

Synopsys and Yamaha

Yamaha's XMP-1 DSP Doubles Functionality While Taping Out Six Months Early with Processor Designer



With Processor Designer we doubled functionality for our high definition sound generator, developing it in just one year, including the entire software development toolchain, while reducing cost.”



Morito Morishima

Product Development Department Manager, Semiconductor Division, Yamaha Corporation

Business

Yamaha operates in multiple business segments: Musical Instruments, AV/IT, Electronic Devices and Others. Yamaha is a leader in markets driven by technical expertise in music, sound and networks. The company develops and supplies high-quality products and semiconductors to meet customer expectations for various consumer and communications applications.

Challenges

- ▶ Handle complexity of both the hardware and software of DSP/processor built in-house, with a very tight project deadline
- ▶ Reduce development time for software development environment including C-Compiler
- ▶ Need more functional flexibility to quickly respond to evolving market requirements

System-Level Design Solution

- ▶ Processor Designer

Benefits

- ▶ Reduced DSP development time by 6 months and device size by 20% reducing total cost
- ▶ Doubled number of channels and improved system performance over previous system
- ▶ Enabled HW/SW co-design using automatically generated high-speed instruction set simulator

- ▶ Increased flexibility allowed team to add new algorithm even after completing system development

Overview

The Yamaha semiconductor development team designed a custom digital signal processor (DSP) for high definition sound generation. This DSP, the XMP-1, features 32 channel phrase sound generation based on “AM5 stream decoder” technology, an AudioEngine™ — a Yamaha proprietary technology — enabling feature-rich loud speaker sound using the algorithm for Yamaha Professional Audio equipment, and it also comes with an LED direct control functionality for amusement and consumer applications.

The XMP-1 allows users to achieve more varied and attractive lighting effects tied to sound generation while reducing the processing load from the main CPU. The device has a 24 bit PCM output with up to 6 channels and a SPDIF output, also with up to 6 channels.

This DSP design had a one year project schedule and 3 engineering resources assigned. The top goal was to improve design and functional flexibility while reducing the DSP development time and cost over the previous generation device using a software-based solution rather than fixed hardware.



XMP-1 delivers 32 channel phrase sound generation and AudioEngine™ rich sound effects — a level of complexity not possible with fixed hardware, and Processor Designer made it easier to attain higher quality.”

Morito Morishima

Product Development Department Manager, Semiconductor Division, Yamaha Corporation

Leading Custom Processor Solution

The Yamaha design team selected Processor Designer to meet their goals of increased flexibility and reduced development cost. Processor Designer automated the DSP development process by providing the software toolchain including: assembler, linker, debugger and C-Compiler and then generating the final RTL code.

Input to Processor Designer is based on the LISA language which the team found easy to use when adding special instructions and functions. Also, because Processor Designer provided consistency between the generated ISS and later the RTL, the team was able to significantly reduce verification time.

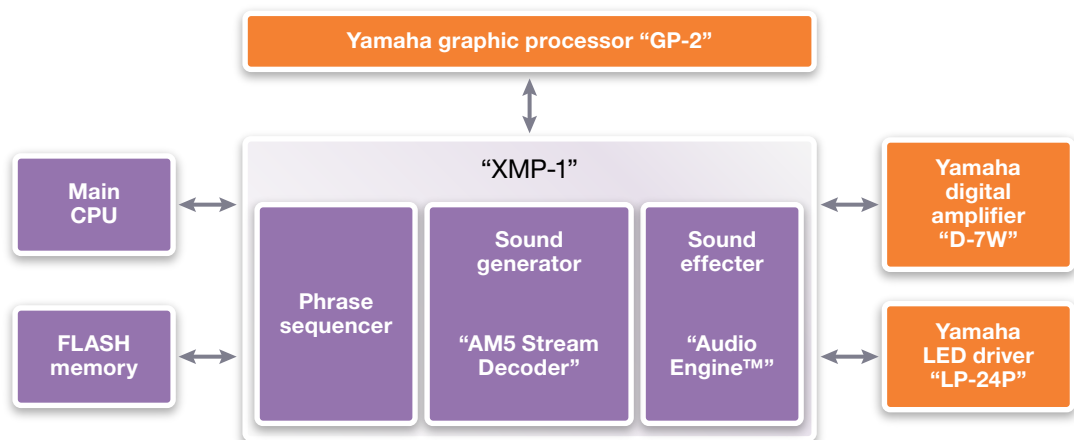
The flexibility of creating a multi-functional ASIP system enabled the team to double the number of sound channels from the previous project design. Rather than having limited functionality in fixed hardware, the team was able to easily develop a new product algorithm with this flexible custom DSP solution even after the platform design was completed.

High Quality Results

Using Processor Designer the Yamaha team completed their XMP-1 DSP project 6 months early while doubling the functionality, or number of sound channels, compared to the previous generation design. The team was also able to reduce the silicon size of the DSP by 20% versus the previous generation fixed hardware block.

With integrated verification and optimized RTL automatically generated with Processor Designer, the design team could focus on providing more feature-rich functionality to their customers, such as the AudioEngine™ enabling rich sound effects adapted to product shape and size.

While in-house design and competitive offerings were options, Yamaha chose Processor Designer since the tool uniquely provided a complete toolchain — a single source for generating optimized software tools, RTL, and ISS. Yamaha plans to use Processor Designers as their primary application-specific instruction-set processor (ASIP) development solution on future projects.



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