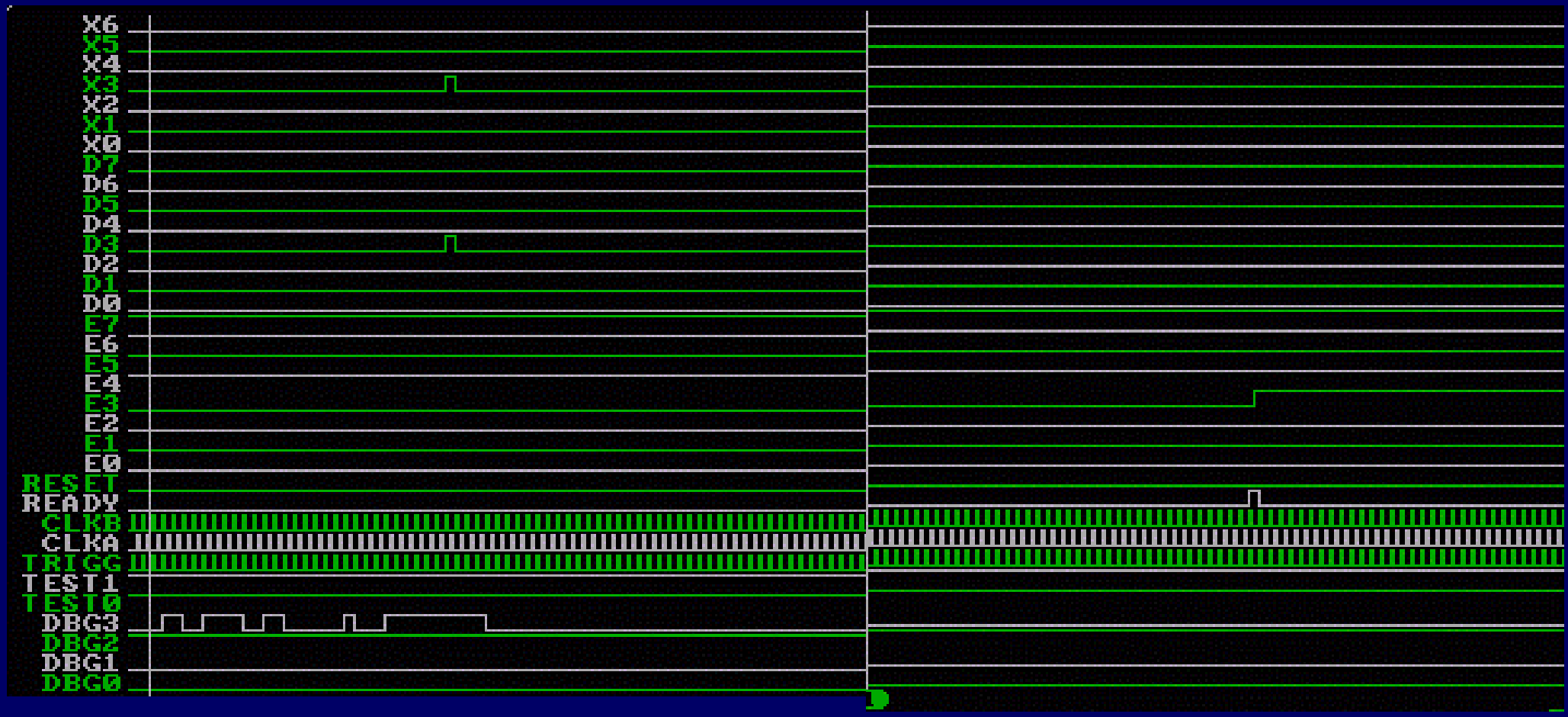
- Both X and D are FFh
- Since the Filter Weights are initially 0, the Error Output is (0 – (-1) => 1)
- Verified Multiplier Inputs A (0, 1) and B (0, 1)





Last Input in Simple Test

- X is 08h and D is 08h
- Error Output is F8h



Noise Cancellator Prototype

- Two A/D converters used for converting X and D inputs
- One A/D converter for output signal
- Initially we were not using the A/D & D/A converters correctly so not sure of correctness yet

Speed Test Results

- Works up to maximum frequency in OmniLab (34 MHz / 4)
- Works using Functional Generator at 36MHz

Yield

- 4 out of 5 chips work
- Fifth chip was plugged in upside down
  - Unable to determine whether it was fabricated without error