

LAB 3

Motion sensor

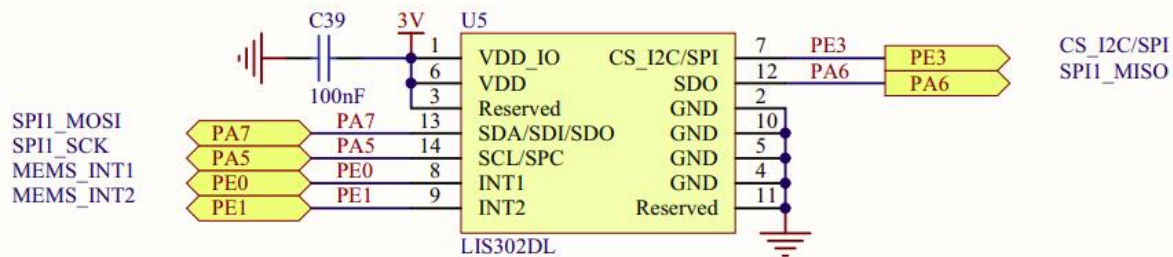
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Prelab 目的

- 讓同學確保motion sensor能使用，以節省lab3在課堂上花費的時間，避免到時候還要處理設備問題。

Motion sensor

- Lab預設motion sensor型號: ST MEMS LIS3DSH
- The STM32F407VG microcontroller controls this motion sensor through the SPI interface.
- 下圖為加速規接在哪些開發版的pin腳上。



MEMS

Motion sensor setup

Pinout & Configuration

Software Packs

Pinout

Pinout view

System view

Categories A->Z

System Core

Analog

Timers

Connectivity

CAN1

CAN2

ETH

FSMC

I2C1

I2C2

I2C3

SDIO

SPI1

SPI2

SPI3

UART4

UART5

USART1

USART2

USART3

USART6

USB_OTG_FS

USB_OTG_HS

Multimedia

Security

Computing

Middleware

SPI1 Mode and Configuration

Mode

Mode Full-Duplex Master

Hardware NSS Signal Disable

Configuration

Reset Configuration

NVIC Settings

DMA Settings

GPIO Settings

Parameter Settings

User Constants

Configure the below parameters :

Search (Ctrl+F)

Basic Parameters

Frame Format Motorola

Data Size 8 Bits

First Bit MSB First

Clock Parameters

Prescaler (for Baud R... 2

Baud Rate 8.0 MBits/s

Clock Polarity (CPOL) Low

Clock Phase (CPHA) 1 Edge

Advanced Parameters

CRC Calculation Disabled

NSS Signal Type Software

Pinout

PE2

PE3

PE4

PE5

PE6

VBAT

PC1

PC1

PC1

YSS

VDD

PH0

PH1

NRST

PC0

PC1

PC2

PC3

VDD

VSSA

VRE

VDDA

PA0

PA1

PA2

PA2

VSS

VDD

PA4

PA5

PA6

PA7

PC4

PC5

PC6

PC7

PC8

PC9

PC10

PC11

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Motion sensor setup

The image displays the STM32CubeMX software interface for configuring a motion sensor setup. The left sidebar shows the 'Categories' list with 'SPI1' selected under 'Connectivity'. The main panel shows the 'SPI1 Mode and Configuration' settings, including 'Mode' set to 'Full-Duplex Master' and 'Hardware NSS Signal' set to 'Disable'. The 'Configuration' tab is active, showing 'Parameter Settings' for SPI1. The 'Basic Parameters' section shows 'Frame Format' as 'Motorola', 'Data Size' as '8 Bits', and 'First Bit' as 'MSB First'. The 'Clock Parameters' section shows 'Prescaler (for Baud Rat...)' as '2', 'Baud Rate' as '8.0 MBits/s', 'Clock Polarity (CPOL)' as 'Low', and 'Clock Phase (CPHA)' as '1 Edge'. The 'Advanced Parameters' section shows 'CRC Calculation' as 'Disabled' and 'NSS Signal Type' as 'Software'.

Red arrows point to specific pins in the pinout diagram on the right, labeled with red text:

- PE3 : GPIO_Output (for CS)** - Points to pin PE3.
- PE0 : GPIO_EXTIO (for INT)** - Points to pin PE0.

The pinout diagram shows the STM32F407VGTx LQFP100 package with pins labeled from PA0 to PA15, PB0 to PB15, PC0 to PC15, PD0 to PD15, PE0 to PE15, PF0 to PF15, PG0 to PG15, PH0 to PH15, and PI0 to PI15. The pins are color-coded: PA0-PA15 are yellow, PB0-PB15 are green, PC0-PC15 are blue, PD0-PD15 are orange, PE0-PE15 are red, PF0-PF15 are purple, PG0-PG15 are brown, PH0-PH15 are pink, and PI0-PI15 are light blue.

Motion sensor register

- 這些是能用來控制加速規的一些register，事先define好每個的地址方便之後使用。

```
/* USER CODE BEGIN PM */
#define LIS3DSH_WHO_AM_I_ADDR      0x0F
#define LIS3DSH_STAT_ADDR          0x18
#define LIS3DSH_CTRL_REG4_ADDR     0x20
#define LIS3DSH_CTRL_REG1_ADDR     0x21
#define LIS3DSH_CTRL_REG2_ADDR     0x22
#define LIS3DSH_CTRL_REG3_ADDR     0x23
#define LIS3DSH_CTRL_REG5_ADDR     0x24
#define LIS3DSH_CTRL_REG6_ADDR     0x25

#define LIS3DSH_STATUS_ADDR         0x27

#define LIS3DSH_OUT_X_L_ADDR        0x28
#define LIS3DSH_OUT_X_H_ADDR        0x29
#define LIS3DSH_OUT_Y_L_ADDR        0x2A
#define LIS3DSH_OUT_Y_H_ADDR        0x2B
#define LIS3DSH_OUT_Z_L_ADDR        0x2C
#define LIS3DSH_OUT_Z_H_ADDR        0x2D

#define LIS3DSH_ST1_1_ADDR          0x40
#define LIS3DSH_ST1_2_ADDR          0x41
#define LIS3DSH_THRS1_1_ADDR        0x57
#define LIS3DSH_MASK1_B_ADDR        0x59
#define LIS3DSH_MASK1_A_ADDR        0x5A
#define LIS3DSH_SETT1_ADDR          0x5B
```

MEMS_Read/ MEMS_Write

- 透過SPI來讀寫register 的函式。

```
/* USER CODE BEGIN 0 */  
⊖ void MEMS_Write(uint8_t address,uint8_t data){  
    HAL_GPIO_WritePin(GPIOE, GPIO_PIN_3, GPIO_PIN_RESET);  
    HAL_SPI_Transmit(&hspi1,&address,1,10);  
    HAL_SPI_Transmit(&hspi1,&data,1,10);  
    HAL_GPIO_WritePin(GPIOE, GPIO_PIN_3,GPIO_PIN_SET);  
}  
⊖ void MEMS_Read(uint8_t address,uint8_t *data){  
    address |= 0x80;  
    HAL_GPIO_WritePin(GPIOE,GPIO_PIN_3,GPIO_PIN_RESET);  
    HAL_SPI_Transmit(&hspi1,&address,1,10);  
    HAL_SPI_Receive(&hspi1,data,1,10);  
    HAL_GPIO_WritePin(GPIOE,GPIO_PIN_3,GPIO_PIN_SET);  
}  
/* USER CODE END 0 */
```

Motion sensor testing

- 透過讀取**WHO_AM_I register**的值，來使綠燈閃爍。

```
97 void LED_Task(void *pvParameter)
98 {
99     for(;;){
100         uint8_t data;
101         MEMS_Read(LIS3DSH_WHO_AM_I_ADDR,&data);
102         if(data == 0x3F){
103             HAL_GPIO_TogglePin(GPIOD, GPIO_PIN_12);
104         }
105         vTaskDelay(500/portTICK_RATE_MS);
106     }
107 }
108 }
```

7.4 WHO_AM_I (0Fh)

Who_AM_I register.

Table 20. WHO_AM_I register default values

0	0	1	1	1	1	1	1
---	---	---	---	---	---	---	---

預設值0x3F



測試code連結: [Code](#)

已包括6、7、8頁code

理論上如果沒有問題，板子的綠色 LED 燈會閃爍

(承接lab0，記得設定 綠 LED 燈相關 pin 腳)

Testing Result

- 理論上如果第7頁的測試code有正常運行，表示開發版和加速規都和課堂上預設的一致，方便之後lab3的實作。
- 如遇到測試code實作不出來的同學，可能是以下問題：
 - 板子是透過甚麼控制加速規的(SPI or I2C)? (lab設計都是以SPI)
 - 開發版型號不一樣，導致要設定的pin腳(第3頁)不同(需參閱板子的SPEC做對照)
 - 加速規型號不一樣，導致要設定的WHO_AM_I register值不同(需參閱加速規的SPEC做對照)。
- 請同學盡量去想辦法解決，如真的解決不了，有問題可以E-MAIL給 lab3助教。