What You Can Do in The Integrated Circuit Industry

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Who am I

In the IC industry
- Analog IC designer (from year 2008 to now)
- Specializing in power regulators, gate drivers, motor drivers, etc.

At HKUST
- Adjunct Assistant Professor (from year 2020 to now)
- Teaching ELEC2350 and ELEC4430
- Supervising FYP in the area of analog and power IC design
Objective

+ Introduce different technical positions in the integrated circuit (IC) industry (emphasizing on hardware-related positions)
+ How they collaborate to develop IC products to the market
+ What knowledge and skills are required for those positions
Positions

To develop one IC product, we need following people

- Marketing/Sales
- Application Engineer
- Analog/Digital Design Engineer
- Verification Engineer
- Layout Engineer
- Test Engineer
- Package Engineer (normally with mechanical engineering background)
- Product Engineer (more like a project manager)
- Software/Firmware Engineer (normally for System-on-Chip (SoC) ICs)
- CAD (Computer-Aided Design) Engineer (Manage CAD software for design teams)

How they work together to develop an IC product?
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How they work together to develop an IC product?
Marketing/Sales & Application Engineer: Role

- They both work together to communicate with customers

  - **Marketing/Sales**
    - Manage the profit and loss of IC products
    - Identify profitable markets and corresponding customers
    - Define IC products to fulfill needs of customers

  - **Application Engineer**
    - Provide technical supports about the use of IC products
    - Evaluate performance of IC products
    - Sometimes, they also define system architectures of IC products
Marketing/Sales & Application Engineer: Skills

They both have good verbal and written communication skills

Marketing/Sales
- Understand cost structure of IC products
- Understand the market needs and customer needs
- Identify key features of IC products to differentiate from competitors
- Strong interpersonal and networking skills

Application Engineer
- Strong foundations and skills on hardware and electronics (e.g., ELEC1100, ELEC2400)
  - Use of bench equipment, PCB design and layout, debugging skills...
- Programming skills for firmware and/or GUI development (e.g., C/C++, Python)
- Strong system knowledge (depends on what exactly you are working on)
Analog/Digital Design Engineer: Role

- Design Engineer
  - Determine whether the defined products and system architectures are implementable or not
  - Select an IC process (e.g., 180nm vs 28nm) suitable for the defined products
  - Perform system-level evaluations
  - Perform circuit-level implementations
  - Supervise floorplan and layout (Layout engineer implements the actual layout)
  - Define test plan (Test engineer develop test PCB and test program)
  - Define packaging plan (Package engineer oversee the whole package process)
Analog/Digital Design Engineer: Skills

- Design Engineer
  - Understand IC process and technology (e.g., ELEC3500, ELEC4520)
  - Strong foundations and skills on circuit-level implementations
    - Analog design (e.g., ELEC3400, ELEC4420)
    - Digital design (e.g., ELEC3310, ELEC4410, ELEC4320)
  - Understand floor planning and layout (e.g., ELEC4410)
  - Understand what is Electrostatic Discharge (ESD)
  - Understand what is Latch-Up (LU)
  - Understand what is DFT (Design for Testing)
  - Understand what is IC packaging
Verification Engineer: Role and Skills

+ Verification Engineer
  + This position exists in companies producing sophisticated IC products
  + Verify circuit-level implementations fulfilling the requirements or not
  + Good understanding on circuit-level implementations
  + Strong skills on verifying circuit-level implementations
    + Analog design (e.g., ELEC3400, ELEC4420)
    + Digital design (e.g., ELEC3310, ELEC4410, ELEC4320)
  + Following are names of "programming" language used by verification engineers
    + e.g., System Verilog, Verilog-AMS, Linux scripting language
Layout Engineer: Role and Skills

+ **Layout Engineer**
  + Perform floor planning to optimize the performance of IC products
    + e.g., minimize silicon area, noise coupling, impacts of manufacturing variations, ...
  + Implement the layout design
    + For analog design, layout is normally done manually
    + For digital design, layout is generally generated by Place-and-Route (P&R) software
  + Understand IC process and technology (e.g., ELEC3500, ELEC4520)
  + Understand floor planning and layout (e.g., ELEC4410)
  + Understand what are Design-Rule Check (DRC), Layout-versus-Schematic (LVS), Electrical-Rule Check (ERC), and Parasitic Extraction (PEX)
Test Engineer: Role

- **Test Engineer**
  - Design different testing circuit boards for different tests
    - e.g., Automated Test Equipment (ATE) board, burn-in board
  - Write ATE program to automate the IC production test
  - Perform different tests to qualify the performance and reliability of IC products
    - e.g., ATE test, ESD test, reliability test
Test Engineer: Skills

+ Test Engineer
  + Strong foundations and skills on hardware and electronics (e.g., ELEC1100, ELEC2400)
    + Use of bench equipment, PCB design and layout, debugging skills...
  + General high-level programming skills
  + Understand different ESD test standards
    + e.g., Human-Body Model, Machine Model, and Charged-Device Model
  + Understand different reliability test standards
    + e.g., High Temperature Operating Life (HTOL), Latch-Up, ...
Q & A

Thanks