

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

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18.1.2 SPI

master ss sclk mosi MISO SS SPI SCLK MOSI MISO SCLK

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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

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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

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18.2.3.3 ECSPIx_CONREG

SPI

image-20220107163253051

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18.2.3.4 ECSPIx_CONFIGREG

SPI SPI

image-20220107163353864

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18.2.3.5 ECSPIx_STATREG

8 SPI FIFO 0x00000003

image-20220107163402129

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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

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2. IOMUXC_SW_MUX_CTL_PAD_UART2_RX_DATA

SPI3 SCLK SPI3_SCLK

image-20220107163611126

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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

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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

Image not found or type unknown

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

Image not found or type unknown

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 ± 250 ± 500 ± 1000 ± 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
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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

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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

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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
-----	-----------

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image-20220107164946111

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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

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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

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- Bit31:20 SPI 2¹² 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

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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

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ICM-20608-G

18.5.1 ICM-20608-G

18.5.1.1

0x19 AMPLE_RATE = 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

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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

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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

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