Customer case study

FULL SPECTRUM LASER IMPLEMENTS ACCURATE MOTION CONTROL – FAST!

Las Vegas is well known for live shows, bright lights and strange goings-on, but there is a lot more out there in the desert. In a northern suburb a few miles away from the neon signs on the main strip, Full Spectrum Laser are putting on a show of their own using high power lasers.

Precision is a vital part of any cutting, engraving or printing system and the laser machines from Full Spectrum Laser are no exception.

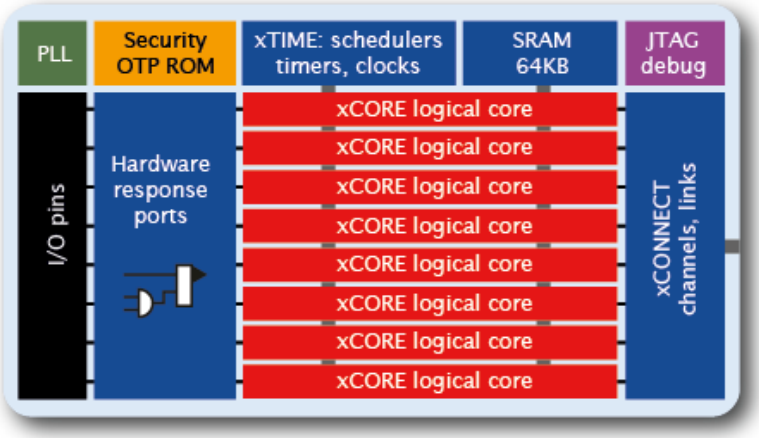
The FSL range of laser cutters and engravers feature 1000dpi resolution and accuracy to 0.001in. This requires high precision control of many simultaneous functions.

The RetinaEngrave Laser Controller enables printing directly from any Windows application that can print to a standard printer, making laser engraving and cutting available to everyone.

Laser cutting requires precise and synchronized control of the laser, with a number of motors to control the position of the laser in three dimensional space.

Full Spectrum Laser systems employ up to six axes, each of which is controlled by an independent high speed stepper motor. Each motor has step and direction controls which are updated at 200kHz, a speed that requires accurate timing control which is beyond the capabilities of software in most systems.

Full Spectrum Laser deployed an xCORE XS1-L8-64 multicore microcontroller from XMOS, providing the configurability and performance needed to implement both the high accuracy I/O interfaces and the processing tasks required for motion control.



Full Spectrum Laser used the xCORE L8 multicore microcontroller

"This is a naturally parallel system; using a multicore device like xCORE makes perfect sense for me" continued Dr Liu

One interesting feature of the design is in the calculations that compute the trajectories for each motor in real time. One logical core is used to monitor the current position of each motor and determine how it should move in order to reach its next position, relying on the DSP processing of the xCORE processor. Each motor needs to move at precisely the right speed and must be fully coordinated with the other motors to achieve the right laser cut, all with zero jitter.

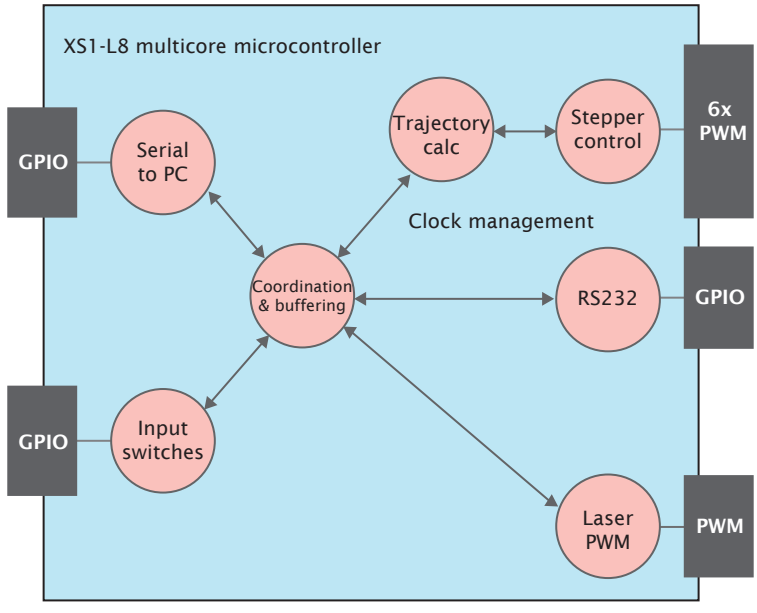
The FSL system uses one core to coordinate the activity of the other multiple cores, using the low latency inter-core communication channels to communicate.

"The system is complex with lots going on. Using XMOS allowed us to easily manage the simultaneous control tasks and allowed us to put multiple functions on one chip, reducing our cost." said **Henry Liu PhD,** from **Full Spectrum Laser.**

xCORE devices include precise I/O timing that can be programmed directly from high-level software. Using this capability FSL was easily able to achieve the performance required with just one of the eight logical cores in the xCORE device handling all motor and laser functions.

With eight cores available in an XS1-L8 device and 16 cores in an XS1-L16, the developer has complete control over their system behavior. Each of the 62.5MIPS cores can execute a separate concurrent task that has been defined by the user. Cores can be used for either I/O, digital signal processing or software stacks. Intelligent I/O ports together with the 500MHz processor core make xCORE a flexible, low cost solution.

Alongside the single core used for the motors, the other cores in the Full Spectrum Laser design handle the Human Machine Interface (HMI), communications interfaces, and the system control.



Using a multicore microcontroller allowed the system to be implemented as a number of independent processes

Each core in the system executes concurrently, deterministically and predictably, and independently from the other cores – a particularly beneficial feature for real time systems. The developer can implement and verify the code on each core independently, building up the system by connecting cores together. As each new core is added to the system, its behavior doesn't affect that of the existing multiple cores. Similarly, changing code on one core doesn't affect the performance or timing of the other cores, allowing changes to be incorporated without fuss.

xCORE devices have no fixed I/O peripherals – XMOS provides a library of xSOFTip peripherals that can be used to configure the device. FSL actually created their own custom interfaces as well to provide the precise controls at high speed that their system needed.

The heart of the RetinaEngrave system

"Mixing both hardware and software in C is really advantageous; it allowed us to get to market very fast. Revising the IP was quick, even late in the design process. It's all implemented in software, so we were able to make improvements and add functionality even after the product had shipped."

Development tools are vital when using microcontrollers and XMOS aims to make its tools incredibly easy to use. The xTIMEcomposer Studio environment includes compiler, assembler, debugger, simulator, waveform viewer and more. Best of all, its free!

"The simulator is great, better than all the others I've used and is really useful for trying out ideas"

The xCORE processor is so predictable that the xTIMEcomposer Studio includes a timing analyzer to statically time how long it takes to execute a given piece of code. It's also a great tool for code optimization, showing which areas of code take the most time to execute.

"By reusing IP and code that we have already designed for our first xCORE based laser controller, we can now create new products in a few days so it's incredibly quick and easy" stated **Dr Liu**

Based in Nevada, USA, Full Spectrum Laser LLC has been building laser products since 2007. Full Spectrum Laser develops laser control electronics and software, delivering high quality lasers to customers around the world. Its wide range of products cover lasers for the hobby market, through to professional projector style scanning galvo fiber lasers.