



**MASARYK
UNIVERSITY**
Czech Republic

PV198 – One-chip Controllers

SPI



Content

1. What is SPI
2. What is it used for
3. How does it work
4. FRDM-K66F SPI
5. Sensor – BMP 280
6. Application

What is SPI

- **SPI** – **S**erial **P**eripheral **I**nterface
- Serial interface bus



What is it used for

- Intra-board communication
- External peripherals
- Sensors

How does it work – Scheme

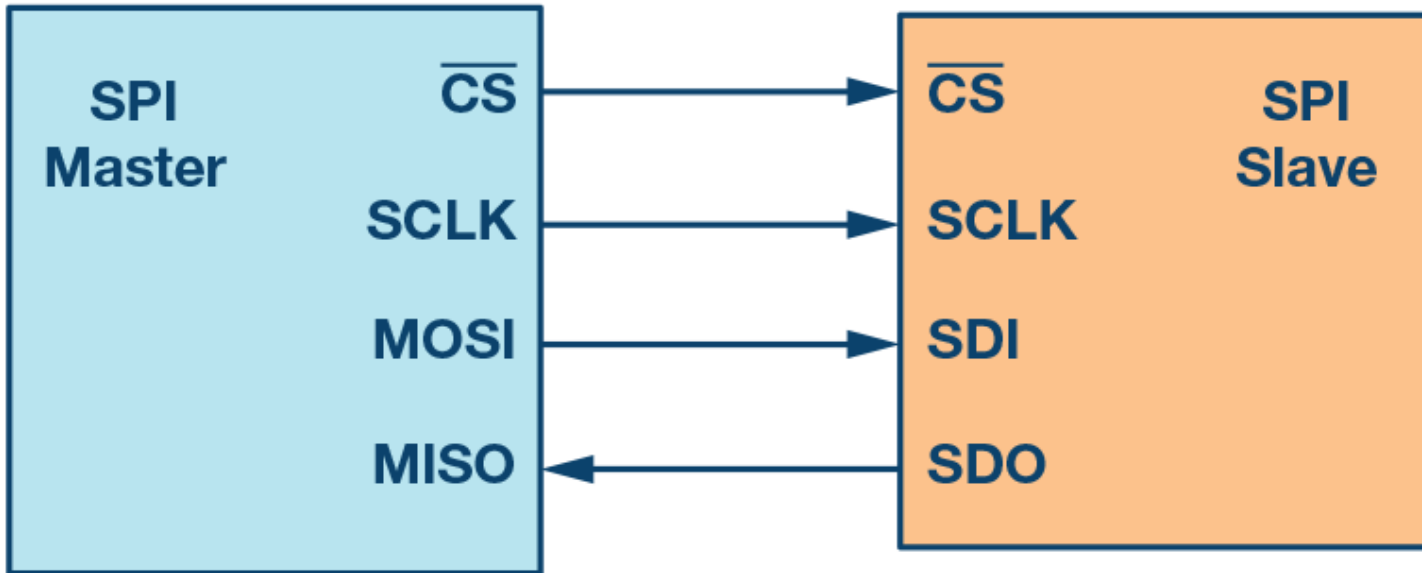


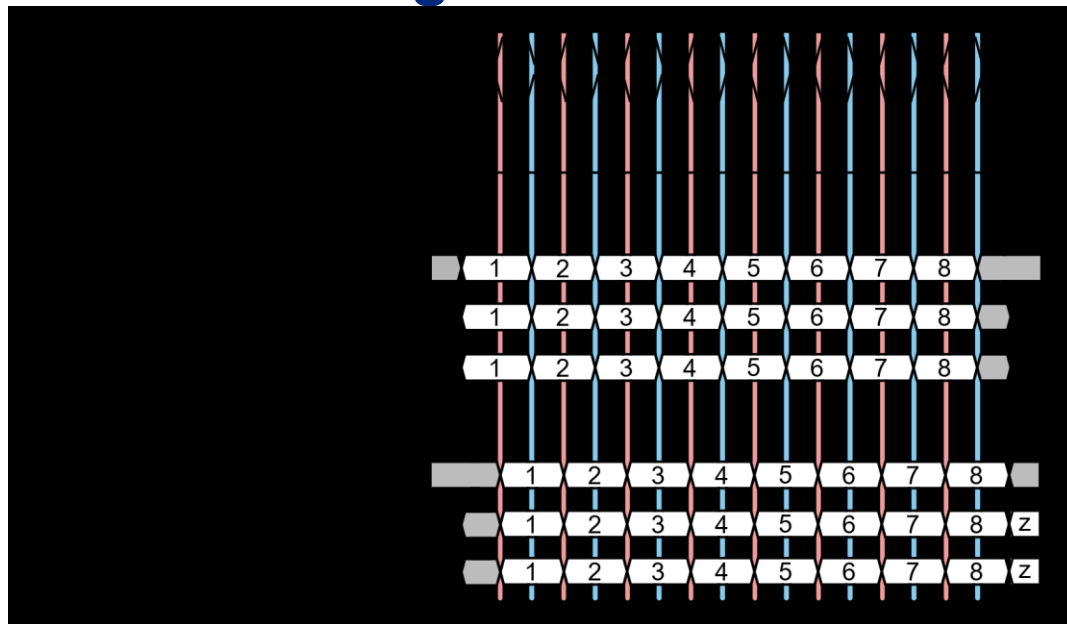
Figure 1. SPI configuration with master and a slave

<https://www.analog.com/en/analog-dialogue/articles/introduction-to-spi-interface.html>

How does it work

- 4 wires (Clock, Chip Select, Master In Slave Out, Master Out Slave In)
- Single-master & multi-slave
- Chip Select selects slave for communication
- Synchronous
- Full-duplex
- Possibility to use only 3 wires (only 1 data wire)

How does it work – Message



By SPI_timing_diagram.svg: en:User:Cburnettderivative work: Jordsan (talk) - SPI_timing_diagram.svg, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=11405368>

FRDM-K66F SPI

- 3 SPI modules
- Master & Slave support
- Interrupts
- Programmable frame size (4 to 16 bits)
- 6 peripheral Chip Selects

Temperature & Pressure sensor

- Bosch BMP280 Digital Pressure Sensor – [link](#)
- Digital interfaces I²C (up to 3.4 MHz) SPI (3 and 4 wire, up to 10 MHz)
- Pressure resolution 0.16 Pa
- Temperature resolution 0.01°C

BMP 280

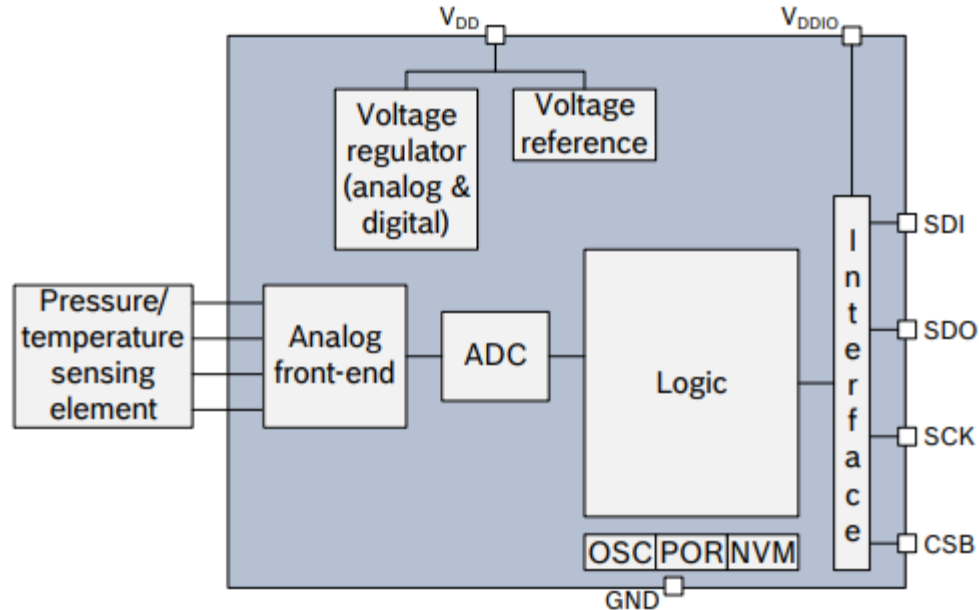


Figure 1: Block diagram of BMP280

Warning. Holding any interface pin (SDI, SDO, SCK or CSB) at a logical high level when V_{DDIO} is switched off can permanently damage the device due caused by excessive current flow through the ESD protection diodes.

BMP 280 SPI

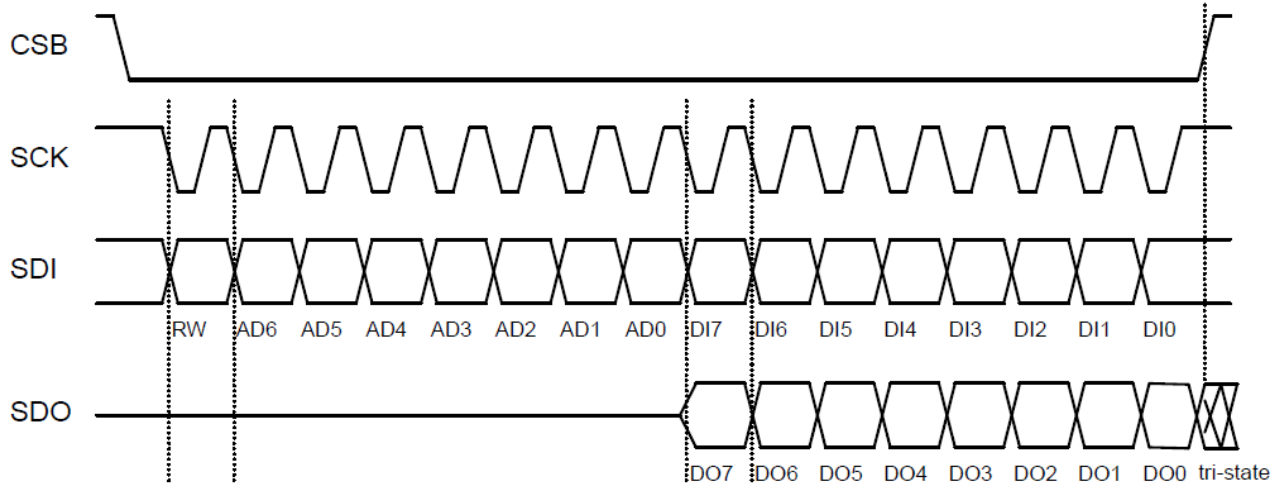


Figure 9: SPI protocol (shown for mode '11' in 4-wire configuration)

BST-BMP280-DS001-11

BMP 280 SPI – Write

CS	RW	Address (0x7F)							Data (0x55) at 0x7F							Data (0xAA) at 0x80							CS		
0	0	1	1	1	1	1	1	1	0	1	0	1	0	1	0	1	1	0	1	0	1	0	1	0	1



BMP 280 SPI – Read

CS	RW	Address (0xF6)							Data (from 0xF6)							Data (from 0xF7)							CS		
0	1	1	1	1	1	1	1	0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	1



Application

- Create an application that reads temperature from BMP280 sensor
- Print temperature into console

Accelerometer & Magnetometer

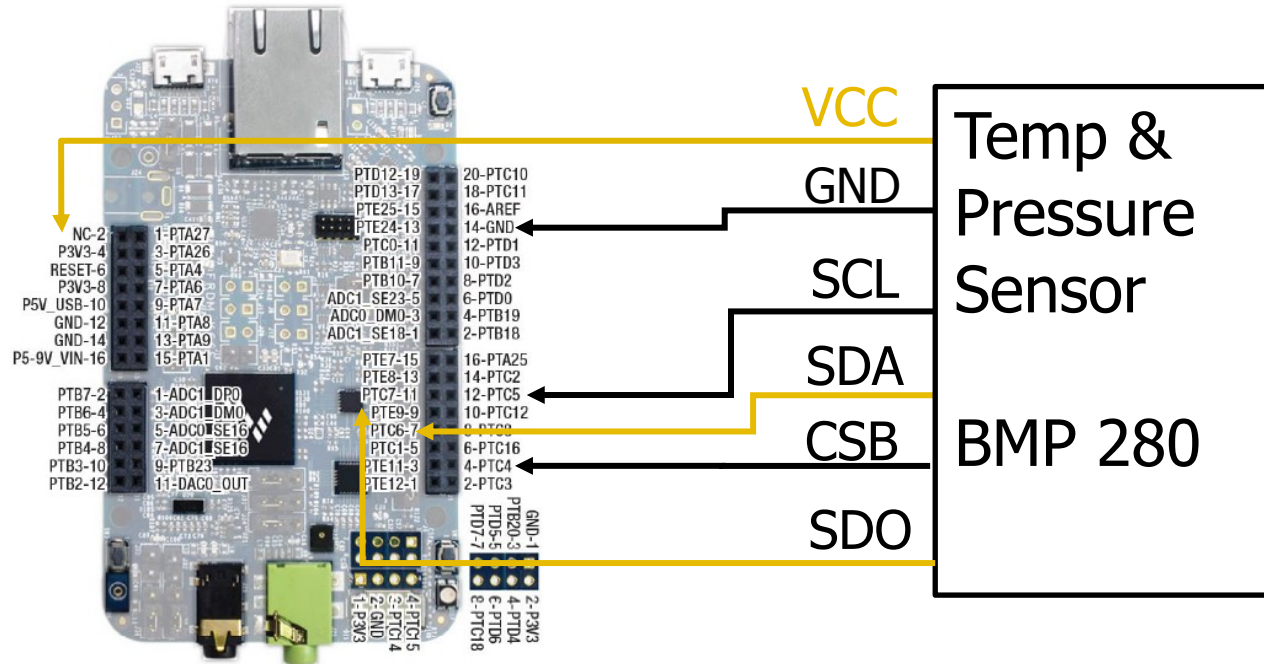






Figure 26. FRDM-K66F I/O header pinout

Application – Step-by-step guide

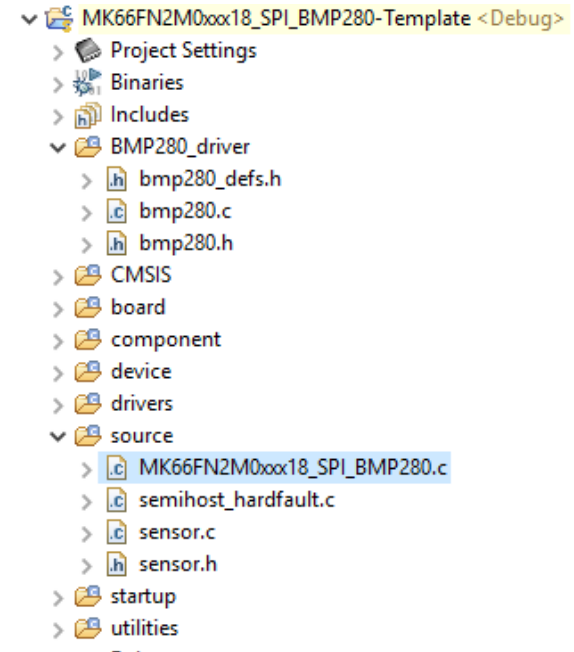
1. Study BMP280 Datasheet
2. Study Serial Peripheral Interface (SPI) chapter in MCU Reference manual
3. Setup pin routing
4. Setup DSPI peripheral driver (speed, timing, etc.)
5. Download BMP280_driver and temperature example
6. Import driver to the project, use example code
7. **Implement HW specific functions – your main task**
8. Repeat steps 1-7 if necessary

Application – Template

1. Study BMP280 Datasheet
2. Study Serial Peripheral Interface (SPI) chapter in MCU Reference manual
-  3. Setup pin routing
-  4. Setup DSPI peripheral driver (speed, timing, etc.)
-  5. Download BMP280_driver and temperature example
-  6. Import driver to the project, use example code
- 7. Implement HW specific functions – your main task**
8. Repeat steps 1, 2 and 7 if necessary

Application – Template

- Check pin routing
- Check DSPI configuration
 - Check timing
- Check sensor.c/.h files



Application – Traps

- There are multiple traps in the template, here are hints:
 - Make sure you do proper error checking for input data (And check that it works)
 - You have to enable continuous chip select for the Transfer call



Homework

- Update the application to print pressure as well as temperature
- Make sure to print the uncompressed pressure (don't change it)