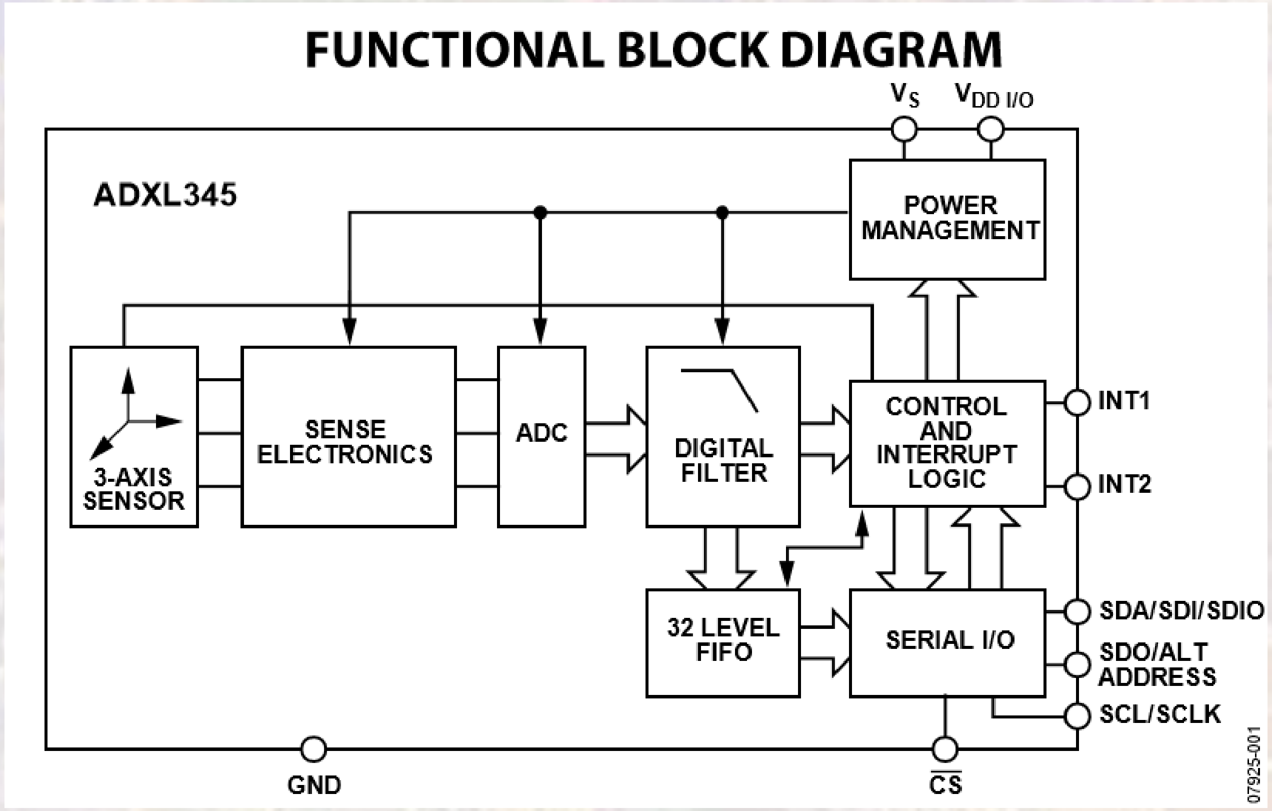
Accelerometer Example

Last updated 7/21/23

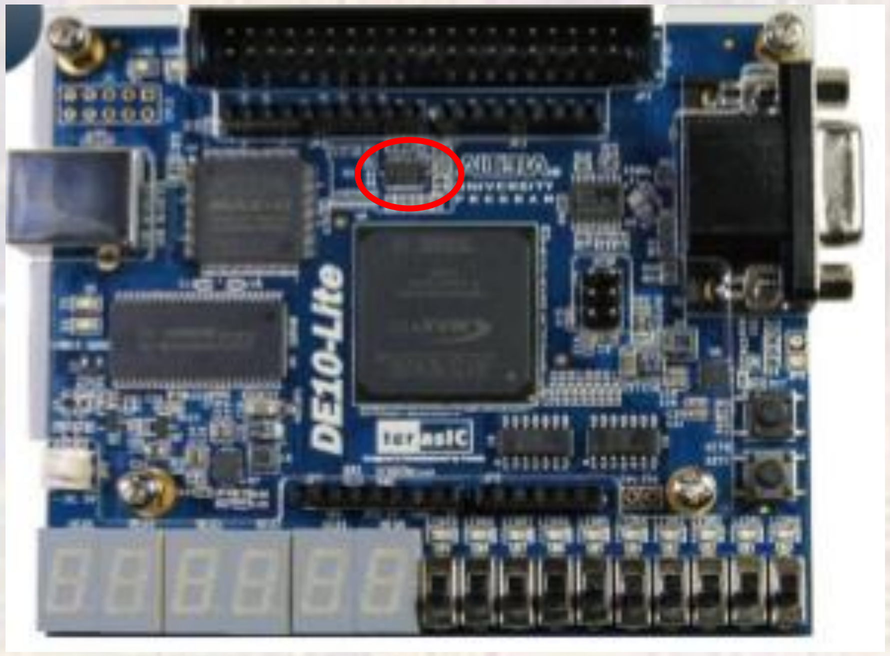
Accelerometer

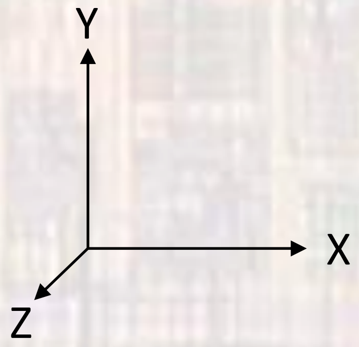
- ADXL345 – 3-axis Accelerometer
  - I2C and SPI interfaces
  - FIFO sample storage



Accelerometer

- ADXL345 – 3-axis Accelerometer
  - Selectable ±2, ±4, ±8, ±16 g measurement range
  - 10bit resolution: 4.3mg/LSB -34.5mg/LSB
  - Up to 3200Hz data rate



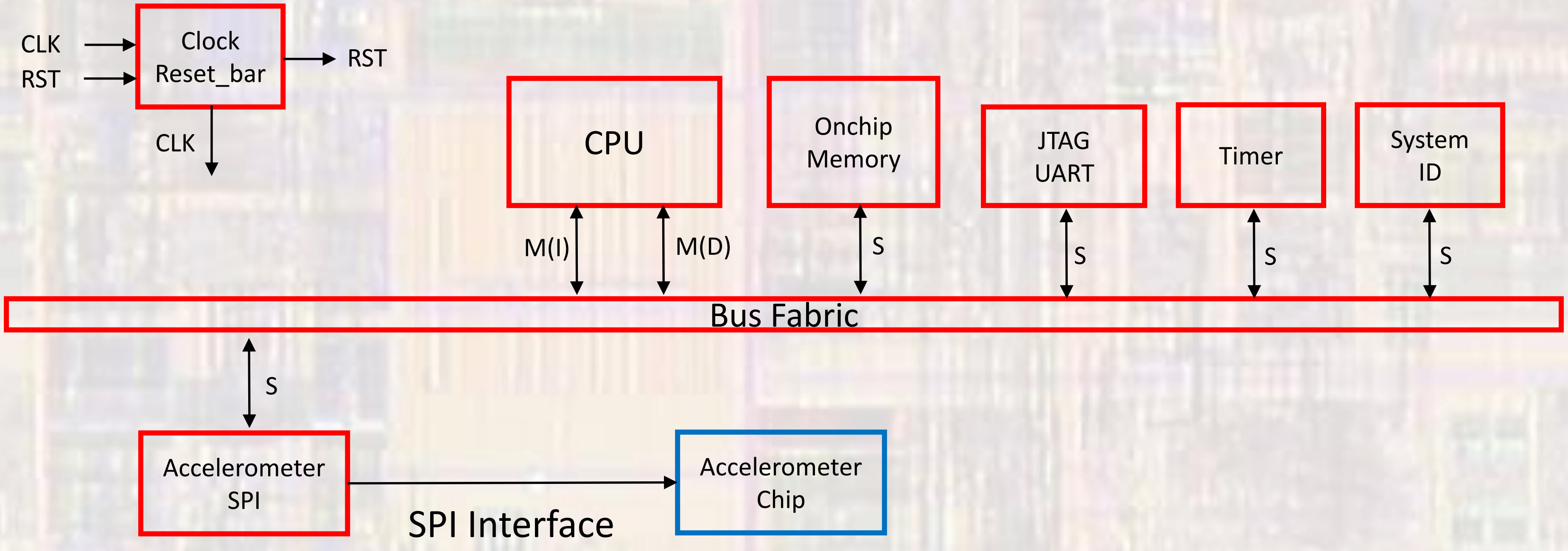


Accelerometer

- ADXL 345 Default modes
  - 4 wire SPI
  - 10bit
  - Data: right justified, sign extended
  - +/- 2g range
  - Trigger on int1

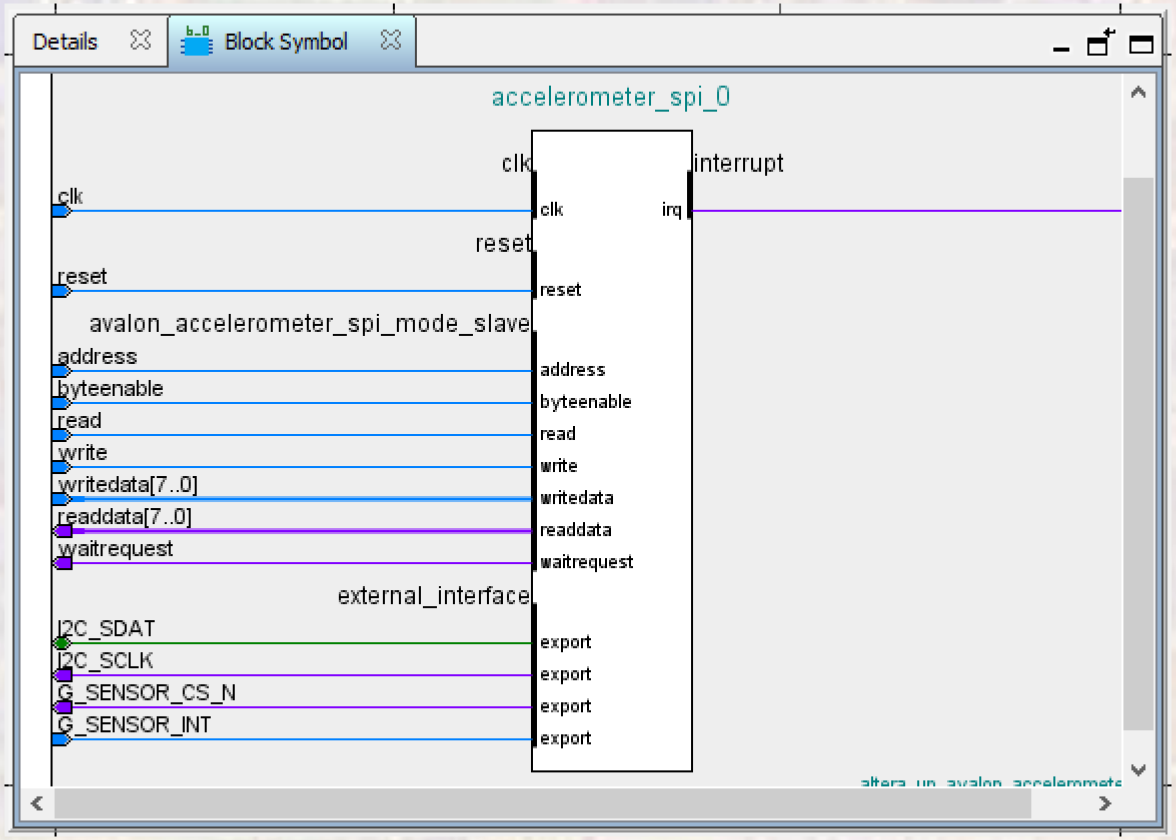
Accelerometer Example

- Accelerometer
  - Create a processor system to use the Accelerometer SPI

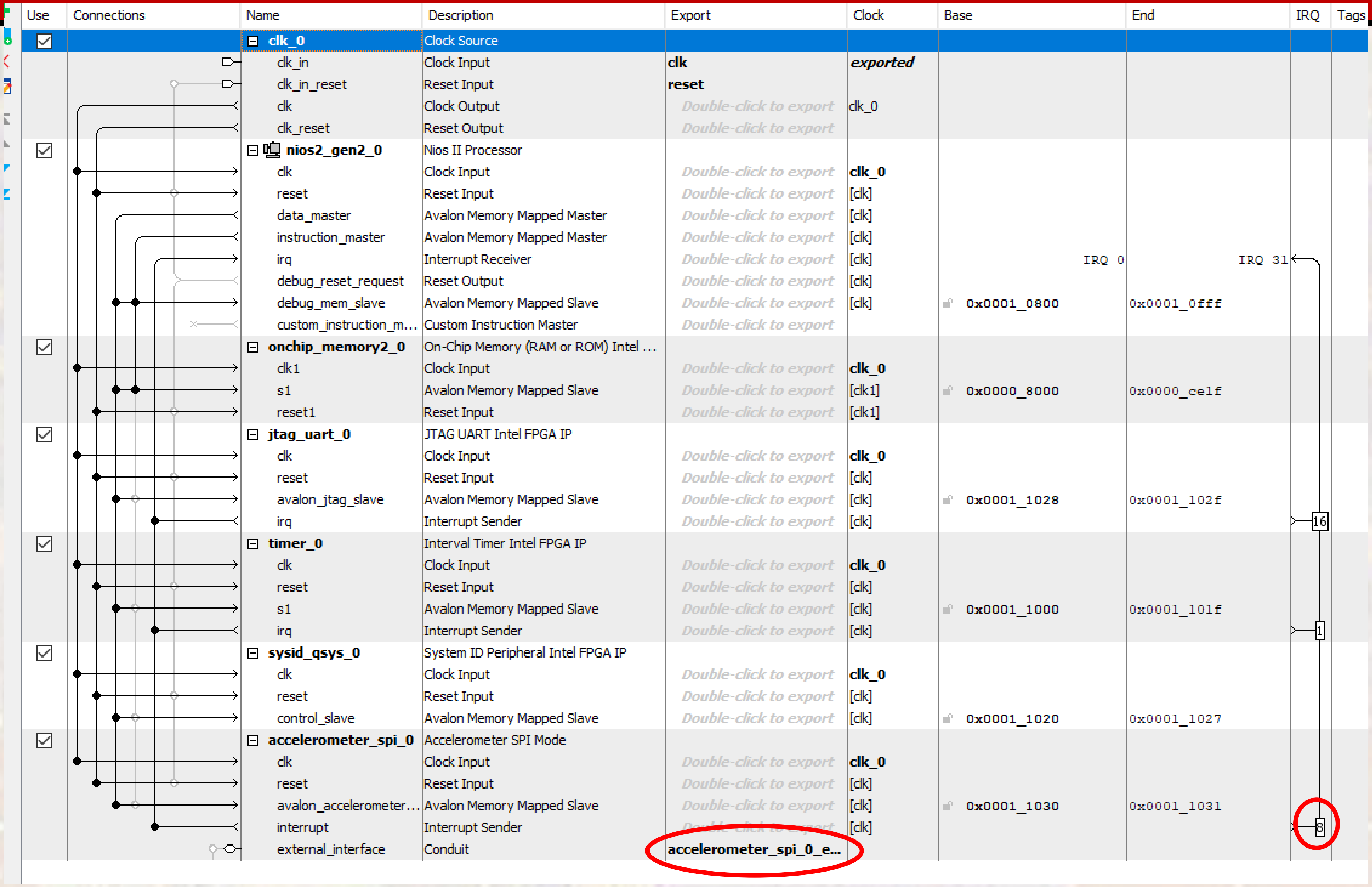


Accelerometer

- Library→ University Program → Generic IO → Altera UP Avalon Accelerometer SPI
  - No Parameters to set

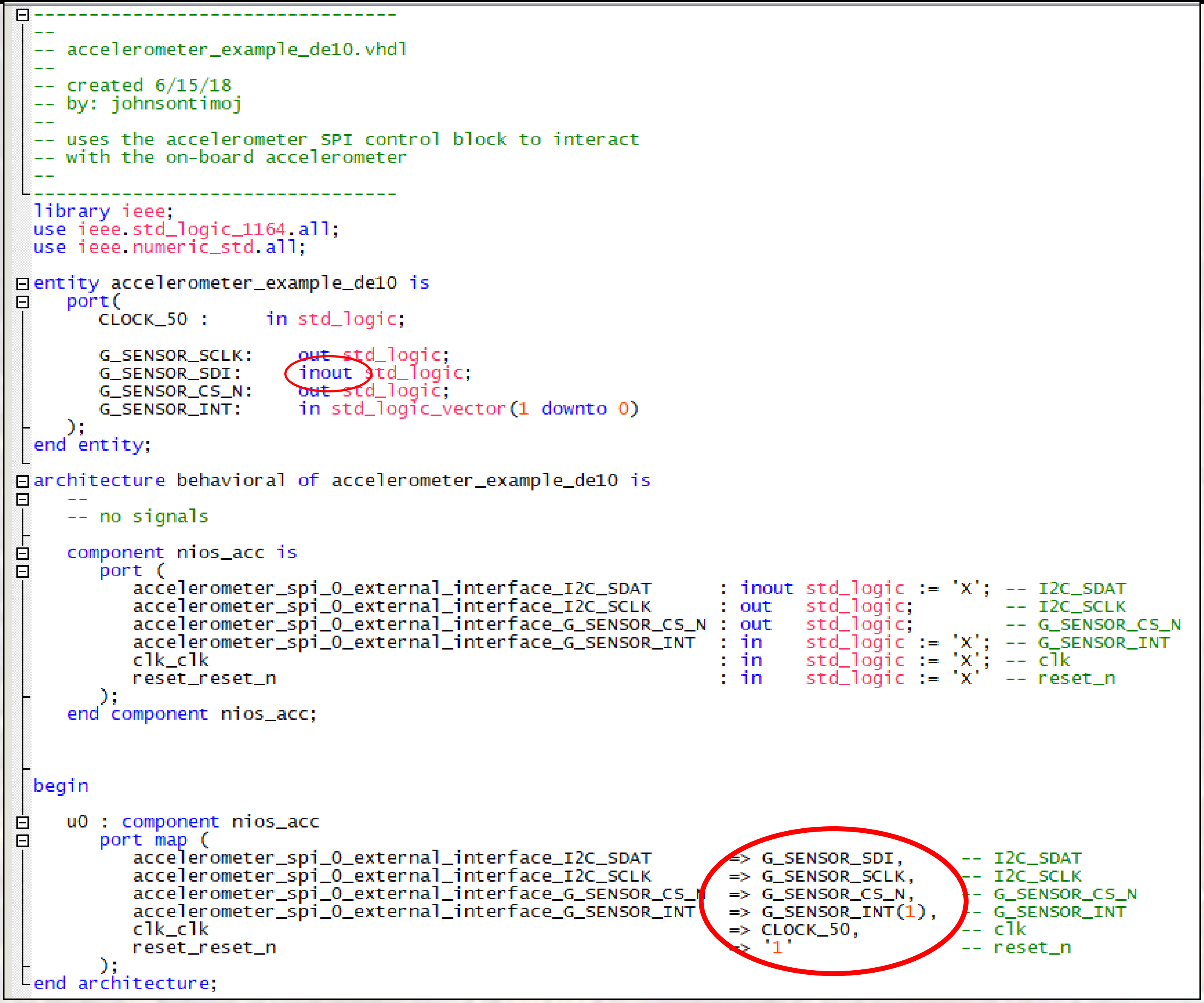


Accelerometer



Use	Connections	Name	Description	Export	Clock	Base	End	IRQ	Tags
✓		⊟ **clk_0**	Clock Source						
		clk_in	Clock Input	**clk**	***exported***				
		clk_in_reset	Reset Input	**reset**					
		clk	Clock Output	*Double-click to export*	clk_0				
		clk_reset	Reset Output	*Double-click to export*					
✓		⊟ **nios2_gen2_0**	Nios II Processor						
		clk	Clock Input	*Double-click to export*	**clk_0**				
		reset	Reset Input	*Double-click to export*	[clk]				
		data_master	Avalon Memory Mapped Master	*Double-click to export*	[clk]				
		instruction_master	Avalon Memory Mapped Master	*Double-click to export*	[clk]				
		irq	Interrupt Receiver	*Double-click to export*	[clk]	IRQ 0	IRQ 31		
		debug_reset_request	Reset Output	*Double-click to export*	[clk]				
		debug_mem_slave	Avalon Memory Mapped Slave	*Double-click to export*	[clk]	0x0001_0800	0x0001_0fff		
		custom_instruction_m...	Custom Instruction Master	*Double-click to export*					
✓		⊟ **onchip_memory2_0**	On-Chip Memory (RAM or ROM) Intel ...						
		clk1	Clock Input	*Double-click to export*	**clk_0**				
		s1	Avalon Memory Mapped Slave	*Double-click to export*	[clk1]	0x0000_8000	0x0000_ce1f		
		reset1	Reset Input	*Double-click to export*	[clk1]				
✓		⊟ **jtag_uart_0**	JTAG UART Intel FPGA IP						
		clk	Clock Input	*Double-click to export*	**clk_0**				
		reset	Reset Input	*Double-click to export*	[clk]				
		avalon_jtag_slave	Avalon Memory Mapped Slave	*Double-click to export*	[clk]	0x0001_1028	0x0001_102f		
		irq	Interrupt Sender	*Double-click to export*	[clk]			16	
✓		⊟ **timer_0**	Interval Timer Intel FPGA IP						
		clk	Clock Input	*Double-click to export*	**clk_0**				
		reset	Reset Input	*Double-click to export*	[clk]				
		s1	Avalon Memory Mapped Slave	*Double-click to export*	[clk]	0x0001_1000	0x0001_101f		
		irq	Interrupt Sender	*Double-click to export*	[clk]			1	
✓		⊟ **sysid_qsys_0**	System ID Peripheral Intel FPGA IP						
		clk	Clock Input	*Double-click to export*	**clk_0**				
		reset	Reset Input	*Double-click to export*	[clk]				
		control_slave	Avalon Memory Mapped Slave	*Double-click to export*	[clk]	0x0001_1020	0x0001_1027		
✓		⊟ **accelerometer_spi_0**	Accelerometer SPI Mode						
		clk	Clock Input	*Double-click to export*	**clk_0**				
		reset	Reset Input	*Double-click to export*	[clk]				
		avalon_accelerometer...	Avalon Memory Mapped Slave	*Double-click to export*	[clk]	0x0001_1030	0x0001_1031		
		interrupt	Interrupt Sender	*Double-click to export*	[clk]			8	
		external_interface	Conduit	**accelerometer_spi_0_e...**					

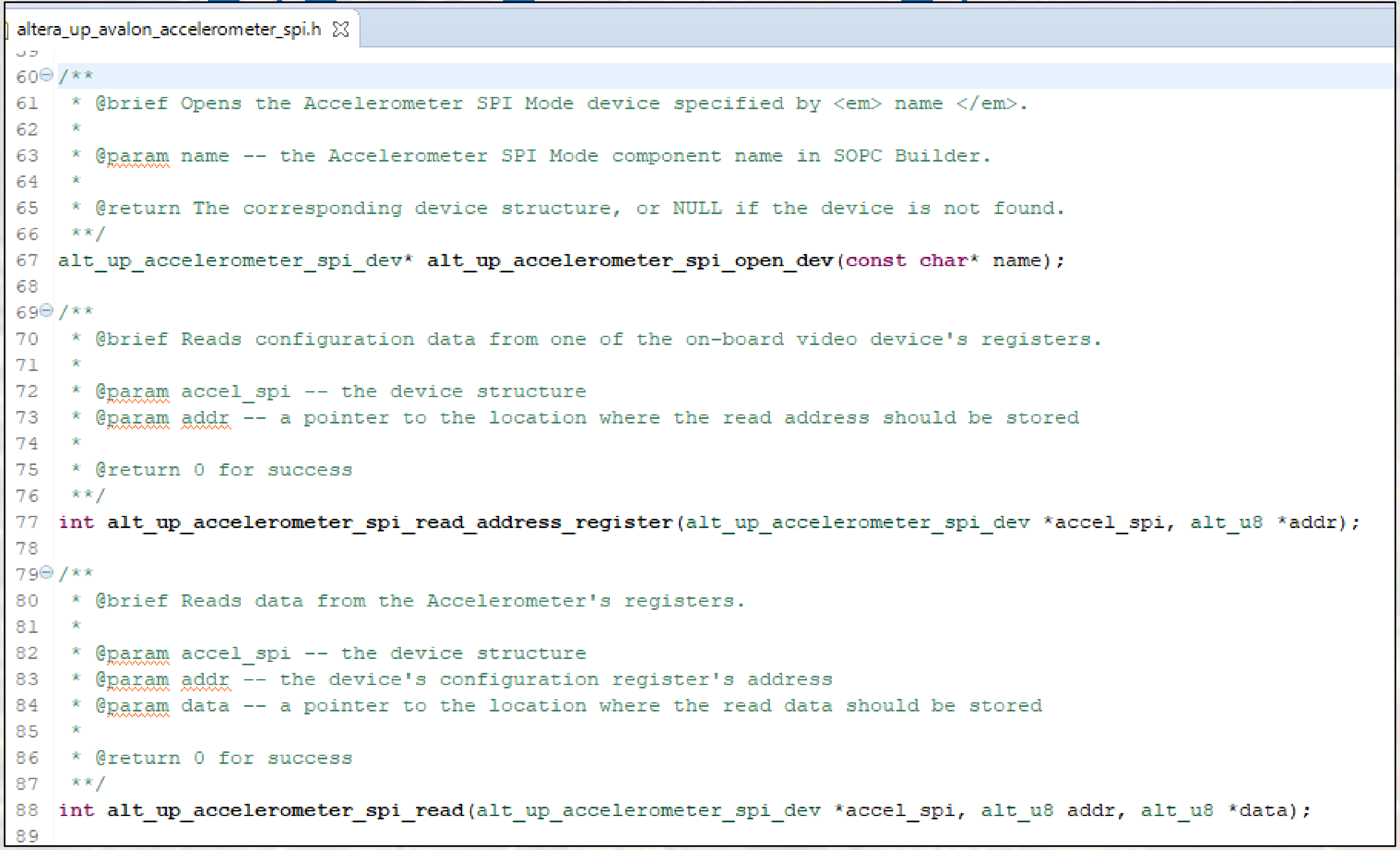
Accelerometer



```
---------------------------------
--
-- accelerometer_example_de10.vhdl
--
-- created 6/15/18
-- by: johnsontimoj
--
-- uses the accelerometer SPI control block to interact
-- with the on-board accelerometer
--
---------------------------------
library ieee;
use ieee.std_logic_1164.all;
use ieee.numeric_std.all;

entity accelerometer_example_de10 is
    port(
        CLOCK_50 :      in std_logic;

        G_SENSOR_SCLK:     out std_logic;
        G_SENSOR_SDI:      inout std_logic;
        G_SENSOR_CS_N:     out std_logic;
        G_SENSOR_INT:      in std_logic_vector(1 downto 0)
    );
end entity;

architecture behavioral of accelerometer_example_de10 is
    --
    -- no signals

    component nios_acc is
        port (
            accelerometer_spi_0_external_interface_I2C_SDAT      : inout std_logic := 'X'; -- I2C_SDAT
            accelerometer_spi_0_external_interface_I2C_SCLK      : out   std_logic;        -- I2C_SCLK
            accelerometer_spi_0_external_interface_G_SENSOR_CS_N : out   std_logic;        -- G_SENSOR_CS_N
            accelerometer_spi_0_external_interface_G_SENSOR_INT  : in    std_logic := 'X'; -- G_SENSOR_INT
            clk_clk                                              : in    std_logic := 'X'; -- clk
            reset_reset_n                                        : in    std_logic := 'X'  -- reset_n
        );
    end component nios_acc;


begin

    u0 : component nios_acc
        port map (
            accelerometer_spi_0_external_interface_I2C_SDAT      => G_SENSOR_SDI,     -- I2C_SDAT
            accelerometer_spi_0_external_interface_I2C_SCLK      => G_SENSOR_SCLK,    -- I2C_SCLK
            accelerometer_spi_0_external_interface_G_SENSOR_CS_N => G_SENSOR_CS_N,    -- G_SENSOR_CS_N
            accelerometer_spi_0_external_interface_G_SENSOR_INT  => G_SENSOR_INT(1),  -- G_SENSOR_INT
            clk_clk                                              => CLOCK_50,         -- clk
            reset_reset_n                                        => '1'               -- reset_n
        );
end architecture;
```

Accelerometer

- altera_up_avalon_accelerometer_spi.h

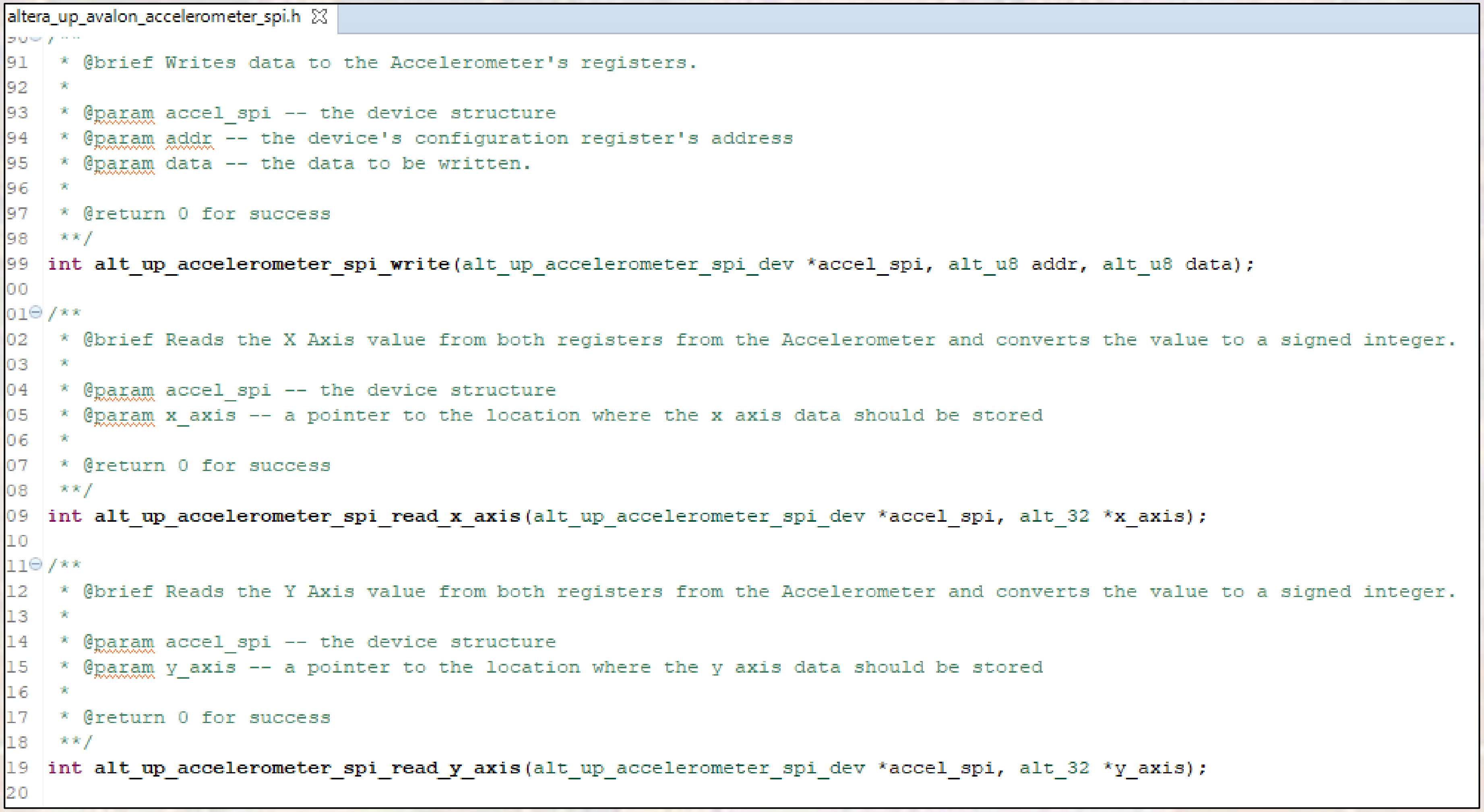


altera_up_avalon_accelerometer_spi.h

```
/**
 * @brief Opens the Accelerometer SPI Mode device specified by <em> name </em>.
 *
 * @param name -- the Accelerometer SPI Mode component name in SOPC Builder.
 *
 * @return The corresponding device structure, or NULL if the device is not found.
 **/
alt_up_accelerometer_spi_dev* alt_up_accelerometer_spi_open_dev(const char* name);

/**
 * @brief Reads configuration data from one of the on-board video device's registers.
 *
 * @param accel_spi -- the device structure
 * @param addr -- a pointer to the location where the read address should be stored
 *
 * @return 0 for success
 **/
int alt_up_accelerometer_spi_read_address_register(alt_up_accelerometer_spi_dev *accel_spi, alt_u8 *addr);

/**
 * @brief Reads data from the Accelerometer's registers.
 *
 * @param accel_spi -- the device structure
 * @param addr -- the device's configuration register's address
 * @param data -- a pointer to the location where the read data should be stored
 *
 * @return 0 for success
 **/
int alt_up_accelerometer_spi_read(alt_up_accelerometer_spi_dev *accel_spi, alt_u8 addr, alt_u8 *data);
```

Accelerometer

- altera_up_avalon_accelerometer_spi.h

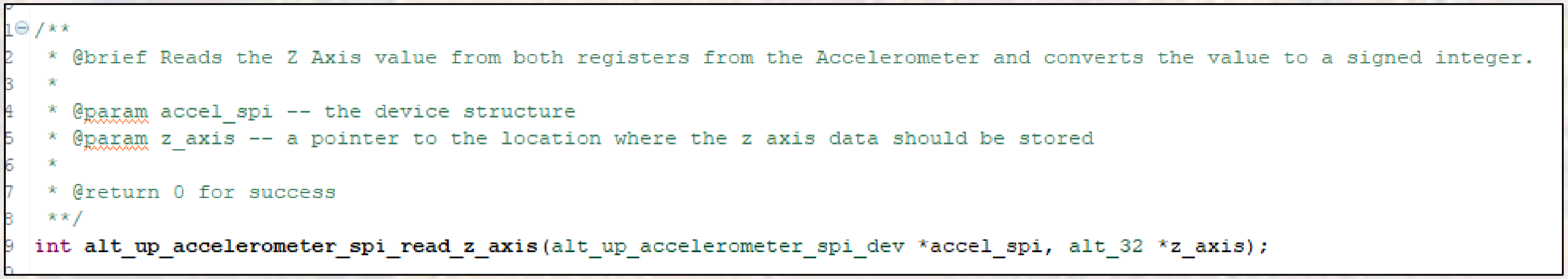


altera_up_avalon_accelerometer_spi.h

```
/**
 * @brief Writes data to the Accelerometer's registers.
 *
 * @param accel_spi -- the device structure
 * @param addr -- the device's configuration register's address
 * @param data -- the data to be written.
 *
 * @return 0 for success
 **/
int alt_up_accelerometer_spi_write(alt_up_accelerometer_spi_dev *accel_spi, alt_u8 addr, alt_u8 data);

/**
 * @brief Reads the X Axis value from both registers from the Accelerometer and converts the value to a signed integer.
 *
 * @param accel_spi -- the device structure
 * @param x_axis -- a pointer to the location where the x axis data should be stored
 *
 * @return 0 for success
 **/
int alt_up_accelerometer_spi_read_x_axis(alt_up_accelerometer_spi_dev *accel_spi, alt_32 *x_axis);

/**
 * @brief Reads the Y Axis value from both registers from the Accelerometer and converts the value to a signed integer.
 *
 * @param accel_spi -- the device structure
 * @param y_axis -- a pointer to the location where the y axis data should be stored
 *
 * @return 0 for success
 **/
int alt_up_accelerometer_spi_read_y_axis(alt_up_accelerometer_spi_dev *accel_spi, alt_32 *y_axis);
```

Accelerometer

- altera_up_avalon_accelerometer_spi.h



```
/**
 * @brief Reads the Z Axis value from both registers from the Accelerometer and converts the value to a signed integer.
 *
 * @param accel_spi -- the device structure
 * @param z_axis -- a pointer to the location where the z axis data should be stored
 *
 * @return 0 for success
 **/
int alt_up_accelerometer_spi_read_z_axis(alt_up_accelerometer_spi_dev *accel_spi, alt_32 *z_axis);
```

Accelerometer

```
*
* accel.c
*
*  Created on: Oct 7, 2017
*      Author: johnsontimoj
*
*      Basic accelerometer operation
*/
/////////////////
// Includes
/////////////////
#include "altera_up_avalon_accelerometer_spi.h"
#include "system.h"
#include <stdio.h>
#include <unistd.h>

int main(void){
   // define a pointer of type alt_up_accelerometer...
   // to use as a reference in the register functions
   //
   alt_up_accelerometer_spi_dev * acc_dev;

   // open the Accelerometer port
   //  - command is in drivers/inc/alter_up_avalon_accelerometer_spi.h
   // name reference is in system.h
   //  - "/dev/accelerometer_spi_0"
   //
   acc_dev = alt_up_accelerometer_spi_open_dev ("/dev/accelerometer_spi_0");
```

```
   // Check for error and output to the console
   //
   if ( acc_dev == NULL)
      printf ("Error: could not open acc device \n");
   else
      printf ("Opened acc device \n");

   alt_32 xAccel = 0;
   alt_32 yAccel = 0;
   alt_32 zAccel = 0;
   // read and print values
   while(1){
      alt_up_accelerometer_spi_read_x_axis(acc_dev, &xAccel);
      alt_up_accelerometer_spi_read_y_axis(acc_dev, &yAccel);
      alt_up_accelerometer_spi_read_z_axis(acc_dev, &zAccel);
      printf("%li  %li  %li\n", xAccel, yAccel, zAccel);
      usleep(100000);// 0.1sec
   } // end while

   return 0;
}
```