國立中正大學
National Chung Cheng University

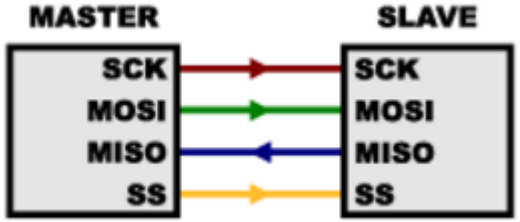
微處理機系統與介面技術

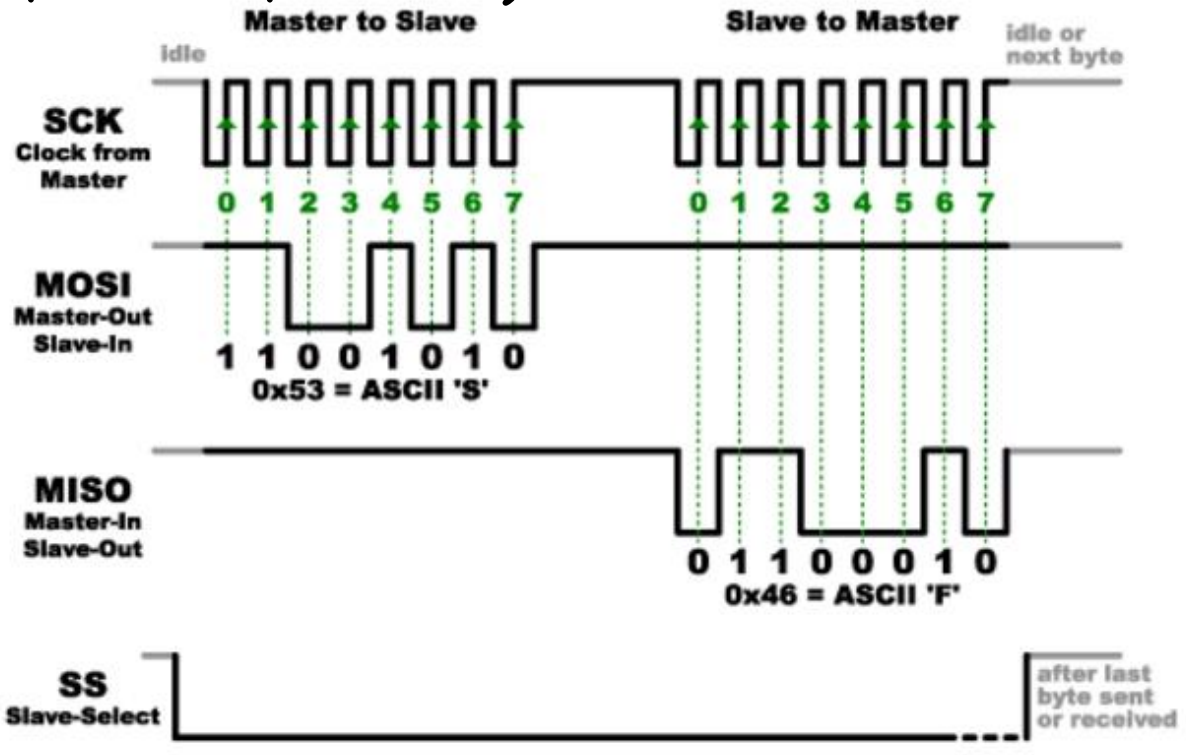
LAB 7 – SPI

www.neatlab.tw
neat Laboratory
CCU@Taiwan 中正大學

SPI – Serial Peripheral Interface

- Synchronous serial data communication(can operate in full duplex)
- 4 wire communication(SS,CLK,MOSI,MISO)
- M0 has four set SPI





https://learn.sparkfun.com/tutorials/serial-peripheral-interface-spi

SPI register

- SPI->SSR: SPI slave select register
  - SS_LVL
  - AUTOSS
  - SSR

31	30	29	28	27	26	25	24
Reserved							
23	22	21	20	19	18	17	16
Reserved							
15	14	13	12	11	10	9	8
Reserved							
7	6	5	4	3	2	1	0
Reserved		LTRIG_FLAG	SS_LTRIG	AUTOSS	SS_LVL	SSR	

- SPI->CNTRL: SPI control and status register
  - SLAVE
  - CLKP
  - TX_NUM, TX_BIT_LEN
  - TX_NEG, RX_NEG
  - GO_BUSY

31	30	29	28	27	26	25	24
Reserved							
23	22	21	20	19	18	17	16
VARCLK_EN	TWOB	Reserved	REORDER		SLAVE	IE	IF
15	14	13	12	11	10	9	8
SP_CYCLE				CLKP	LSB	TX_NUM	
7	6	5	4	3	2	1	0
TX_BIT_LEN					TX_NEG	RX_NEG	GO_BUSY

ADXL SPI configuration

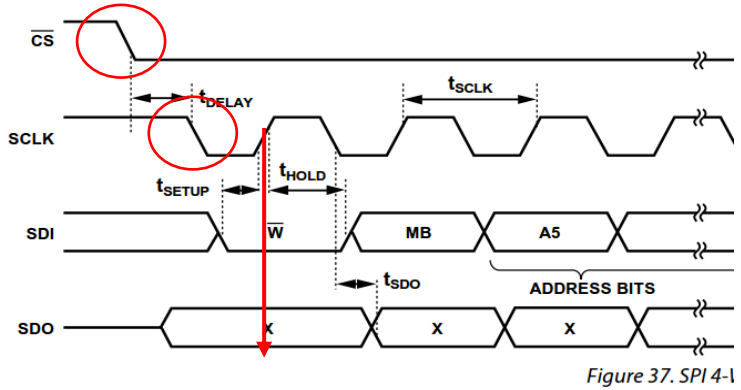


Figure 37. SPI 4-

- SPI->DIVIDER: Set SPI clock(DIVIDER)
- SPI->SSR
  - SS line is active at low-level edge(SSR.SS_LVL)
  - Disable auto ss(SSR.AUTOSS)
- SPI->CNTRL
  - Set SPI as master mode(CNTRL.SLAVE)
  - CLK is idle at high(CNTRL.CLKP)
  - CPOL=1, CPHA=1(CNTRL.TX_NEG, RX_NEG)
  - 8 bit data length for each word transmit(CNTRL.TX_BIT_LEN)
  - One word in one transfer(CNTRL.TX_NUM)

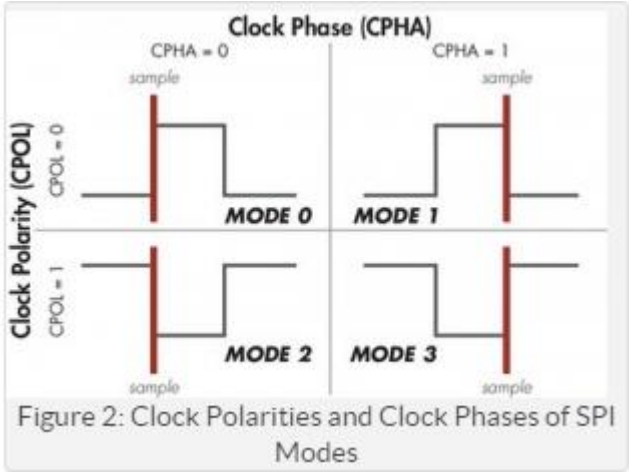


Figure 2: Clock Polarities and Clock Phases of SPI Modes

SPI Write operation

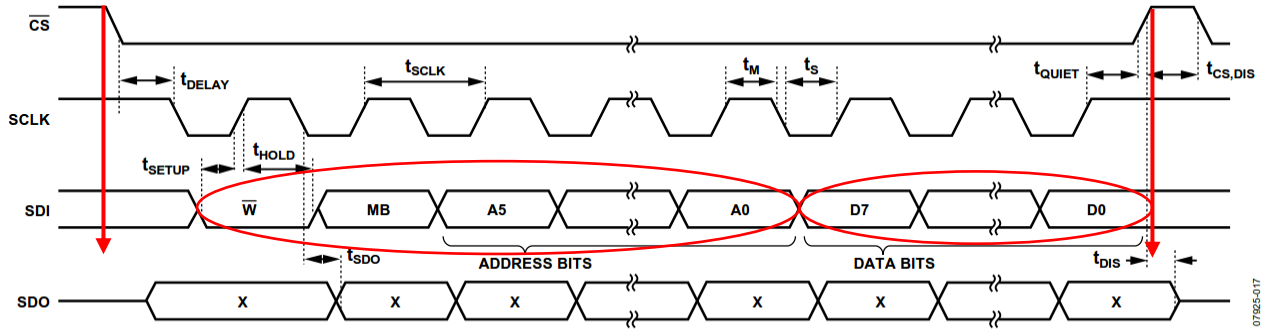
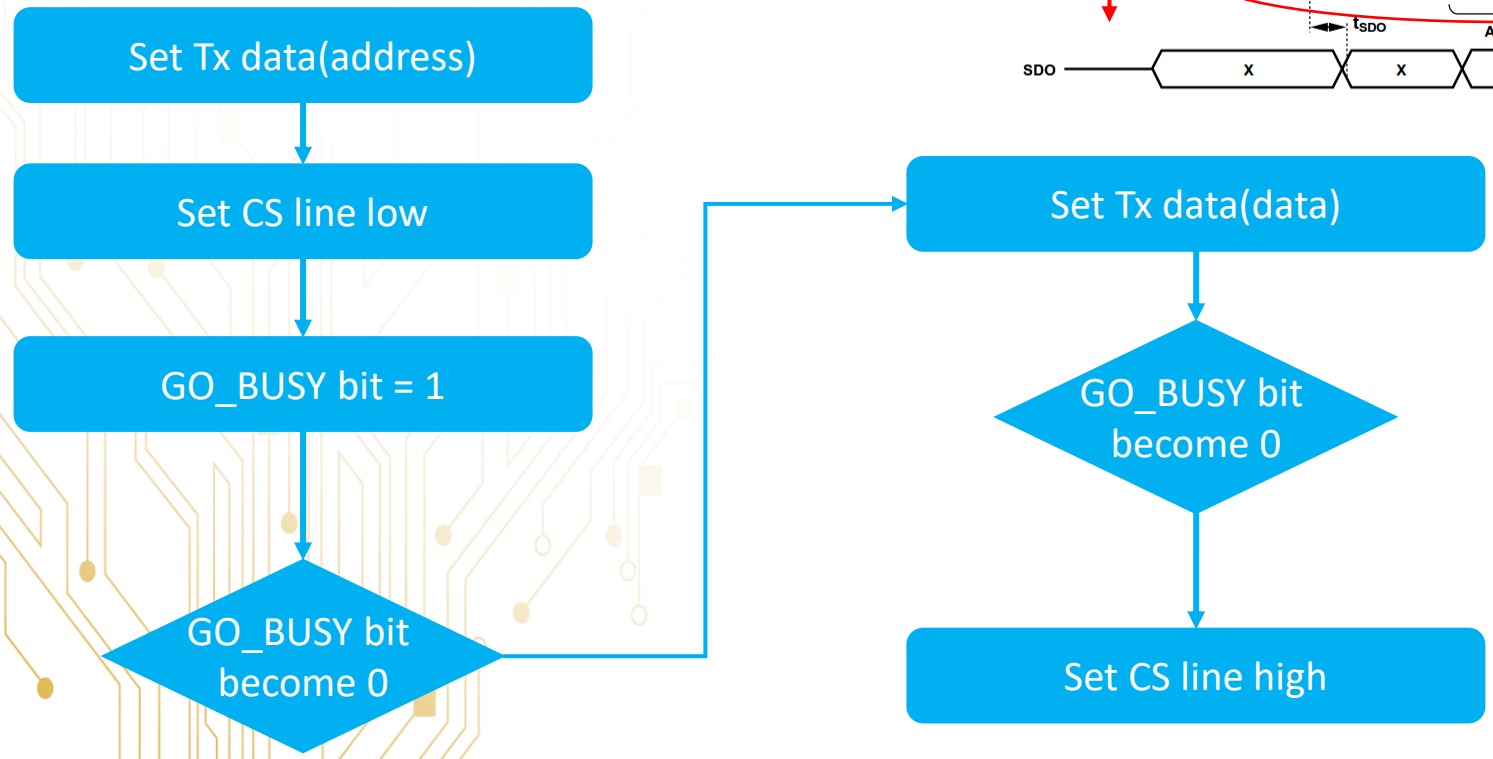


Figure 37. SPI 4-Wire Write



Tips: You can see NuMicro_SPI.ppt p.17 for the example code

SPI Read operation

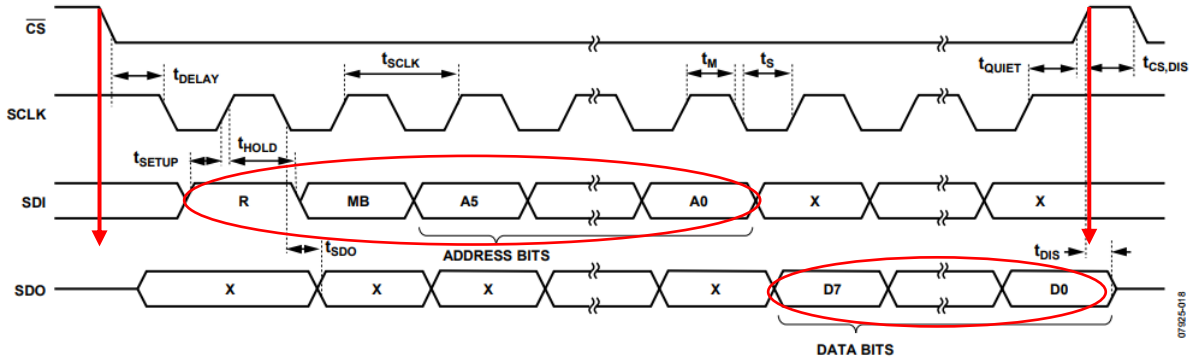
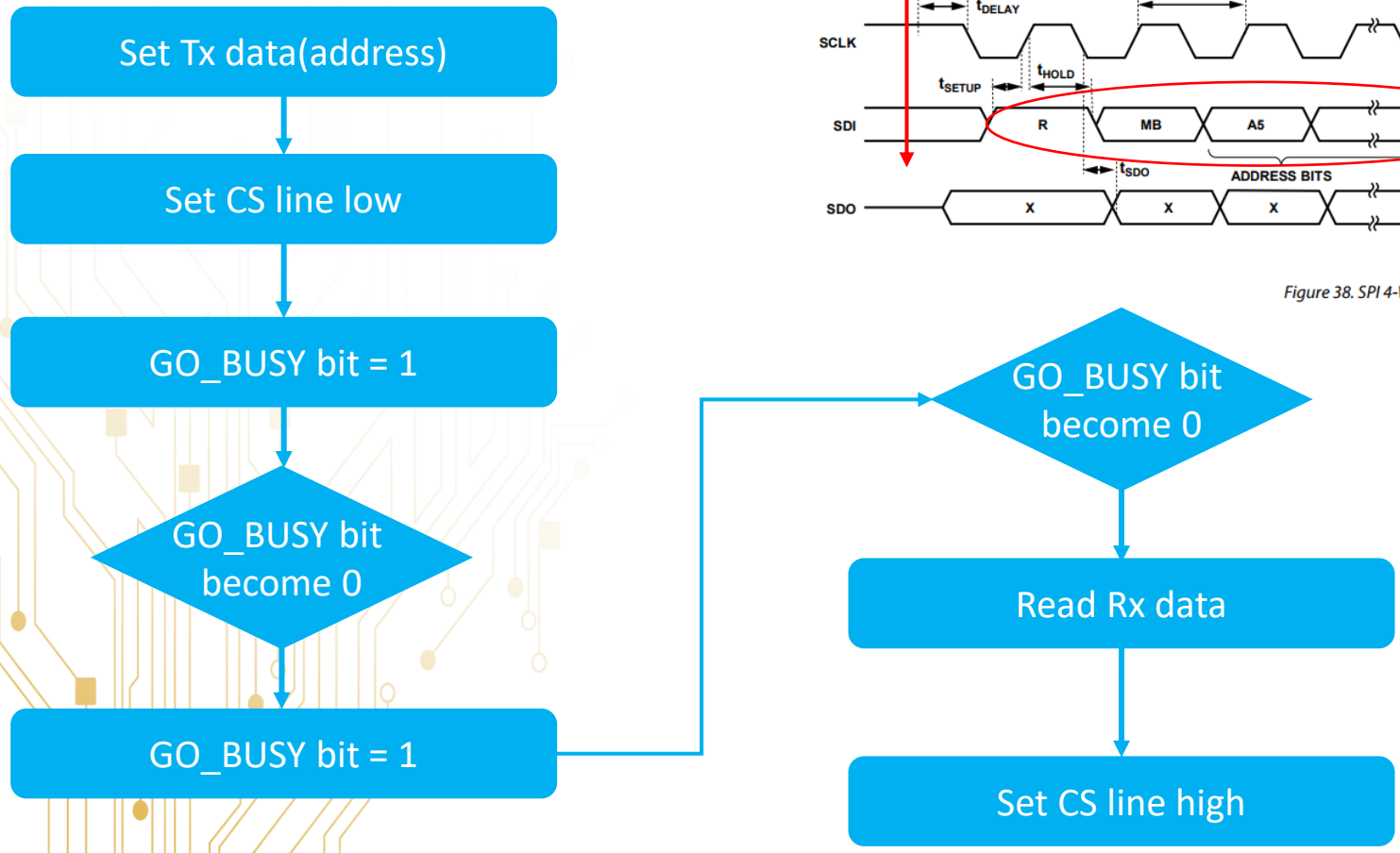


Figure 38. SPI 4-Wire Read



Tips: You can see NuMicro_SPI.ppt p.17 for the example code

ADXL SPI Read/Write

R/W	MB	A5	A4	A3	A2	A1	A0

- Data format
  - Read/Write bit + Multiple-byte bit + 6 bits address
- Configure 0x2D(0x0010_1101) as address, single-byte Read
  - Read + ~~MB~~ + address ➔ 0x1010_1101

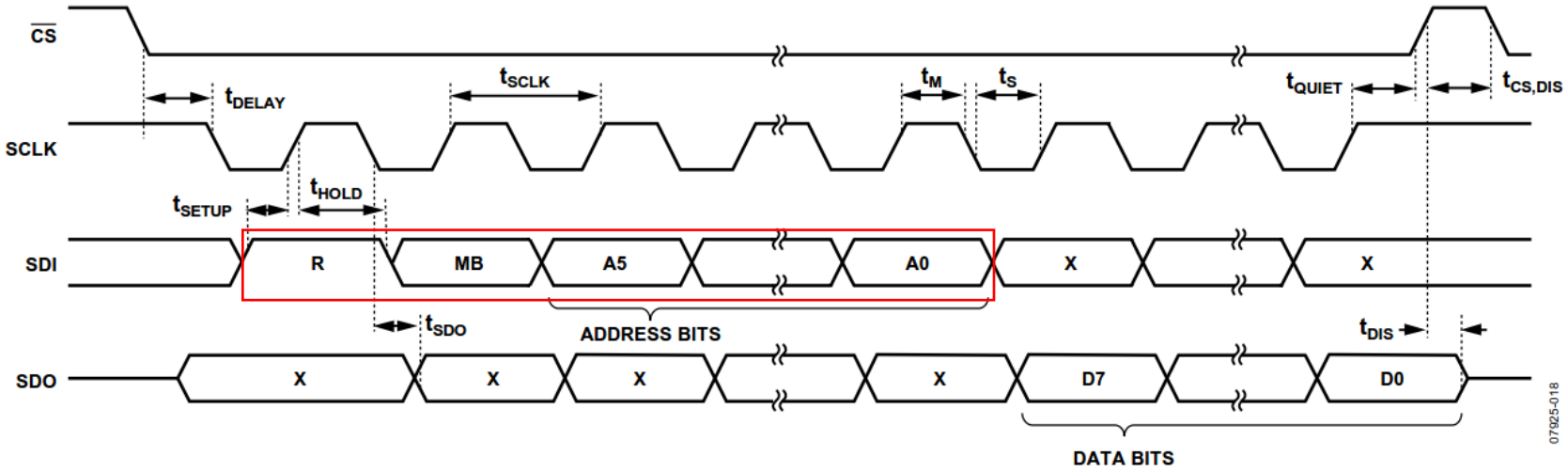


Figure 38. SPI 4-Wire Read

ADXL pin configuration

- CS ---------->SPI2 CS(GPD0)
- SCL ---------->SPI2 CLK(GPD1)
- SDO ---------->SPI2 MISO(GPD2)
- SDA(SDI) ---->SPI2 MOSI(GPD3)

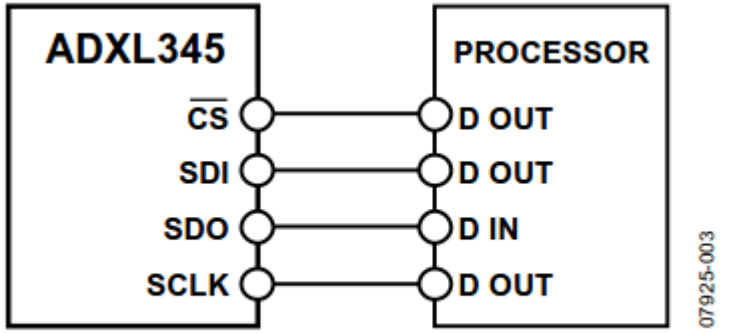
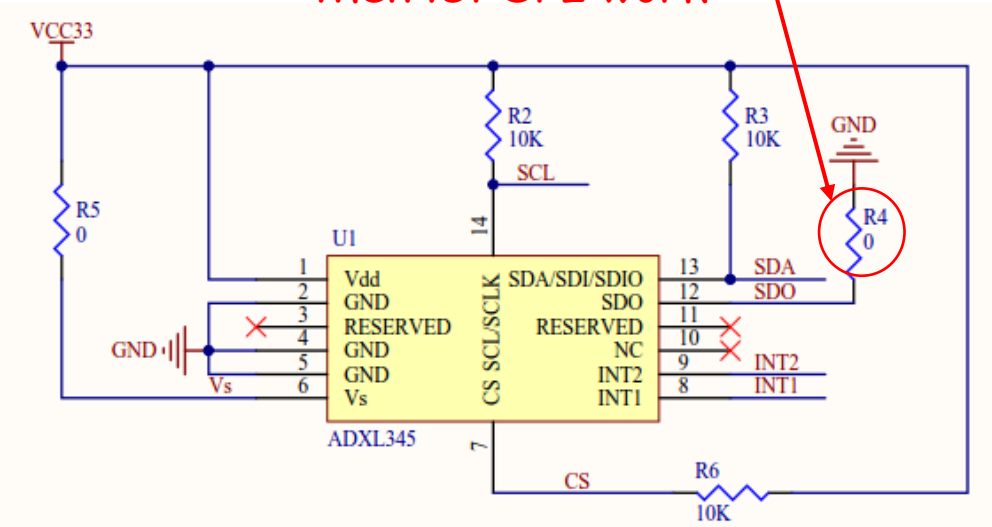


Figure 35. 4-Wire SPI Connection Diagram

- Mark: Don't use SPI0

Bad design for using SPI, we need to remove this resistor then let SPI work



Basic

- Read 3 axis accelerometer and print on putty
- Need to do calibration
  - Result = (Raw data ± offset)/(256 ± offset)

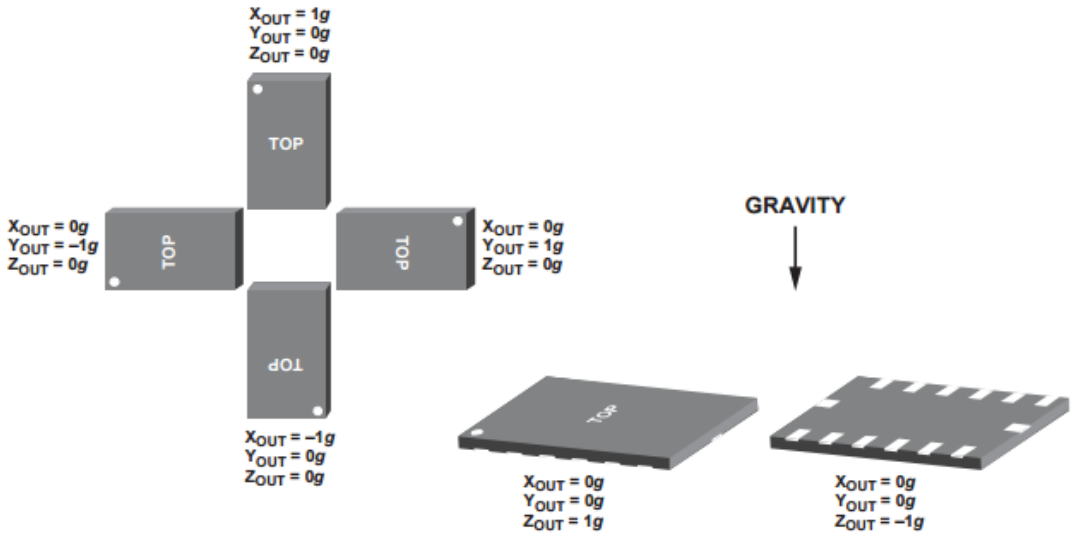


Figure 58. Output Response vs. Orientation to Gravity

```
COM8 - PuTTY
ADXL init...
Start
x: -0.08, y: -0.04, z: -0.12
x: -0.02, y: -0.01, z: 1.01
x: -0.02, y: -0.01, z: 1.01
x: -0.03, y: -0.01, z: 1.01
x: -0.02, y: -0.01, z: 0.93
x: -0.02, y: -0.02, z: 1.02
x: -0.02, y: -0.02, z: 1.01
x: -0.02, y: -0.02, z: 1.00
x: -0.02, y: -0.02, z: 1.01
x: -0.02, y: -0.02, z: 1.02
x: -0.02, y: -0.01, z: 1.01
x: -0.02, y: -0.02, z: 1.02
x: -0.02, y: -0.02, z: 1.01
x: -0.02, y: -0.01, z: 1.02
x: -0.02, y: -0.01, z: 1.01
```

Tips

- 範例程式: SPI_Loopback
- Easy test: you can read the adxl register 0x00 to test SPI communication is correct or not, it will return 0xE5 if your SPI is right
- Remember to change configuration in the SYS_init
  - Ex. CLK_SEL1(ModuleClock), GPx_MFP, ALT_MFP ➔ change SPI to SPI2
- Do not use AutoSS, SPI.c SPI.h are useful.
- Be careful for the SPI configuration !!!
- You can write the code as the example.c

Demo

- Place: 創新大樓515 找助教 夏子聰
- Demo Time: (二)(四)下午三點~五點
- Report deadline: 12/30(五)
- Report title format: LABx_ID_Name.pdf

- Demo必須在Report deadline前完成
- Demo前須先上傳程式碼(上傳main所在的.c檔即可)

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Graded

- Basic : 80%
- Report & Code : 20%

- Last LAB, and No Bonus. ＼(^o^)／