

ARGONNE
NATIONAL LABORATORY



United States
Department of Energy

The University of Chicago

ENTRANCE

BCDA Hardware

Capabilities and Solutions

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BCDA Cross Training Session 2/21/05

Argonne National Laboratory



Office of Science
U.S. Department of Energy

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BCDA Hardware: Overview

- Introduction
- Capabilities
- BCDA hardware that we stock
- Custom BCDA hardware solutions
- Vendor hardware that we support
- New projects
- Conclusion



Bob Pease Nat'l Semiconductor



BCDA Hardware: Introduction

- **Who we are**

- Kurt Goetze
- Peter Fuesz



- **Mission: support APS beamline control systems by...**

- Facilitating access to our hardware solutions
- Keeping stock of the boards and systems used most
- Keeping stock of common electronic parts, connectors and tools
- Assisting beamline personnel with electronics issues
- Assisting BCDA & others with electronics issues
- Developing new hardware solutions as needed
- Testing, diagnosing problems, repairing hardware
- Documenting (☺) what we do
 - *APS HW catalog:* <http://www.aps.anl.gov/aod/bcda/hardware/catalog/index.php>
 - *BCDA HW list:* http://www.aps.anl.gov/aod/bcda/hardware/custom_hw/bcda_hw.php



BCDA Hardware: Capabilities

Analog Electronics Design

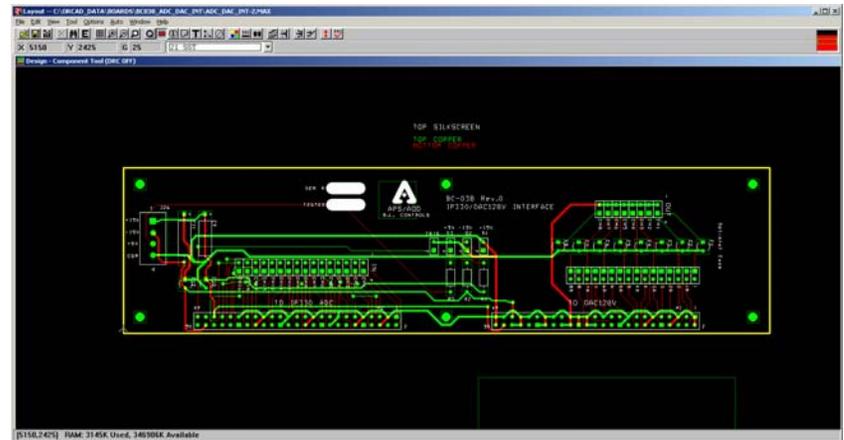
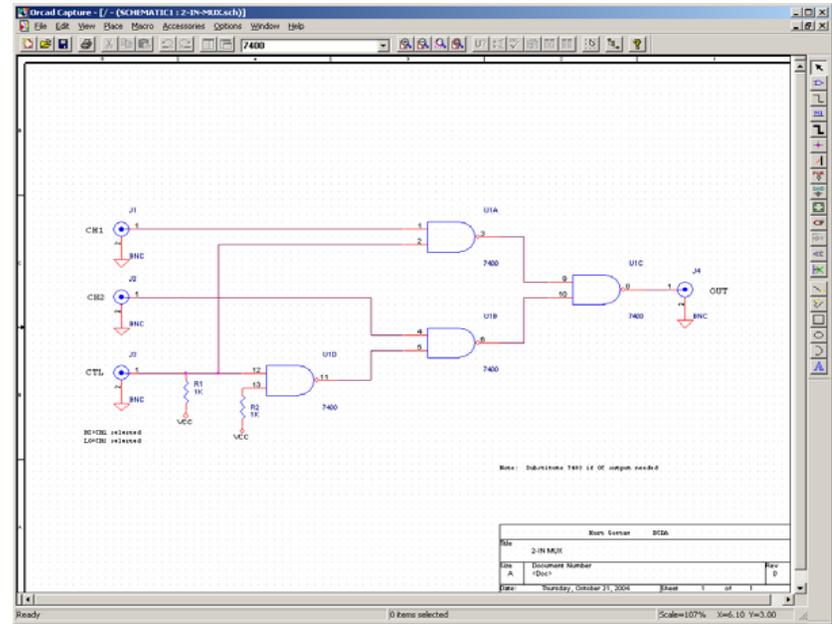
- **V/I Amplifiers, general purpose op-amps**
- **Current buffers (DC motor drivers)**
- **Instrumentation amplifiers (Thermocouples, RTDs)**
- **Arithmetic functions**

Digital Electronics Design

- **TTL, CMOS: glue logic and interface circuits**
- **Altera for high speed/complexity digital circuits**
- **Mixed A/D applications like timers, comparators, DACs & ADCs**
- **Relay circuits**

BCDA Hardware: Capabilities

- **Orcad Schematic Capture**
 - Electronic circuit design
 - Symbolic schematic entry
 - Large library of parts
 - Create netlist for Layout
- **Orcad PCB Layout**
 - Use netlist from schematic
 - Place the components
 - Manually route critical nets
 - Use the autorouter
 - Cleanup/fix traces



BCDA Hardware: Capabilities

ALTERA Technology (APS standard PLD)

- **What is ALTERA?**
 - Programmable logic technology solutions
 - *Devices (chips)*
 - *Design software*
 - *Intellectual Property*
 - *Design services*
- **We are using the free design software called Quartus**
 - Provides support for *some* Altera devices
 - Design entry as schematic, VHDL, Verilog,
 - Enter design -> Compile -> Simulate -> Program device

BCDA Hardware: *Capabilities*

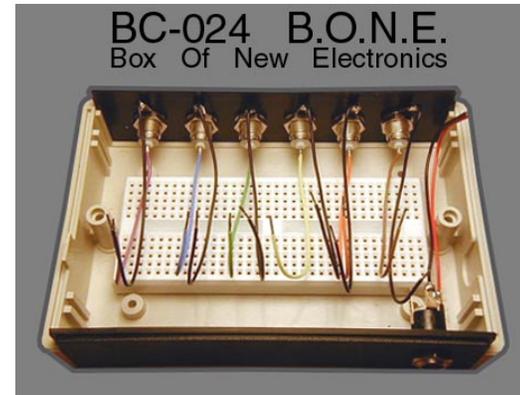
ALTERA Applications:

- **What is Altera used for?**
 - Low volume / High flexibility Digital designs
 - Glue logic involving many gates
 - High performance, compact dedicated functions such as:
 - *Logic gates, memory, counters, arithmetic functions,*
 - *DSP, dual-port RAM, uProcessor cores*
- **Why use it?**
 - Reprogrammable, allowing for design/test iterations
 - Manage component obsolescence by capturing the functional design in high level standard languages such as VHDL or Verilog
 - Allows for some level of silicon independence

BCDA Hardware: *Capabilities*

Other Design, Test & Troubleshooting tools:

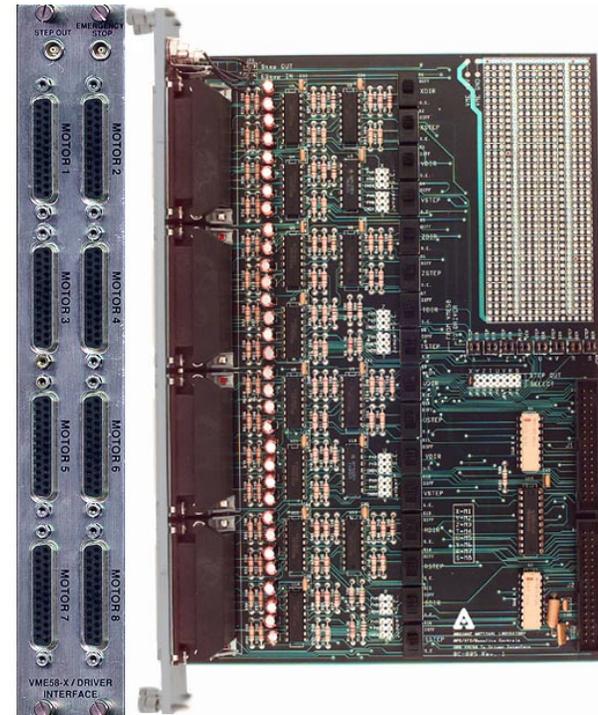
- Autocad
- Light machining
- Electronics circuit prototyping
- Data IO chip programmer
- Test / Troubleshooting tools
 - Digital Multimeters
 - Digital Oscilloscopes
 - Logic Analyzer
 - Waveform generators
 - Other “test bench” devices



BCDA Hardware: *Stock Solutions*

BC-005 OMS Transition Board

- Interface OMS VME Motion controllers to motor drivers
- Pin-compatible with ACS StepPak, Phytron-APS
- TTL Step Output
- Emergency Stop Input
- Prototyping area
- >400 in use at APS



BCDA Hardware: *Stock Solutions*

BC-037 Transition Board

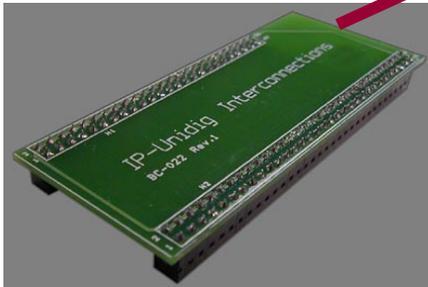
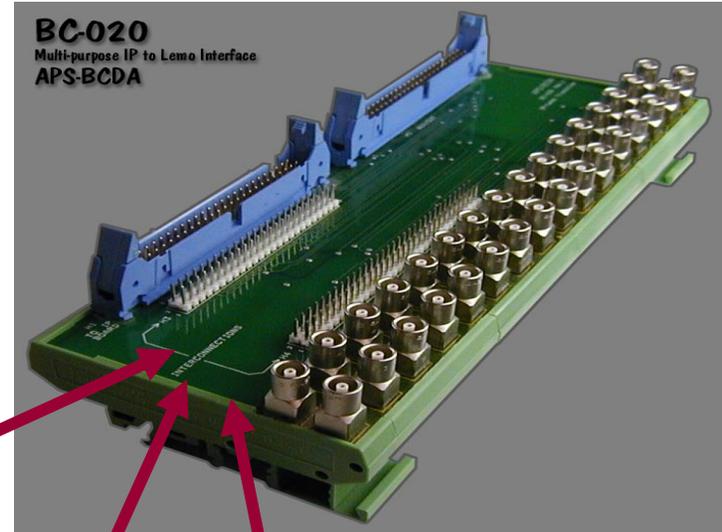
- OMS Controller to 8-RJ45's
- Step, Dir, Limits (no encoders)
- Single-width, less depth
- Easier to build in-house
- Inexpensive



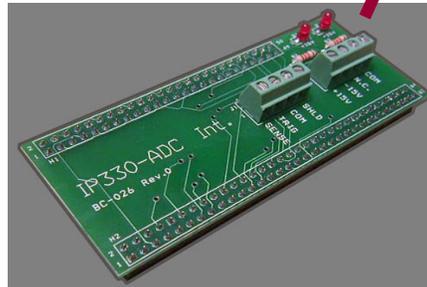
BCDA Hardware: Stock Solutions

BC-020 IP-Lemo Adapter

- 32 Lemo coaxial connectors
- 50-Pin header connects to IP
- Daughter boards available for different IP's



SBS IP-Unidig Dig. I/O Conn.



Acromag IP-330 ADC Conn.

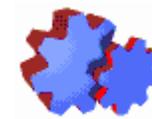


Systran IP-DAC Conn.

BCDA Hardware: Custom Solutions

BC-033 M.A.D. Stepper

- **Manual / Automatic Drive**
- **Stepper motor indexer**
- **Built in microstepping driver**
- **APS standard connectors**
- **Limits indication**
- **Variable speed “Jog” button**
- **1Hz “Step” button**



BCDA Hardware: Custom Solutions

BC-036 Servo Motor Tester

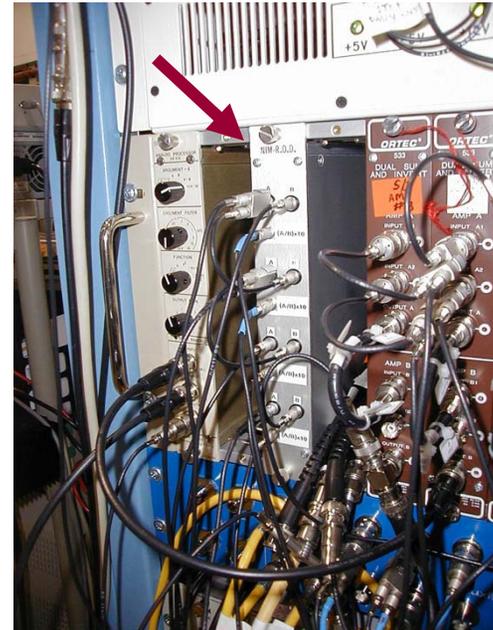
- Designed for BIO-CAT's motors
- Started with a list of requirements from David Gore
- Features:
 - +/- 28V, up to 2A w/Readback
 - Limits indication & cutoff
 - Encoder pulse LED's with 10, 100 & 1K divide by options
 - Parts cost <\$400
- Feedback from David has been positive



BCDA Hardware: Custom Solutions

BC-040 NIM-R.O.D.

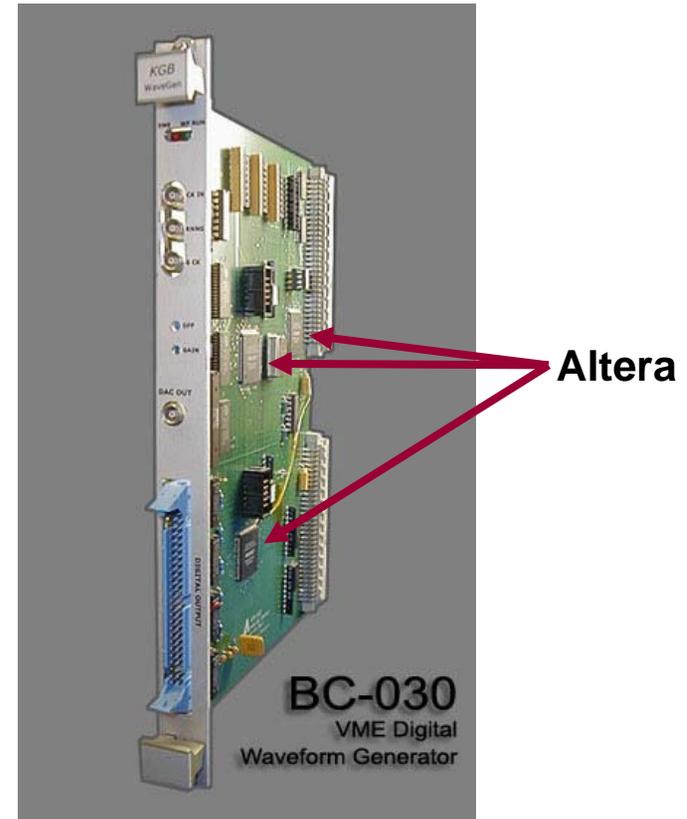
- **Realtime Output Divider**
- **Sec. 2 data acquisition**
- **Uses Analog Devices AD534 precision multiplier/divider**
- **Provides “preprocessing” of raw data during fly scans**



BCDA Hardware: Custom Solutions

BC-030 VME Digital Waveform Gen

- Designed specifically for the Mad City Labs Nano-Drive
- 20-bit digital output
- 64K RAM (20-bit words)
- EPICS Support
- Has been tested at the 2-ID Xray microscope
- 16-bit DAC output was added for testing
- Learning curves:
 - VME interface
 - SRAM implementation
 - Altera applications



BCDA Hardware: Vendor Solutions

Outside vendor equipment we try to keep in stock:

- **SBS VIPC626 (TVME 200) Industry Pack Carrier VME board**
- **SBS IP-Octal RS232 Industry Pack board**
- **SBS XM-Octal RS232 interface**
- **SBS IP-488 GPIB controller IP board (still available?)**
- **SBS IP-Unidig-I 24 channel digital I/O**
- **Systran DAC 8-channel, 12-bit**
- **Acromag ADC 16-channel, 16-bit**

Hot Spares:

- **VME Crates, 21-slot and 7-slot**
- **VME crate controllers, MVME167, 162, 172, 2700, 5100**
- **OMS VME58 boards**
- **Others: Joerger scaler, StepPak, EPICS Brick**

BCDA Hardware: New Projects

- **Stepper pulse generator**
 - Handheld
 - Send motor driver a preset number of pulses
- **4-Channel 2 input multiplexer**
- **EPICS support for Acromag IP-Altera**
- **EBrick interface circuits**
- **RS232 breakout VME module w/Tx & Rx leds**
- **VME bus monitor**
- **NIM Multiplier/Divider (more channels)**

BCDA Hardware: Conclusion

- **“Doing Business” with the BCDA group**
 - We are able to request “cost code transfers” for any items that change hands outside our group (email to Pete)
 - For most transactions, we are only recovering the material costs of the hardware involved
- **Acknowledgements:**
 - Tim Mooney, John Maclean
 - Peter Fuesz
 - BCDA Group
 - Mark Rivers & Many other CAT people
 - ASD Controls: Bob Laird, Ned Arnold, All of the techs

Thanks!