Why the Propeller Works

I know that the Propeller is solid because I designed, debugged, tuned, and tested it myself. The only other person involved in the silicon design was one other layout engineer. This took eight years of my time, and two years of the layout engineer's time. An excruciating amount of attention went into every aspect of the Propeller's design and testing, and I allowed no compromises.

As for industry-standard tests, we recently hired a company called Nano Measurements to perform their own environmental and ESD testing on the Propeller. Specifically, the following tests were conducted:

PPOT - Pressure pot, autoclave: 121ºC, 100% RH, 15 PSIG, 336 hours
TMCL - Tempurature cycle, air, standard ramp: -65ºC to 150ºC, 500 cycles
PREC - Preconditioning (simulates soldering process): 30ºC, 60% RH, 192 hours
HTSL - High tempurature storage life: 150ºC, 1000 hours
ESD HBM - ESD human body model: All pins tested up to +/-8kV

Here are the results:

PPOT - 3 lots of 77 devices (PDIP, LQFP, QFN): 0 failures (a lot of 77 ensures 3-sigma-quality with one failure)
TMCL - 2 lots of 77 devices and 1 lot of 76: 0 failures
PREC - 3 lots of 77 devices: 0 failures
HTSL - 1 lot of 230 devices (near-even mix of PDIP, LQFP, QFN): 0 failures
ESD HBM - 3 devices each of PDIP, LQFP, QFN: all I/O pins survived +/-8kV (limit of tester) with VSS and VDD grounded, VSS-to-VDD zap failed at +/-3kV or greater

So, no environmental failures, and no testable ESD failures on I/O pins, but with the power supply pins failing at +/-3kV or greater (which is quite acceptable). All these environmental tests say almost nothing about the quality of the chip, but only that the plastic packaging was good. The ESD tests start to give some metric of the silicon quality, but say nothing of what is far more likely to be a problem - design quality. There are no universal metrics for this, and it can only be understood by actually applying the device. This is the critical life test!

Here's why the Propeller is high-quality:

The Propeller was an entirely full-custom effort. Every polygon of the Propeller's mask artwork was made here at Parallax - we designed our own logic, RAMs, ROMs, PLLs, bandgap references, oscillators, and even ESD-proof I/O pads. All these structures were first fabricated on test chips and thoroughly tested before being applied to the final chip. This resulted in known-good blocks which could be confidently applied to the overall design. Then, the whole chip was fabricated and tested at many levels, in order to fix any problems resulting from integration and to fine-tune the clocking system and memory timings. The final chip, which is the only version we've ever sold, is the third iteration of this whole-chip process.

Towards the end of development, we invested in a Micrion FIB machine and a Schlumberger e-beam prober to diagnose any problems and fine-tune the silicon. While the money to buy these used machines was only about 0.5% of what they cost new, the time needed to get

them running and to learn how to use them was a good six months. Now, we can do our own maintenance work on them, which is not trivial. These machines made it possible to see what was actually happening on the silicon (contactless, non-loading, 7Ghz oscilloscope function via an electron beam) and to perform modifications (via gallium beam and metalorganic gas) before having another full chip made. All this was a huge adventure in itself, but invaluable in getting the silicon perfected.

I believe that the Propeller has received more attention to its quality than likely any other microcontroller in production. Big companies would never approach such a project in the way we did. It wouldn't make any sense to them. They have a formulaic path they follow which minimizes design time and ensures interchangeability of engineers, in exchange for a passable result. This involves RTL hardware descriptions, synthesis, place-and-route, IP blocks, etc. It's mainly managed chaos, not bottom-up design. The Propeller is correct by construction, not just given a stamp of approval by some $500k software tool that managed to close timing on an inefficient rat's nest of wiring and synthesized gates, that is bound to be big and power-hungry. The other fact is, big companies don't cultivate an environment in which any individual would have the occasion, let alone reason, to know everything about a design, and then be able to insure quality throughout. They rely on teams of people, none of whom knows everything about the chip. They also leverage IP developed by yet other people, in order to avoid reinventing the wheel. Even if the IP isn't buggy, it's rarely a perfect fit. If you've ever programmed Windows apps, you know how frustrating it is to be forced to rely on questionable black-box objects to get your application done. It's like trying to build a custom home, but being limited to shopping at WalMart's Garden Center for your building materials. The Propeller comes from the antithesis of this approach.

We should have a data sheet soon with quite a bit of characterization data in it. I hope it will give people more confidence about using the chip. I think people's response so far on the forum validates what I've said here about quality, though. It is no accident or windfall that the Propeller is tough and reliable (not to mention low-power). It's very intentional.

I want people to understand that big companies don't have a monopoly on quality. Many of the ways in which they do things actually undermine quality in the quest for expediency. We took the time to do everything right on the Propeller, and left no stone unturned.

We plan on a very long sales life for this chip, and have no intention of dilluting the concept with many slight variants, for which you'd inevitably be getting end-of-life notices for after a few years. This is good news for customers because they are the ones who are going to be making investments in programming that will, in sum, dwarf the energy that we spent making the Propeller. We made a platform that is, hopefully, deserving of their coming efforts.

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