

# Inkjet Power Unleashed

## The Spartan-3AN FPGA activates digital ubiquitous marking and printing.



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Marking products and packaging is currently a cumbersome process that involves good planning and several work steps. In most cases, it occurs in production lines as products pass through a fixed printing station located aside the conveyor line.

Post-production marking occurs mainly through labeling, which requires label rolls or sheets to be pre-printed. The labels must then be applied to the product or packaging.

RMPT (random movement printing technology) from PrintDreams makes marking more flexible, easier, and even fun. Powered by Xilinx® Spartan™-3 FPGAs, our printing technology acts as a magic wand – whatever it touches gets marked. All you need to do is to move the device across the area to be marked and the technology will take care of the rest. Figure 1 shows a storage box marked with RMPT technology.

The extremely compact size surprises users, who immediately wonder how they can insert a letter-size sheet of paper through such a small device. Instead, now it is the printer that goes to the paper (or anything else, for that matter).

The secret resides in advanced sensor technology in combination with effective control algorithms to determine what, when, and where to print. We can control all inkjet nozzles as a column. We can also control every nozzle independently if movement with three degrees of freedom is required. By using the Spartan-3AN FPGA platform, we can configure new parameters very quickly. The FPGA accesses the content to be printed directly from its internal block RAM if content size is limited.

RMPT printers are hand-held devices that are portable and battery operated. The unique dual-mode power management (with static power reductions of as much as 99%) combined with great performance is something that our engineers and customers highly appreciate.

#### Unlimited Sizes and Formats

There are basically no size or format limits for what you can achieve with RMPT technology. The great reconfigurable nature of Xilinx FPGAs makes it possible to move into new formats very fast. We can get them to work as separate controllers, adding new entities to achieve larger print swaths.

In this sense, another useful feature in the Spartan-3AN platform is the built-in multi-boot feature, which allows us to use the same hardware design to run different configurations in the geometry of print-head nozzles and print-head blocks. This saves us money and new design efforts.

When we invented RMPT, we broke one of the holiest unspoken rules in the printer industry: “The width of the printer device by default always supersedes the width of the media to be printed.” Suddenly, the physical limit went all the

way down to the print-head cartridge size, a battery, and an electronic board. With our new approach, the PCB footprint starts

to become the bottleneck of further size reduction, while in the old technological approach there was always plenty of space in the large housings. The on-chip flash of the Spartan-3AN platform is therefore a feature we welcome very much, as it helps us to additionally reduce footprint size and external components.

The extremely compact size surprises users, who immediately wonder how they can insert a letter-size sheet of paper through such a small device. Instead, now it is the printer that goes to the paper (or anything else, for that matter). One of our initial customers came up with a slogan that summarizes the technology quite well: “Take the printer to the project.”

#### Affordable and Environmentally Friendly Technology

Our technology is very competitive even when compared to current solutions, both because of the affordability of Spartan-3 FPGAs and the fact that RMPT is basically solid state, without complex mechanical setups.



Figure 1 – PrintDreams RMPT technology deployed on a storage box

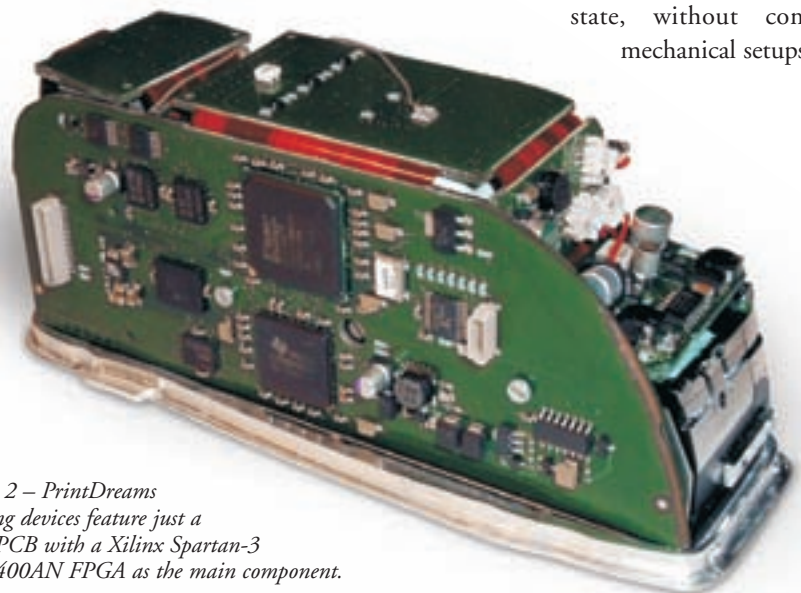


Figure 2 – PrintDreams printing devices feature just a small PCB with a Xilinx Spartan-3 XC3S400AN FPGA as the main component.

If you take apart any desktop or portable printer device, you will notice how many mechanical parts are involved – sometimes more than 200 pieces. It makes the design and manufacture of printer devices a complex, energy-consuming, and costly process to set up. Every part requires special tooling, plus a step in a long assembly line. The industry eats up hundreds of tons of steel and plastic every year for the manufacture of printing devices.

In our case, all we basically need is one small PCB and a print head. Our devices can weigh about as much as a cell phone and are extremely easy to recycle. They eliminate the need for labels and are an excellent choice for marking, coding, and printing specific tasks. The only area where RMPT printing is not competitive is for printing larger print jobs (more than 5-10 pages at a time). We do not aim to compete with very high-quality printing either. Instead, we want to compete with our compact size, affordability, and flexibility.

### Too Much Flexibility?

Our technology is not dependent on certain types of substrates. Provided that a suitable ink is available, there are no limits for the types of substrates on which RMPT can print. Cardboard, wood, fabrics, and plastics are the most common materials, but we even have solutions to print onto metal and glass if required.

One of the first segments where RMPT was introduced was the crafts industry, through a product called the Xyron Design Runner. It is amazing to see the amount and variety of materials that scrapbookers use for their projects. We have been surprised to see some projects done in cork and others in very rough fabrics.

For some of our upcoming products – this time in the toy industry – the great flexibility of our technology becomes even a concern. We would not want children printing “digital graffiti” on floors and walls. The most hair-raising scenario (mainly for parents than for anyone else) would be children painting each other using our devices, because skin is just another one of the various substrates where our technology has no problem printing.

In other areas, this flexibility is welcome. Because we can control not only common inkjet print heads but also other types of equipment such as laser heads, we can easily arrange more advanced and permanent marking of metal parts or other hard substrates. Again, the flexibility of Xilinx FPGAs is indispensable to us.

### Pushing Technology to its Limits

The most critical issue during technical development of the advanced version of RMPT has been the real-time aspects. In many industries, such as telecom and networking, the delays that define real time are measured in milliseconds. We measure real time on a microsecond level.

Our system must be able to handle as many as 2.5 million decisions every second, deciding whether to print from one of each of the print-head nozzles. In a typical 600-dpi inkjet print head, this corresponds to more than 300 nozzles. That exerts an immense pressure on both the hardware and software components.

It has been a bottleneck elimination process all along. Whereas we once used a DSP to serially run more than 300 calculations, we have now enhanced our system to operate at high capacity and with great parallelization, without losing the ability to reconfigure new types of print heads. An ASIC would have locked us into probably one single type of print-head architecture.

Being the first with a technology like this, we are of course very keen on protecting our IP. Therefore, the new Spartan-3AN platform security features that protect against cloning and reverse engineering eliminated our outstanding concerns during the selection of computing technology for our devices.

### Conclusion

High flexibility and performance with good security at an affordable price are the features that led us to choose the Xilinx Spartan-3AN platform. Even better power management and a smaller footprint make the platform simply irresistible.

For more information about PrintDreams and its RMPT technology, visit [www.printdreams.com](http://www.printdreams.com).

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