



Research Consortium in Speckled Computing

Low Power RF Transceivers

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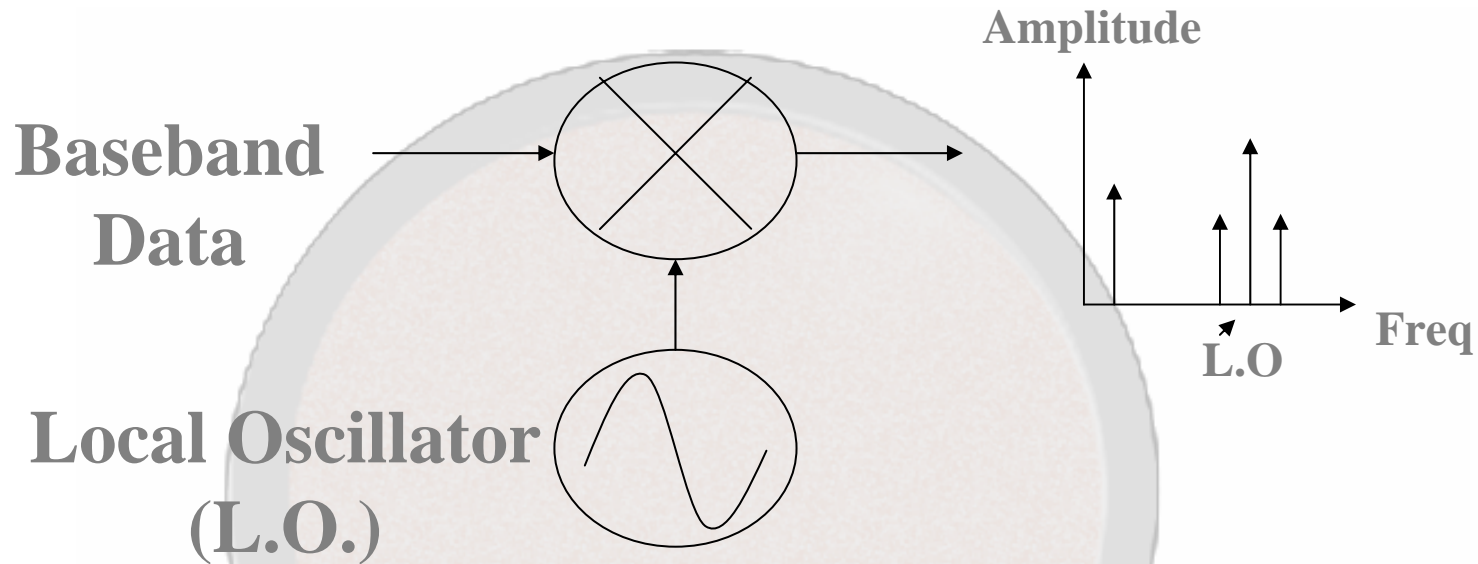
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Outline of Talk

- Traditional Superhet – Drawbacks
- Direct conversion (Tx) – OOK – Advantages
- Super Regeneration (Rx)
- Complete Transceiver architecture
- Prototype – results
- MMIC – expected performance data
- Improvements/Extensions to basic SRRX

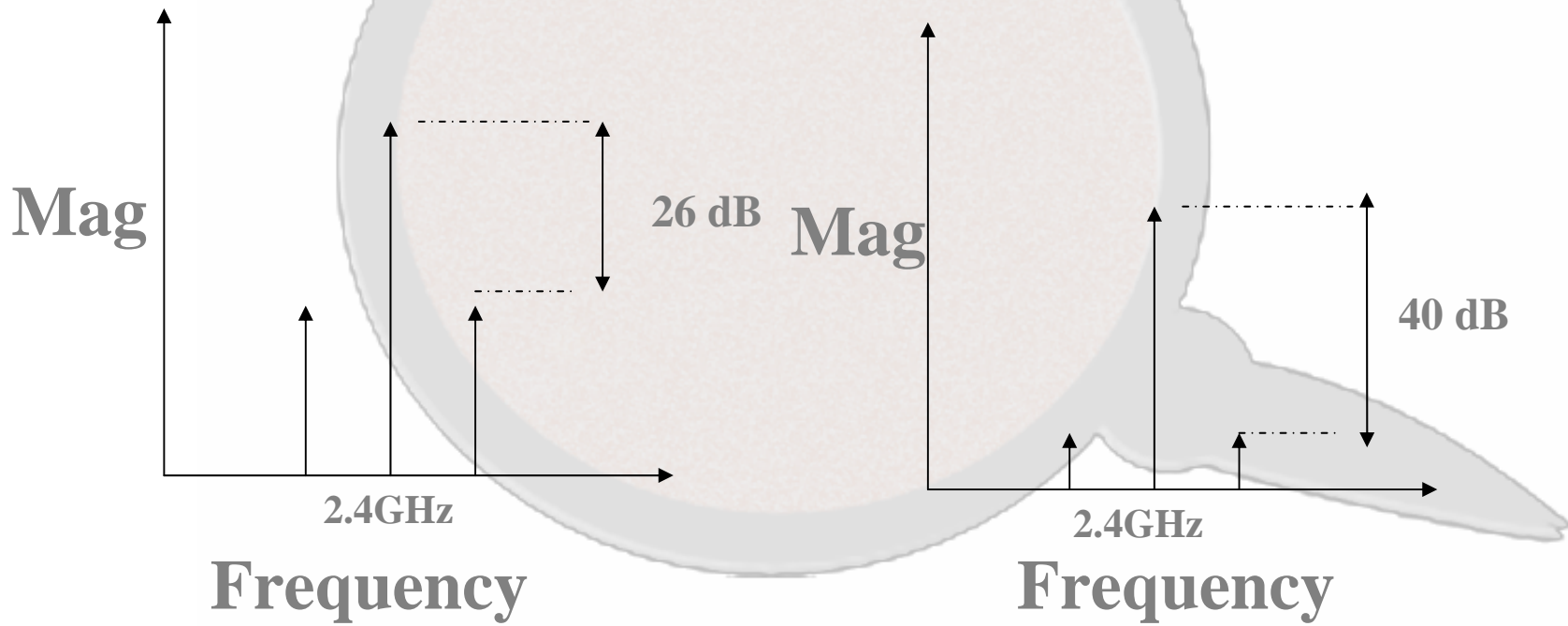
Common Superheterodyne Tx Scheme



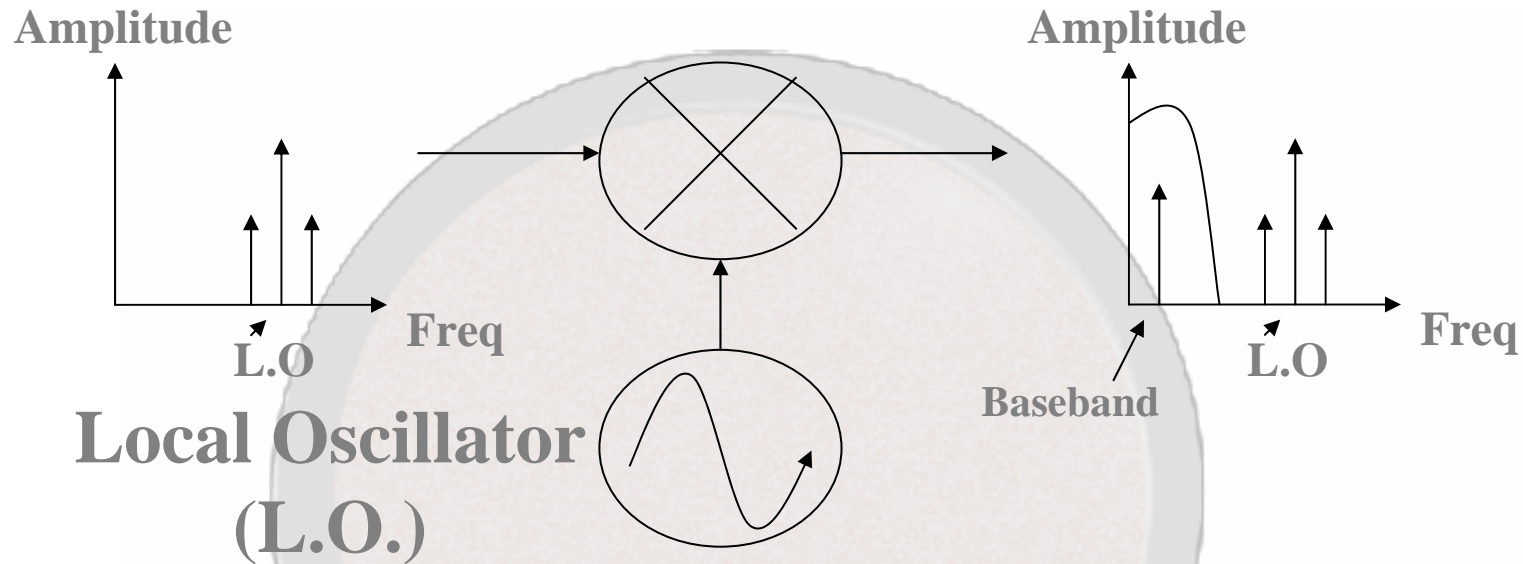
- Drawbacks – Baseband source needs to supply power
 - Associated Conversion Losses > 7 dB
 - Mixer needs relatively high L.O. Power

Mixer Conversion Loss and varying LO Power

- RF(baseband) fixed at -15 dBm, 100MHz
- LO at 0 dBm (1mW) and -10 dBm (0.1mW)

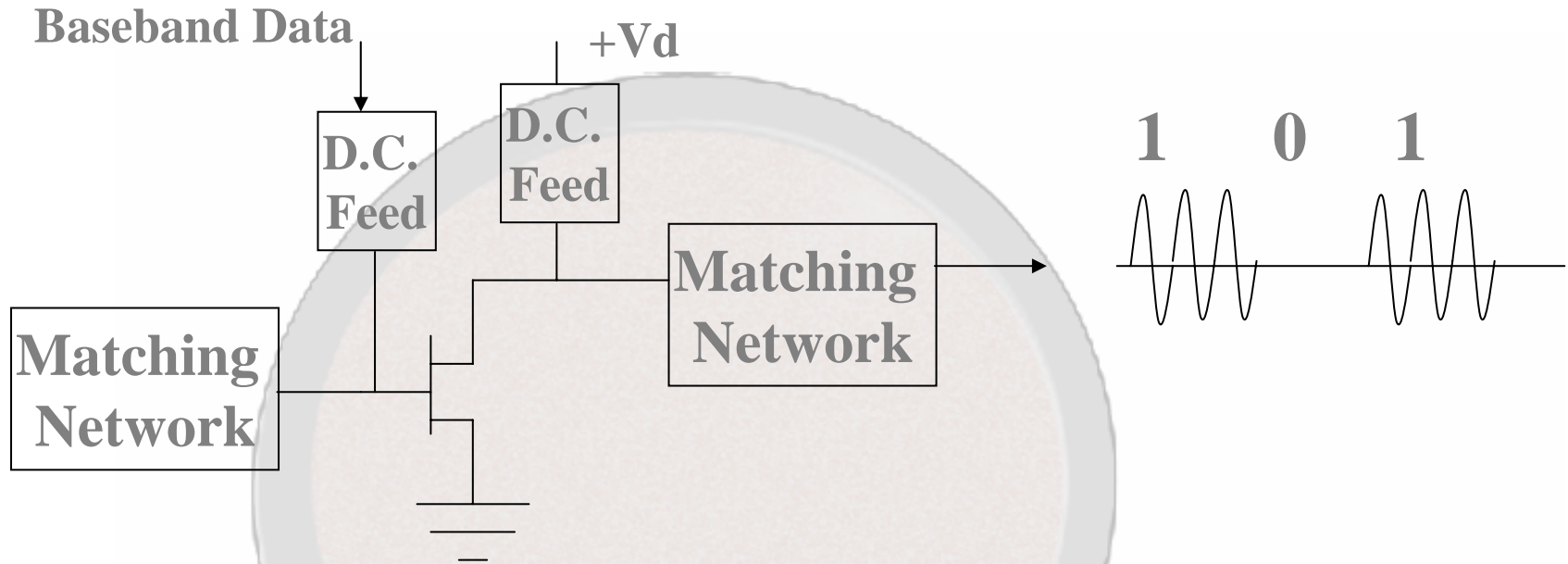


Common Superhet Rx Scheme



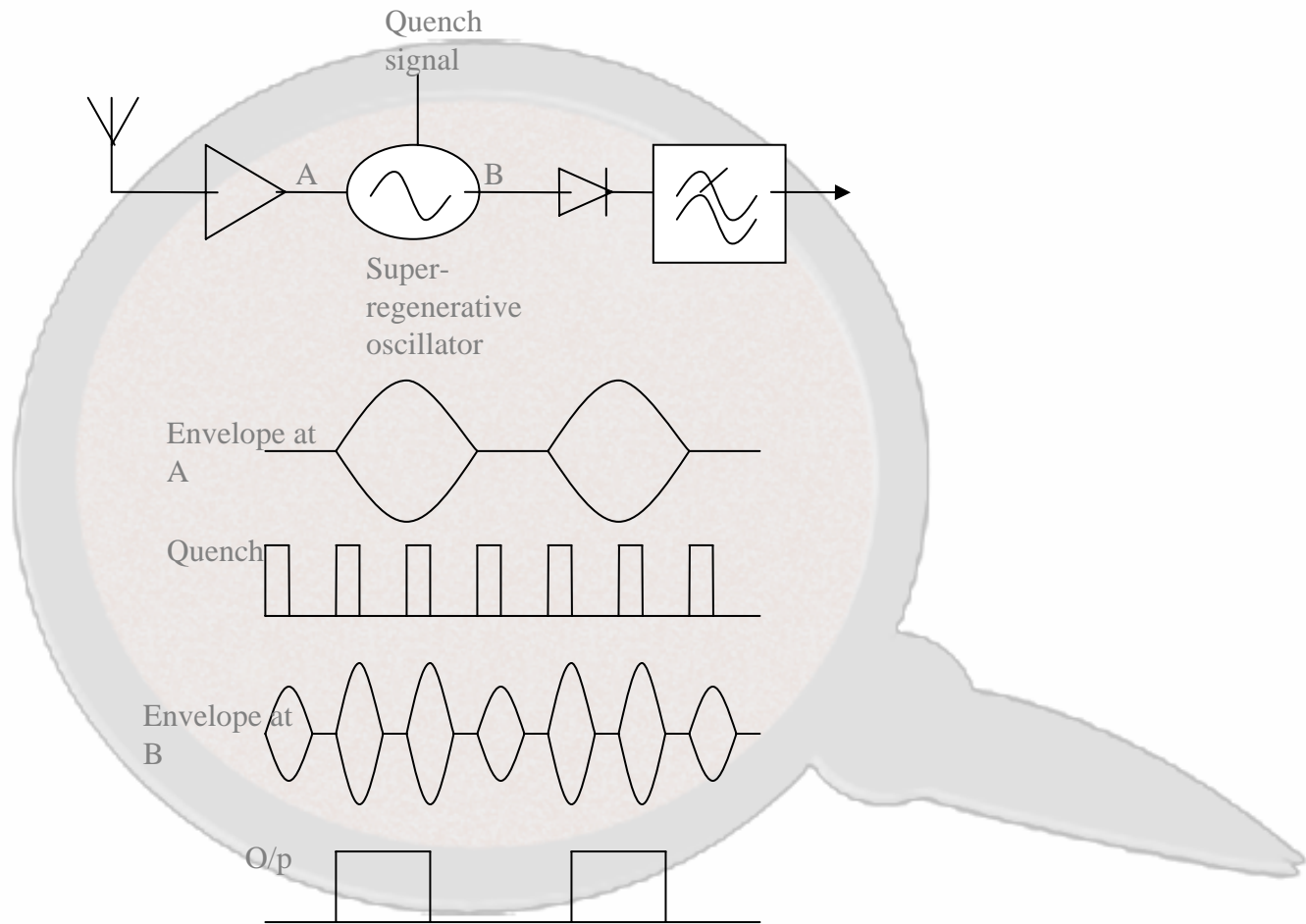
- Drawbacks – Associated Conversion Losses
 - L.O. frequency needs to be exactly the same frequency as received signal

Direct Conversion – On Off Keying (OOK)

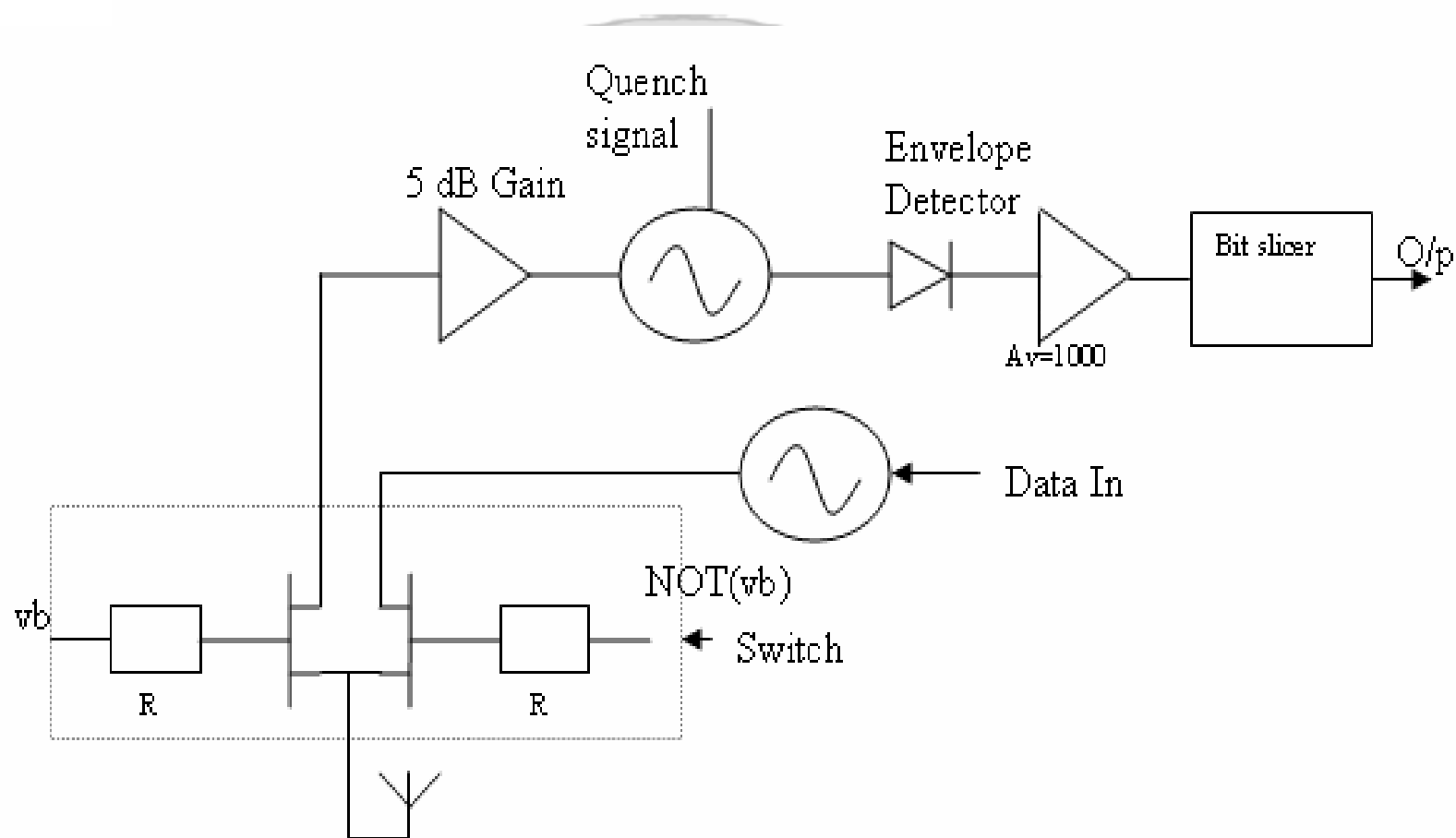


- Highly efficient modulation of carrier
- Very little power is drawn from baseband source (gate of transistor is open circuit)

Super Regenerative Receiver

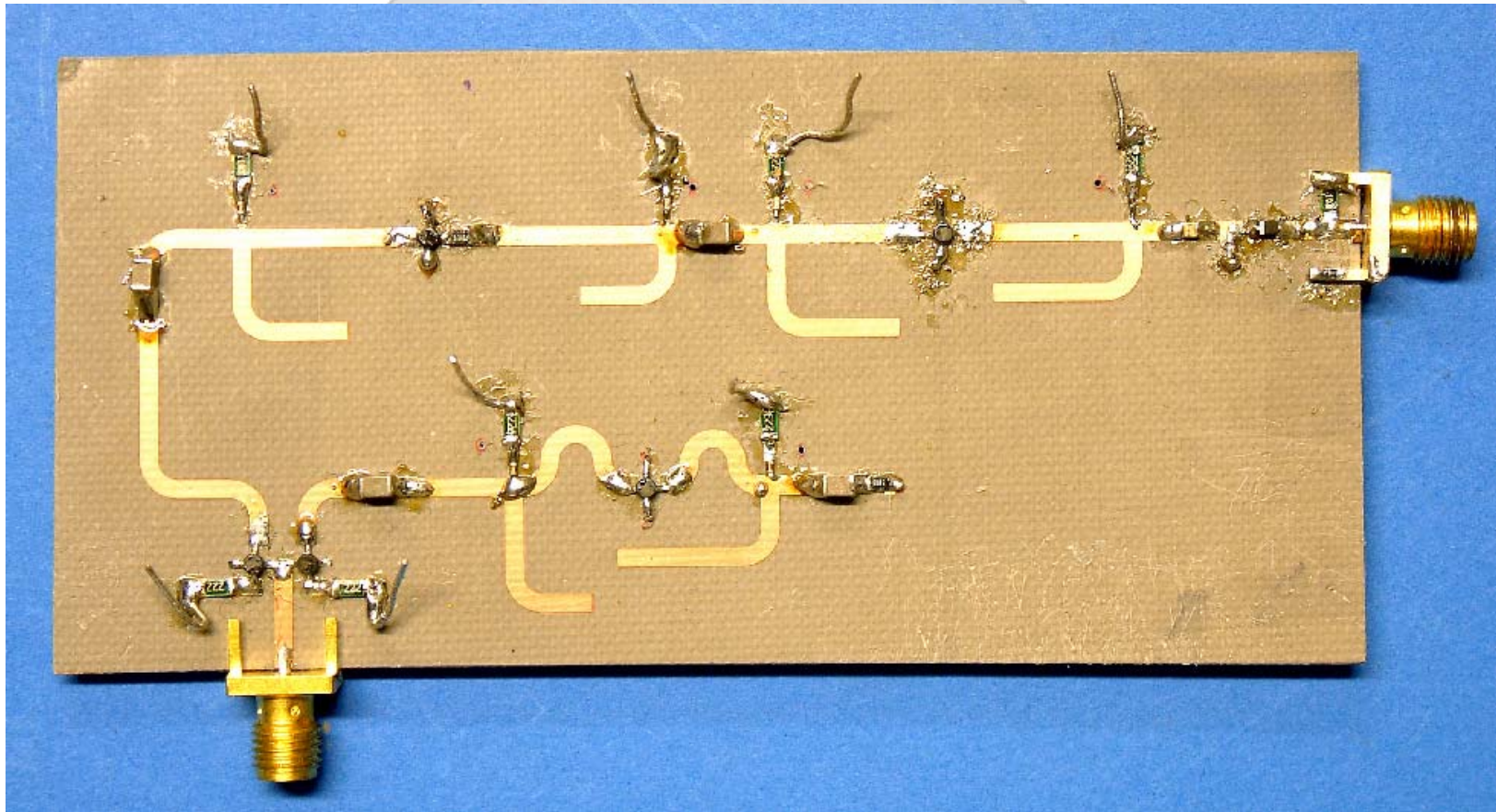


Architecture of complete Xceiver

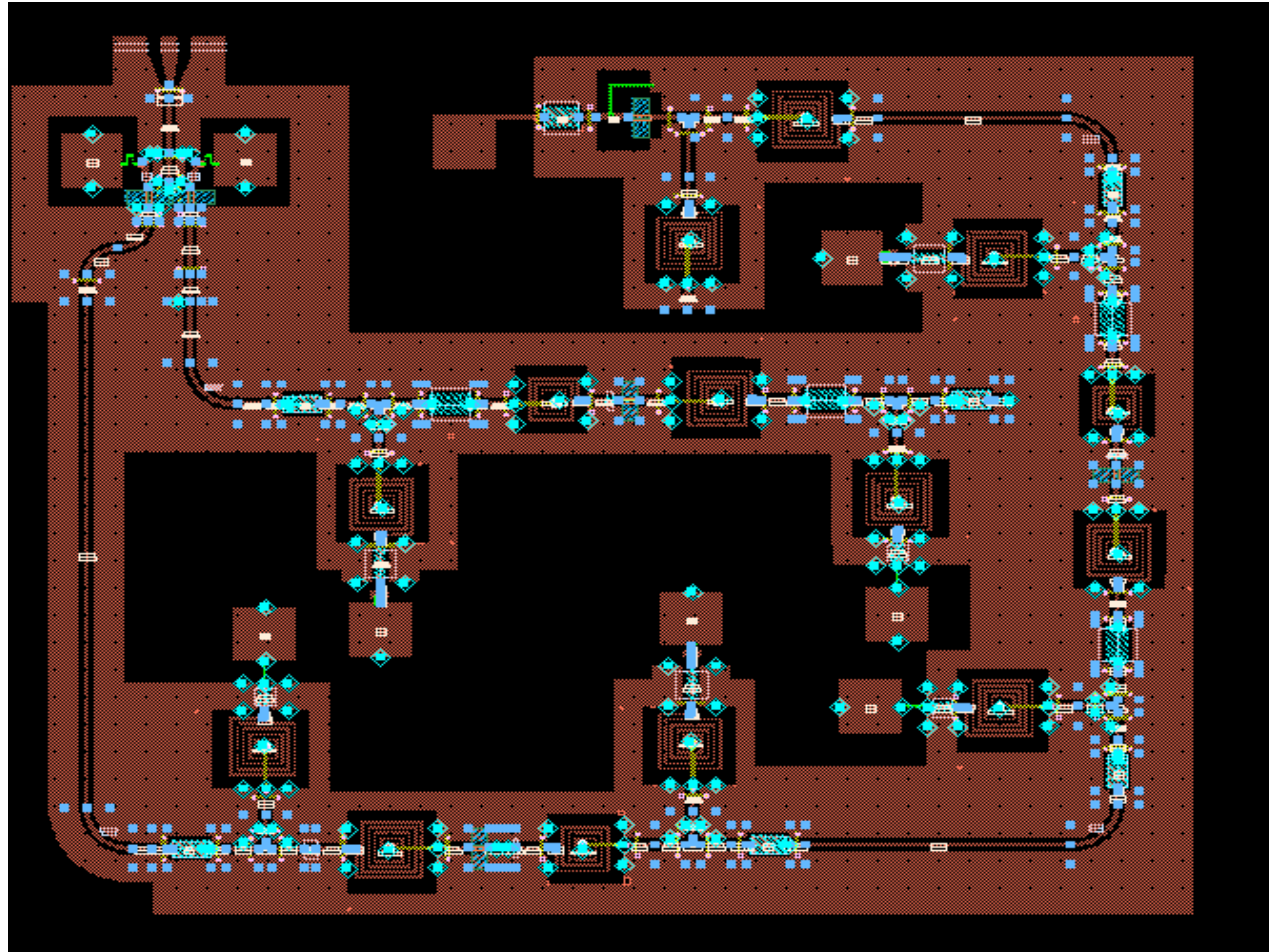


Implemented Prototype at 2.4GHz

- $R_x=380 \text{ uW}$ $T_x=400 \text{ uW}$
- o/p power = -10.5dBm



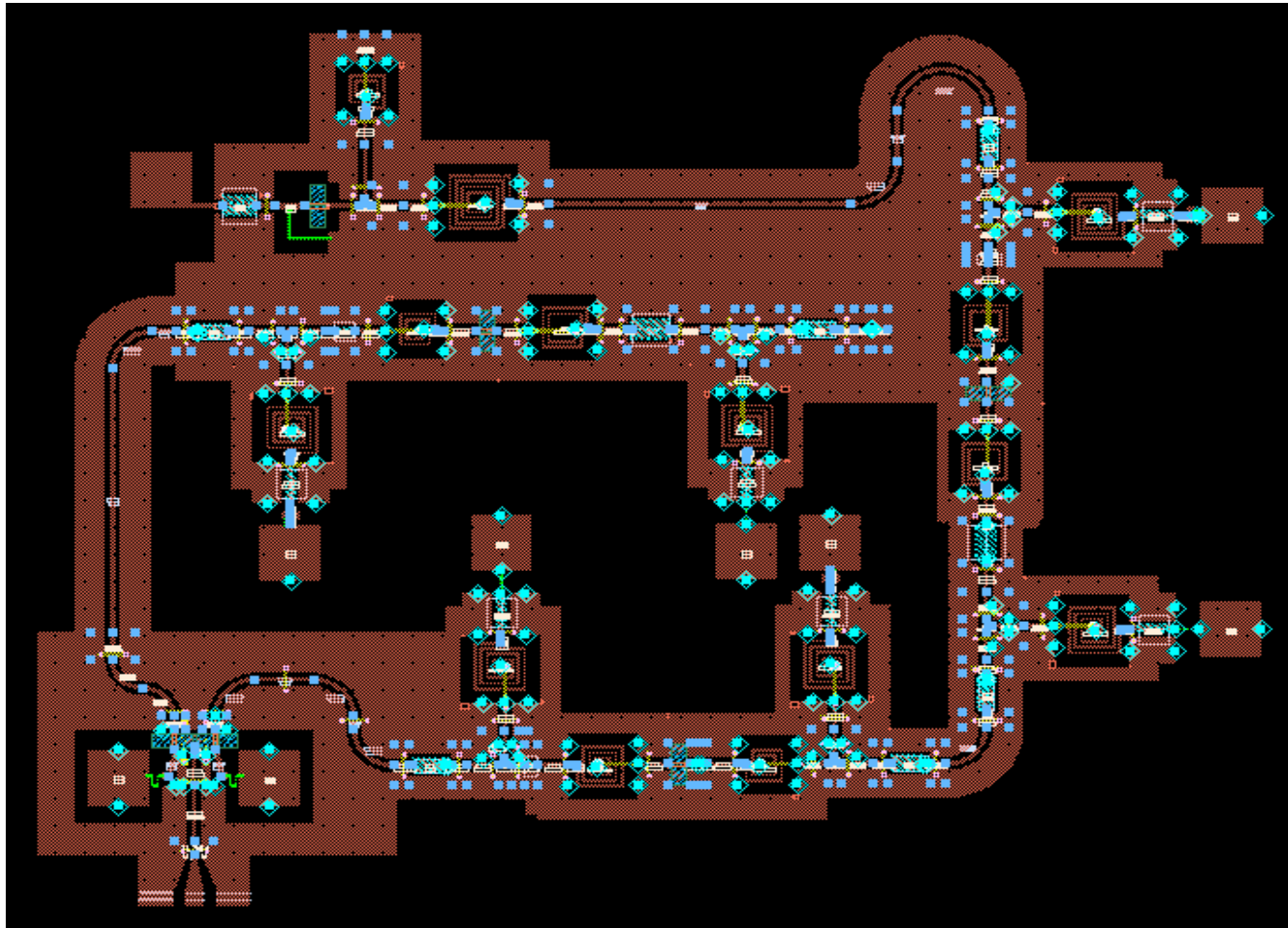
MMIC Implementation at 8GHz



Size = 3.8x3.2 mm

Power consumption = RX, 800uW Tx, 560uW

MMIC Implementation at 14GHz



Size = 4×3.1 mm

Power consumption = RX, 800uW Tx, 560uW

Modifications/Improvements to Basic Xceiver

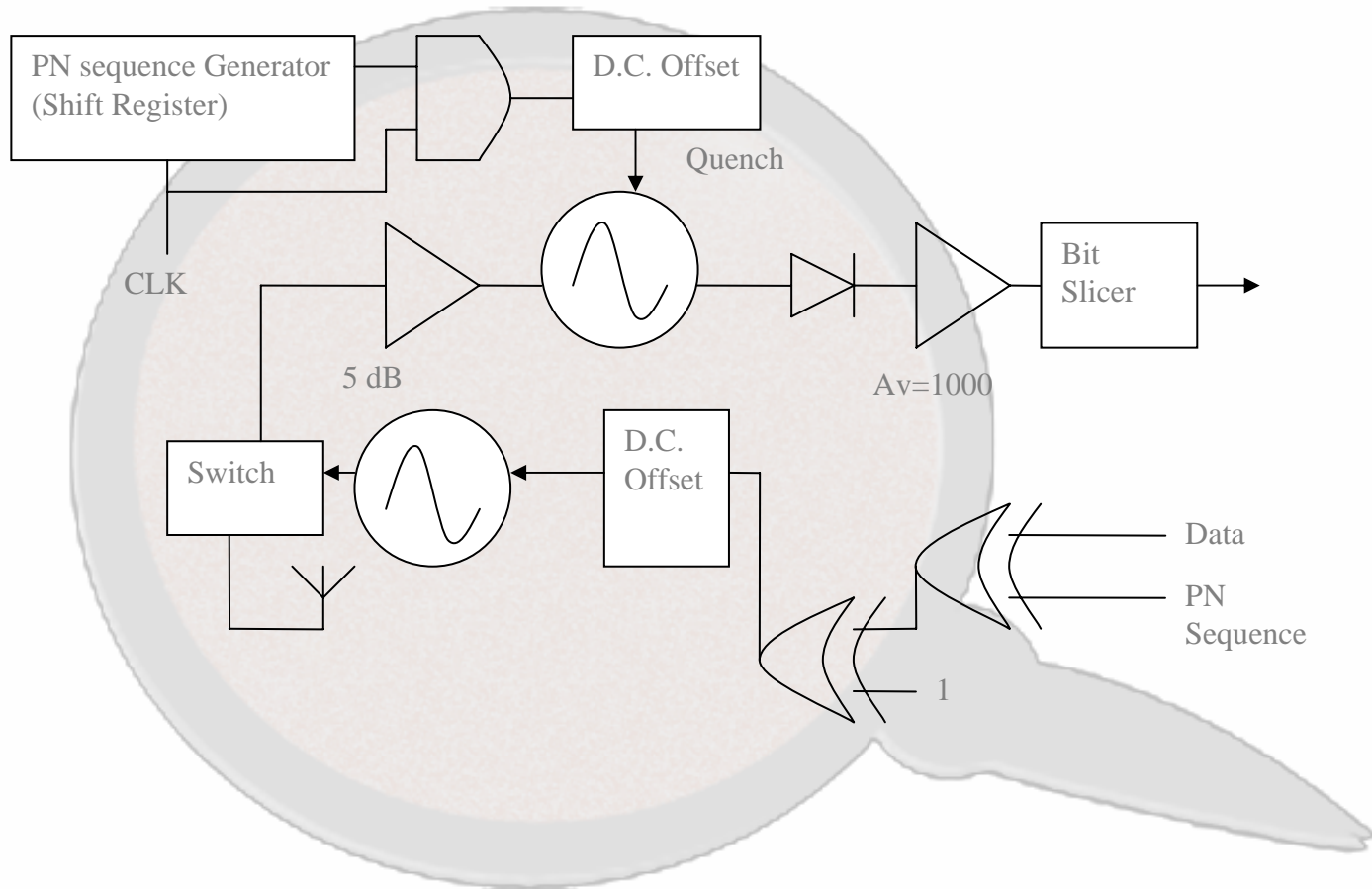
- Spread Spectrum Transceiver (Moncunhill et al)

Advantages: Multiple users divided by codes
occupying the same frequency band
Improved resistance to noise

- Low Duty Cycle SuperRegenerative Xceiver

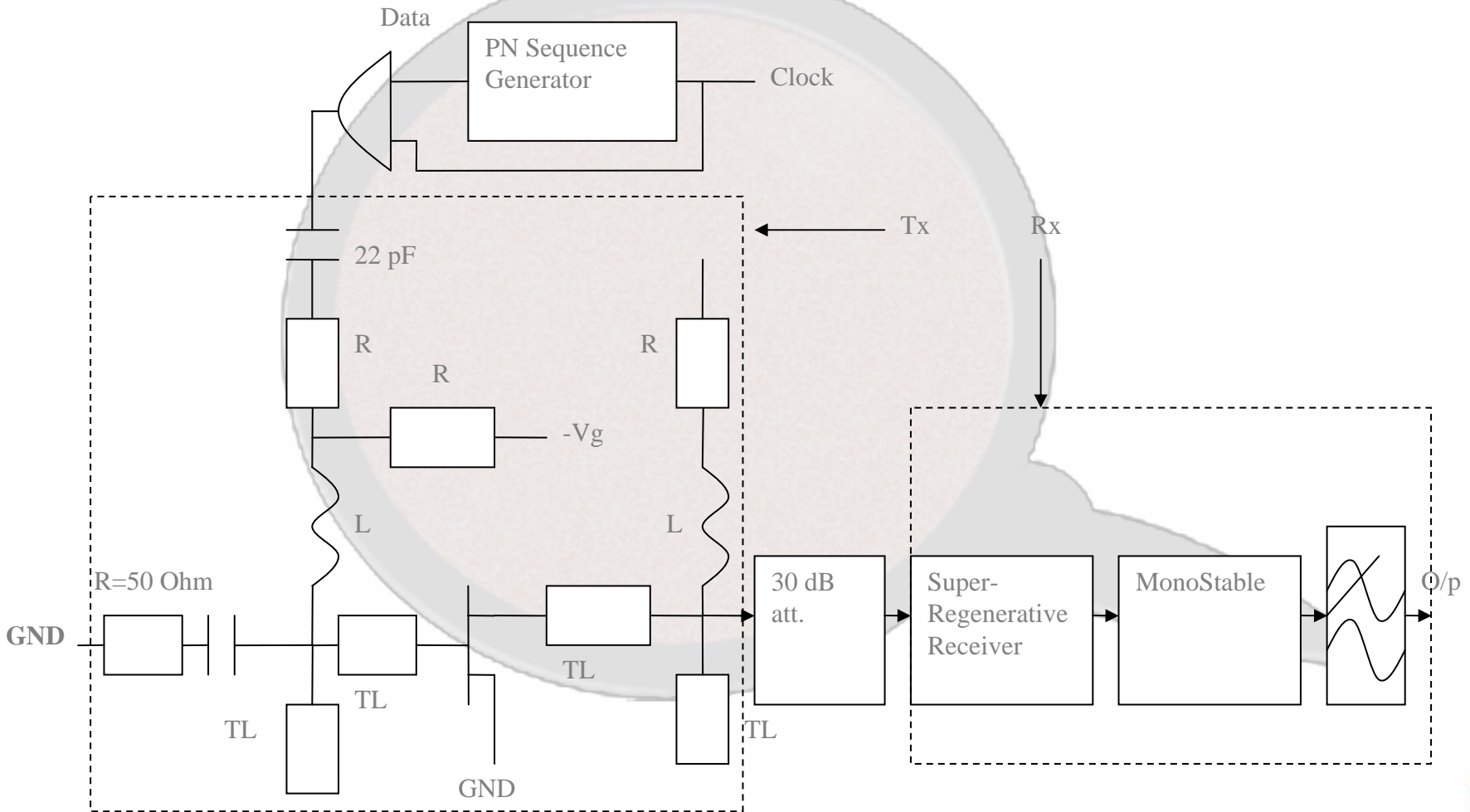
Advantages: Tx power greatly reduced for same
performance

Spread Spectrum Implementation

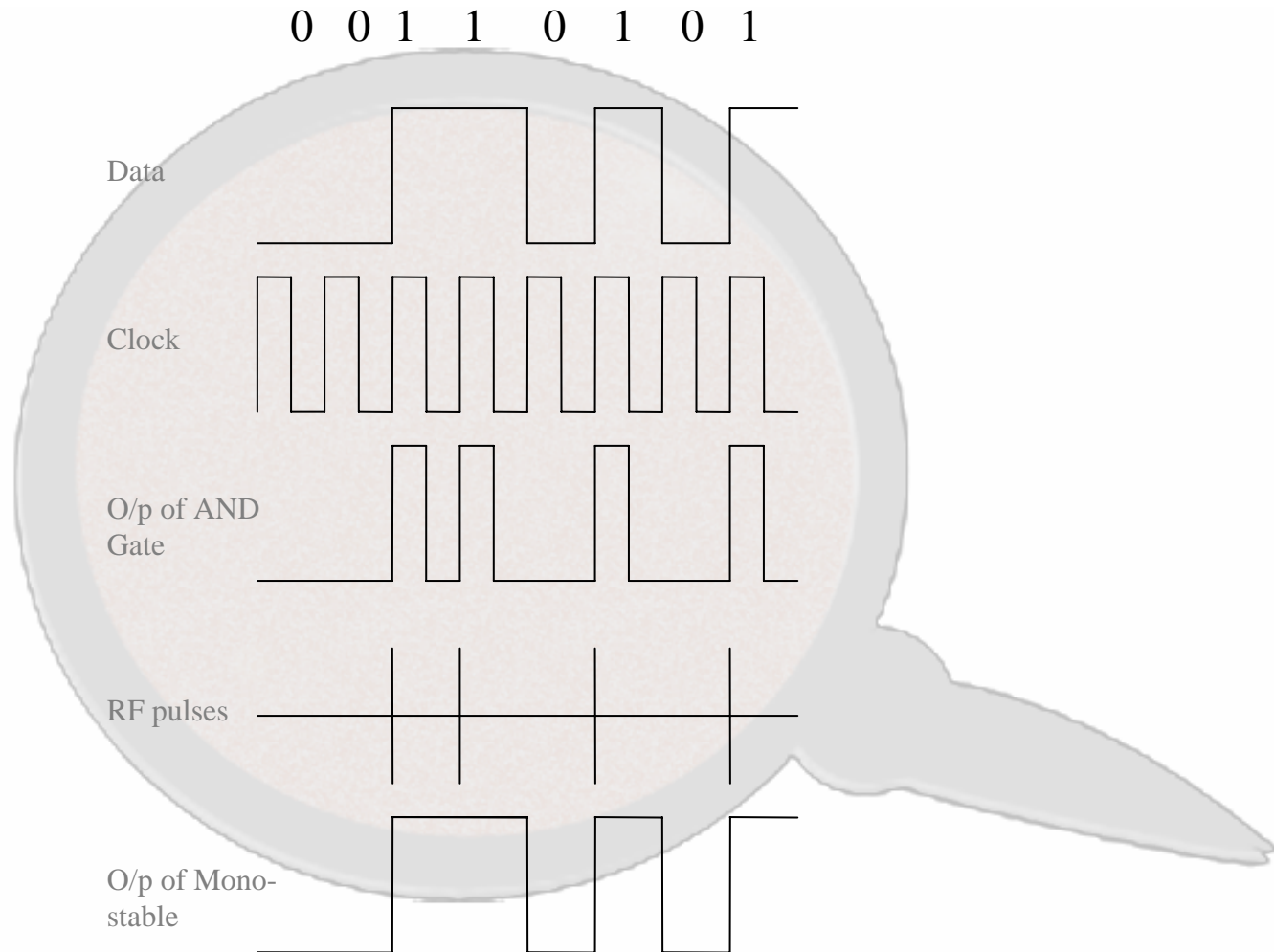


Low Duty Cycle Implementation

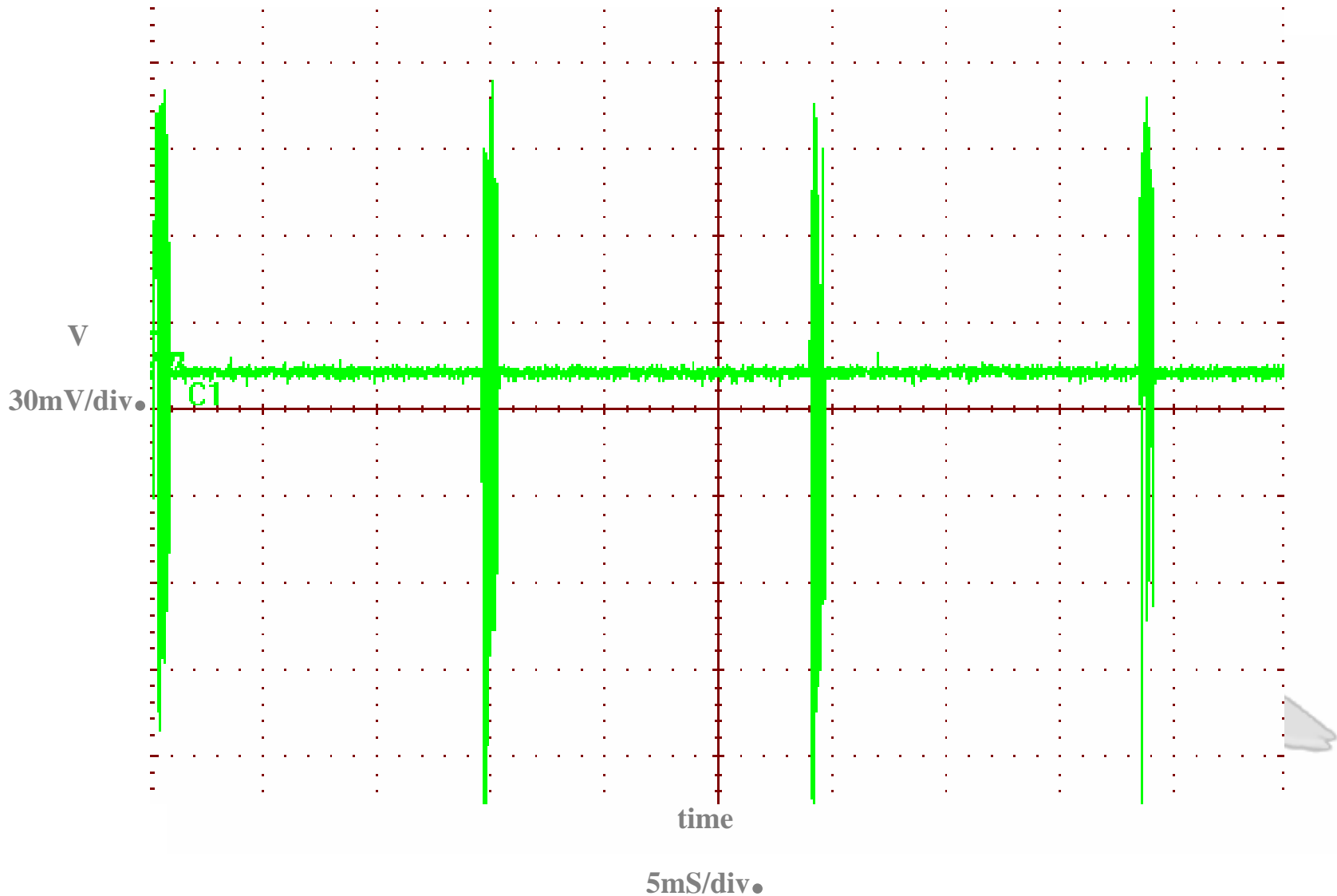
- Assuming Bandwidth of pulses does not exceed approx 50MHz performance is the same as normal Transceiver



Waveforms for Low duty Cycle Xceiver



Measured RF Pulses



Measured Results

