

You are a senior device development engineer for a major microelectronics manufacturer. You are given the task of designing and fabricating a single device with the following characteristics:

Device Characteristics:

- Current handling capability: 10 A.
- Reverse voltage blocking capability: 40 V
- On-state voltage: 0.4V at 10A
- Switching time requirements: < 200 ns.
- Operating temperature range: -40°C to 180°C.

Section A: Your tasks are as follows:

1. Design the device structure that may meet the required device characteristics. Sketch the cross section of the device structure that indicates the material used in each layer. You must estimate the required device dimension, both vertically and laterally. State all assumptions (such as critical breakdown field, transit time, etc) made.
2. Describe the packaging approach to be used for this device, assuming a single chip packaging solution.
3. Design a process flow that can be used to fabricate the device. You must include sufficiently defined information (such as equipment type, temperature, processing material used, etc.) that your fellow engineers can develop a financial model for the factory to build the device.
4. Provide a summary of relevant information for the patent lawyers to evaluate whether a patent application on the most novel portion of your device should be prepared. This should include the results of a patent search for similar technology already protected.

Section B: The device you have just defined has certain mechanical and electrical characteristics that affect the reliability of the device in field operation.

1. Identify in rank order of importance the significant reliability failure mechanisms of the device you have defined.
2. Design a testing regimen to demonstrate the reliability performance of your device against these failure mechanisms.

Section C: You now need to integrate your device with the standard logic control circuitry for a complete system solution to the customer. Describe the approach you would use to solve this customer need. Your answer should be a management level discussion of the main points that would allow your management team to make the decision on whether to allow you to give them a detailed technical presentation on the subject next week.