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Low Power Pulse-Based Communication

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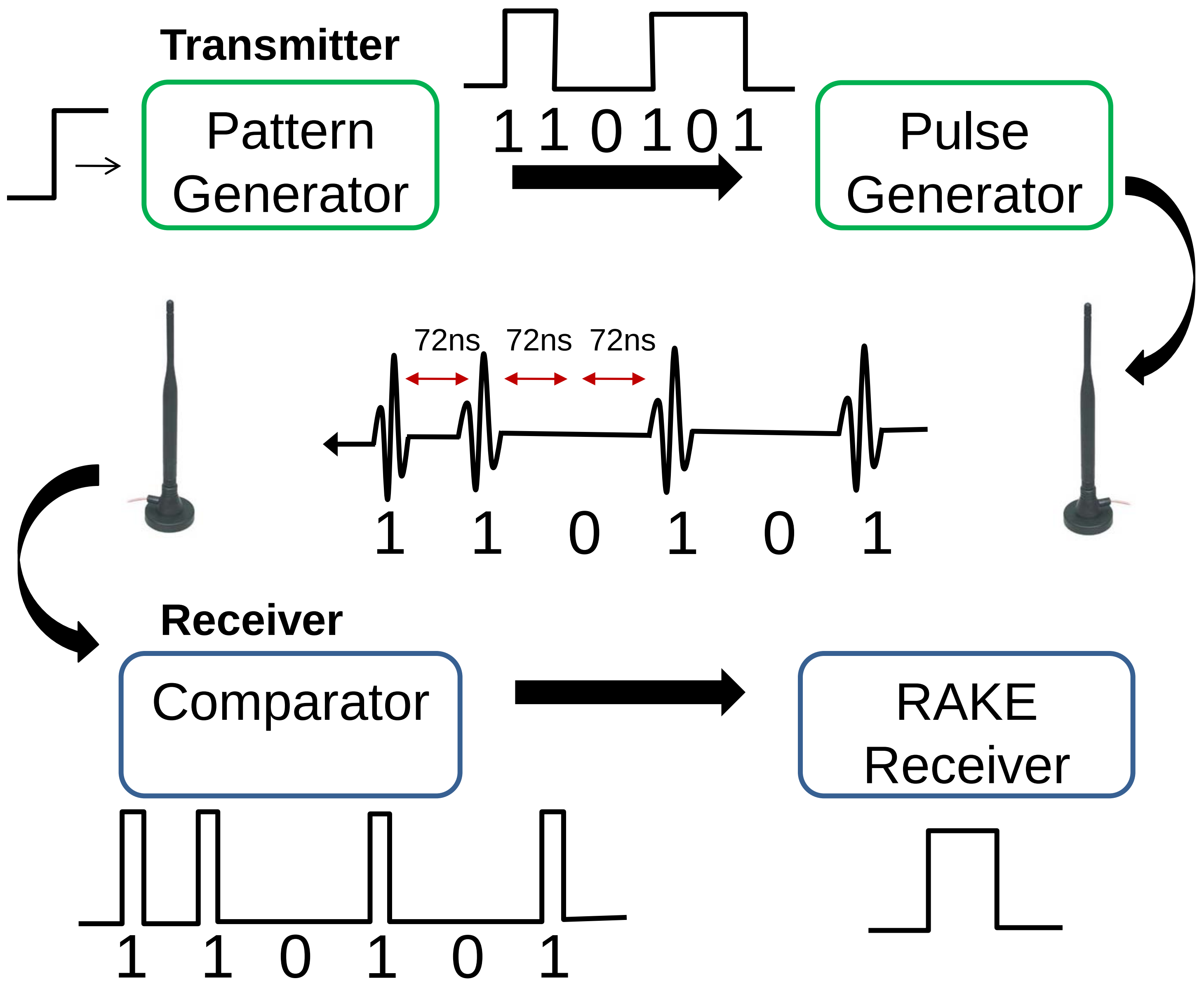
Design Objectives

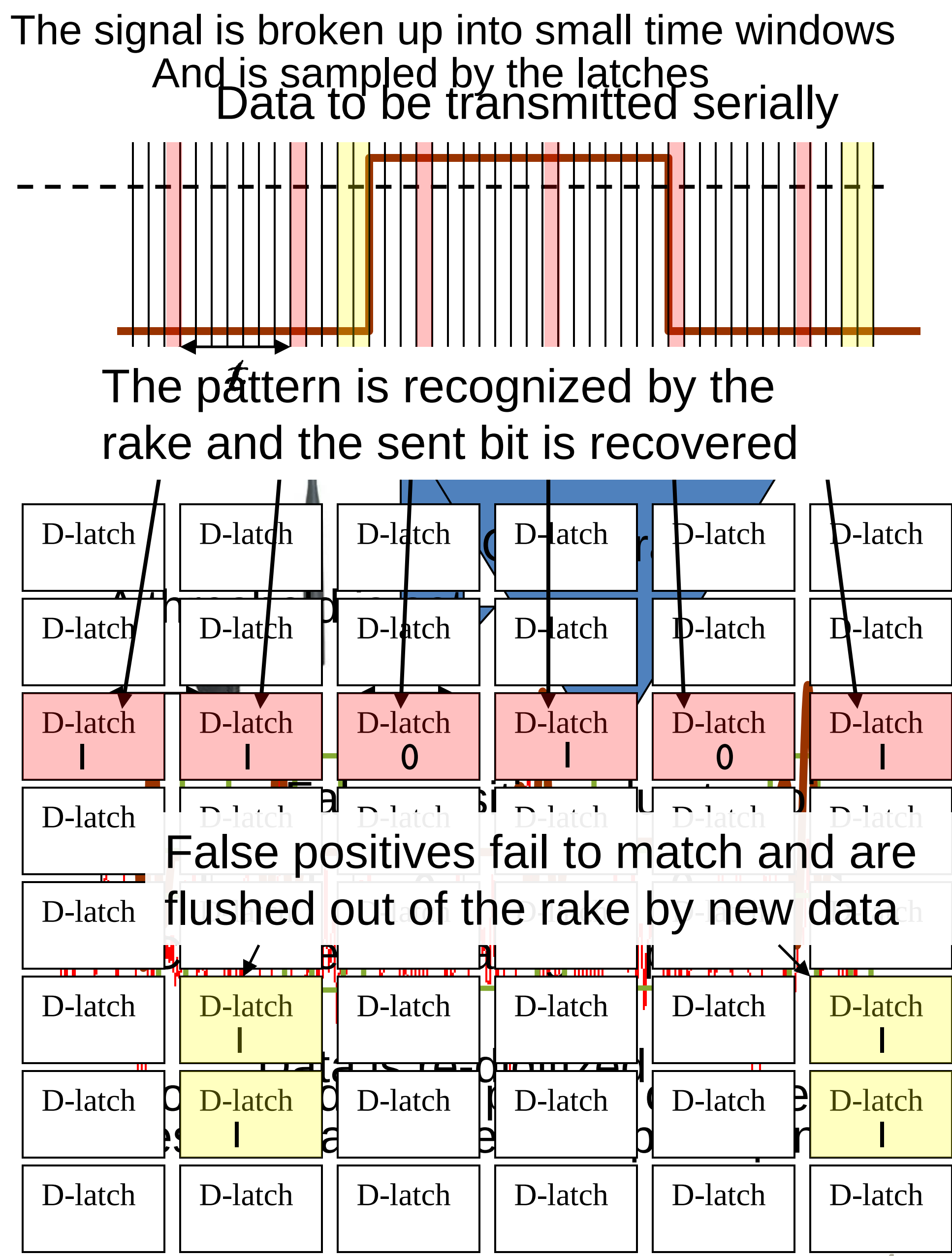
- Carrier-less (baseband) communication
  - Low power consumption
- Data transmission through E.M. pulses
- Generation of short pulses
  - Large bandwidth
  - Fast data transmission rate
- Accurate reception of transmitted data

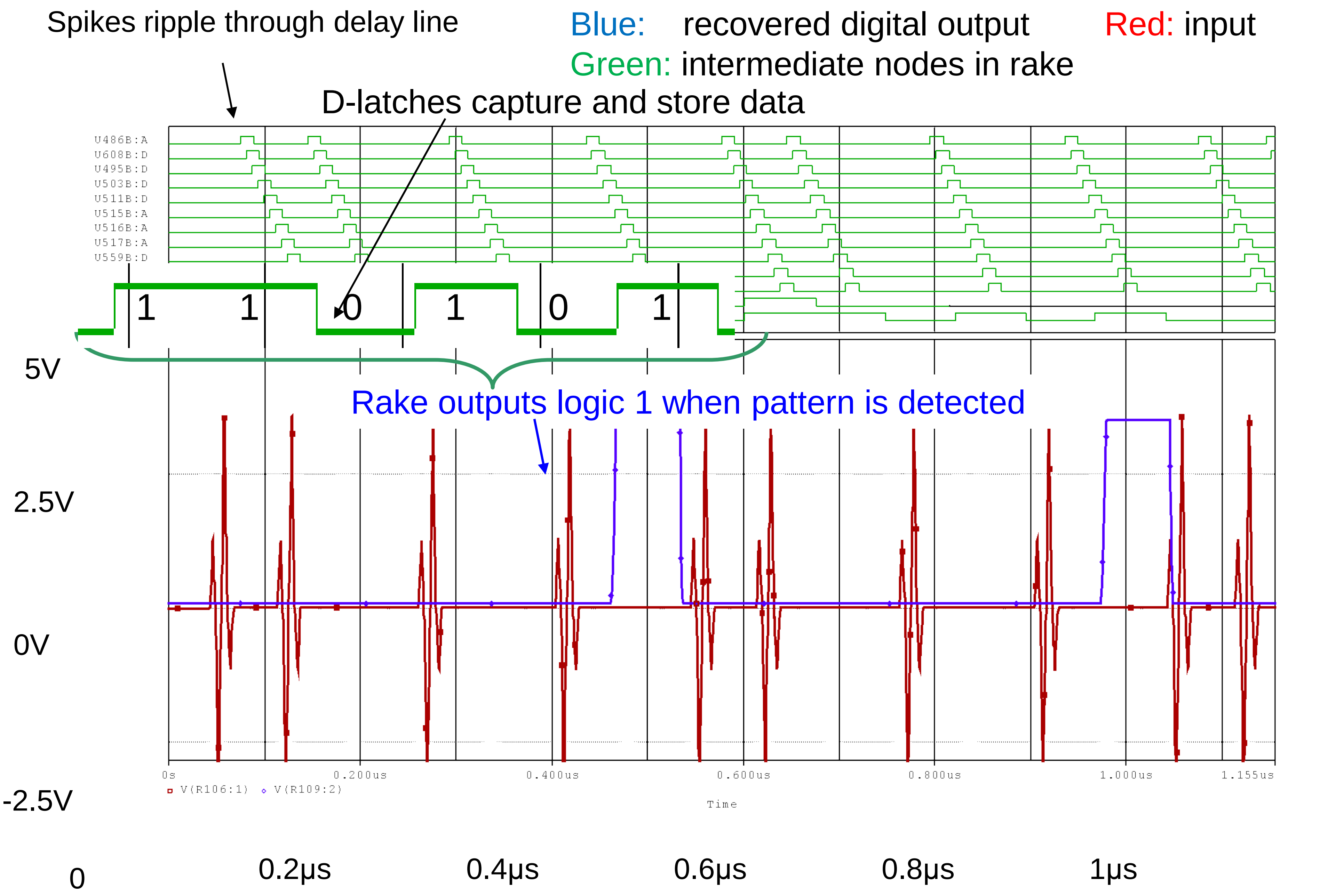
Design Overview



Summary

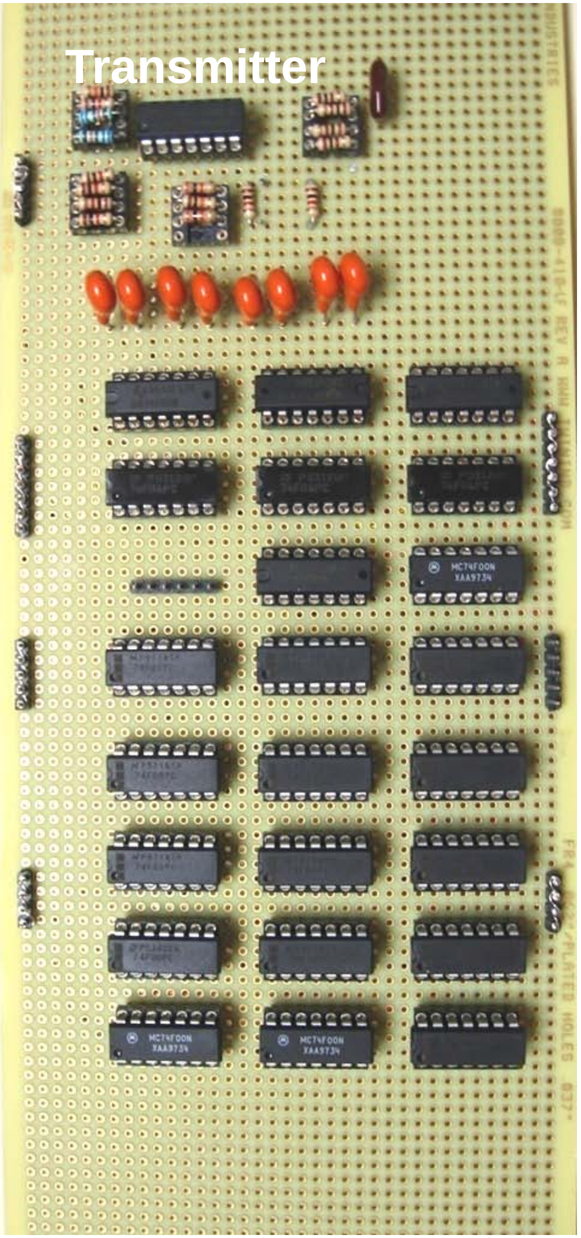
- Each bit is coded into a pattern of 1's and 0's
- A sequence of pulses is generated from that pattern
- There is a unit time during which a pulse represents '1'
- Data is transmitted through noisy channel
- Signal is re-digitized
- Noise creates false positives
- RAKE rejects false positives
- Digital data is recovered

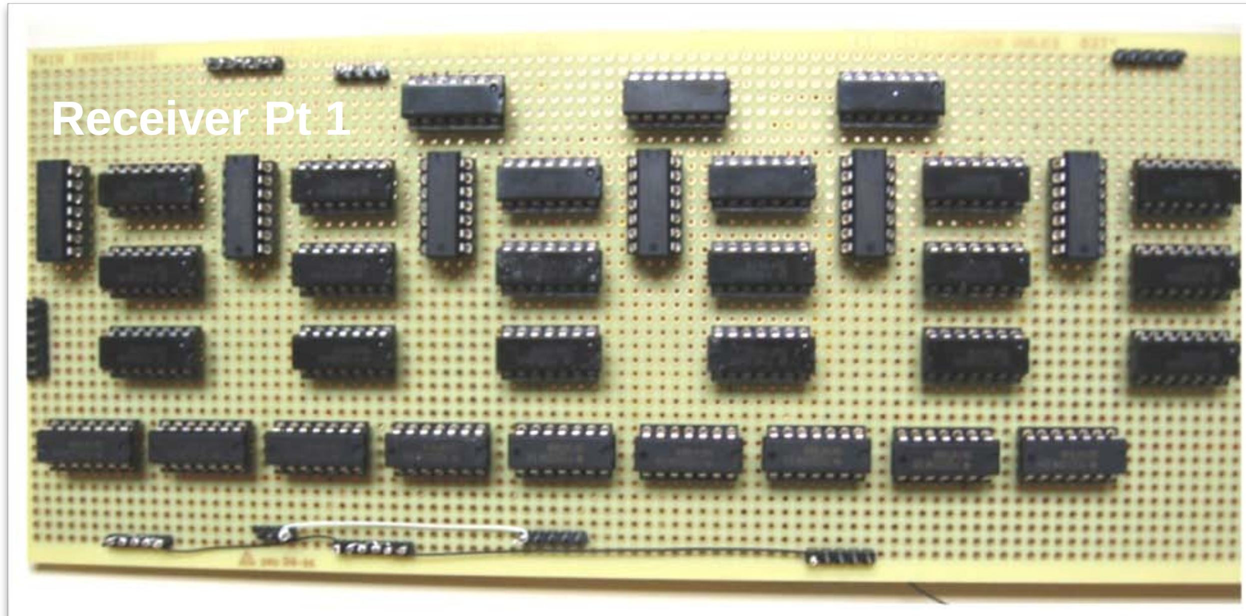


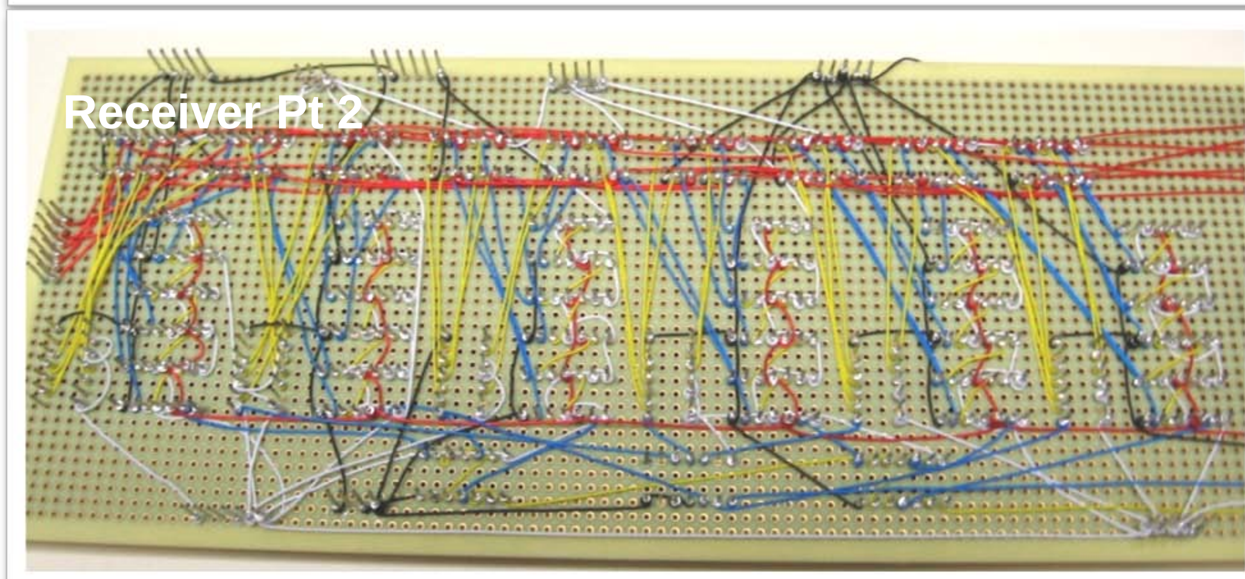


Spikes ripple through delay line
Blue: recovered digital output
Red: input
Green: intermediate nodes in rake
D-latches capture and store data
U486B:A
U608B:D
U495B:D
U503B:D
U511B:D
U515B:A
U516B:A
U517B:A
U559B:D
1
1
0
1
0
1
5V
2.5V
0V
-2.5V
Rake outputs logic 1 when pattern is detected
0s
0.200us
0.400us
0.600us
0.800us
1.000us
1.155us
V(R106:1)
V(R109:2)
Time
0
0.2μs
0.4μs
0.6μs
0.8μs
1μs

Transmitter/Receiver Circuits

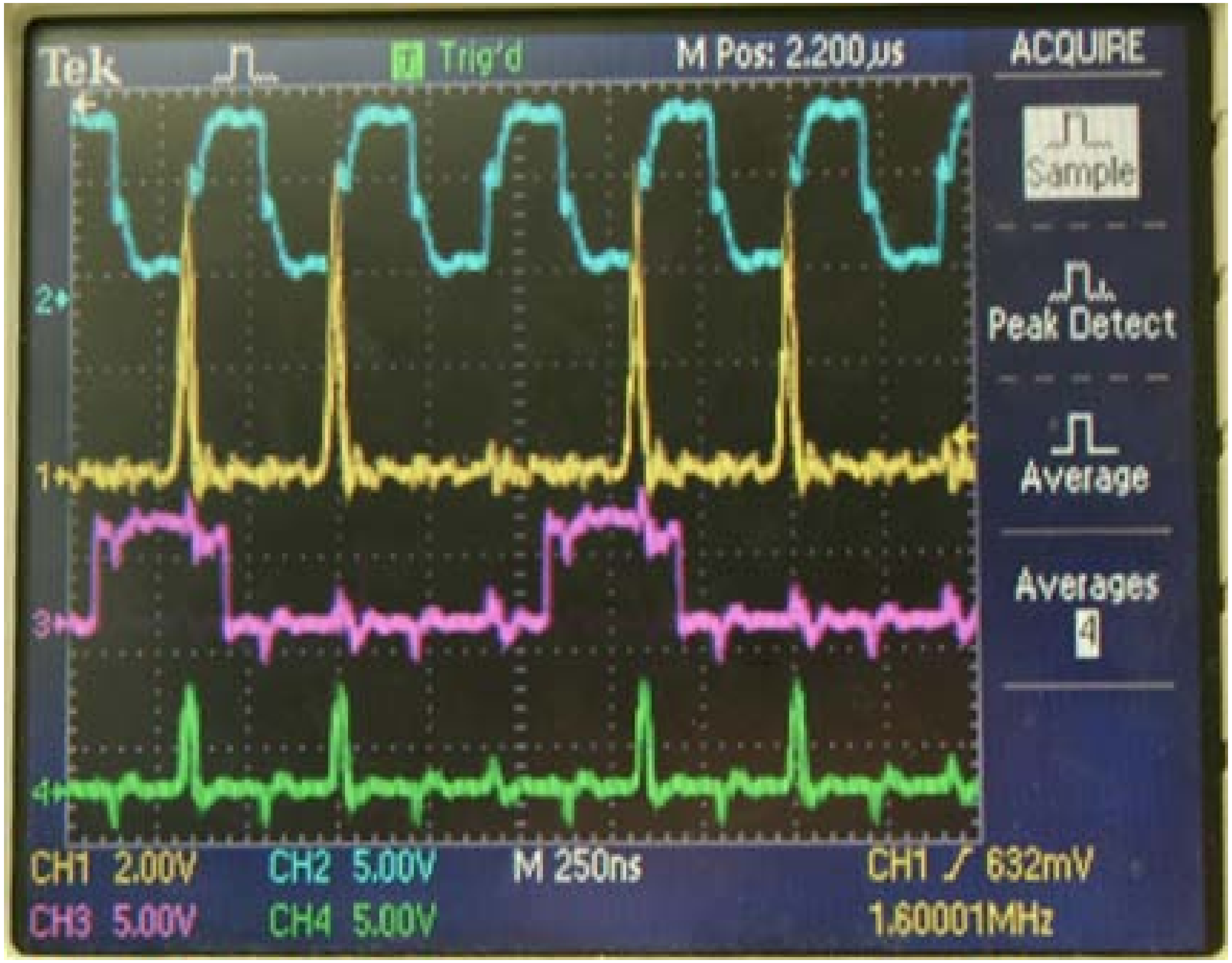






Experimental Results

Low noise signal
Pattern: 110110



Blue: Clock

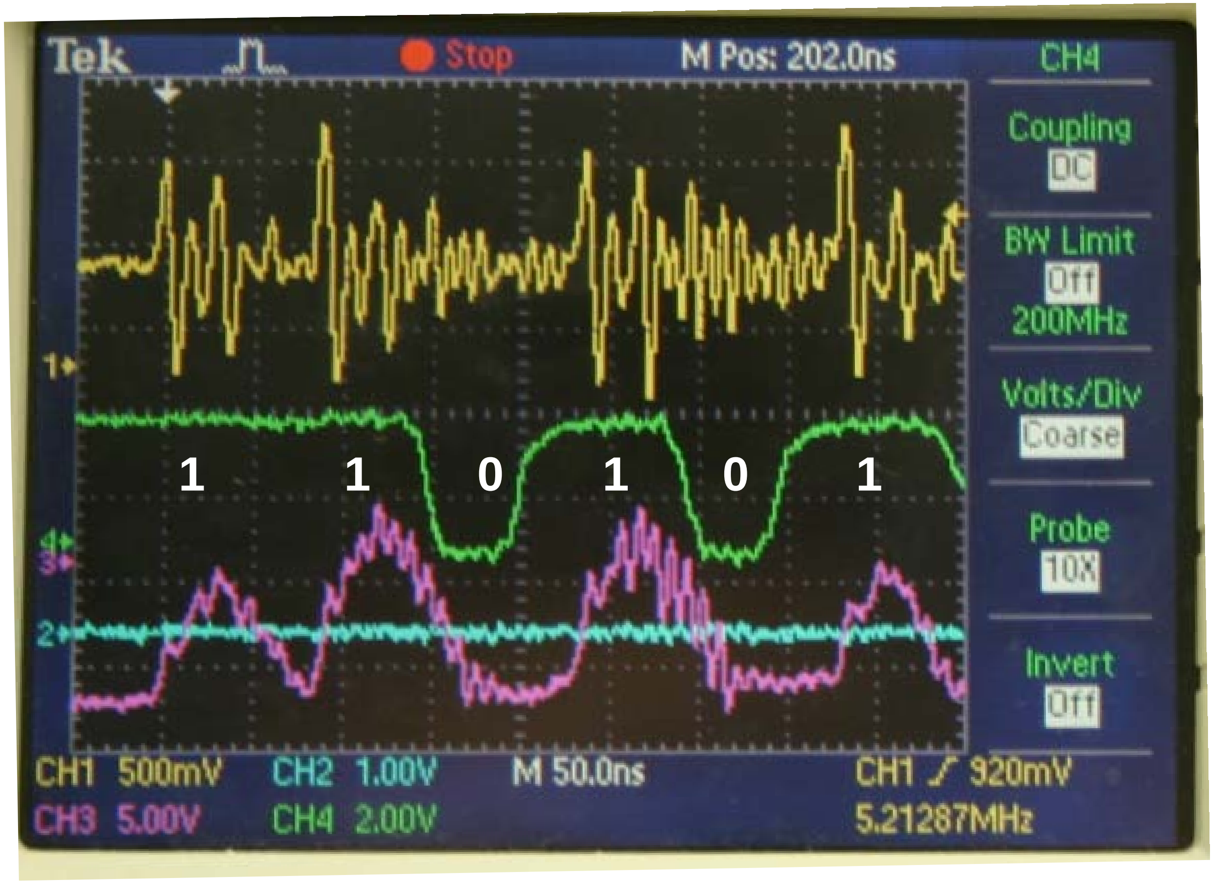
Yellow: Filtered incoming pulses

Purple: Digital output

Green: Digital pulses moving through the delay line

Experimental Results

Noisy signal
Pattern: 110101



Yellow: Incoming noisy pulses

Green: Recovered digital data (110101)

Purple: Output of the comparator circuit

Blue: Threshold

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Conclusion

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- Computer simulations have shown data transmission under low noise condition
- The circuits have been implemented using discrete devices
- Testing of the transmitter and receiver have shown promising results
- Timing issues are the most persistent problems
- Despite these problems data was recovered successfully

Further work:

- Transmission through antennas at various distances
- Implementation of integrated circuit design to obtain
    - Faster and more accurate pulses
    - Faster comparisons
    - Smaller devices