

Unit / Module Description:	Sundance <> Simulink® Multi-DSP & Multi-FPGA Toolbox for co-design and code generation
Unit / Module Number:	SMT6040
Document Issue Number:	1.3
Issue Date:	14/01/2009
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Application Note for SMT6040

Abstract

The SMT6040 is a SW tool for automatic generation of VHDL & C code from Simulink® diagrams. It also includes libraries providing Simulink blocks to support multi-DSP and multi-FPGA Sundance systems.

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Certificate Number FM 55022

Revision History

Issue	Changes Made	Date	Initials
1.0	First revision	13/09/2007	GM
1.1	More modules supported	28/08/2008	GM
1.2	All licenses now listed	04/11/2008	GM
1.3	More modules supported Updated Licenses & Requirements	14/01/2009	GM

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1 Introduction

Rapid prototyping systems employ various components such as DSPs, FPGAs, ADCs and DACs. Developing a digital signal processing system requires designing software, digital hardware and analog hardware subsystems, which will tightly interact. Design validation requires simulating the interacting subsystems as a whole; this invariably leads to appropriate co-simulation and co-design techniques.

The Sundance innovative SMT6040 co-design tool allows easy conversion of a Simulink diagram into hybrid software compiled and ready to run on Sundance hardware.

The main strengths of the SMT6040 are:

- **Multi-DSP & multi-FPGA systems are supported**
- **Co-simulating all subsystems together with the ease-of-use offered by the Simulink® environment (Blockset Libraries).**

The user can describe his project by means of a set of interconnected blocks, which are functionally identical to those from the Simulink library (math and logical operators, non-linear and trigonometric functions, vector and matrix operations, modulators, etc.).

The Sundance-provided blocks have a Data Flow calculation paradigm, just like Simulink blocks. The SMT6040 blocks accurately simulate their digital and analog counterparts; at the same time, the entire system is kept hardware-independent. Together with Sundance *Lego™-like* modular approach, the SMT6040 lets users port the same high-level Simulink project to many different Sundance systems quickly and easily.

Compared to *Xilinx System Generator®*, a similar product for system co-design, the SMT6040 FPGA generation capabilities are far more flexible, and support also simulation, optimization, modeling and code generation of:

- ✓ **vectors**
- ✓ **matrices**
- ✓ **images**
- ✓ **floating-point**
- ✓ **communication with DSP**
- ✓ **analog blocks**

2 Supported Boards

The product can support almost all Sundance boards. At the moment it supports the following modules:

FPGA boards: SMT358, SMT398-VP70, SMT338-VP30-6, SMT368, SMT351T-SX50-1, SMT351T-LX50-1, SMT351T-SX95-1, SMT351T-LX110-1

DSP boards: SMT365, SMT365E, SMT395-VP30-6, SMT395Q, SMT374-300, SMT362

DAQ boards: SMT370, SMT364, SMT350, SMT384

Video boards: SMT319, SMT339

Systems: SMT8036, SMT8036E, SMT8096, SMT8039 and basically any other combination of the above boards, in particular **Multi-DSP and Multi-FPGA systems**. Demos available also for these hardware combinations: SMT362+SMT368+SMT350, SMT362+SMT351T+SMT350, SMT395+SMT351T+SMT350

Notes: SMT381 and SMT391 are currently not supported and the SMT339 is supported partially. In particular, the SMT6040 fully supports the DSP and the FPGA on the SMT339, but for developing Video-related applications, the SMT6040-generated output will have to be integrated with Diamond and the Diamond Video Library. Xilinx System Generator and Diamond are requirements for Simulink model-based projects based on SMT339 platforms.

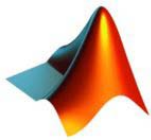
3 Licenses

The SMT6040 is a MULTI-DSP & MULTI-FPGA TOOLBOX, suitable both for large designs and for projects in which many different Sundance boards are employed.

The product has the following licensing scheme:

- SMT6040 – DSP: supports DSP boards (and DAQ modules).
- SMT6040 – DSP&FPGA: full support for all modules as described in *Section 2 – Supported Boards*.
- SMT6040 – 6136: targets specifically the SMT8036 & SMT8036E platforms.
- SMT6040 – 6039: targets specifically the SMT8039 platform.

4 Software tools involved in the process



The following *MathWorks* products are required: *Matlab*[®], *Simulink*[®] and the *Real-Time Workshop*[®]. Together, they form a powerful graphical modeling system that allows complex projects to be designed with simple block diagrams.



TI Code Composer Studio[®] is a fully featured IDE suite that spans the entire DSP development process. It includes C/C++ compiler, assembler, linker, debugger, integrated code editor & visual project manager.

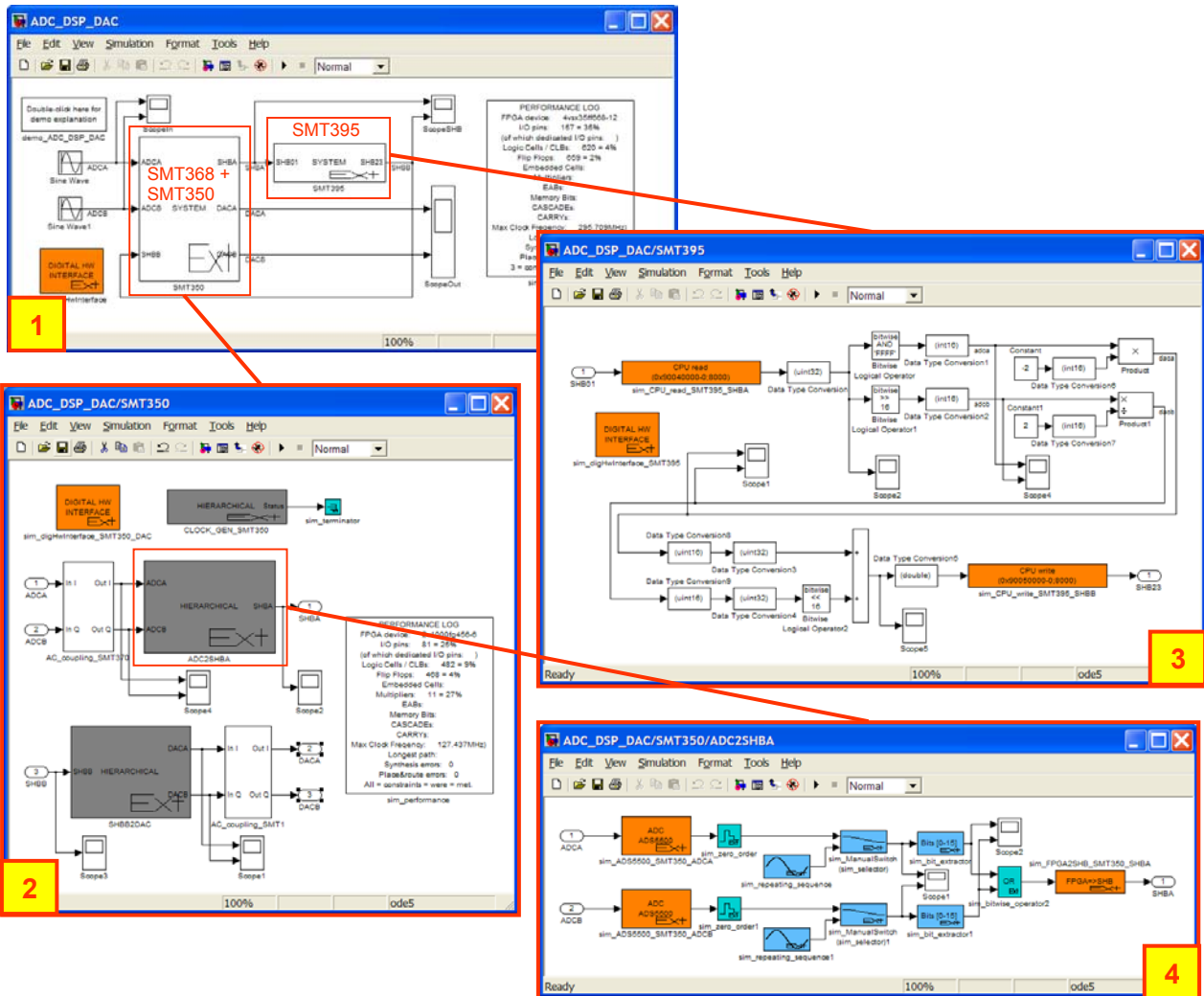


Xilinx[®] *Integrated Software Environment (ISE)* is an IDE solution for FPGAs providing VHDL synthesis and simulation, implementation and device fitting. It supports almost all Sundance boards.

The above tools are not included in the SMT6040 and shall be purchased separately.

5 Basic operation

The SMT6040 can be used for simulation, co-design and co-generation. Some examples follow.



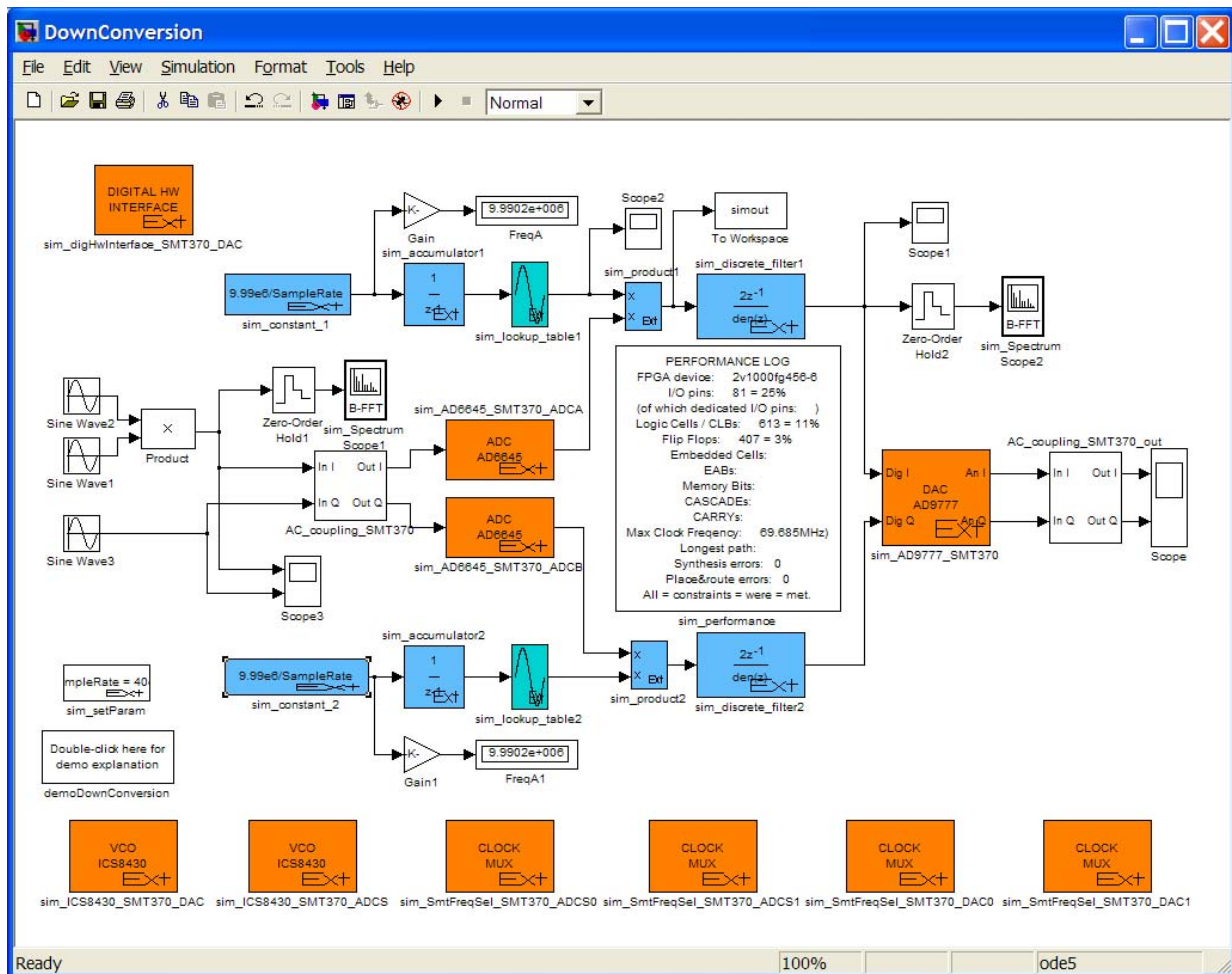
Example 1: SMT8096 complete model.

Picture 1 shows the top level containing an SMT368/350 block and an SMT395. Interconnections are made with SHB channels; the input stimuli in this case are two analogue sine waves; a few scopes are employed to monitor internal and output signals.

Picture 2 depicts the schematics that will be compiled and placed inside the SMT368/350 block.

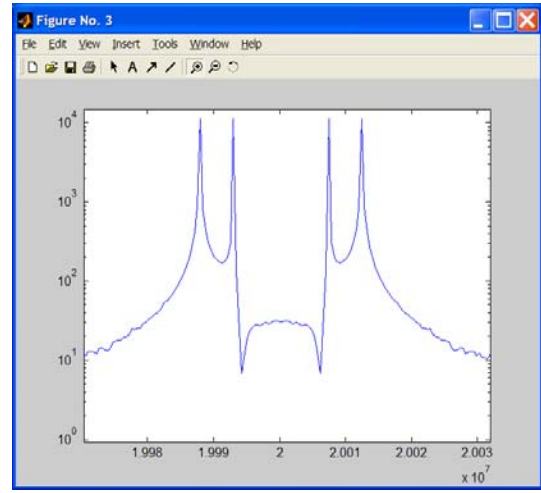
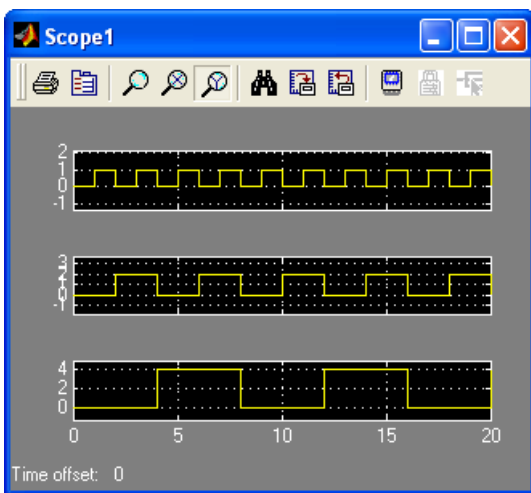
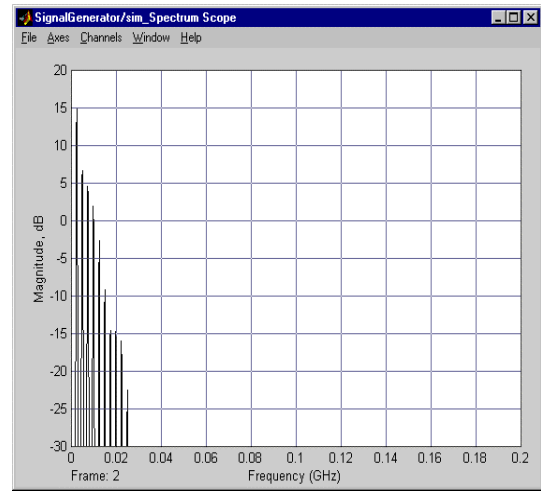
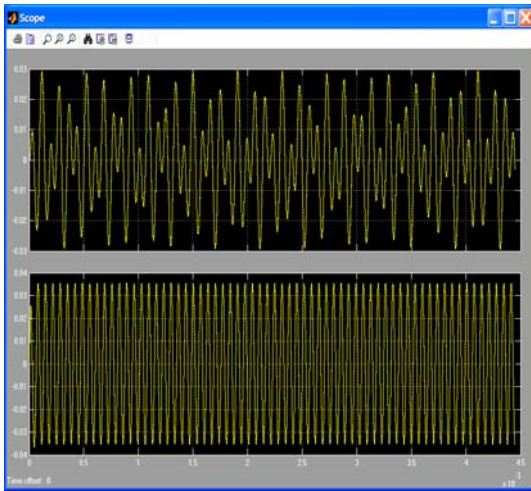
Picture 3 contains the schematics for the SMT395 (DSP module), which will process the signals coming from the ADCs and going to the DACs.

Picture 4 depicts the various blocks that make up the SMT368/350.



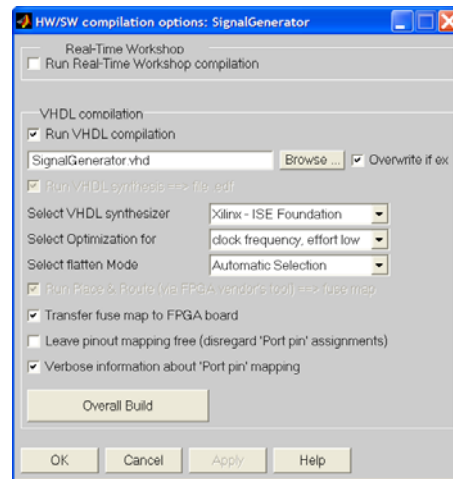
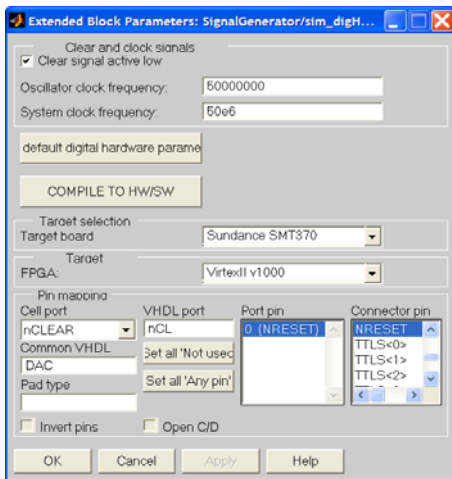
Example 2: DownConversion, a high-level Simulink project comprising Sundance hardware

As soon as your complex Simulink project has been co-designed, co-simulated and tuned by using the powerful capabilities of Matlab, it can be automatically converted into C code for all SW blocks and VHDL code for all HW blocks. Mixed HW/SW interfaces are converted into both C and VHDL sub-blocks.



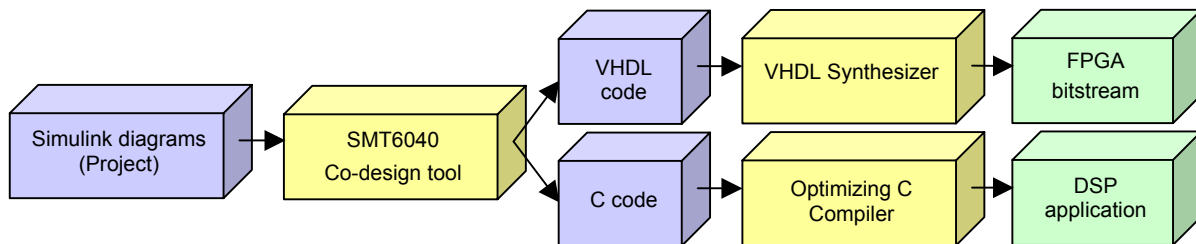
Some examples of input and output signals

The generated code is then compiled with TI CCS optimizing Compiler and Xilinx ISE VHDL synthesizer respectively. Finally, the resulting bitstream and DSP application are downloaded into the target hardware system.



With the SMT6040 is it easy to set each block properties and synthesis options

The power of the SMT6040 is that it fully supports systems comprising many DSP and FPGA modules, making it possible for large projects to fully exploit the Sundance hardware resources.



6 Requirements

Matlab® 7.5.0 and Simulink® 7.0

Real Time Workshop (version found in Matlab® 7.5.0)

TI Code Composer Studio® 3.3

Xilinx® ISE Foundation 9.2 or 10.1

7 Useful resources

7.1 Links

SMT6040 Webpage:

<http://www.sundance.com/web/files/productpage.asp?STRFilter=SMT6040>

7.2 Contact

Contact Person:

Dr. Fabio Ancona (email: fabio.ancona@sundanceitalia.191.it)