

# High-Tech Design as Modern Engineering Entrepreneurship

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**Prof. Bruce Jacob**

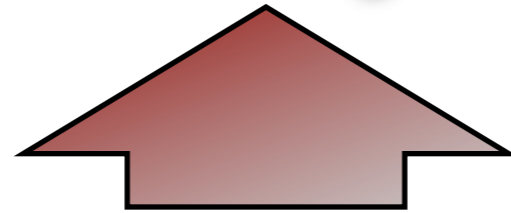
Keystone Professor & Director of Computer Engineering Program  
Electrical & Computer Engineering  
University of Maryland at College Park



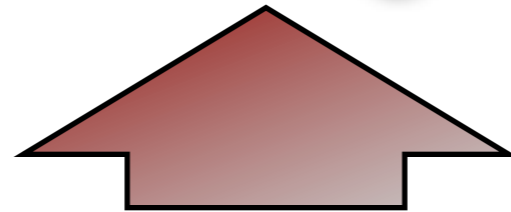
# The Point

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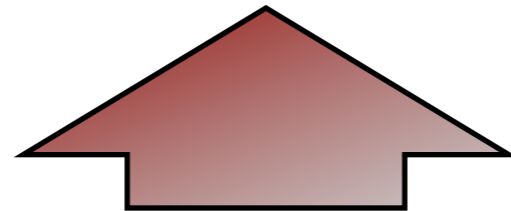
**all individuals in society become wealthier**



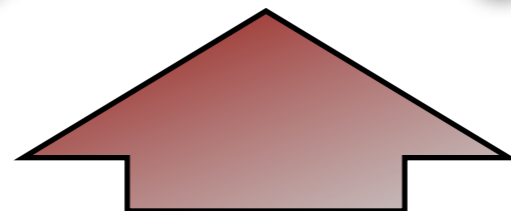
**economic growth**



**innovation**



**good design**



**???**

# It's All About Innovation ...

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“Innovation and trade: the ultimate engines of growth.”

—*Economist*, Oct 3, 2009

“We have to choose to do what past generations have done: shape a brighter future through hard work and innovation.”

—Barack Obama, Sep 22, 2009

(ASEE’s “Obama Touts Innovation Agenda At New York Community College”)

“In the new knowledge economy, innovation and knowledge are the most important factors driving economic growth.”

—Progressive Policy Institute: *The Innovation Economy*, Oct 2003

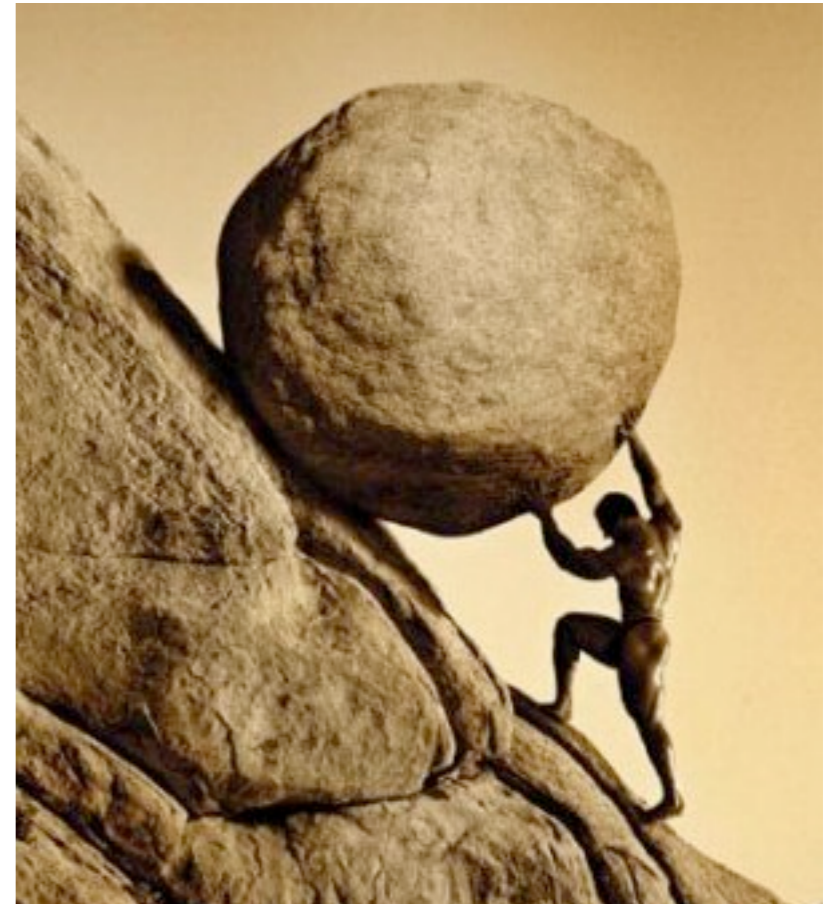
“Innovation is the heart of economic recovery & future prosperity.”

—*Roll Call*, Nov 20, 2008

# ... But, Boy, Is Innovation Hard

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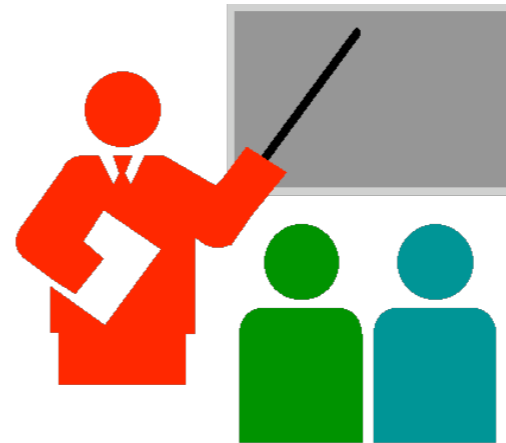
- “In an era when most technology outfits have tightened their belts to adapt to a slower-growing market, one company stands out for forging ahead on innovation: Apple Computer.” (*BusinessWeek*)
- “Big companies are losing their ‘A’ players, and they’re struggling to attract ‘B’ players. In an industry where everything is about people, large tech companies are in trouble because they are losing the talent war. And keep in mind, an ‘A’ player in an organization can usually produce the same results as three ‘B’ players.” (*VentureBeat*)
- “Lots of companies have tons of great engineers and smart people. But ultimately, there needs to be some gravitational force that pulls it all together. Otherwise, you can get great pieces of technology all floating around the universe. But it doesn’t add up to much.” (*Steve Jobs, on innovation*)



# Today's Talk

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1. Despite what we may think, we don't really teach it here



2. How can you instill it in your business partners/employees?



3. Why #2 matters

# Talk 1: Thoughts on Teaching Design

# What is Design? What is Innovation?

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- Can't define it, but you know it when you see it ... 😊
- Close interaction with **burnout** phenomenon in start-ups
- An inability to eat, think, sleep, care for one's self while technical problem remains
- Requires staring at one problem for extended period (much like Ph.D. in that regard)



# Let's Look More Closely at that Last Bit

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- *Innovation and design requires staring at one problem for extended period*
- Contrast that with academia (undergrad in particular):
  - Attention flits from topic to topic in a scheduled, often frenetic pace
  - Semester concept is both arbitrary and contrived/artificial (innovation recognizes no schedule)



Larry Ellison



Bill Gates



Stephen Spielberg



Richard Branson



Michael Dell



Steve Jobs

**Is it any wonder that SO MANY successful entrepreneurs/innovators dropped out of school?**



# Teach Innovation Despite Scheduled Frenzy?

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## Necessary Elements:

- Look at one problem for extended period (years?)
- Personal investment in outcome (reward, pride, etc.)
- Time commitment need not be large on per-week basis
- Need to see **real examples** of both success and failure
- Must be guided by innovators (not academicians, not MBAs)
- Failure is acceptable (grades)



Olin College, est. 1997

# More on Grades

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Students calculate the effort needed to get the desired (or lowest acceptable) grade.

They do the minimum work required.

**We** (unconsciously) **train them** to do this.

Needless to say, this doesn't fly for design.  
In design, anything less than full attention = failure.

# What Are We Doing?

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- Electric Guitar Design Class
- MIPS: sponsored R&D
- Innovative engineering designs
- Coil LLC: Commercial venture involving students

# What Are We Doing? (You know, besides PR ...)

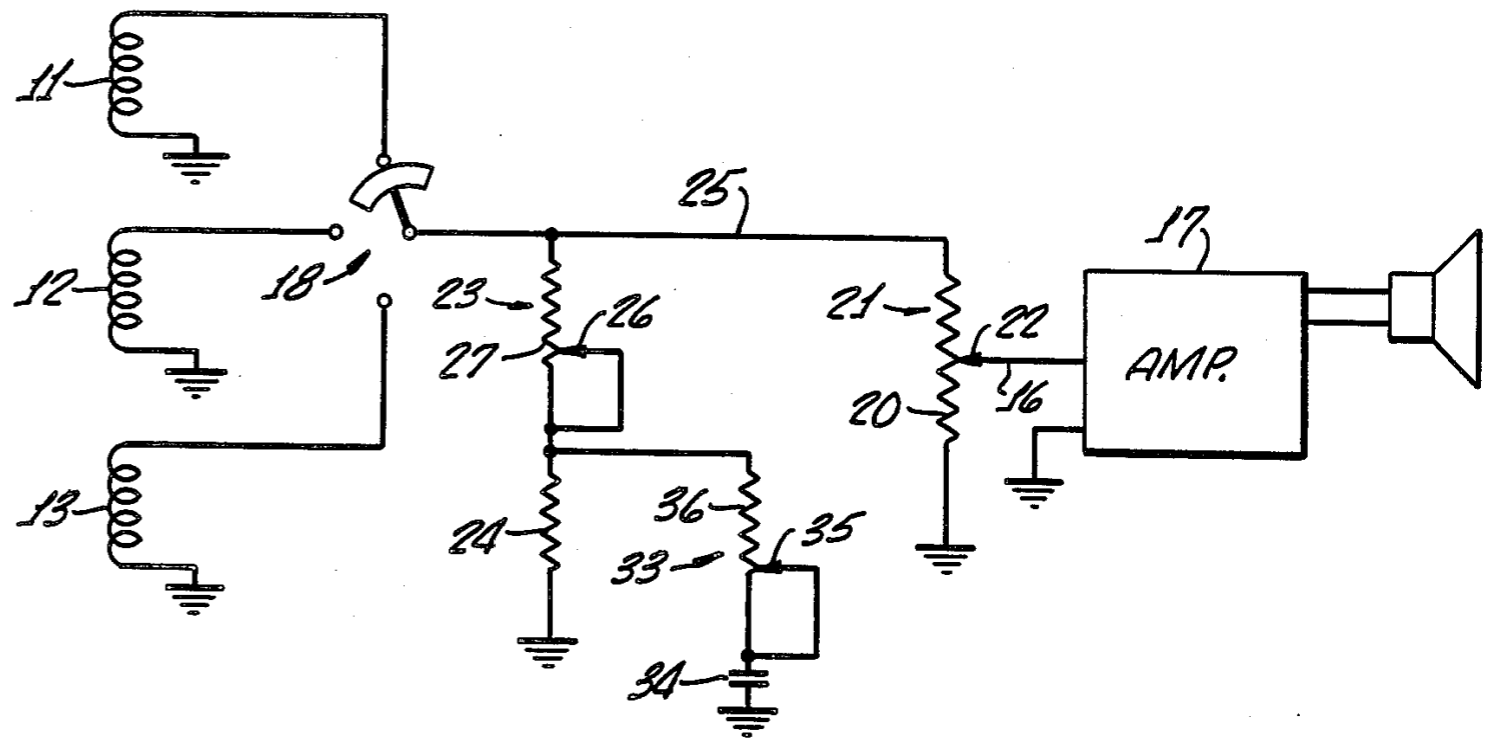
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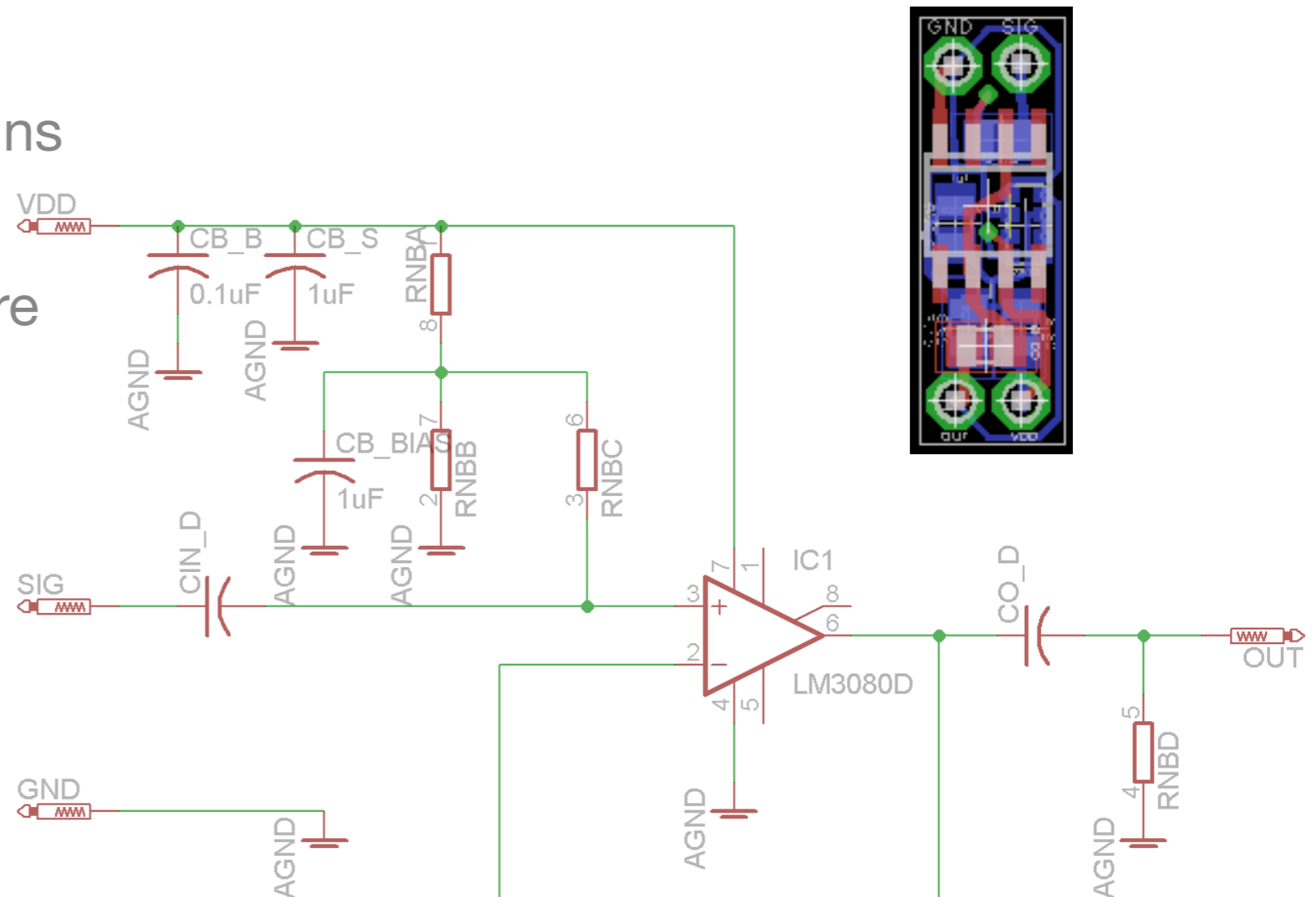


Basic Switching Circuit  
(Fender-Style *and* Gibson-Style)

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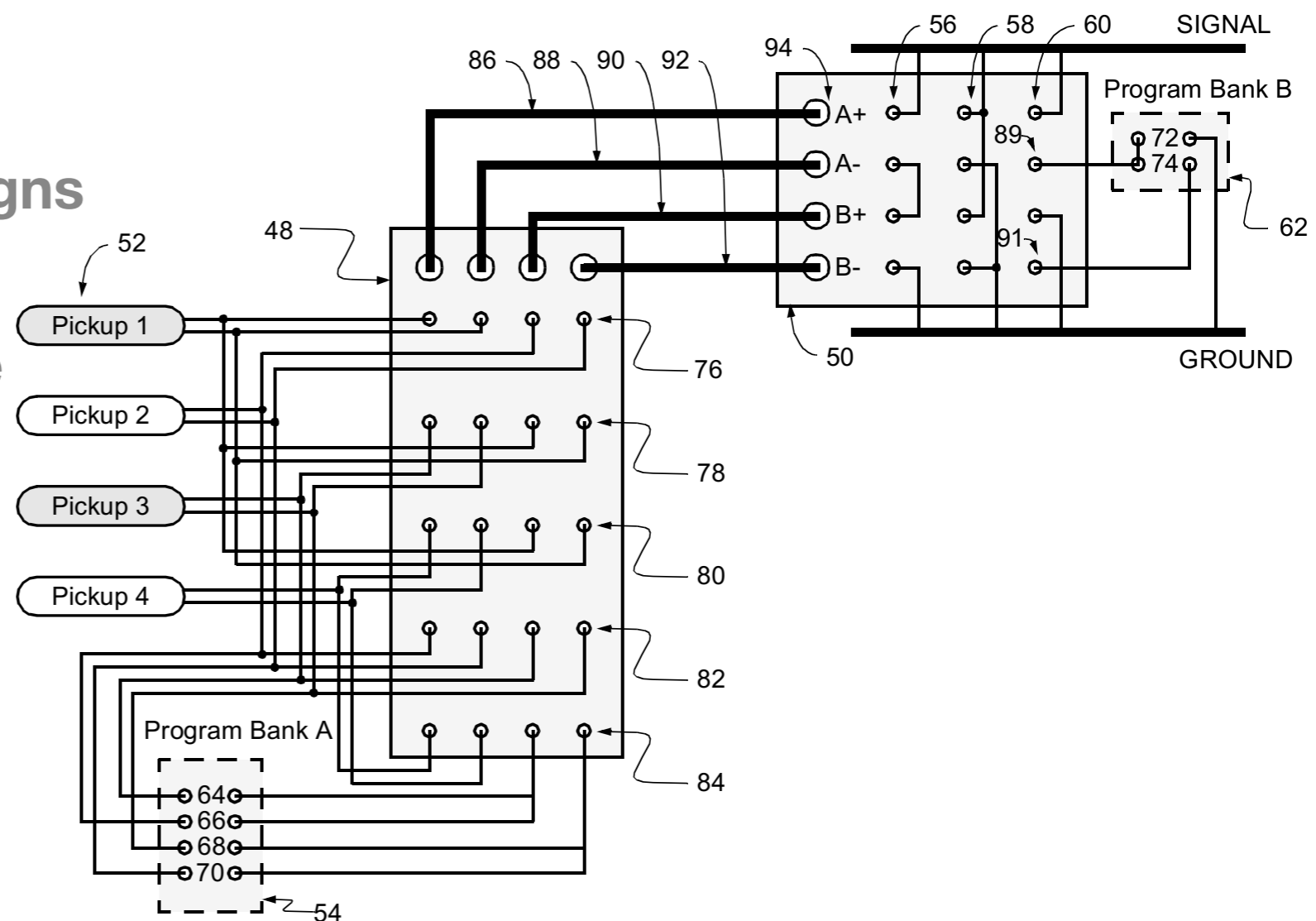
## Preamp Design for Active Cables



# What Are We Doing?

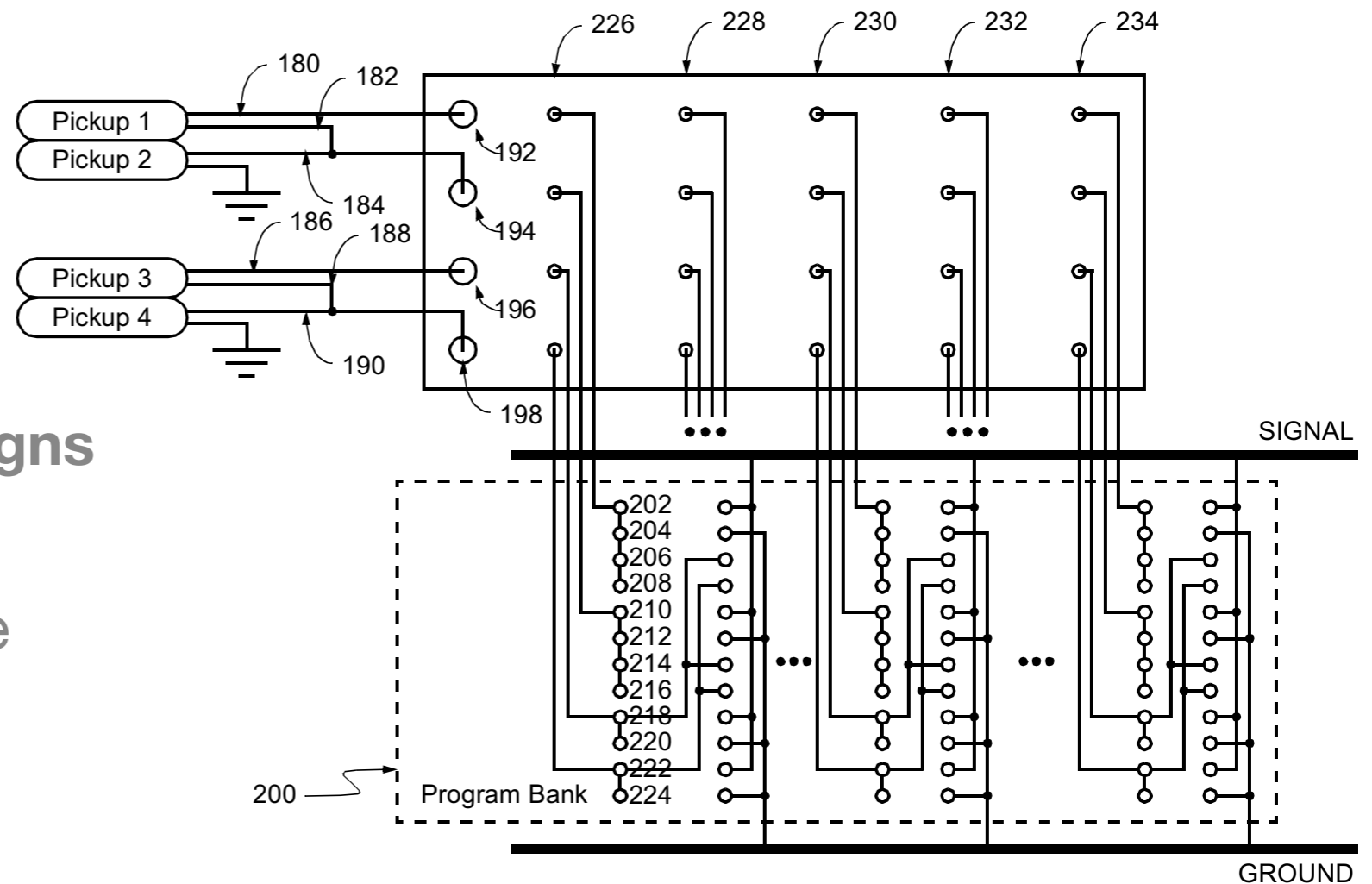
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Switching Patent (one type)



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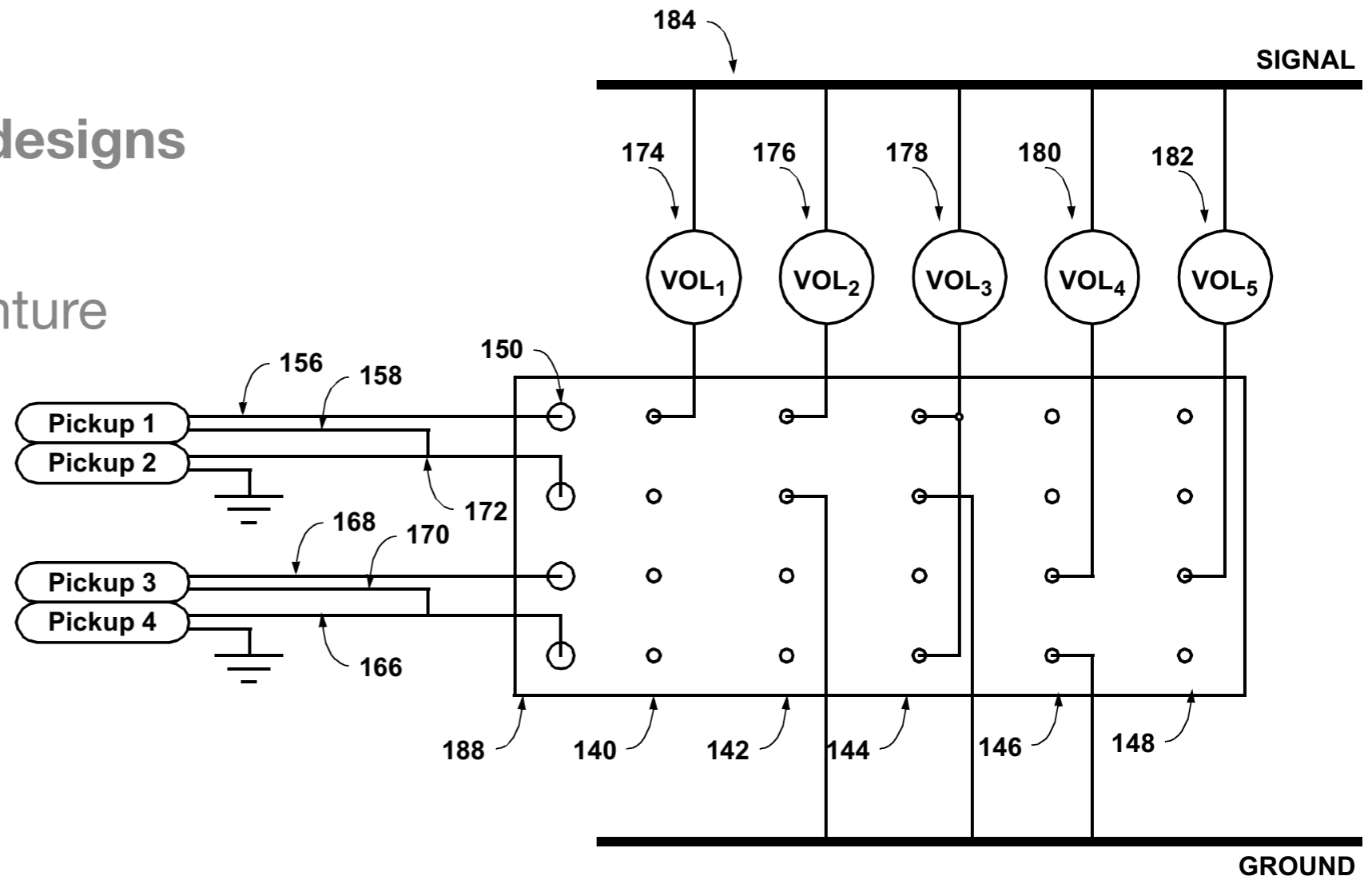
Switching Patent (another type)



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Volume Patent



# What Are We Doing?

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How do you make them care enough to do it right?

## Talk 2: Innovation and the Lion's Share of Reward

# Bottom Line

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**For details:** B Jacob. “Reward: How to foster a technology-innovation culture within a large organization.” Chapter 69 in The Handbook of Technology Management, Wiley & Sons, January 2010.

- Existing trend is to study innovative exceptions (Apple, Google, Fiat, etc.) and try to emulate them.
- Why not emulate an entire **industry** instead? In particular, the one industry known for **innovating** regularly.
- What do startups do? They recognize that engineers are their primary innovators, and they **PAY** them.



Innovation = Wealth

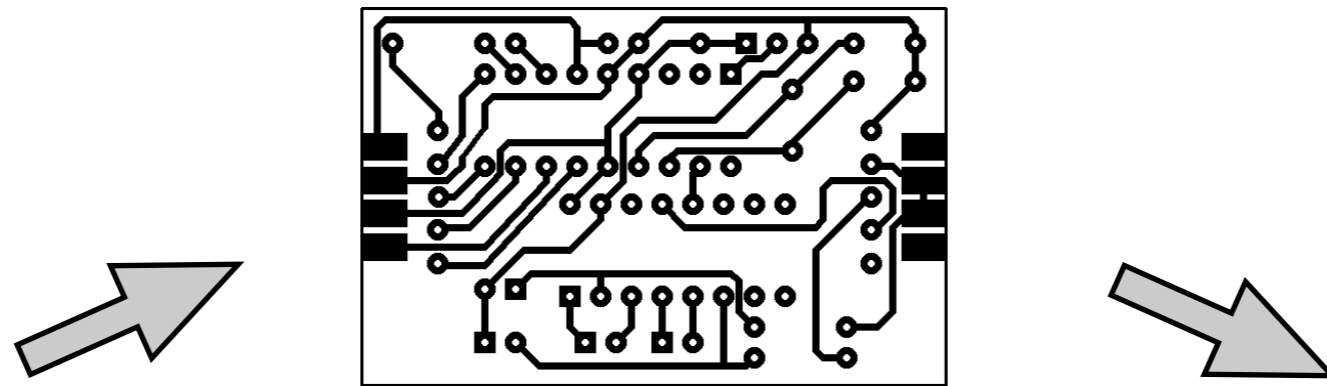
# Talk 3: Design and Modern Entrepreneurship

Important development in last decade:

# **Manufacturing as a Service**

# The Basic Idea

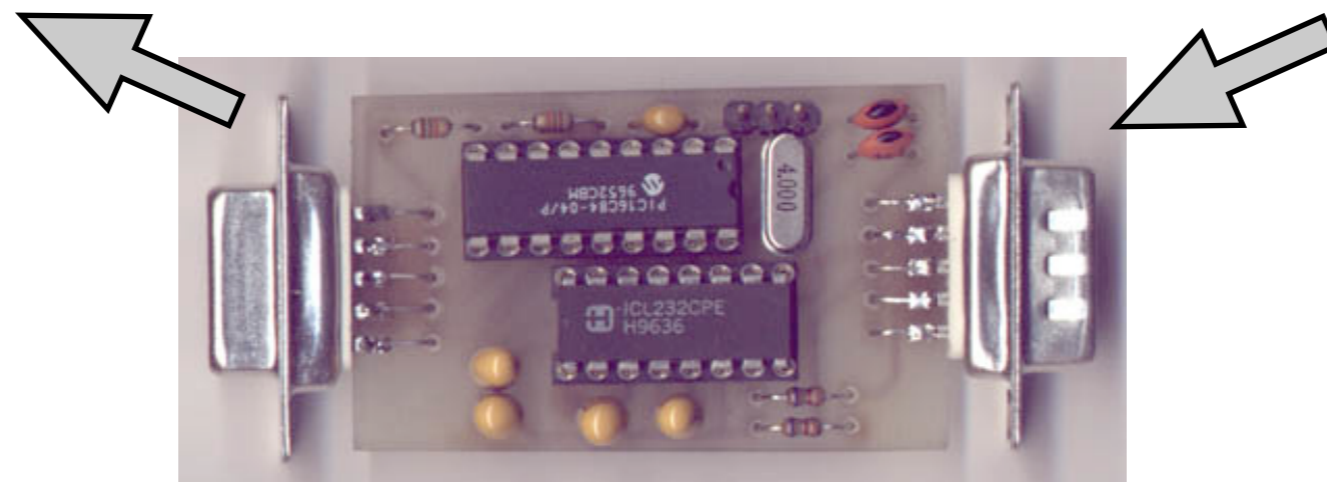
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**Design Blueprint**



**Factory**



**Manufactured Device**

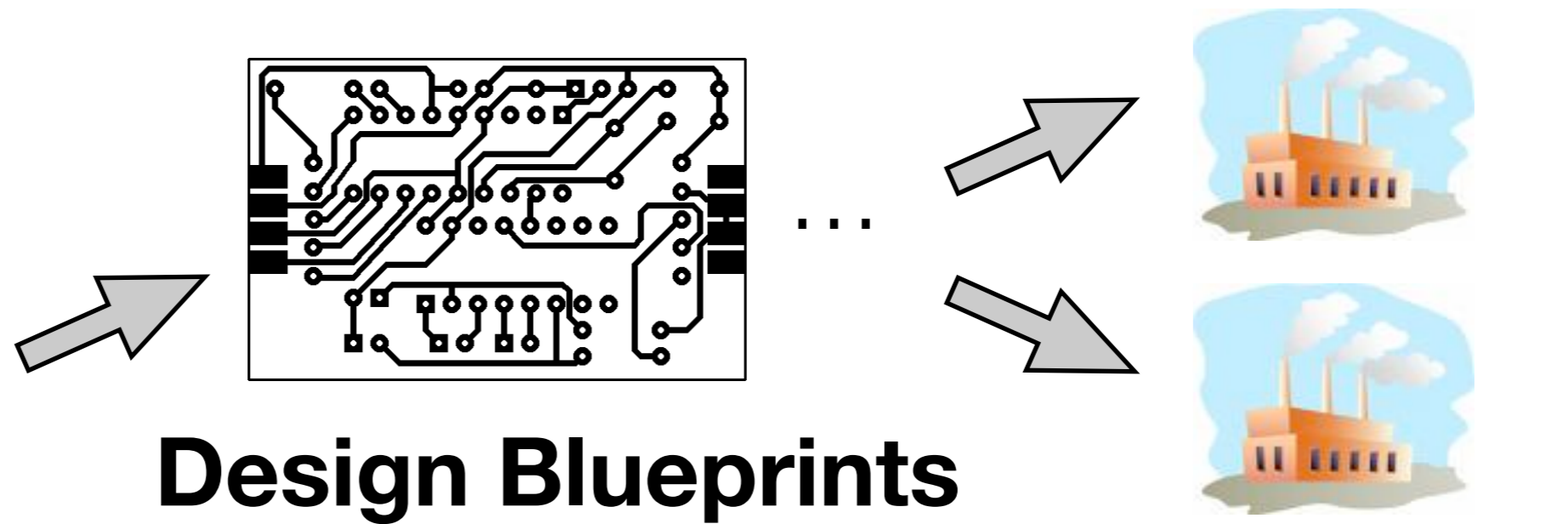


**You**



# The Basic Idea

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**You**

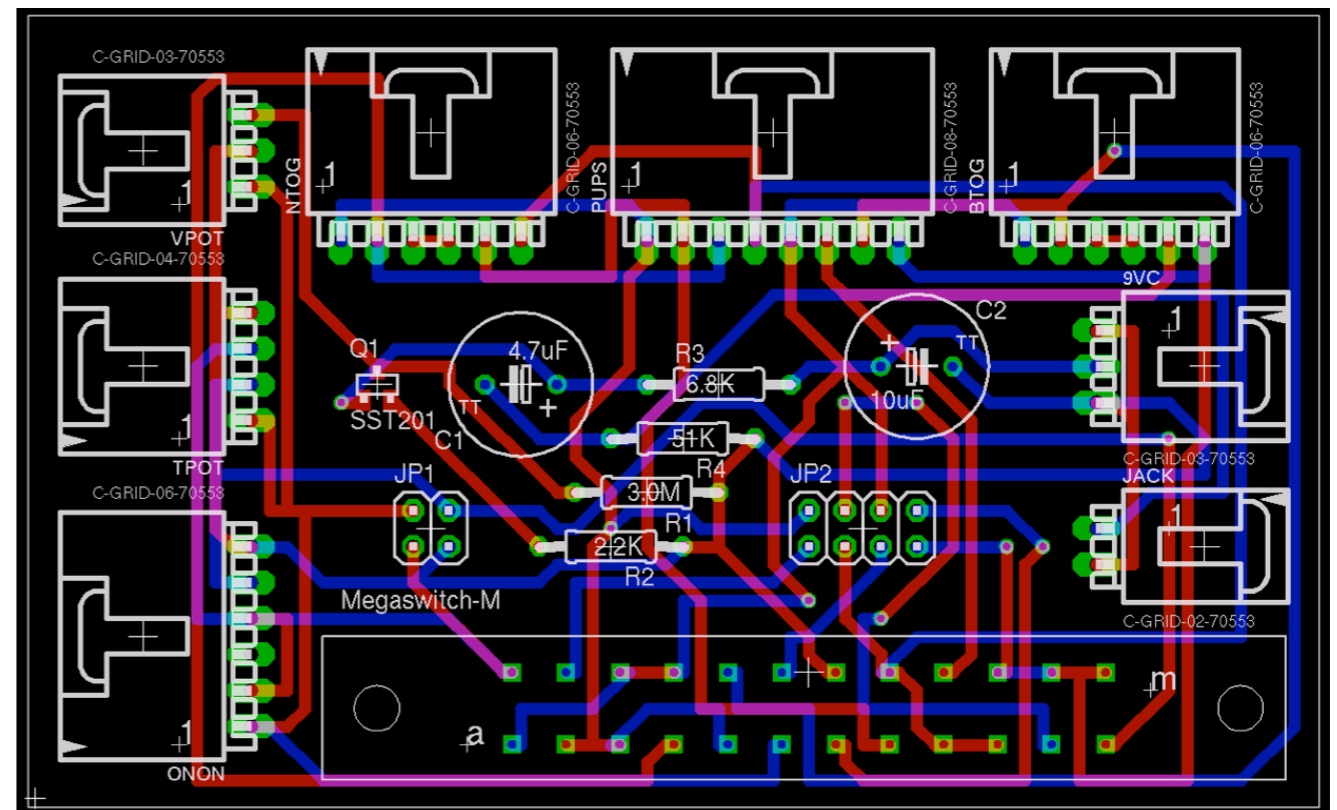
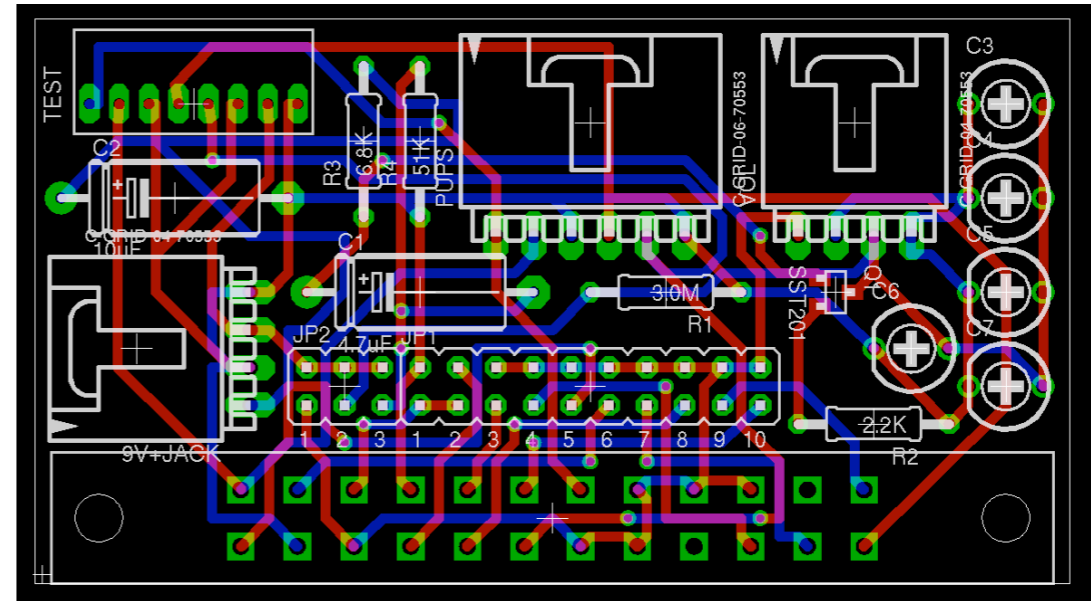
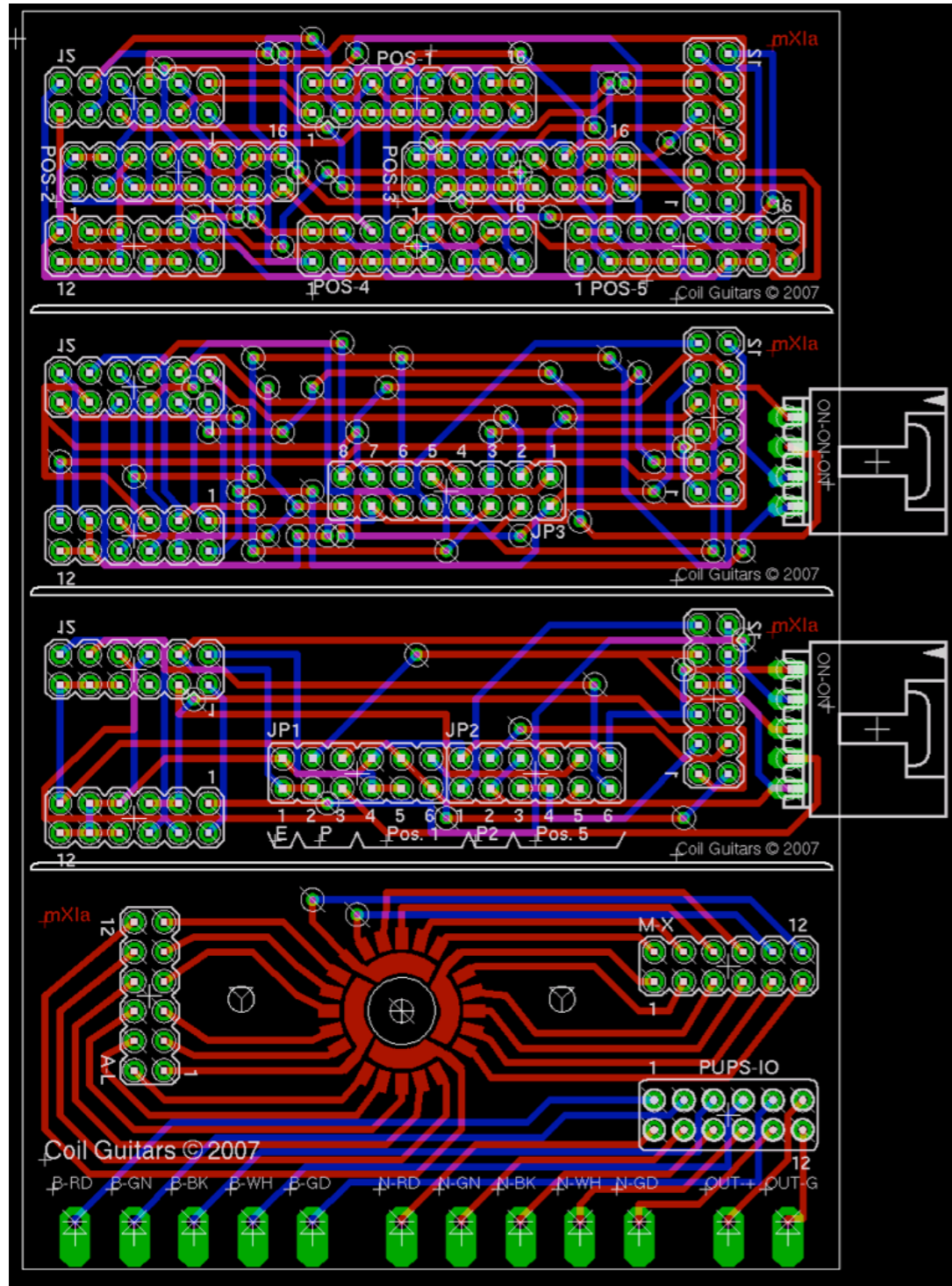


**Manufactured Device**

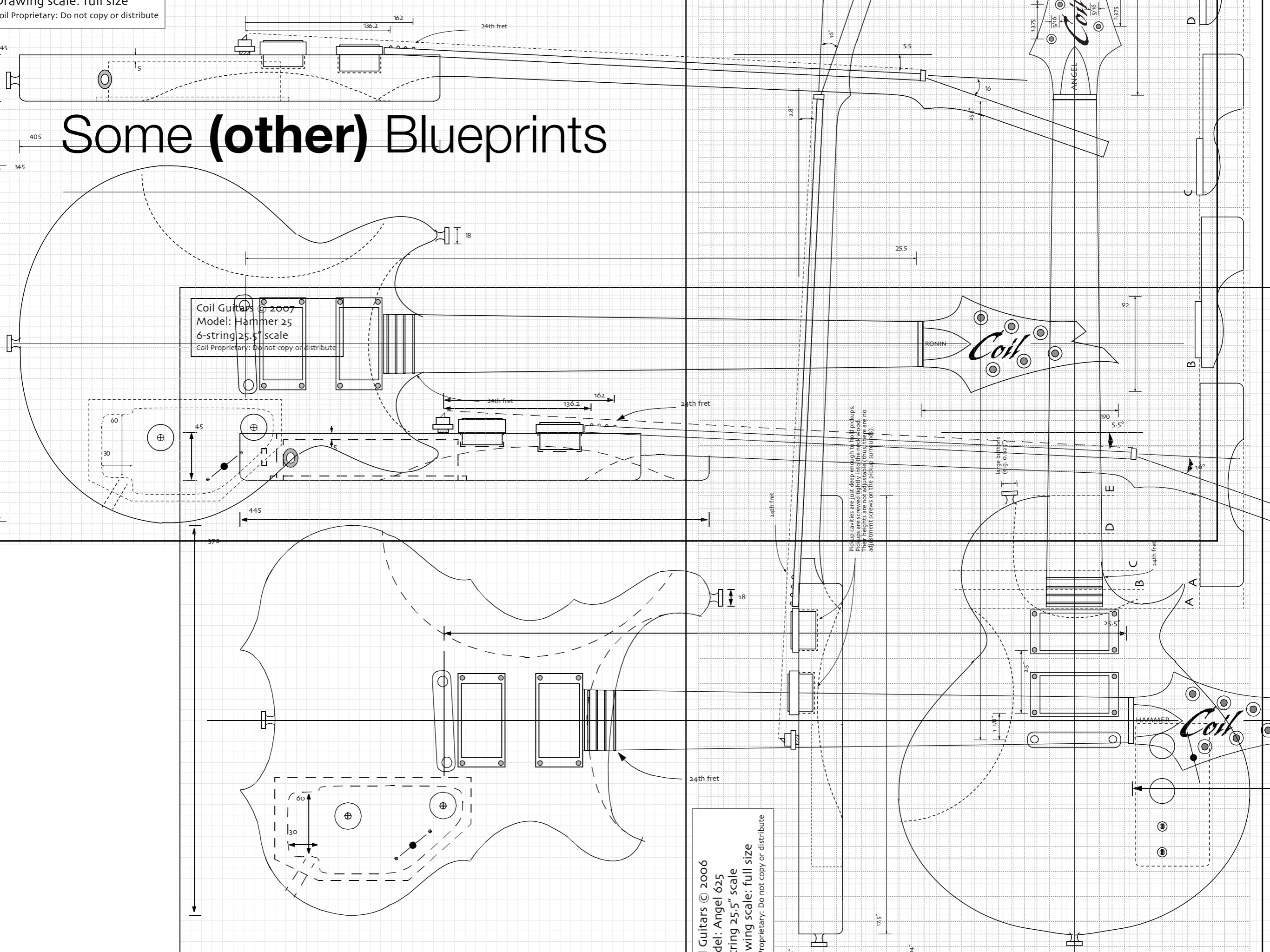


**Assembly**

# Some Blueprints



# Some (other) Blueprints



Coil Guitars © 2007  
Model: Hammer 25  
6-string 25.5" scale  
Coil Proprietary: Do not copy or distribute

Coil Guitars © 2006  
Model: Angel 625  
6-string 25.5" scale  
Coil Proprietary: Do not copy or distribute

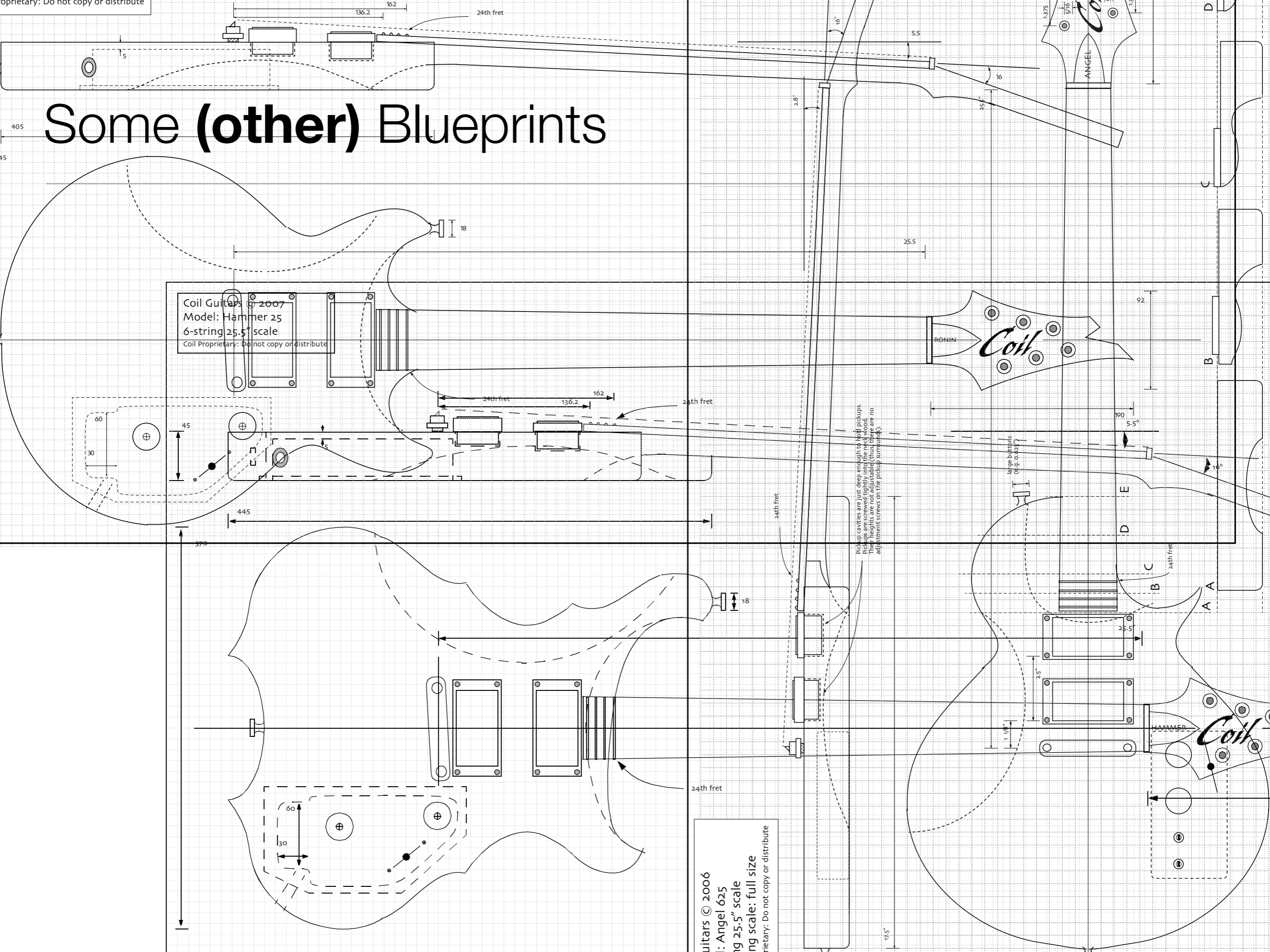
Pickup cavities are just deep enough to hold pickups.  
Pickups are screwed tightly into the neck wood.  
Pickup heights are not adjustable (thus, there are no  
adjustment screws on the pickup burlings).

Coil Guitars © 2006  
Model: Angel 625  
6-string 25.5" scale  
Drawing scale: full size  
Coil Proprietary: Do not copy or distribute

ANGEL  
Coil

RONIN  
Coil

HAMMER  
Coil



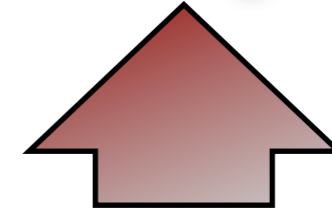
# Pros & Cons

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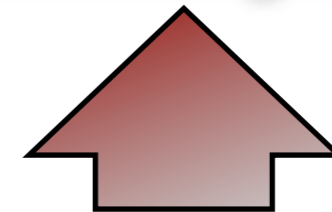
- Can't Possibly compete with big companies
- Might fail
- Can't afford it
- Window of opportunity?
- Idea already proven in marketplace (shareware, boutique electronics)
- Win/win situation (even company failure is good résumé material)
- Low risk/reward ratio
- Start soon

*Bottom line: a path well worth exploring*

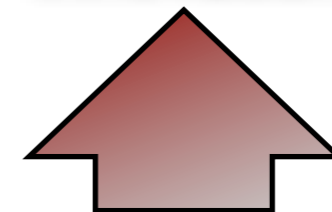
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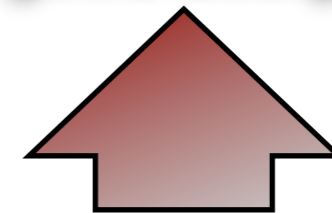
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**good design**



**???**

# Questions?

(thank you for your attention)

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... or just Google "bruce jacob"