GOES CDMA Overlay Project

A Software Radio Approach

MICROCOM DESIGN

Richard Schwarz

Project Goals

- Determine feasibility of CDMA Overlay
- Evaluate and Test Current System Hardware
  - Satellite filter wideband specs
- Implementation a Flexible Software Radio Prototype Eval System
- Actual in system testing
- Actual working prototype system

MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030
410-771-1070 http://www.microcomdesign.com

Description

- **CDMA Overlay Project will evaluate a CDMA/TDMA overlay system using highly flexible and programmable hardware and analysis tools using a flexible software radio approach.**
  - **Phase 1 Evaluation System: –Matlab/AMIQ/PC Digitizer**
    - **Fully digital Matlab Preprocessed test signals**
      - **Rohde Schwarz AMIQ**
    - **Digitization of entire IF and post processing demodulation**
      - **GAGE PC Digitizer**
  - **Phase 2 Evaluation System: Prototype Software Radio Approach**
    - **Modification of existing Microcom equipment**
    - **Real hardware-ready to use**

MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030
410-771-1070 http://www.microcomdesign.com

Hardware Analysis

- **Exisiting System Evaluation**
  - **System bandwidth, filters etc.**
    - **Satellite band pass filter**
      - **Linearity**
      - **Ripple**
      - **Spreading SNR impact**
  - **Existing TDMA system Stats**
    - **Microcom's Database analysis software**

CDMA Analysis

- **Coding Properties**
  - **Chip Rate**
  - **Type of codes**
    - **Tap, Length, Fill, programmable**
    - **GOLD, Kassami, Maximal, Any…..**
    - **Number of channels**
- **Noise & interfere immunity (MAI,TDM)**
- **Preamble approach**

MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030
410-771-1070 http://www.microcomdesign.com

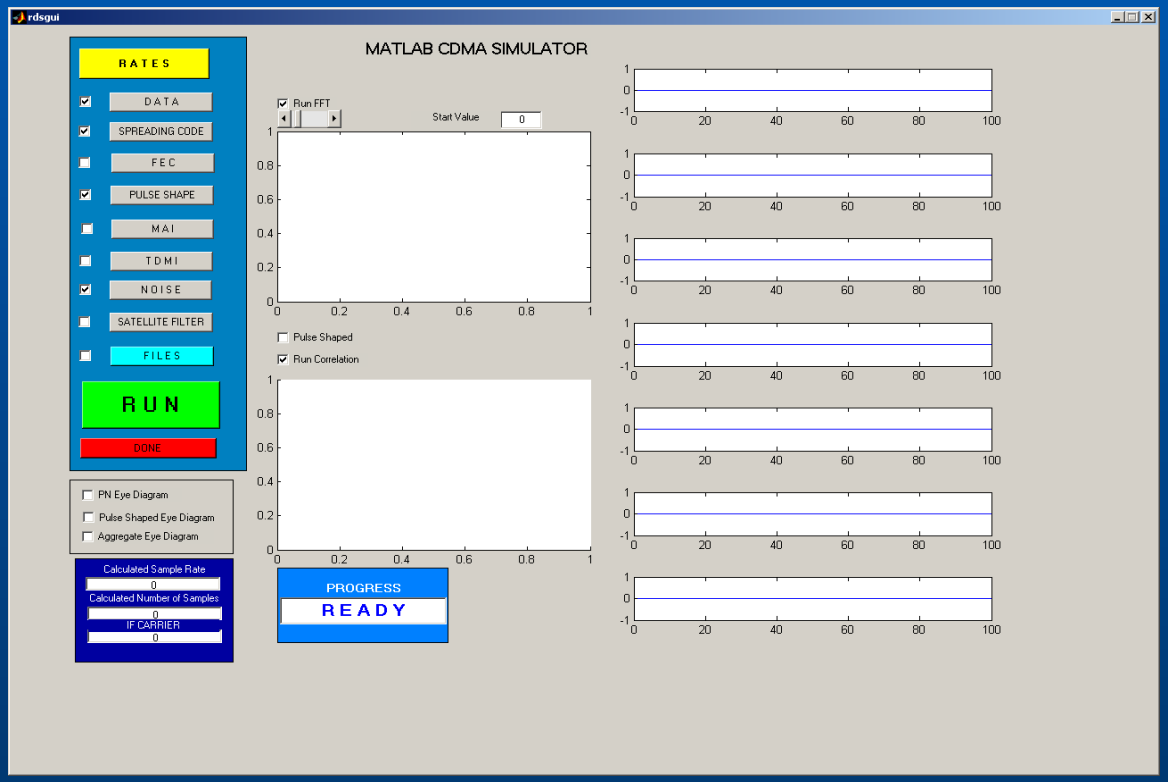
CDMA Simulation System

- **Phase 1: Matlab Post Digitizer Processor**
  - **MATLAB Test Signal Generation**
  - **Rohde Schwarz AMIQ Tx Digital to Analog**
  - **GAGE Digitizer card Rx Analog to Digital**
  - **MATLAB Down conversion and Analysis**

MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030
410-771-1070 http://www.microcomdesign.com

Matlab Test Signal Generation

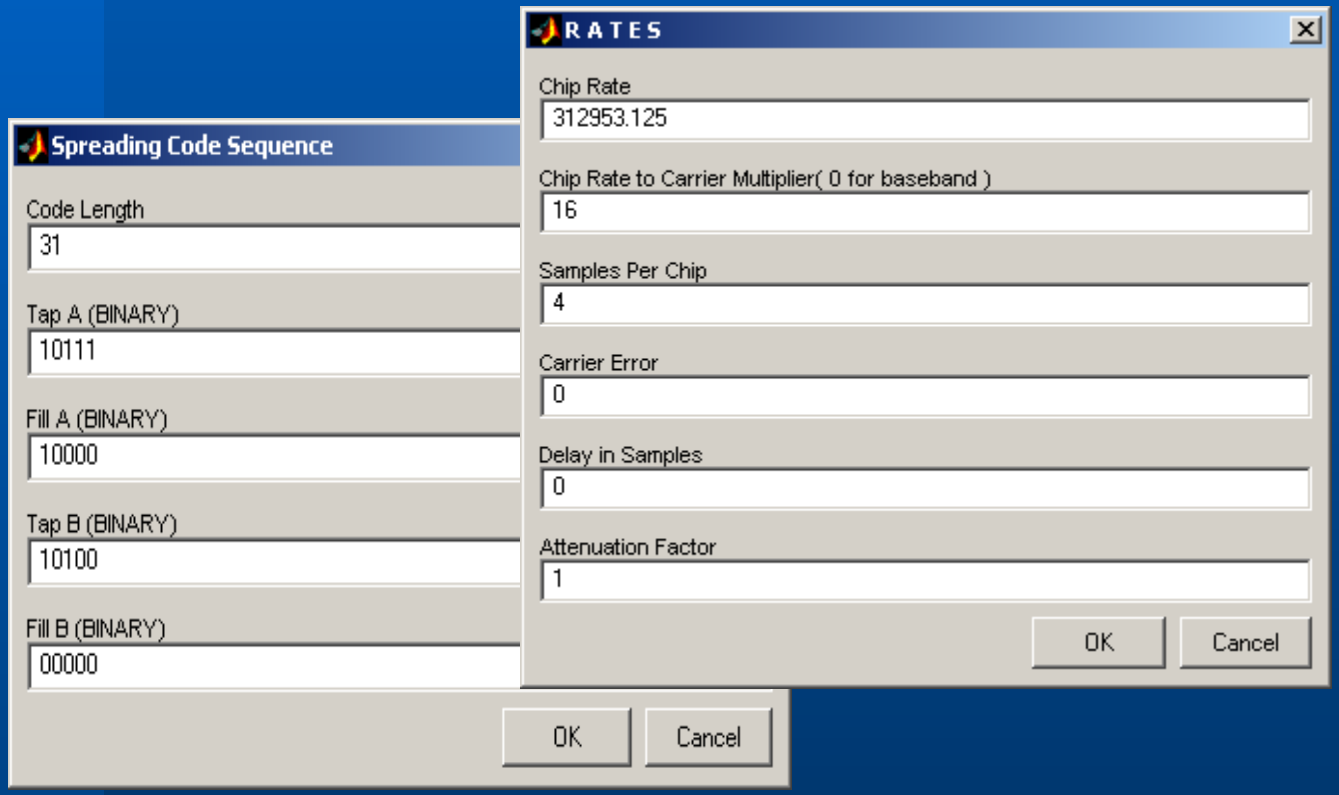
- Written in Matlab
- TX GUI
- Flexible
- Data plots
  - Frequency Spectrum
  - Time Signals
  - Correlations



MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030

410-771-1070 http://www.microcomdesign.com

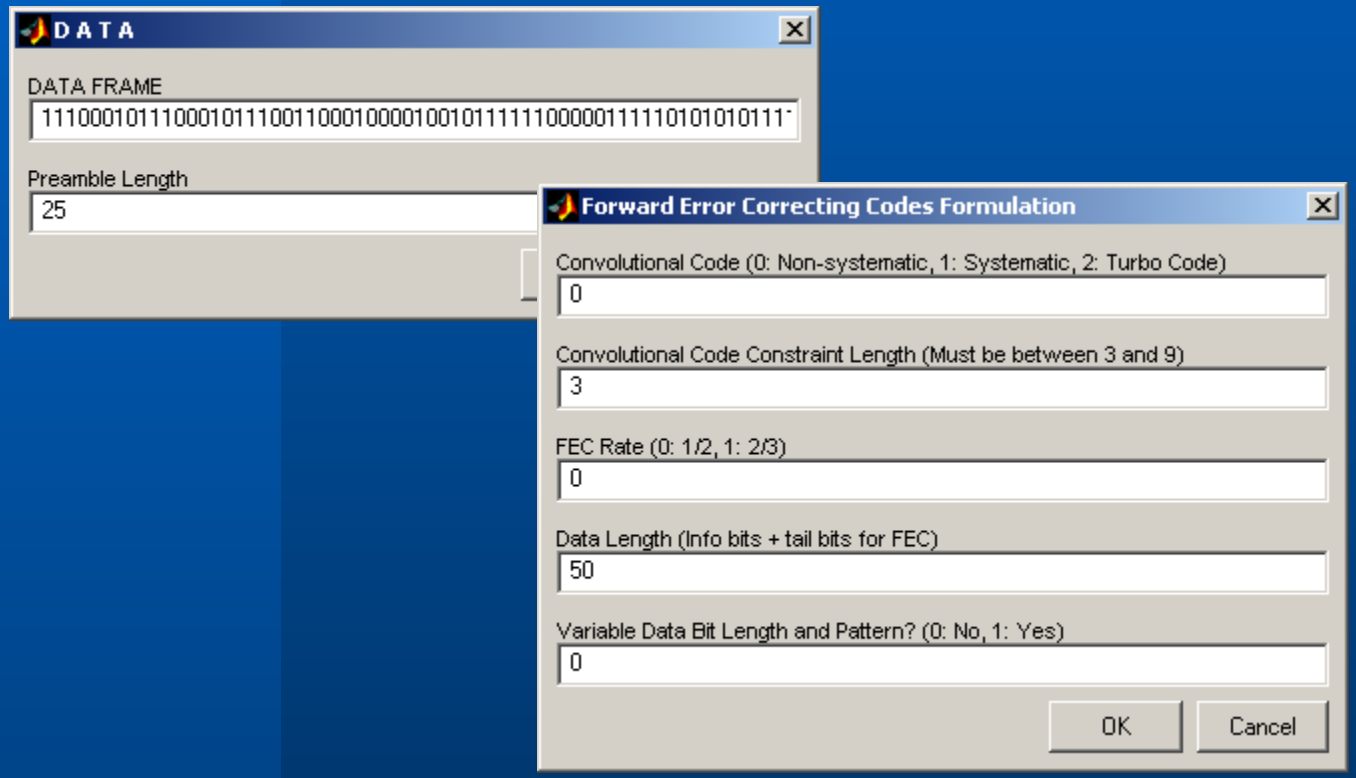
Flexible PN Settings



MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030

410-771-1070 http://www.microcomdesign.com

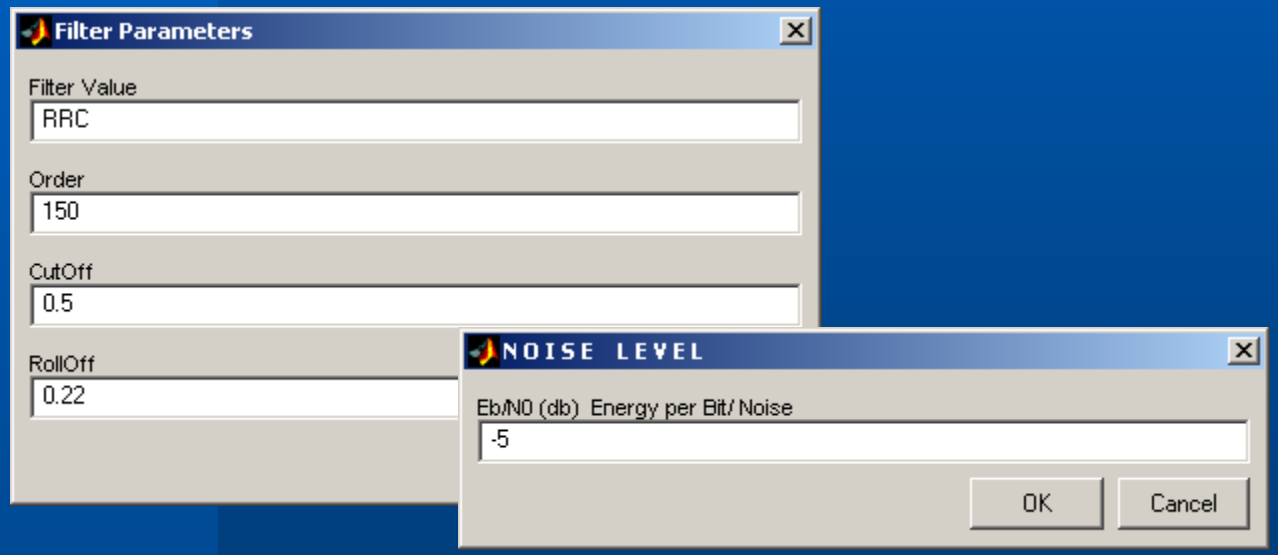
Data & FEC Settings



MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030

410-771-1070 http://www.microcomdesign.com

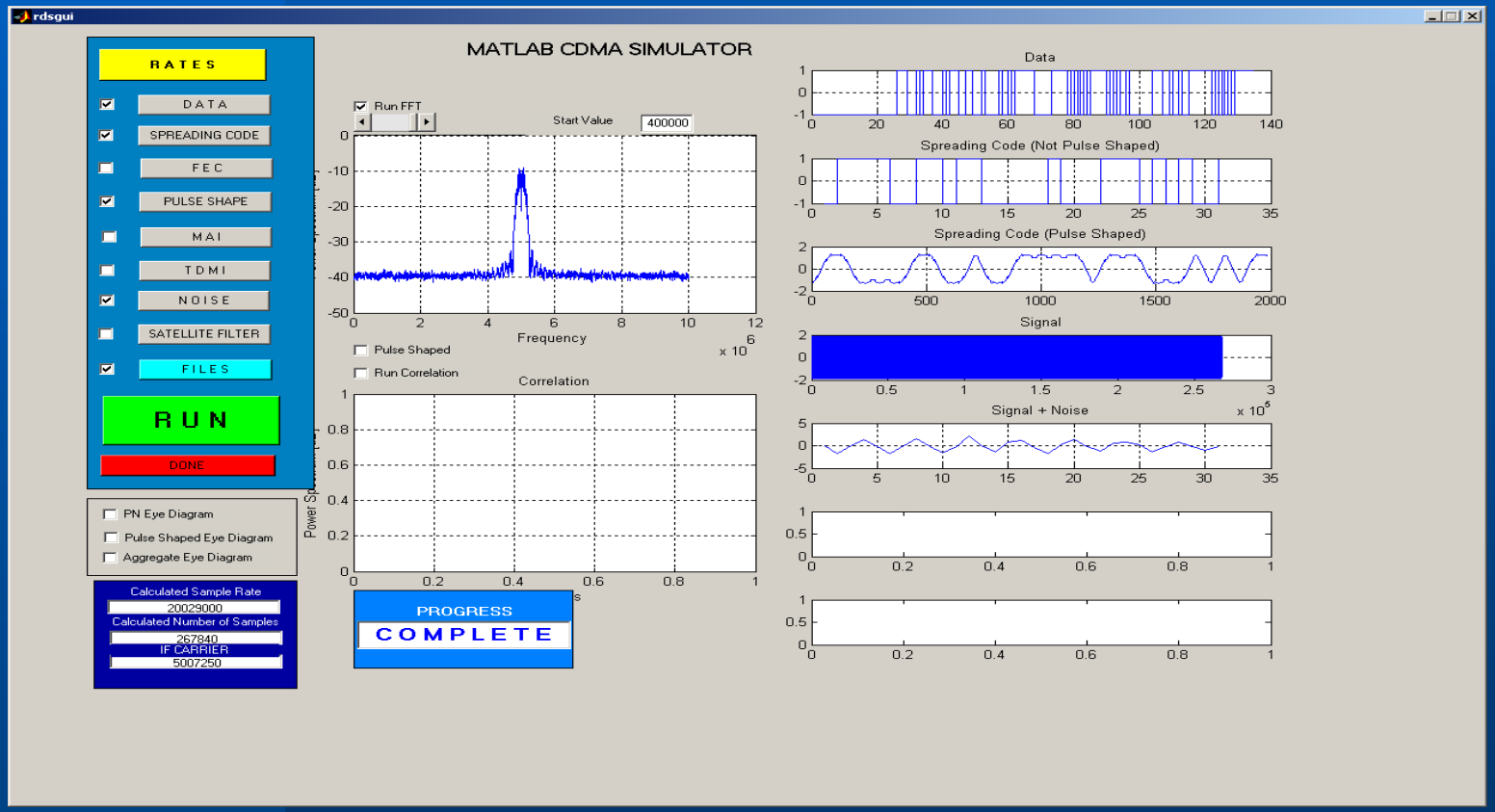
Pulse Shaping / Noise



MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030

410-771-1070 http://www.microcomdesign.com

Signal Viewing

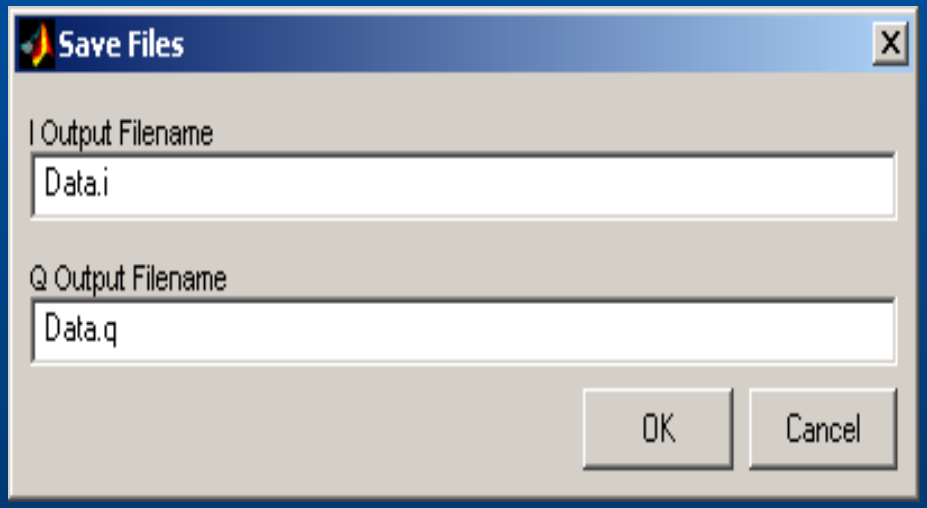


MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030

410-771-1070 http://www.microcomdesign.com

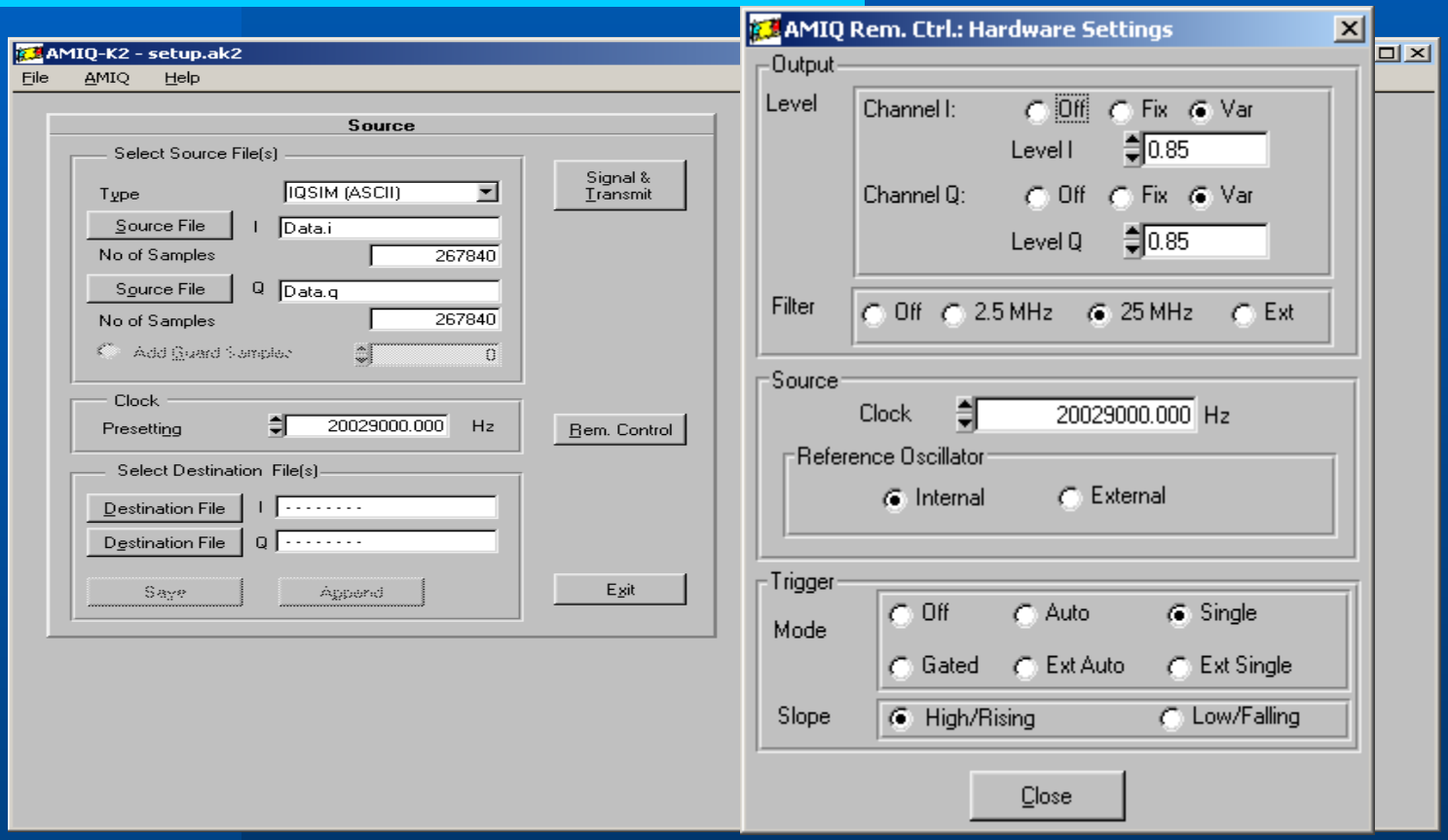
Signal Files

- **Files can be saved and formatted for Rhode and Schwarz AMIQ generation**



MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030
410-771-1070 http://www.microcomdesign.com

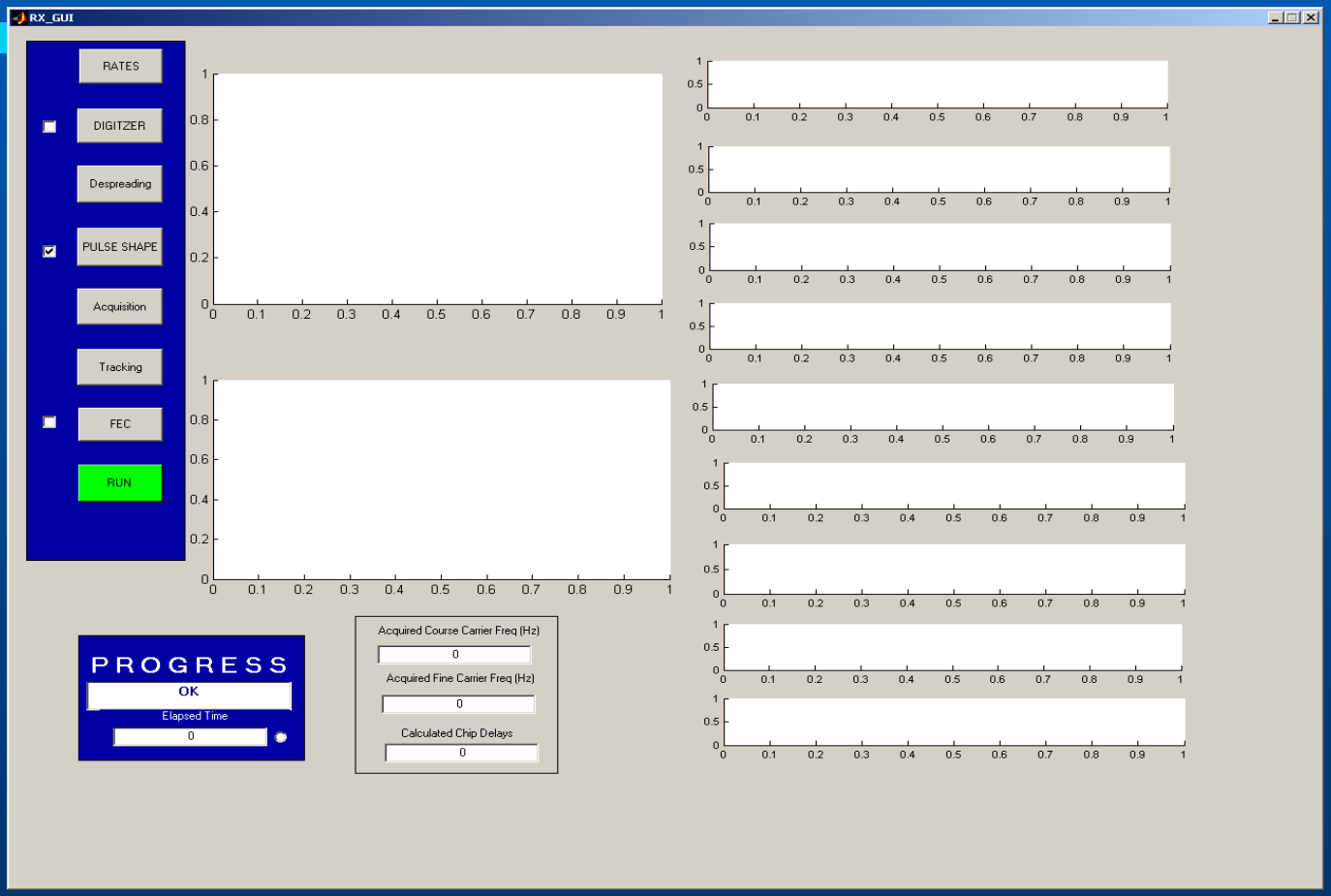
Rhode and Schwarz AMIQ



MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030

410-771-1070 http://www.microcomdesign.com

Phase 1 Rx Simulation

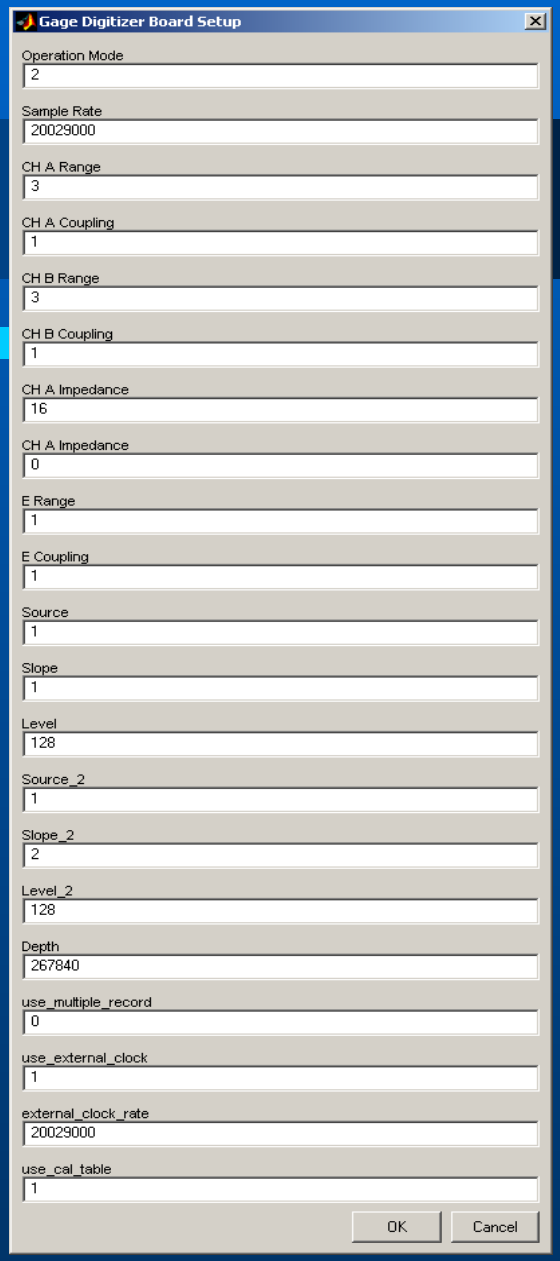


MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030

410-771-1070 http://www.microcomdesign.com

Digitizer Set Up

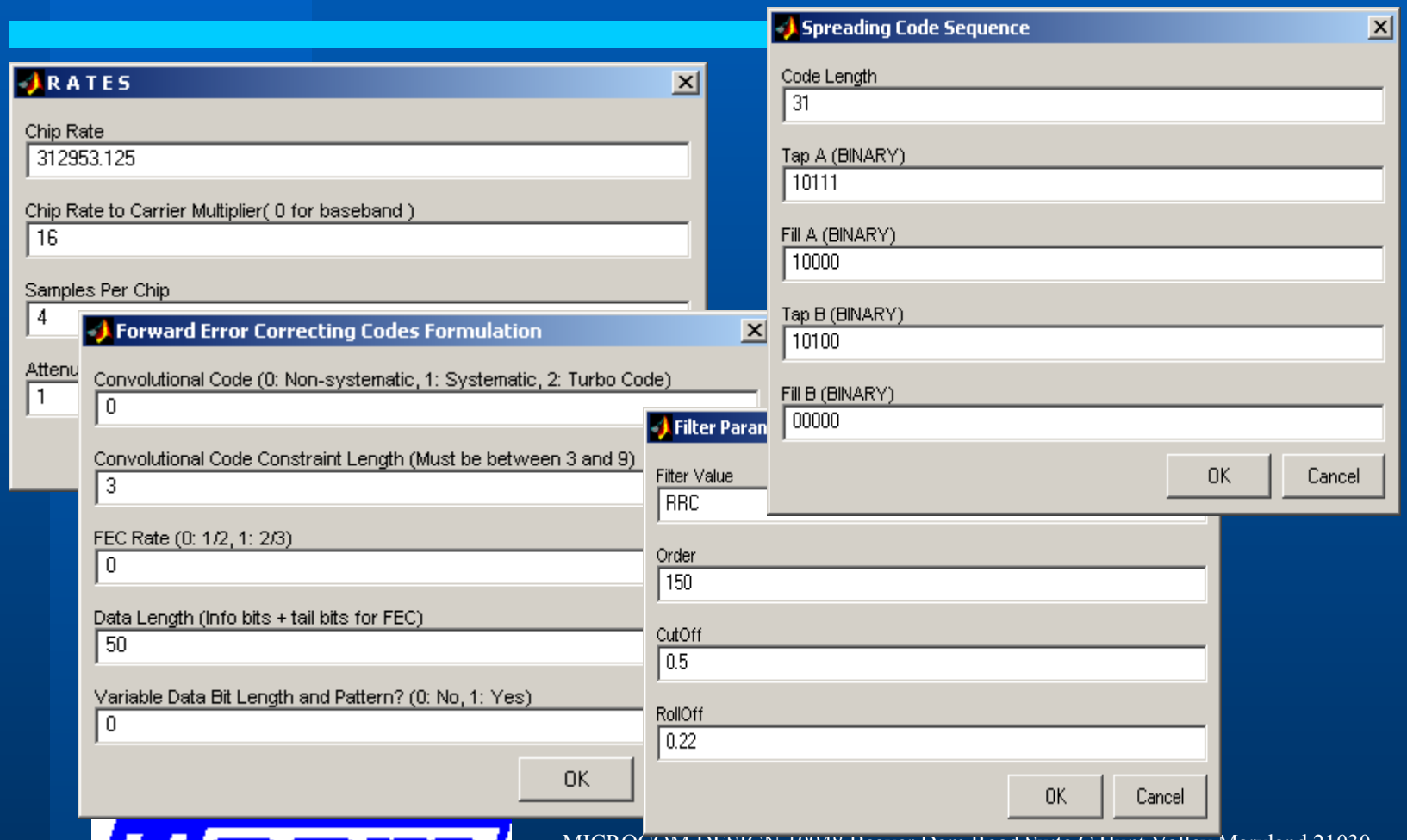
- Gage digitizer program sets up like a digital oscilloscope through Matlab



MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030

410-771-1070 http://www.microcomdesign.com

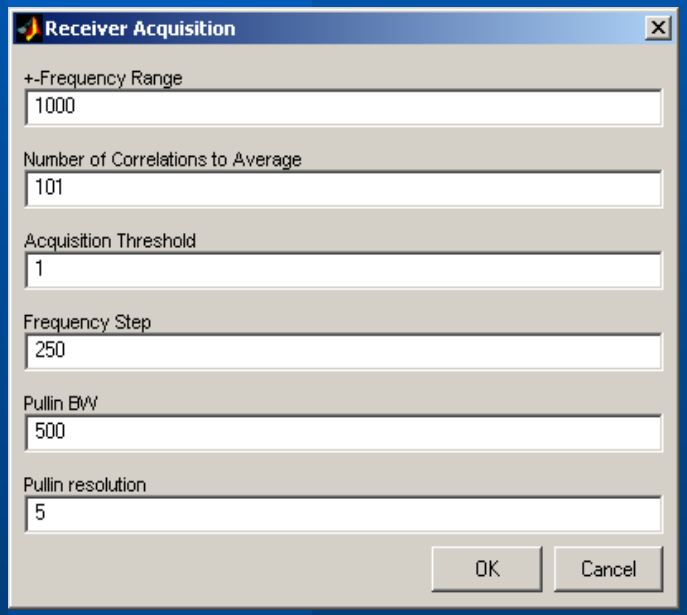
Rx Setup dialogs

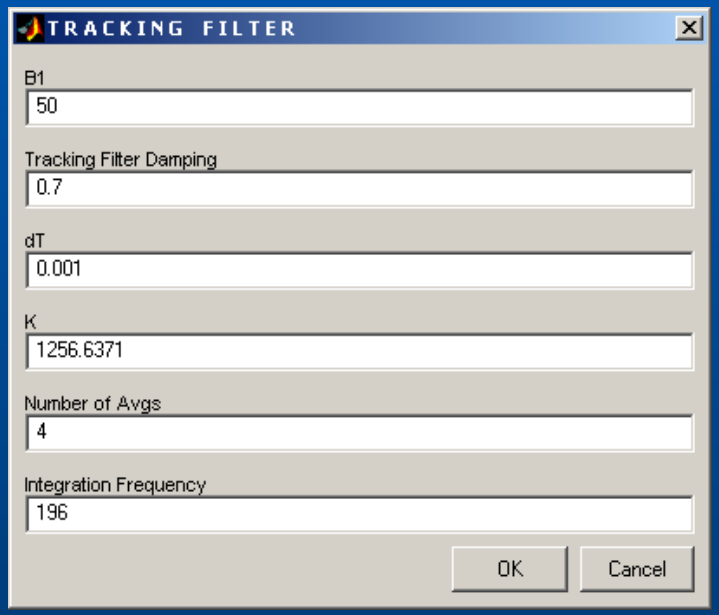


MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030

410-771-1070 http://www.microcomdesign.com

Acquisition and Tracking

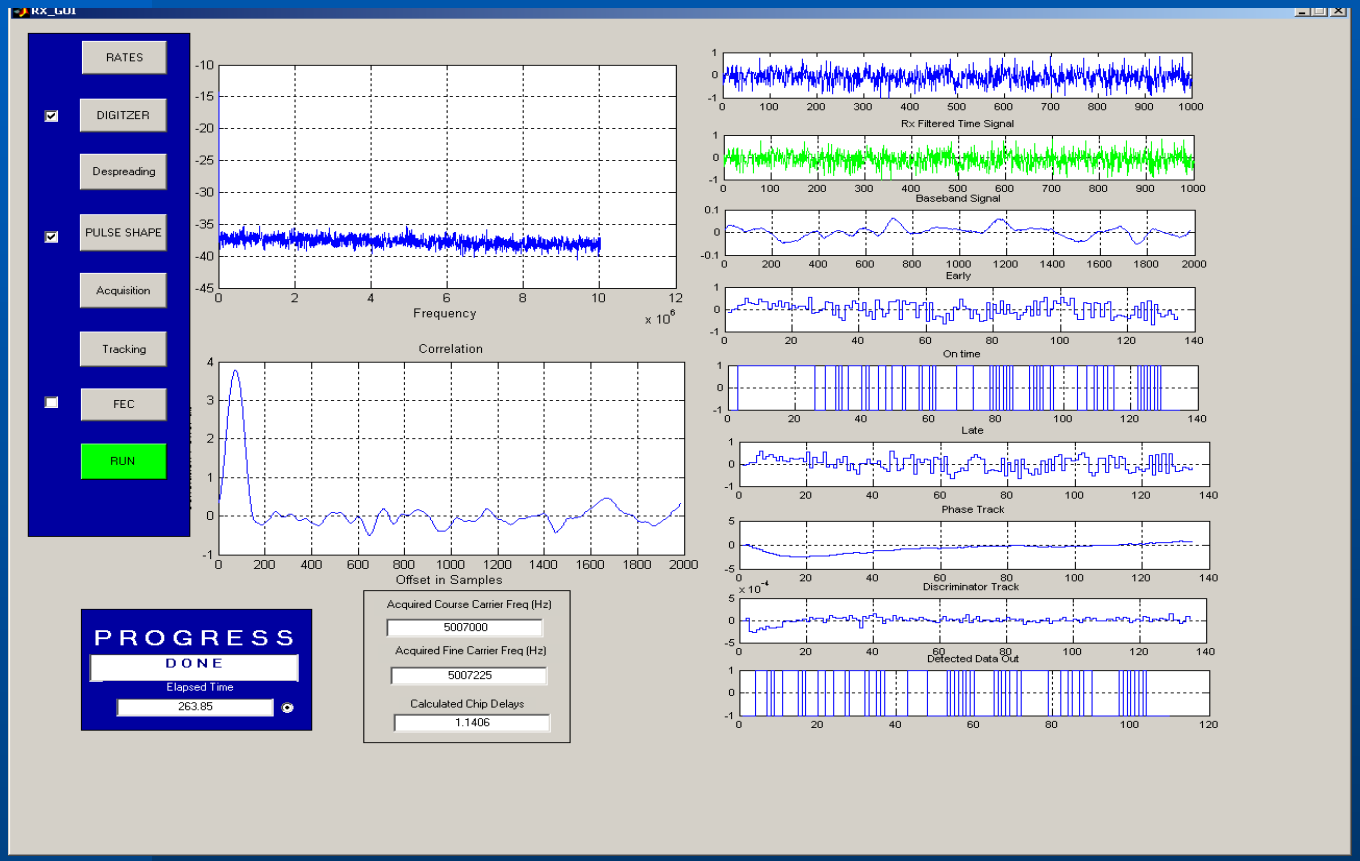




MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030

410-771-1070 http://www.microcomdesign.com

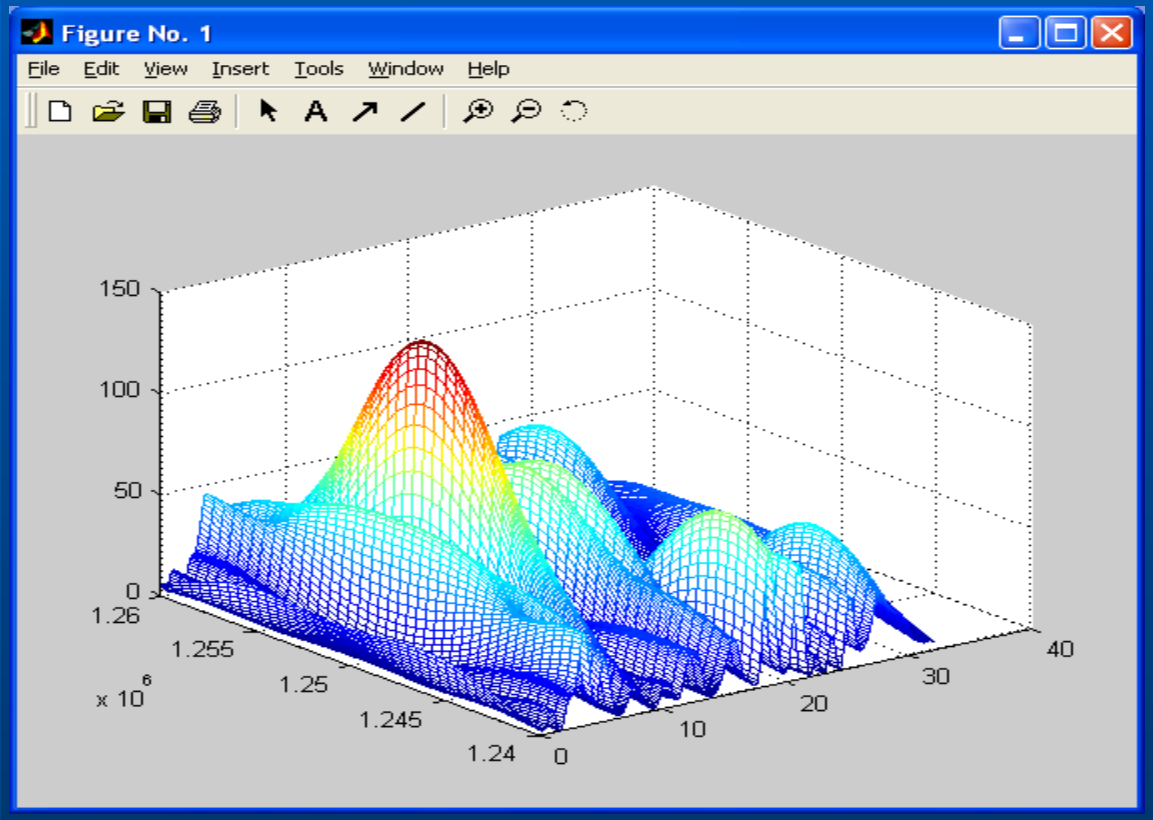
Demodulator Results



MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030

410-771-1070 http://www.microcomdesign.com

3D Correlation Results



MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030

410-771-1070 http://www.microcomdesign.com

Prototype Implementation

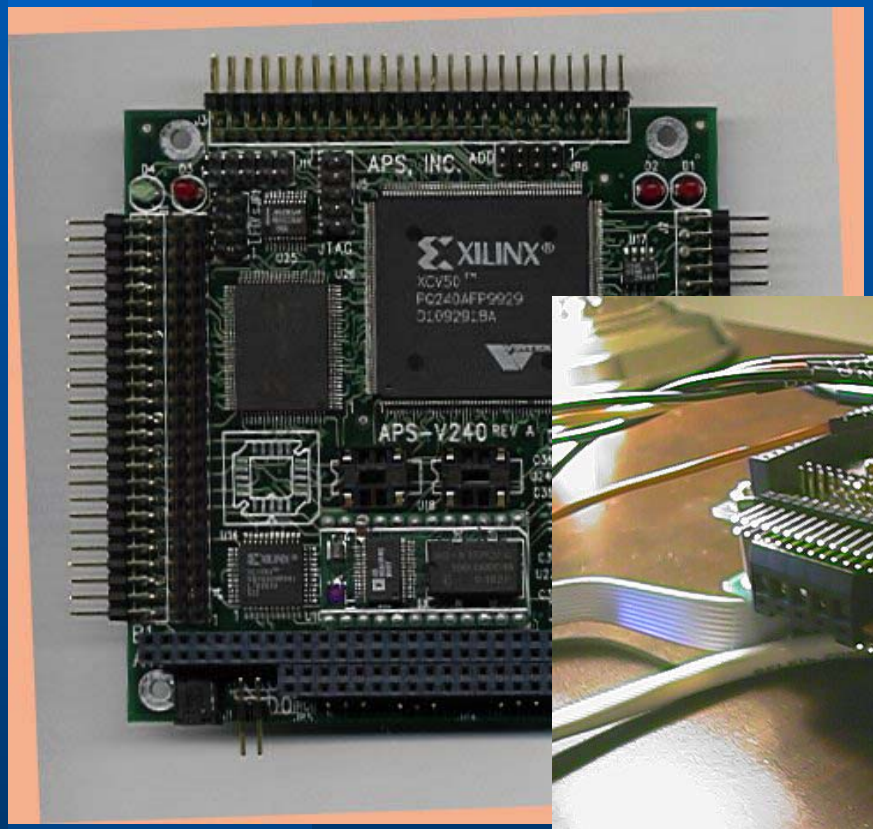
- **Phase 2:**
  - Transmitter Implementation
    - Modified Microcom Modulator
    - FPGA Daughter card handles Spreading
  - Receiver Implementation
    - ASIC Tuner Front End
      - AGC
      - Down conversion
      - Pulse Shaping / Filtering
    - FPGA / VHDL PC104
      - Interference Cancellation
      - Correlation Acquisition*
      - Tracking
      - Sample clock control
      - Tracking*
    - Pentium PC104 Processor / C/++
      - Tracking/Acquisition *
      - FEC
      - Data Demodulation and forwarding

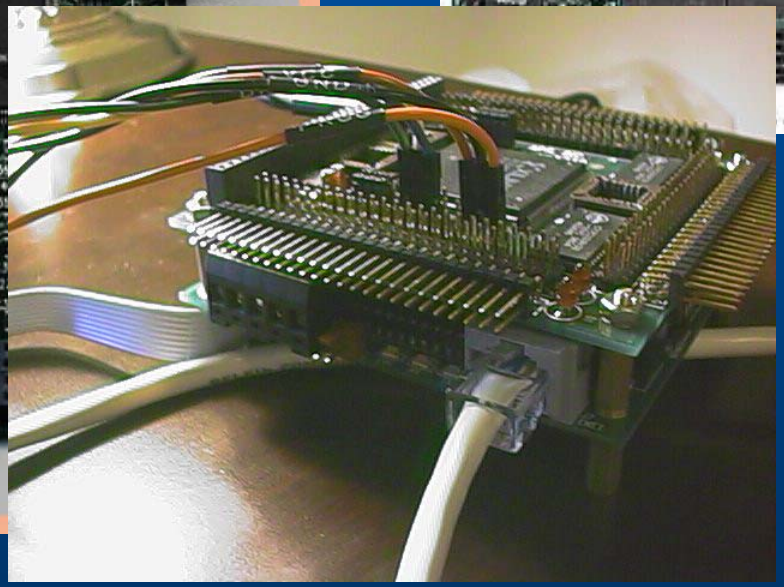
* Tracking and Acquisition trade offs will be implemented in FPGA and PC104

MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030

410-771-1070 http://www.microcomdesign.com

Rapid Development

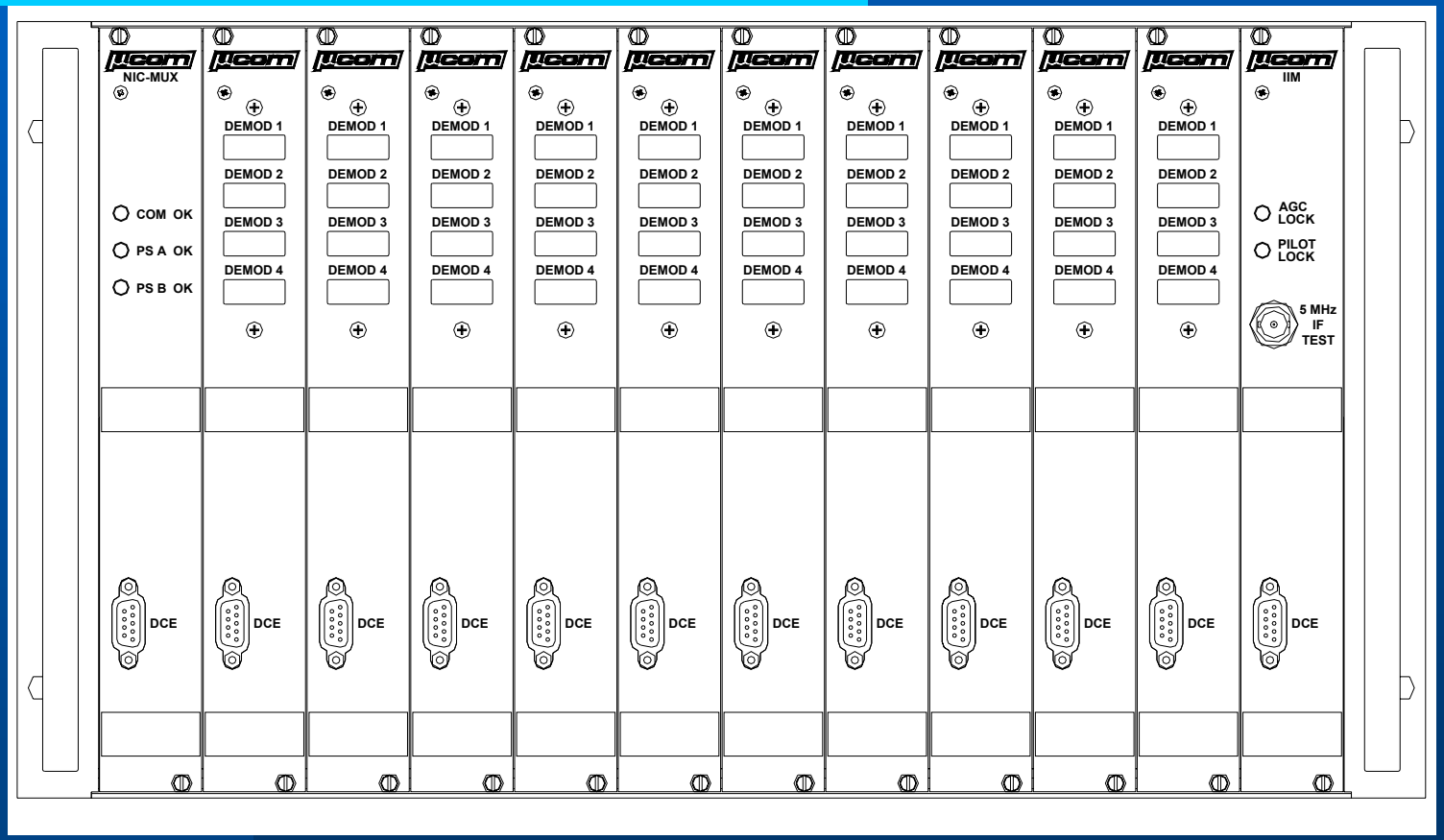




MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030

410-771-1070 http://www.microcomdesign.com

Integrated into existing GOES Equipment



MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030

410-771-1070 http://www.microcomdesign.com

Phase 2 System Integration

- Tx CDMA functionality integrated via FPGA daughter card on existing Microcom HDR Modulator
- Rx CDMA functionality implemented into recently delivered Microcom Design DAMS NT system.

MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030
410-771-1070 http://www.microcomdesign.com

Expectations

- We are targeting around 50 CDMA users
- Expect to use ~312500 Hz chip rate
- R11 Gold Code PN Generators
  - 152.6 Hz data stream.
- Root Raised Cosine Pulse shaping
- Expect Software radio to be able to implement TDMA and or CDMA signals as well as others
- Expect Power control synchronous back channel to be eventually implemented ?
- System flexible enough to implement new features

FOR MORE INFO...

Contact MICROCOM DESIGN

MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030

410-771-1070 http://www.microcomdesign.com

Summary

- **CDMA Overlay Project will evaluate a CDMA/TDMA overlay system using highly flexible and programmable hardware and analysis tools using a flexible software radio approach.**
  - **Phase 1 Evaluation System: –Matlab/AMIQ/PC Digitizer**
    - **Fully digital Matlab Preprocessed test signals**
      - **Rhode Schwarz AMIQ**
    - **Digitization of entire IF and post processing demodulation**
      - **GAGE PC Digitizer**
    - **System currently in place and working in Microcom Spaces**
  - **Phase 2 Evaluation System: Prototype Software Radio Approach**
    - **Modification of existing Microcom equipment**
    - **Real hardware- integrated into existing Microcom GOES Hardware**
    - **System partially designed and in the works.**

MICROCOM DESIGN 10948 Beaver Dam Road Suite C Hunt Valley Maryland 21030

410-771-1070 http://www.microcomdesign.com