General Description

The Digital Blocks DB-I2C-M-APB Controller IP Core interfaces an ARM, MIPS, PowerPC, ARC or other high performance microprocessor via the AMBA 2.0 APB System Interconnect Fabric 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-APB 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-APB Controller IP Core embedded within an integrated circuit device.

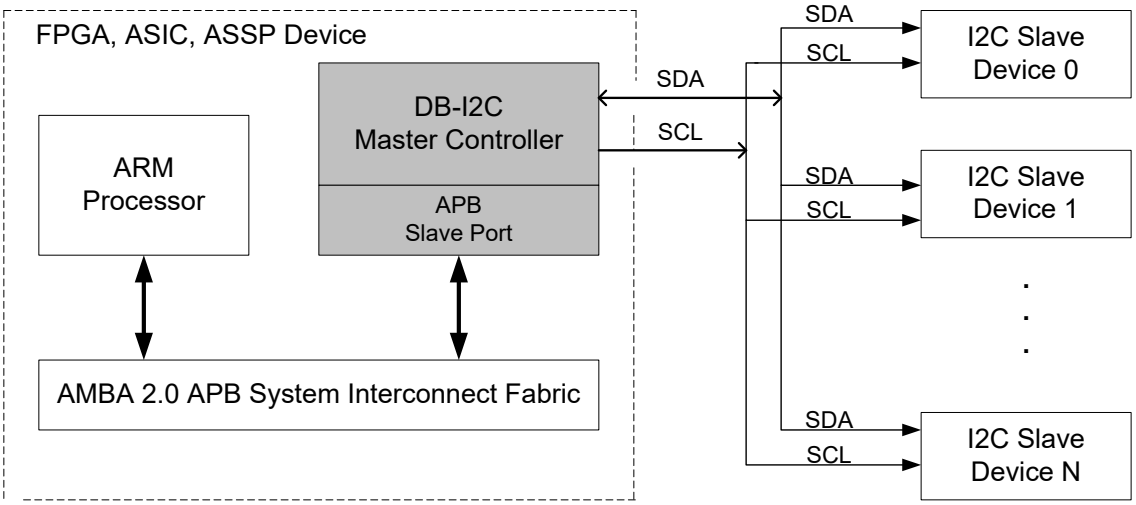

Figure 1: DB-I2C-M-APB Controller – System Diagram

The DB-I2C-M-APB 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-APB contains a parameterized FIFO and Finite State Machine control for the processor to off-load the I2C transfer to the DB-I2C-M-APB Controller. Thus, while the DB-I2C-M-APB is busy, independently controlling the I2C Transmit or Receive transaction of data, the processor can go off and complete other tasks. Note that the Master only capability of the DB-I2C-M-APB adds to its small VLSI footprint requirements.

Features

- Master I^2C 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^2C transfers from the processor:
  - Targets embedded processors with higher performance algorithm requirements, by the I^2C 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
- 13 sources of internal interrupts with masking control
- Compliance with AMBA 2.0 and I2C specifications:
  - AMBA Specification (Rev 2.0), APB Bus
  - Philips/NXP – The I2C-Bus Specification, Version 2.1, January 2000 and UM10204 Rev 7 – 1 Oct 2021
- Fully-synchronous, synthesizable Verilog or VHDL 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

Name	Type	Description
APB Bus Interface		
PCLK	Input	Bus Clock
PRESETn	Input	APB Reset (Active Low)
PADDR[11:0]	Input	APB Address Bus
PSEL_DB_I2C	Input	APB Select for DB-I2C
PENABLE	Input	APB Strobe
PWRITE	Input	APB Transfer Direction (Read/Write)
PRDATA[7:0]	Output	APB Read Data Bus
PWDATA[7:0]	Input	APB WriteData Bus
I2C Bus interface		
SDAi	Input	Serial Data
SDAo	Output	Serial Data
SCLo	Output	Serial Clock Line

Table 1: DB-I2C-M-APB – I/O Pin Description

Verification Method

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

The DB-I2C-M-APB Controller IP Core has been verified as follows:

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

Customer Evaluation

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

Deliverables

The DB-I2C-M-APB is available in synthesizable RTL Verilog or VHDL or a technology-specific netlist for FPGAs, along with synthesis scripts, a simulation test bench with expected results, datasheet, and user manual.

Ordering Information

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

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