Reference: Chapter 31, Atmel-11289-32-bit-Cortex-M4-Microcontroller-SAM-G55\_Datasheet

Use 16-bit mode SPI Master in Atmel CPU

Interfaces

SPI interface between FPGA and Atmel CPU

|  |  |  |
| --- | --- | --- |
| Name | Direction | Descriptions |
| spi\_clk | Input | SPI clock feed by SPI Master |
| spi\_en\_n | Input | Active low enable for SPI comm. |
| spi\_mosi | Input | Master Output/Slave Input, serial in from SPI Master |
| pi\_miso | output | Master Input/Slave Output, serial output to SPI Master |

Local Bus to FPGA's internal modules

|  |  |  |
| --- | --- | --- |
| Name | Direction | Descriptions |
| clk | Input | Main clock of SPI Slave module,  Frequency of clk must be 4-times higher than spi\_clk |
| rst\_b | Input | Active low, asynchronous reset |
| wr\_en | Output | Active high, write strobe to write data to internal memory  Related signals: adr, dout |
| rd\_en | Output | Active high, read strobe to read data from internal memory  Related signals: adr, din |
| adr[11:0] | Output | 12-bit Address to access (read/write) internal memory |
| dout[7:0] | Output | 8-bit SPI Data Register, data prepared to be written to internal memory |
| din[7:0] | Input |  |

Operation Format:

bit 15-12: SPI Command defined as following

4'b0000: Read from SPI 8-bit Data Register

4'b0010: Read from SPI 8-bit Data Register and

Assert a Read Command from the same Address

4'b0011: Read from SPI 8-bit Data Register and

Assert a Read Command from (Address Register + 1)

4'b0100: Read from SPI 12-bit Address Register

4'b1000: Write to SPI 8-bit Data Register

4'b1010: Write to SPI 8-bit Data Register and

Assert a Write Command

4'b1011: Write to SPI 8-bit Data Register and

Assert a Write Command and then

Increase Address Register by 1

4'b1100: Write to SPI 12-bit Address Register

4'b1101: Write to SPI 12-bit Address Register and

Prepare data in SPI 8-bit Data Register

bit 11-0: Data/Address Field (AD)

Example Access sequences

1. Setup data to SPI slave Registers w/o access internal memory

//Setup 12-b Address Register

Atmel TDR = 'hc133 (cmd='hc, ad='h133)

SPI Op...

//Setup 8-b Data Register

Atmel TDR = 'h8001 (cmd='h8, ad='h001)

SPI Op...

1. Random Read: Read data from internal memory with Address = 'h055

//Setup 12-b Address Register and Prepare data in SPI 8-bit Data Register

Atmel TDR = 'hd055 (cmd='hd, ad='h055)

SPI Op...

//Read from SPI 8-b Data Register

Atmel TDR = 'h00ff (cmd='h0)

SPI Op...

***Atmel RDR = 0a5, after SPI operation***

1. Random Write: Write Data(='h55) to Address('h133)

//Setup 12-b Address Register

Atmel TDR = 'hc133 (cmd='hc, ad='h133)

SPI Op...

//Setup 8-b Data Register and Assert Write Command

Atmel TDR = 'ha055 (cmd='ha, ad='h055)

SPI Op...

1. Burst FIFO Read: Read 4-Byte Data from Address ('h055)

//Setup 12-b Address Register and Prepare data in SPI 8-bit Data Register

Atmel TDR = 'hd055 (cmd='hd, ad='h055)

SPI Op...

//Read from SPI 8-b Data Register and Prepare next data in SPI 8-bit Data Register

Atmel TDR = 'h20ff (cmd='h2)

SPI Op...

***Atmel RDR = 0a5, after SPI operation***

//Read from SPI 8-b Data Register and Prepare next data in SPI 8-bit Data Register

Atmel TDR = 'h20ff (cmd='h2)

SPI Op...

***Atmel RDR = 0a6, after SPI operation***

//Read from SPI 8-b Data Register and Prepare next data in SPI 8-bit Data Register

Atmel TDR = 'h20ff (cmd='h2)

SPI Op...

***Atmel RDR = 0a7, after SPI operation***

//Read from SPI 8-b Data Register and Prepare next data in SPI 8-bit Data Register

Atmel TDR = 'h20ff (cmd='h2)

SPI Op...

***Atmel RDR = 0a8, after SPI operation***

1. Burst FIFO Write: Write 4-Byte Data to Address('h1CC)

Data = {'h55, 'h56, 'h57, 'h58}

//Setup 12-b Address Register

Atmel TDR = 'hc1CC (cmd='hc, ad='h1CC)

SPI Op...

//Setup 8-b Data Register and Assert Write Command

Atmel TDR = 'ha055 (cmd='ha, ad='h055)

SPI Op...

//Setup 8-b Data Register and Assert Write Command

Atmel TDR = 'ha056 (cmd='ha, ad='h056)

SPI Op...

//Setup 8-b Data Register and Assert Write Command

Atmel TDR = 'ha057 (cmd='ha, ad='h057)

SPI Op...

//Setup 8-b Data Register and Assert Write Command

Atmel TDR = 'ha058 (cmd='ha, ad='h058)

SPI Op...

1. Burst Memory Read: Read 3-Byte Data from Address('h200-'h202)

//Setup 12-b Address Register and Prepare data in SPI 8-bit Data Register

Atmel TDR = 'hd200 (cmd='hd, ad='h200)

SPI Op...

//Read from SPI 8-b Data Register and Prepare next data in SPI 8-bit Data Register from Addr+1

Atmel TDR = 'h30ff (cmd='h3)

SPI Op...

***Atmel RDR = 0a9, after SPI operation***

//Read from SPI 8-b Data Register and Prepare next data in SPI 8-bit Data Register from Addr+1

Atmel TDR = 'h30ff (cmd='h3)

SPI Op...

***Atmel RDR = 0aa, after SPI operation***

//Read from SPI 8-b Data Register and Prepare next data in SPI 8-bit Data Register from Addr+1

Atmel TDR = 'h30ff (cmd='h3)

SPI Op...

***Atmel RDR = 0ab, after SPI operation***

1. Burst Memory Write: Write 3-Byte Data to Address('h200-'h202)

Data = {'h55, 'h56, 'h57}

//Setup 12-b Address Register

Atmel TDR = 'hc200 (cmd='hc, ad='h200)

SPI Op...

//Setup 8-b Data Register and Assert Write Command and Adr Increase by 1

Atmel TDR = 'hb055 (cmd='hb, ad='h055)

SPI Op...

//Setup 8-b Data Register and Assert Write Command and Adr Increase by 1

Atmel TDR = 'hb056 (cmd='hb, ad='h056)

SPI Op...

//Setup 8-b Data Register and Assert Write Command and Adr Increase by 1

Atmel TDR = 'hb057 (cmd='hb, ad='h057)

SPI Op...