SmartFusion2, IGLOO2, and RTG4

Hard Multiplier Configuration

Microsemi

Table of Contents

Introduction

The Hard Multiplier for SmartFusion2, IGLOO2, and RTG4 supports two's complement normal (Figure 1) and dot product (Figure 2) multiplication.

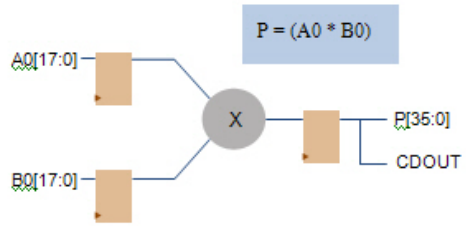

***Figure 1* • Normal Multiplier**

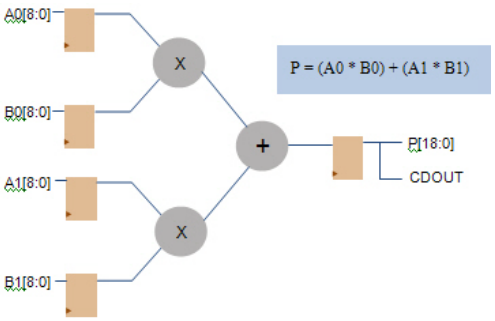

***Figure 2* • Dot Product Multiplier**

Key Features

The Hard Multiplier supports two operating modes: Normal and Dot Product.

- A structural netlist is generated in either Verilog or VHDL.
- Individual inputs and outputs can be optionally registered with:
  - A common rising edge clock
  - Independent active-low asynchronous and synchronous clear controls
  - Independent active-high enable controls
- Additional cascade output CDOUT can be enabled. This is the sign-extended 44 bit copy of output P.
- Normal Mode Features:
  - Configurable operand widths for A0 and B0 between 2 and 18.
  - Optional assignment of operand A0 to an 18 bit two's complement constant.
- Dot Product Mode Features:
  - Configurable operand widths for A0, B0, A1, B1 between 2 and 9.
  - Optional assignment of operand A0 and A1 to a 9 bit two's complement constant.

1 – SmartDesign

The Hard Multiplier for SmartFusion2, IGLOO2, and RTG4 is available for download from the Libero® SoC IP Catalog via the web repository. Once listed in the Catalog you can double-click the macro to configure it in SmartDesign. For information on using SmartDesign to configure, connect, and generate cores, see the Libero SoC online help.

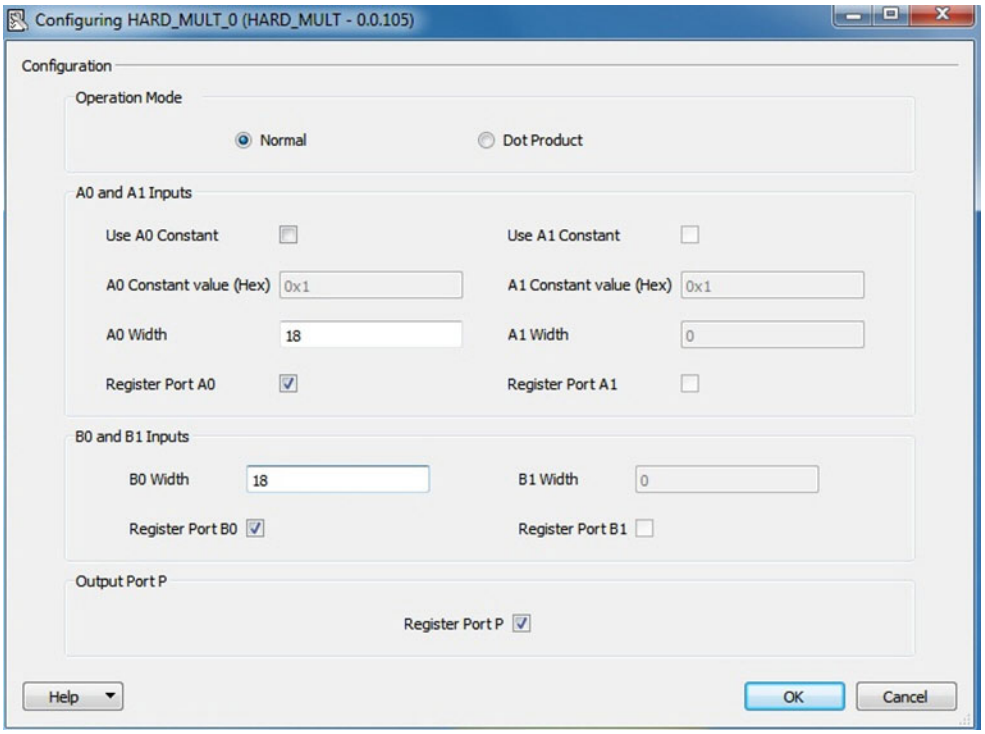

Figure 1-1 **• Hard Multiplier Configuration Options - Normal Mode**

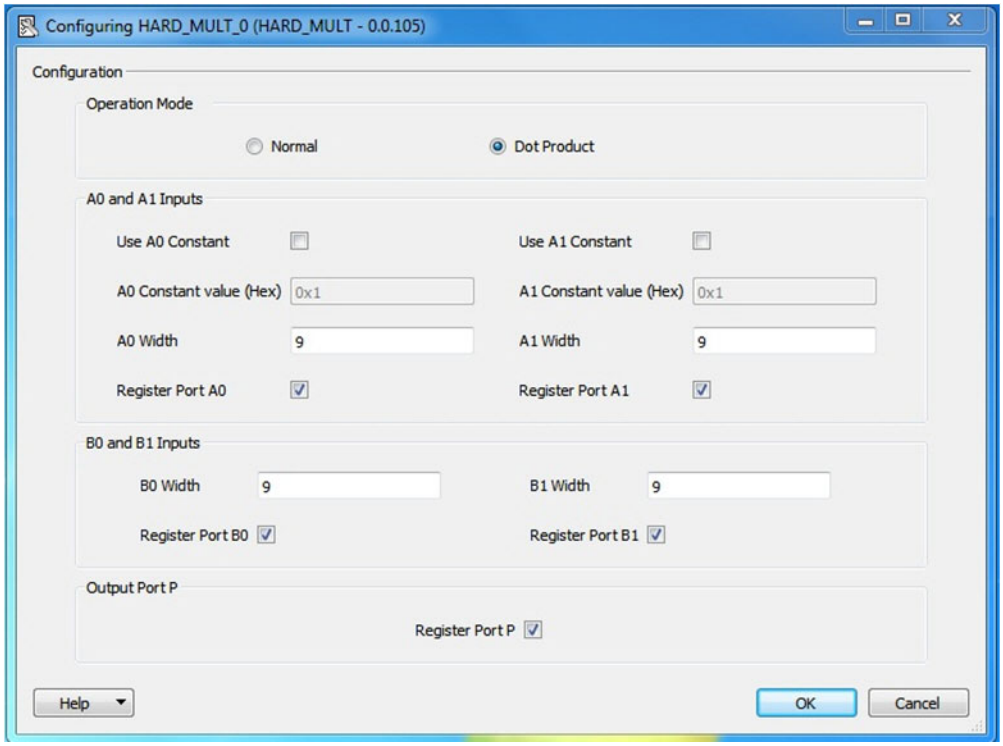

***Figure 1-2* • Hard Multiplier Configuration Options - Dot Product Mode**

After configuring and generating the macro instance, you can simulate basic functionality. The macro can then be instantiated as a component of a larger design.

2 – Core Parameters

Table 2-1 lists the Normal mode Hard Multiplier settings; Table 2-2 lists the Dot Product mode settings.

***Table 2-1* • Hard Multiplier Normal Mode Configuration Description**

Name	Valid Range	Description
Input Port A0		
Use Constant		Sets input port A0 to constant
Constant Value (Hex)	-2^{17} to (2^{17} - 1)	Two's complement value of A0, if A0 is constant. Values shorter than 18 bits are padded with zeros. Negative values must be a full 18 bits wide. For example, 0x1FFFF means +131071 (2^{17} - 1), while 0x3FFFF means -1
Width	2 to 18	Width of input port A0; if shorter than 18 bits it is sign-extended. For example, if the width is 8, a value of 0x7F means +127 and a value of 0xFF means -1
Register Port		Registers input port A0 (if A0 is not constant)
Input Port B0		
Width	2 to 18	Width of input port B0; if shorter than 18 bits it is sign-extended. For example, if the width is 8, a value of 0x7F means +127 and a value of 0xFF means -1.
Register Port		Registers input port B0
Output Port P		
Register Port		Registers output port P and CDOUT

***Table 2-2* • Hard Multiplier Dot Product Mode Configuration Description**

Name	Valid Range	Description
Input Port A0		
Use Constant		Sets input port A0 to constant
Constant Value (Hex)	-2^{8} to (2^{8} - 1)	Two's complement value of A0, if A0 is constant. Values shorter than 9 bits are padded with zeros. Negative values must be a full 9 bits wide. For example, 0xFF means +255 (2^{8} - 1), while 0x1FF means -1
Width	2 to 9	Width of input port A0; if shorter than 9 bits it is sign-extended. For example, if the width is 8, a value of 0x7F means +127 and a value of 0xFF means -1.
Register Port		Registers input port A0 (if A0 is not constant)
Input Port A1		
Use Constant		Sets input port A1 to constant

***Table 2-2* • Hard Multiplier Dot Product Mode Configuration Description**

Name	Valid Range	Description
Constant Value (Hex)	-2^8 to (2^8 - 1)	Two's complement value of A1, if A1 is constant. Values shorter than 9 bits are padded with zeros. Negative values must be a full 9 bits wide. For example, 0xFF means +255 (2^8 - 1), while 0x1FF means -1
Width	2 to 9	Width of input port A1; if shorter than 9 bits it is sign-extended. For example, if the width is 8, a value of 0x7F means +127 and a value of 0xFF means -1.
Register Port		Registers input port A1 (if A1 is not constant).
Input Port B0		
Width	2 to 9	Width of input port B0; if shorter than 9 bits it is sign-extended. For example, if the width is 8, a value of 0x7F means +127 and a value of 0xFF means -1.
Register Port		Registers input port B0
Input Port B1		
Width	2 to 9	Width of input port B1; if shorter than 9 bits it is sign-extended. For example, if the width is 8, a value of 0x7F means +127 and a value of 0xFF means -1.
Register Port		Registers input port B1
Output Port P		
Register Port		Registers output port P and CDOUT

3 – Port Description

The figures below display the Hard Multiplier input and output ports for Normal mode (Figure 3-1) and Dot Product mode (Figure 3-2). The ports shown are a superset of all possible ports. Only a subset of the ports is used in any given Hard Multiplier configuration.

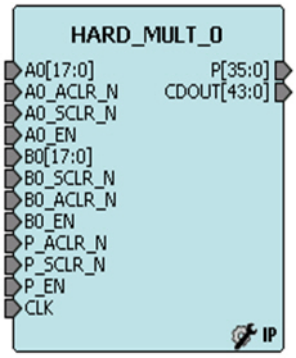

***Figure 3-1* • Hard Multiplier Ports, Normal Mode**

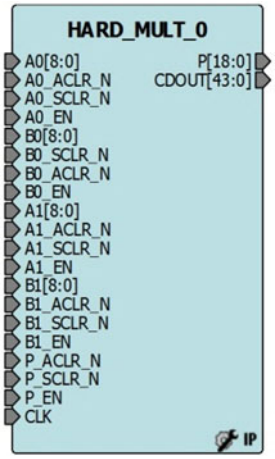

***Figure 3-2* • Hard Multiplier Ports, Dot Product Mode**

Table 3-1 lists the Hard Multiplier port signals for Normal mode.

***Table 3-1* • Hard Multiplier Ports - Normal Mode**

Signal	Direction	Description
A0	Input	Input data A0, 2 - 18 bits wide
B0	Input	Input data B0, 2 - 18 bits wide
CLK	Input	Input clock for A0, B0, P and CDOUT registers
A0_ACLR_N	Input	Asynchronous reset for data A0 registers
A0_SCLR_N	Input	Synchronous reset for data A0 registers
A0_EN	Input	Enable for data A0 registers
B0_ACLR_N	Input	Asynchronous reset for data B0 registers
B0_SCLR_N	Input	Synchronous reset for data B0 registers
B0_EN	Input	Enable for data B0 registers
P_ACLR_N	Input	Asynchronous reset for result P and CDOUT registers
P_SCLR_N	Input	Synchronous reset for result P and CDOUT registers
P_EN	Input	Enable for result P and CDOUT registers
P	Output	Result data: P = A0 * B0
CDOUT	Output Cascade	Cascade output of result P. CDOUT is a copy of P, sign- extended to 44 bits. The entire bus must either be dangling or drive an entire CDIN of another MATH block in normal mode.

Table 3-2 lists the Hard Multiplier port signals for Dot Product mode.

***Table 3-2* • Hard Multiplier Ports - Dot Product Mode**

Signal	Direction	Description
A0	Input	Input data A0, 2 - 9 bits wide
A1	Input	Input data A1, 2 - 9 bits wide
B0	Input	Input data B0, 2 - 9 bits wide
B1	Input	Input data B1, 2 - 9 bits wide
CLK	Input	Input clock for A0, A1, B0, B1, P and CDOUT registers
A0_ACLR_N	Input	Asynchronous reset for data A0 registers
A0_SCLR_N	Input	Synchronous reset for data A0 registers
A0_EN	Input	Enable for data A0 registers
B0_ACLR_N	Input	Asynchronous reset for data B0 registers
B0_SCLR_N	Input	Synchronous reset for data B0 registers
B0_EN	Input	Enable for data B0 registers
A1_ACLR_N	Input	Asynchronous reset for data A1 registers
A1_SCLR_N	Input	Synchronous reset for data A1 registers
A1_EN	Input	Enable for data A1 registers
B1_ACLR_N	Input	Asynchronous reset for data B1 registers
B1_SCLR_N	Input	Synchronous reset for data B1 registers
B1_EN	Input	Enable for data B1 registers
P_ACLR_N	Input	Asynchronous reset for result P and CDOUT registers
P_SCLR_N	Input	Synchronous reset for result P and CDOUT registers
P_EN	Input	Enable for result P and CDOUT registers
P	Output	Result data: P = (A0 * B0) + (A1 * B1)
CDOUT	Output Cascade	Cascade output of result P. CDOUT is a copy of P, sign- extended. The entire bus must either be dangling or drive an entire CDIN of another MATH block in dot product mode.

A – Product Support

Microsemi SoC Products Group backs its products with various support services, including Customer Service, Customer Technical Support Center, a website, electronic mail, and worldwide sales offices. This appendix contains information about contacting Microsemi SoC Products Group and using these support services.

Customer Service

Contact Customer Service for non-technical product support, such as product pricing, product upgrades, update information, order status, and authorization.

From North America, call 800.262.1060
From the rest of the world, call 650.318.4460
Fax, from anywhere in the world, 408.643.6913

Customer Technical Support Center

Microsemi SoC Products Group staffs its Customer Technical Support Center with highly skilled engineers who can help answer your hardware, software, and design questions about Microsemi SoC Products. The Customer Technical Support Center spends a great deal of time creating application notes, answers to common design cycle questions, documentation of known issues, and various FAQs. So, before you contact us, please visit our online resources. It is very likely we have already answered your questions.

Technical Support

Visit the Customer Support website (www.microsemi.com/soc/support/search/default.aspx) for more information and support. Many answers available on the searchable web resource include diagrams, illustrations, and links to other resources on the website.

Website

You can browse a variety of technical and non-technical information on the SoC home page, at www.microsemi.com/soc.

Contacting the Customer Technical Support Center

Highly skilled engineers staff the Technical Support Center. The Technical Support Center can be contacted by email or through the Microsemi SoC Products Group website.

Email

You can communicate your technical questions to our email address and receive answers back by email, fax, or phone. Also, if you have design problems, you can email your design files to receive assistance. We constantly monitor the email account throughout the day. When sending your request to us, please be sure to include your full name, company name, and your contact information for efficient processing of your request.

The technical support email address is soc_tech@microsemi.com.

My Cases

Microsemi SoC Products Group customers may submit and track technical cases online by going to My Cases.

Outside the U.S.

Customers needing assistance outside the US time zones can either contact technical support via email (soc_tech@microsemi.com) or contact a local sales office. Sales office listings can be found at www.microsemi.com/soc/company/contact/default.aspx.

ITAR Technical Support

For technical support on RH and RT FPGAs that are regulated by International Traffic in Arms Regulations (ITAR), contact us via soc_tech_itar@microsemi.com. Alternatively, within My Cases, select **Yes** in the ITAR drop-down list. For a complete list of ITAR-regulated Microsemi FPGAs, visit the ITAR web page.

Microsemi Corporate Headquarters
One Enterprise, Aliso Viejo,
CA 92656 USA

Within the USA: +1 (800) 713-4113
Outside the USA: +1 (949) 380-6100
Sales: +1 (949) 380-6136
Fax: +1 (949) 215-4996

E-mail: sales.support@microsemi.com

Microsemi Corporation (Nasdaq: MSCC) offers a comprehensive portfolio of semiconductor and system solutions for communications, defense and security, aerospace, and industrial markets. Products include high-performance and radiation-hardened analog mixed-signal integrated circuits, FPGAs, SoCs, and ASICs; power management products; timing and synchronization devices and precise time solutions, setting the world's standard for time; voice processing devices; RF solutions; discrete components; security technologies and scalable anti-tamper products; Power-over-Ethernet ICs and midspans; as well as custom design capabilities and services. Microsemi is headquartered in Aliso Viejo, Calif. and has approximately 3,400 employees globally. Learn more at **www.microsemi.com**.