

# SPI ( )

- 18. SPI

# 18. SPI

## 18.1 SPI

SPI Serial Peripheral Interface SPI SCLK

### 18.1.1 SPI

SPI slave master APU n master MASTER SPI ss

image-20220107143401855

Image not found or type unknown

### 18.1.2 SPI

master ss sclk mosi MISO SS SPI SCLK MOSI MISO SCLK

image-20220107143430735

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SPI SPI CS POL PHA POL: SPICLK 0 1 CHA:

POL	PHA		
0	0	0	
0	1	1	
1	0	2	
1	1	3	

0 3

image-20220107162721035

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# 18.2 IMX6ULL SPI

## 18.2.1 SPI

IMX6ULL SPI    ECSPI(Enhanced Configurable Serial Peripheral Interface) 4

- 
- MASTER SLAVE
- 
- 
- 64X32    FIFO 64X32    FIFO
- 
- DMA Direct Memory Acess
- 

SPI                                  FIFO                                  SPI                                  SPI

image-20220107163027163

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## 18.2.2 SPI

SPI

1.    CONFREG    EN
2.    SPI        CCM
3.                ECSPI\_CONFREG    EN
4.    SPI        IOMUX
5.    SPI        SPI

MASTER        SPI

image-20220107163102420

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## 18.2.3 SPI

IMX6ULL 4 SPI                                  SPI                                  SPI                                  IO                                  SPI3                                  ,SPI3

image-20220107163123688

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18.2.3.1 ECSPIx\_RXDATA

FIFO 0

image-20220107163227986

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18.2.3.2 ECSPIx\_TXDATA

FIFO

image-20220107163245837

Image not found or type unknown

18.2.3.3 ECSPIx\_CONREG

SPI

image-20220107163253051

Image not found or type unknown

18.2.3.4 ECSPIx\_CONFIGREG

SPI SPI

image-20220107163353864

Image not found or type unknown

18.2.3.5 ECSPIx\_STATREG

8 SPI FIFO 0x00000003

image-20220107163402129

Image not found or type unknown

18.2.3.6 ECSPIx\_TESTREG

SPI

image-20220107163431517

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## 18.2.4 SPI

SPI                    IO   spi3   PAD

image-20220107163542616

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### 18.2.4.1      SPI3

SPI3

image-20220107163559253

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#### 1. IOMUXC\_SW\_MUX\_CTL\_PAD\_UART2\_TX\_DATA

SPI3 SS0                    SPI3\_SS0                    CS                    GPIO

image-20220107163605899

Image not found or type unknown

#### 2. IOMUXC\_SW\_MUX\_CTL\_PAD\_UART2\_RX\_DATA

SPI3 SCLK                    SPI3\_SCLK

image-20220107163611126

Image not found or type unknown

#### 3. IOMUXC\_SW\_MUX\_CTL\_PAD\_UART2\_CTS\_B

SPI3 MOSI                    SPI3\_MOSI

image-20220107163616139

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#### 4. IOMUXC\_SW\_MUX\_CTL\_PAD\_UART2\_RTS\_B

SPI3 MISO      SPI3\_MISO

image-20220107163623707

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SPI3      SW\_CTL\_PAD

## 18.2.4.2      SPI3

image-20220107163718602

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### 1. IOMUXC\_SW\_PAD\_CTL\_PAD\_UART2\_TX\_DATA

UART2\_TX\_DATA

image-20220107163724691

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### 2. IOMUXC\_SW\_PAD\_CTL\_PAD\_UART2\_RX\_DATA

UART2\_RX\_DATA

image-20220107163732738

Image not found or type unknown

### 3. IOMUXC\_SW\_PAD\_CTL\_PAD\_UART2\_CTS\_B

UART2\_CTS\_B

image-20220107163737567

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### 4. IOMUXC\_SW\_PAD\_CTL\_PAD\_UART2\_RTS\_B

UART2\_RTS\_B

image-20220107163741931

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## 18.3 ICM-20608-G

### 18.3.1 ICM-20608-G

ICM-20608-G	LGA16	30.75mm	6	3	3
-------------	-------	---------	---	---	---

- X Y Z  $\pm 250$   $\pm 500$   $\pm 1000$   $\pm 2000$   $\square/$  16 ADC
- X Y Z  $\pm 2g$   $\pm 4g$   $\pm 8g$   $\pm 16g$  16 ADC
- 512 FIFO
- 
- 
- 400kHz I2C 8MHz SPI
- self-test
- 

ICM-20608-G

image-20220107163934560

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### 18.3.2 ICM-20608-G

ICM-20608-G	SPI I2C	SPI	SPI	imx6ull	imx6ull spi3	ICM-2060
-------------	---------	-----	-----	---------	--------------	----------

image-20220107163953919

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### 18.3.3 ICM-20608-G

ICM-20608-G	spi	ID	SPI	ICM-20608-G
-------------	-----	----	-----	-------------

image-20220107164000427

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- ### 1. Sample rate divider

FIFO

- ## 2. Configuration

FIFO

3. Gyroscope configuration

4. Accelerometer configuration

5. Accelerometer configuration2

6. Low power mode configuration

ICM-20608-G

7. Fifo enable

FIFO 1 0 FIFO

8. Power management1

ICM-20608-G

9. Power management2

10. Who am i

ID ICM-20608-G 0xAF

11. Accelerometer measurements

6 X/Y/Z

12. Temperature measurements

13. Gyroscope measurement

6 X/Y/Z

## 18.4 SPI



spi3	ICM-20608-G	spi3	spi			
	SPI	SP	SPI	SPI	SPI	SPI

18.4.1 SPI

SPI3 ICM-20608-G

image-20220107164100677

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18.4.1.1

1.

SPI3

SS0

ICM-20608-G

GPIO,

IOMUX\_SW\_MUX\_CTL\_PAD\_UART2\_TX\_DATA

ALT5

GP

image-20220107164214439

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2.

SPI3

SCLK

IOMUXC\_SW\_MUX\_CTL\_PAD\_UART2\_RX\_DATA

ALT8
3.

SPI3

MOSI

IOMUXC\_SW\_MUX\_CTL\_PAD\_UART2\_CTS\_B

ALT8
4.

SPI3

MISO

IOMUXC\_SW\_MUX\_CTL\_PAD\_UART2\_RTS\_B

ALT8
- SW\_PAD\_CTL\_PAD

18.4.1.2

SPI3 CS ALT5 ALT8

\*\*
 Git
 NoosProgramProject/18\_SPI
 (001\_spi\_init/spi.c)\*\*
 87 ~ 96

```

//

iomuxc_sw_set(UART2_TX_BASE, 5); // GPIO0 GPIO1_I020

GPIO1_GDIR = (volatile unsigned int *)(0x209C000 + 0x4);

GPIO1_DR = (volatile unsigned int *)(0x209C000);

*GPIO1_GDIR |= (1<<20); //
  
```

```
*GPI01_DR |= (1<<20);

iomuxc_sw_set(UART2_RX_BASE, 8);

iomuxc_sw_set(UART2_RTS_BASE, 8);

iomuxc_sw_set(UART2_CTS_BASE, 8);
```

18.4.2 SPI

SPI	CONREG	SPI					
SPI	PLL3	SPI	PLL3	480MHz	8	60MHz	SPI

image-20220107164924325

Image not found or type unknown

18.4.2.1 SPI

1. SPI

CCM_CSCDR2	CCM_CCGR1	CCM_CSCDR2	SPI	PLL3	1
------------	-----------	------------	-----	------	---

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2. SPI

SPI	CCM_CCGR1
-----	-----------

image-20220107164941528

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image-20220107164946111

Image not found or type unknown

CG	bit5:4	2'b11,	SPI	( STOP )	imximage.cfg.cfgtr
----	--------	--------	-----	----------	--------------------

image-20220107164954834

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3. SPI

SPI SCLK 4MHz 1 CONREG Bit15:12 Bit11:8

image-20220107165210889

Image not found or type unknown

SPI 4MHz bit15:11 14

image-20220107165229108

Image not found or type unknown

CONREG bit115:11 14 CONREG 14<<11

18.4.2.2 SPI

SPI \*\* Git NoosProgramProject/18\_SPI (001\_spi\_init/spi.c)\*\* 71 ~ 85

```
/* */

/*

RM chapter18 PLL3

1 pll3_sw_clk_sel 0 pll3 1 ccm_pll3_bys pll3 pll3_sw_clk spi spi 4

75 2 spi CCM_CCGR1 bit5:2 .imx

3 CONREG

bit15:12 div_1

bit11:8 div_2

spip

60M/(div+1)*(2^div_2))

4M
```

```

        bit15:12 = 15    60M/4 = 15Mhz

*/

uc_num->CONREG &= ~(0xf<<12|0xf<<8); //

uc_num->CONREG |= (14<<12); //  clk = 60/(14+1) = 4M

```

## 18.4.3 SPI

SPI      master      SPI

### 18.4.3.1 1 CONREG

CONREG

image-20220107165337713

Image not found or type unknown

- Bit31:20 SPI      2<sup>12</sup>      7
  - Bit19:18 SPI      0~3      0~3      0      0
  - Bit17:16 SPI\_RDY#
  - Bit15:12 Bit11:8 SPI      SPI
  - Bit7:4      0 slave      1 master      0 master
  - Bit3      0      SPI XCH      XCH 1      1      TXFIFO
  - Bit2 SPI XCH
  - Bit1
  - Bit0 SPI      1      SPI      CONREG
- CONREG      master

7<<20 | 1<<4 | 1<<3 | 1<<0

### 18.4.3.2 2 CONFIGREG

CONFIGREG

image-20220107165549664

Image not found or type unknown

- Bit28:24 HT
- Bit23:20 SCLK
- Bit19:16
- Bit15:12 SS
- Bit11:8 SS SMC 1
- Bit7:4 SCLK 0
- Bit3:0 SCLK 0 1

CONFIGREG 0

### 18.4.3 3 SPI

IOMUX ( )

SPI \*\* Git NoosProgramProject/18\_SPI (001\_spi\_init/spi.c)\*\* 40 ~ 70

```
/*

1  CONREG  EN

2  ccm  spi

3  control register  CONREG EN  spi

4  spi  IOMUX

5  spi  spi

*/

printf("spi  \n\r") ;

/**/

uc_num->CONREG = 0; // clear all bits
```

```

/*

    bit0:  SPI

    bit3:  TXDATA

    bit4:    0 master mode

    bit31:20  burst length 7  8bits

*/

uc_num->CONREG |= ( 7<<20) | ( 1<<4) | ( 1<<3) | ( 1<<0);

/*  CONFIGREG

    *

    *bit0          PHA=0

    *bit7: 4      sclk

    *bit11: 8      SMC =1      SMC=1

    *bit15: 12     POL=0

    *bit19: 16

    *bit23: 20     sclk

    *bit28: 24

    *

*/

uc_num->CONFIGREG = 0; //

```

# 18.4.4 SPI     TESTREG

TESTREG FIFO

image-20220107165850731

Image not found or type unknown

TESTREG 1 Bit14:8 FIFO Bit6:0 FIFO

image-20220107165854896

Image not found or type unknown

bit32 1 fifo SPI

# 18.4.5 SPI     TXDATA RXDATA

TXDATA RXDATA

spi.c spi\_writeread

```
while(!( spi_num->STATREG&(1<<0))); // FIFO

spi_num->TXDATA = uc_txdata;


while(!( spi_num->STATREG&(1<<3))); // 1

return spi_num->RXDATA;
```

# 18.5 ICM-20608-G

SPI     ICM-20608-G ICM-20608-G

- MSB LSB
- sclk
- sclk
- 8MHz
- 16
-

SPI	ICM-20608-G	ICM-20608-G	SPI
ICM-20608-G	SPI	MSB	10

image-20220107165933856

Image not found or type unknown

ICM-20608-G

## 18.5.1 ICM-20608-G

### 18.5.1.1

0x19       $AMPLE\_RATE = \frac{INTERNAL\_SAMPLE\_RATE}{(1 + SMPLRT\_DIV)}$  Where INTERNAL\_ = 1kHz      1K      0.

image-20220107170304335

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### 18.5.1.2

0x1A      FIFO      FSYNC      DLPF      250Hz      ,      0x00

image-20220107170311178

Image not found or type unknown

DLPF\_CFG      20Hz

image-20220107170316913

Image not found or type unknown

### 18.5.1.3

0x1B      ±250dps      0x00

image-20220107170324625

Image not found or type unknown

### 18.5.1.4

0x1C      ±2g      0x00



image-20220107170329812

Image not found or type unknown

18.5.1.5 2

0x1D 218.1Hz 0x00

image-20220107170335479

Image not found or type unknown

18.5.1.6

0x1E 0

image-20220107170340614

Image not found or type unknown

18.5.1.7 FIFO

0x23 FIFO FIFO 0 FIFO

image-20220107170346118

Image not found or type unknown

18.5.1.8 1

0x6B ICM-20608-G 0x80

image-20220107170351662

Image not found or type unknown

18.5.1.9 2

0x6C 0x00

image-20220107170357124

Image not found or type unknown

ICM20608-G \*\* Git NoosProgramProject/18\_SPI (003\_spi\_read\_icm20608\_id)  
NoosProgramProject/18\_SPI /004\_read\_sensor\_data \*\* icm20608g.c icm20608g\_init

```

icm20608_write_addr(ICM20608G_PWR_MGMT_1, 0x80); //

icm20608g_write_addr(ICM20608G_PWR_MGMT_1, 0x01); //

icm20608g_write_addr(ICM20608G_SMPLRT_DIV, 0x00); //      1K

icm20608g_write_addr(ICM20608G_CONFIG, 0x00); //  FIFO

icm20608g_write_addr(ICM20608G_GYRO_CONFIG, 0x00); //

icm20608g_write_addr(ICM20608G_ACC_CONFIG, 0x00); //

icm20608g_write_addr(ICM20608G_ACC_CONFIG2, 0x00); //

icm20608g_write_addr(ICM20608G_LP_MODE_CFG, 0x00); //

icm20608g_write_addr(ICM20608G_FIFO_EN, 0x00); //      FIFO

icm20608g_write_addr(ICM20608G_PWR_MGMT_2, 0x00); //

```

## 18.5.2 ICM-20608-G ID

ID      0x75      WHO\_AM\_I      WHO\_AM\_I      8      ID      0xAF

image-20220107170437872

Image not found or type unknown

ID      \*\*      Git      NoosProgramProject/18\_SPI      /003\_read\_icm20608\_id)  
NoosProgramProject/18\_SPI      /004\_read\_sensor\_data)\*\*      icm20608g.c      icm20608g\_init      62 ~

```

//      id      0xaf

uc_dev_id = icm20608g_read_addr(ICM20608G_WHO_AM_I);

printf("read icm20608g id is 0x%x\n\r", uc_dev_id);

if(uc_dev_id != 0xAF)

```

```
{
    printf("read id fail\n\r");
    return -1;
}
```

### 18.5.3 ICM-20608-G

0x41 0x42

Temp\_degC = (Temp\_out-RoomTemp\_Offset)/Temp\_s

image-20220107170506715

Image not found or type unknown

\*\* Git NoosProgramProject/18\_SPI /004\_read\_sensor\_data/icm20608g.c)\*\*

```
icm20608g_read_len(0x41,uc_buf,2);
icm20608g_get.temp_adc = (signed short)((uc_buf[0]<<8)|uc_buf[1]);
```

### 18.5.4 ICM-20608-G

ICM-20608-G

59 64

59 60

X

61 62

Y

63 64

Z

image-20220107170528695

Image not found or type unknown

\*\* Git NoosProgramProject/18\_SPI /004\_read\_sensor\_data/icm20608g.c)\*\*

```
icm20608g_read_len(0x3b,uc_buf,6);

icm20608g_get.acc_x_adc = (signed short)((uc_buf[0]<<8)|uc_buf[1]);

icm20608g_get.acc_y_adc = (signed short)((uc_buf[2]<<8)|uc_buf[3]);

icm20608g_get.acc_z_adc = (signed short)((uc_buf[4]<<8)|uc_buf[5]);
```

### 18.5.5 ICM-20608-G

ICM-20608-G

67 72

67 68

X

69 70

Y

71 72

Z

image-20220107170545413

Image not found or type unknown

**\*\* Git NoosProgramProject/18\_SPI /004\_read\_sensor\_data/icm20608g.c)\*\***

```
icm20608g_read_len(0x43, uc_buf, 6);

icm20608g_get.gyro_x_adc = (signed short)((uc_buf[0] << 8) | uc_buf[1]);

icm20608g_get.gyro_y_adc = (signed short)((uc_buf[2] << 8) | uc_buf[3]);

icm20608g_get.gyro_z_adc = (signed short)((uc_buf[4] << 8) | uc_buf[5]);
```

## 18.6

### 18.6.1 SPI

`spi_init(ESCPI3_BASE);`      `SPI`      `spi_writeread 0x54`      `SCLK`

**Git NoosProgramProject/18\_SPI /001\_spi\_init/main.c)**

```
int main()

{

    unsigned char uc_cnt;

    spi_init(ESCPI3_BASE);

    return 0;

}
```

#### 18.6.1.1 4-1.4

**\*\* Git NoosProgramProject/18\_SPI /001\_spi\_init)\*\***

#### 18.6.1.2 3-1.4

## 18.6.2 SPI

SPI

```
** Git NoosProgramProject/18_SPI /002_spi_loopback/spi_test_rw) Git  
NoosProgramProject/18_SPI /002_spi_loopback/main.c)** .
```

SPI . 20

```
spi_test_rw ** Git NoosProgramProject/18_SPI /002_spi_loopback/spi.c)**
```

```
// loop

spi_num->TESTREG = (1<<31);

printf("spi      \n\r");

//

for(uc_cnt=0; uc_cnt<20; uc_cnt++)

{

    uc_buf_write[uc_cnt] = 0x20+uc_cnt;

}

//

for(uc_cnt=0; uc_cnt<20; uc_cnt++)

{

    printf("write_cnt %d\t",uc_cnt);

    spi_writeread(spi_num,uc_buf_write[uc_cnt]);

    printf("write %d\t",uc_buf_write[uc_cnt]);

    uc_buf_read[uc_cnt]=spi_writeread(ESCP13_BASE, 0xff);
```

```

        printf("read %d\n\r",uc_buf_read[uc_cnt]);

    }

    //

    for(uc_cnt=0;uc_cnt<20;uc_cnt++)

    {

        if(uc_buf_read[uc_cnt]!=uc_buf_write[uc_cnt])

        {

            /*

            printf("spi \n\r");

            return -1;

        }

    }

    printf("@@spi \n\r");

    printf("spi \n\r");

    //exit loopback mode

    spi_num->TESTREG = 0;

```

**Git NoosProgramProject/18\_SPI /002\_spi\_loopback/mainspi\_test\_rw**

### 18.6.2.1 4-1.4

**\*\* Git NoosProgramProject/18\_SPI /002\_spi\_loopback)\*\***

### 18.6.2. 3-1.4

image-20220107170631856

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## 18.6.3 ICM-20608-G ID

ICM-20608-G SPI ID SPI

**Git NoosProgramProject/18\_SPI /003\_spi\_read\_icm20608\_id/main.c**  
20608-G ID

```
int main()

{

    unsigned char uc_cnt;
    icm20608g_init();// ICM-20608-G
    return 0;

}
```

### 18.6.3.1 4-1.4

**\*\* Git NoosProgramProject/18\_SPI /003\_spi\_read\_icm20608\_id/)\*\***

### 18.6.3.4 3-1.4

ID 0xAF ICM-20608-G ID

image-20220107171628819

Image not found or type unknown

## 18.6.4 ICM-20608-G

**Git NoosProgramProject/18\_SPI /004\_read\_sensor\_data/main.c**  
) icm20608g\_read\_acc icm20608g\_read\_ac icm20608g\_read\_temp

```
int main()

{
```

```
    unsigned char uc_cnt;

    icm20608g_init();//      ICM-20608-G

    for(uc_cnt=0;uc_cnt<1;uc_cnt++)

    {

        icm20608g_read_acc();

        icm20608g_read_gyro();

        icm20608g_read_temp();

    }

    return 0;

}
```

#### 18.6.4.1 4-1.4

\*\* Git NoosProgramProject/18\_SPI /004\_read\_sensor\_data)\*\*

#### 18.6.4.2 3-1.4

image-20220107170705702

Image not found or type unknown