

## General Description

The Digital Blocks DB-I2C-M-Hs-Mode Controller IP Core interfaces a microprocessor via the AMBA AXI / AHB / APB Bus or Avalon Bus to an I2C Bus in Hs-Mode (3.4 Mbit/s) / Fast-Mode Plus (1 Mbit/s) / Fast-Mode (400 Kbit/s) / Standard-Mode (100 Kbit/s). The DB-I2C-M-Hs-Mode Controller IP Core can also interface a set of Registers within an ASIC / ASSP / FPGA device as well as interface Memory (e.g. SDRAM / SRAM / FLASH) to an I2C Bus.

The I2C is a two-wire bidirectional interface standard (SCL is Clock, SDA is Data) for transfer of bytes of information between two or more compliant I2C devices, typically with a microprocessor behind the master controller and one or more slave devices.

The DB-I2C-M-Hs-Mode is a Master I2C Controller that controls the Transmit or Receive of data to or from slave I2C devices. Figure 1 depicts the system view of the DB-I2C-M-AHB Controller IP Core embedded within an integrated circuit device.

In an ASIC / ASSP / FPGA integrated circuit, typically, the microprocessor is an ARM processor, but can be any embedded processor. Figure 1 depicts the system view of the DB-I2C-M-Hs-Mode Controller IP Core embedded within an integrated circuit device with its Microprocessor Configuration.

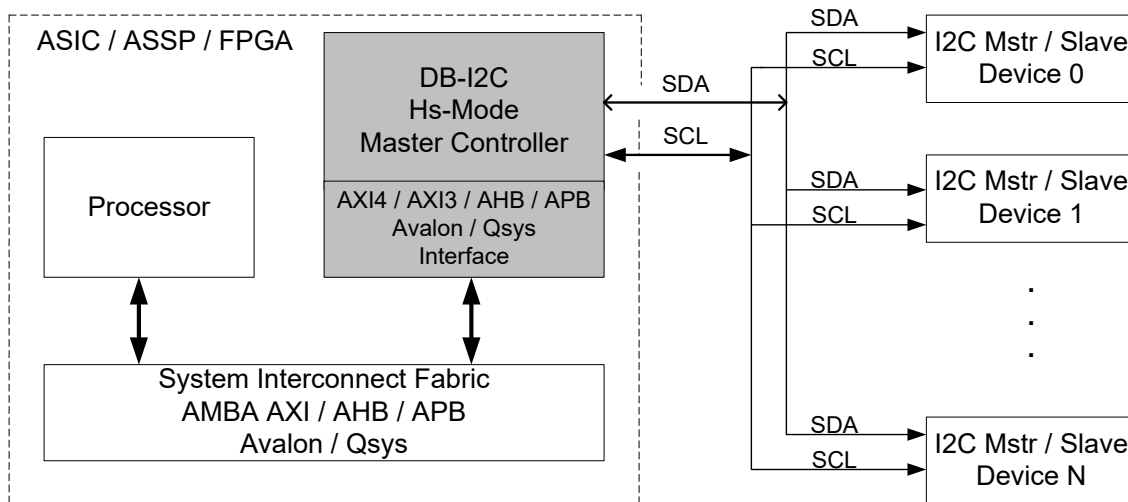


Figure 1: DB-I2C-M-Hs-Mode Controller – System Diagram

The DB-I2C-M-Hs-Mode Controller IP Core targets embedded processor applications with higher performance algorithm requirements. While most I2C controllers require high processor interaction involvement, the DB-I2C-M-Hs-Mode contains a

parameterized FIFO and Finite State Machine Control for the processor to off-load the I2C transfer to the DB-I2C-M-Hs-Mode Controller. Thus, while the DB-I2C-M-Hs-Mode is busy, independently controlling the I2C Master-Transmit or Master-Receive transaction of data, the processor can complete other tasks. All Master Transmit / Receive transfers are with respect to the internal FIFO, thus fully isolating the processor from the I2C transfer of a block of data.

## Features

- Master I<sup>2</sup>C Controller Modes:
  - Master – Transmitter
  - Master – Receiver
- Supports four I2C bus speeds:
  - Hs-Mode (3.4+ Mb/s)
  - Fast Mode Plus (1 Mbit/s)
  - Fast Mode (400 Kb/s)
  - Standard Mode (100 Kb/s)
- Parameterized FIFO memory for off-loading the I<sup>2</sup>C transfers from the processor:
  - Targets embedded processors with higher performance algorithm requirements, by the I<sup>2</sup>C Controller independently controlling the Transmit or Receive of bytes of information buffered to and from a FIFO.
- Enhanced system-level features & integration capabilities:
  - CPU Interface via parameterized FIFO with support for APB / AHB / AXI / AXI-lite / Avalon / Qsys interconnect fabrics
  - Enhanced SCL / SDA spike filtering capabilities
  - Enhanced Repeated Start capabilities
- Enhanced system-level features & integration capabilities (Optional):
  - DMA transfer between the I2C Bus & Memory (SDRAM / SRAM / FLASH)
  - Direct interface to user Registers within ASIC / ASSP / FPGA device, for Master/Slave transfer across the I2C Bus
  - Remote Configuration of a Digital Blocks' I2C Slave by an I2C Master
- I2C compliant features:
  - Multi-Master, Clock Synchronization, Arbitration, Repeated Start, 7/10-bit addressing, & General Call Addressing, Hs-Mode
- 13 sources of internal interrupts with masking control
- Compliance with AMBA and I2C specifications:
  - Compliance with AMBA AXI / AHB/ APB Protocol Specifications
  - Compliance with Avalon / Qsys Protocol Specifications
  - Philips/NXP – The I2C-Bus Specification, Version 2.1, January 2000 and UM10204 Rev 7 – 1 Oct 2021

- Fully-synchronous, synthesizable Verilog RTL core, with rising-edge clocking, no gated clocks, and no internal tri-states, for easy integration into FPGA or ASIC design flows.

Digital Blocks offers I2C Master/Slave, Master-only, and Slave-only Controller IP supporting Hs-Mode / Fast Mode Plus / Fast Mode / Standard Mode.

## Pin Description

In addition to the AMBA AXI Bus interfaces, which include the input CLOCK and RESET signals and the output INTR (interrupt) signal, the I2C interface signals are listed in Table 1.

Name	Type	Description
<b>I2C Bus interface</b>		
SDAI	Input	Serial Data
SDAO	Output	Serial Data
SCLI	Input	Serial Clock Line
SCLO	Output	Serial Clock Line

**Table 1: DB-I2C-M-Hs-Mode – I/O Pin Description**

## Verification Method

The DB-I2C-M-Hs-Mode Controller IP Core contains a test suite with AMBA AXI / AHB / APB Bus or Avalon / Qsys Bus functional models that program the DB-I2C-M-Hs-Mode control & status registers, generates & sends I2C data, monitors the I2C bus protocol, and checks expected results.

The DB-I2C-M-Hs-Mode Controller IP Core has internally been verified as follows:

- Instantiated within an FPGA, controlled by an ARM processor, and communicating with (1) merchant semiconductor devices containing an I2C Slave bus interface; and (2) ASICs containing I2C Slave bus interface

## Customer Evaluation

Digital Blocks offers a variety of methods for prospective customers to evaluate the DB-I2C-M-Hs-Mode. Please contact Digital Blocks for additional information.

## Deliverables

The DB-I2C-M-Hs-Mode is available in synthesizable RTL Verilog or a technology-specific netlist for FPGAs, along with Synopsys Design Constraints, a simulation test bench with expected results, datasheet, and user manual.

The DB-I2C-M-Hs-Mode comes along with example C code software for controlling Transmit and Receive Transactions in an Eclipse-based ARM Integrated Development Environment (IDE).

## Ordering Information

Please contact Digital Blocks for additional technical, pricing, evaluation, and support information.

Digital Blocks, Inc.  
PO Box 192  
587 Rock Rd  
Glen Rock, NJ 07452 USA  
Phone: +1-201-251-1281  
eFax: +1-702-552-1905  
[info@digitalblocks.com](mailto:info@digitalblocks.com)

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