DFT, DFY, DFR: Who Cares?

Scott Fetherston
Advanced Micro Devices
scott.fetherston@amd.com

To live without loving is not really to live.
-- Moliere (17th Century Playwright)

To design and miss market window is not really to design.
-- managers I have known

Parts is parts. (translation: give me something I can sell)
-- another manager I have known

Producing a product for profit (in silicon valley) can be evaluated as follows 1) considerations at the front end (i.e., getting the product into a customer's hands as rapidly as possible without regard for any consequences thereafter); and 2) considerations at the back end (i.e., diagnosing field returns to correct reliability problems to ultimately provide complete customer satisfaction). In general, the need to sell into narrow market windows in a highly competitive climate results in an over-emphasis on front end considerations by providers of semiconductor products.

Is DFT as/more important than DFR and DFY? That's the wrong question. A CEO driven to maximize shareholder return asks, "How can I turn this idea into a profitable product?" As a consequence, the zeal with which the management hierarchy dutifully executes the vision of its leader naturally tends to disappear upon delivery of the product to the customers, since management focus continually shifts to the next generation product in the pipeline. If conscious decisions are not made in advance for costs and resources, little consideration will be given to the ability of that product to survive to its expected end of life (DFR). Nor will there be adequate planning for the diagnosis of field returns to find the root cause of failures (Failure Analysis (FA)) in order to determine and fix reliability problems. Adequate FA capability for complex designs requires use of dedicated embedded hardware (DFT) in the product that can support the tools chosen to perform the FA. Further, goals and resource estimates to achieve high structural test coverage to insure that defective product is not shipped will also be overlooked/underestimated by such managers. Design techniques in the layout that contribute to greater yield will not likely be on their radar screen as their focus will be on getting the design out as soon as possible.

Consideration for reliability such as use of
1) dedicated circuits to protect against Electro-Static Discharge (ESD),
2) Design Rule Checks (DRCs) insuring margin to avoid electro-migration, and
3) DRCs insuring margin to avoid cross-talk,

and consideration for yield such as use of
1) redundant vias,
2) greater spacing between polygons where possible to reduce critical distance (CD), and
3) iso-denso or pattern matching methods to achieve predictability in CD splits

are addressed by the engineering staff with pressure from management to achieve a not-to-exceed tape-out date. Because products, particularly consumer electronics, become obsolete so quickly, the standard 10-year rule associated with designing to avoid electro-migration is taken by many in industry to be a joke.

How does a company satisfy all these conflicting requirements? Generally, if enough people within the organization both understand the requirements and are able to work within their constraints, the company can deliver an adequate solution. If management is doing a good job, it will provide resources and support to satisfy all of the requirements and not just a subset. If the company is well-established, it has likely been burned by, and has now put in place measures to avoid, problems with DFR, DFT, and DFY. And, it will be vigilant in continually improving such measures. If a company is not yet well-established but has an exceptional management team, it may be savvy enough to accommodate solutions for all the problems. It is incumbent upon us all to help "empower" managers de jour to do just that.