GigaDevice Semiconductor Inc.

GD32207I-EVAL
Arm® Cortex®-M3 32-bit MCU

User Guide

Revision 2.2

(Oct. 2021)

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1. Summary

GD32207I-EVAL evaluation board uses GD32F207IKT6 as the main controller. As a complete development platform of GD32F207xx connectivity line powered by ARM® Cortex®-M3 core, the board supports full range of peripherals. It uses Mini USB interface or AC/DC adapter as 5V power supply. JTAG, Reset, Boot, User button key, LED, CAN, I2C, I2S, DCI, SDRAM, USART, RTC, EXMC, SPI, USBFS, ADC, DAC, GD-Link、LCD、SDIO, ENET and Extension Pin are also included. This document details its hardware schematic and the relevant applications.

2. Function pin assignment

Table 2-1. Pin assignment

Function	Pin	Description
LED	PF6	LED1
	PF7	LED2
	PF8	LED3
	PF9	LED4
RESET		K1-Reset
KEY	PA0	KEY1
	PC13	KEY2
	PB14	KEY3
USB	PA9	USB_VBUS
	PA11	USB_DM
	PA12	USB_DP
	PD13	VBUS control pin
CAN	PB8	CAN0_RX
	PB9	CAN0_TX
	PB5	CAN1_RX
	PB6	CAN1_TX
I2C	PB6	I2C0_SCL
	PB7	I2C0_SDA
I2S	PB12	I2S_WS
	PB15	I2S_DIN
	PB13	I2S_CK
	PC6	I2S_MCK
	PA4	MSEL
	PA5	MCLK
	PA7	MDIN
	RESET	NRST
USART0	PA9	USART0_TX
	PA10	USART0_RX
EXMC_NAND	PD14	EXMC_D0
	PD15	EXMC_D1
	PD0	EXMC_D2
	PD1	EXMC_D3
	PE7	EXMC_D4
	PE8	EXMC_D5
	PE9	EXMC_D6
	PE10	EXMC_D7
	PD11	EXMC_A16
	PD12	EXMC_A17

Function	Pin	Description
	PD4	EXMC_NOE
	PD5	EXMC_NWE
	PD6	EXMC_NWAIT
	PD7	EXMC_NCE1
SPI	PA2	SPI0_WP_IO2
	PA3	SPI0_$\overline{\text{HOLD}}$_IO3
	PA5	SPI0_SCK
	PA6	SPI0_MISO_IO1
	PA7	SPI0_MOSI_IO0
	PB1	SPIFlash_CS
ADC	PC3	ADC012_IN13
DAC	PA4	DAC_OUT1
	PA5	DAC_OUT2
SDIO	PC12	SDIO_CLK
	PD2	SDIO_CMD
	PC8	SDIO_DAT0
	PC9	SDIO_DAT1
	PC10	SDIO_DAT2
	PC11	SDIO_DAT3
DCI	PC6	DCI_D0
	PC7	DCI_D1
	PC8	DCI_D2
	PC9	DCI_D3
	PC11	DCI_D4
	PD3	DCI_D5
	PB8	DCI_D6
	PB9	DCI_D7
	PA6	DCI_PIXCLK
	PA8	DCI_XCLK
	PG9	DCI_VSYNC
	PH8	DCI_HSYNC
	PB10	DCI_I2C1_SCL
	PB11	DCI_I2C1_SDA
LCD	PH4	LCD_R0
	Pi3	LCD_R1
	PC10	LCD_R2
	PH9	LCD_R3
	PH10	LCD_R4
	PH11	LCD_R5
	PH12	LCD_R6
	PG6	LCD_R7
	PE5	LCD_G0

Function	Pin	Description
	PE6	LCD_G1
	PH13	LCD_G2
	PH14	LCD_G3
	PH15	LCD_G4
	Pi0	LCD_G5
	Pi1	LCD_G6
	Pi2	LCD_G7
	PE4	LCD_B0
	PG12	LCD_B1
	PG10	LCD_B2
	PG11	LCD_B3
	Pi4	LCD_B4
	Pi5	LCD_B5
	Pi6	LCD_B6
	Pi7	LCD_B7
	PG7	LCD_CLK
	Pi10	LCD_HSYNC
	PF10	LCD_DE
	Pi9	LCD_VSYNC
	PH7	LCD_Touch_Busy
	PH6	LCD_PWM_BackLight
	PA5	LCD_SPI1_SCK
	PA7	LCD_SPI1_MOSI
	PH5	LCD_Touch_PENIRQ
	PG3	LCD_SPI1_NSS
	PA6	LCD_SPI1_MISO
EXMC_SDARM	PD14	EXMC_D0
	PD15	EXMC_D1
	PD0	EXMC_D2
	PD1	EXMC_D3
	PE7	EXMC_D4
	PE8	EXMC_D5
	PE9	EXMC_D6
	PE10	EXMC_D7
	PE11	EXMC_D8
	PE12	EXMC_D9
	PE13	EXMC_D10
	PE14	EXMC_D11
	PE15	EXMC_D12
	PD8	EXMC_D13
	PD9	EXMC_D14
	PD10	EXMC_D15

Function	Pin	Description
	PF0	EXMC_A0
	PF1	EXMC_A1
	PF2	EXMC_A2
	PF3	EXMC_A3
	PF4	EXMC_A4
	PF5	EXMC_A5
	PF12	EXMC_A6
	PF13	EXMC_A7
	PF14	EXMC_A8
	PF15	EXMC_A9
	PG0	EXMC_A10
	PG1	EXMC_A11
	PG2	EXMC_A12
	PE0	EXMC_NBL0
	PE1	EXMC_NBL1
	PH2	EXMC_SDCKE0
	PG4	EXMC_BA0
	PG5	EXMC_BA1
	PG8	EXMC_SDCLK
	PG15	EXMC_SDNCAS
	PF11	EXMC_SDNRAS
	PH3	EXMC_SDNE0
	PC0	EXMC_SDNWE
ENET	PB11	RMII_TX_EN
	PB12	RMII_TXD0
	PB13	RMII_TXD1
	PC4	RMII_RXD0
	PC5	RMII_RXD1
	PA7	RMII_CRS_DV
	PC1	RMII_MDC
	PA2	RMII_MDIO
	PB0	RMII_INT
	PA1	RMII_REF_CLK

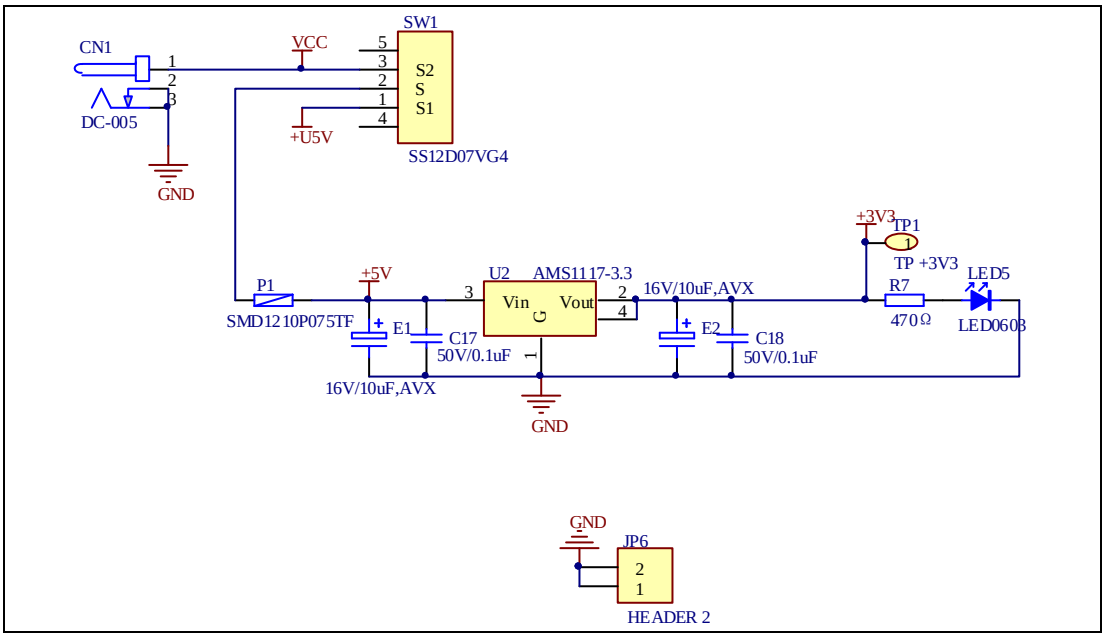
3. Getting started

The EVAL Board uses Mini USB connecter or adapter to get power, the hardware system power is +3.3V. A Mini USB cable and a J-Link tool are necessary to down programs. Select the correct boot mode and then power on, the LED5 will turn on, which indicates the power supply is ready.

4. Hardware layout overview

4.1. Power supply

Figure 4-1. Schematic diagram of power supply



4.2. Boot option

Figure 4-2. Schematic diagram of boot option

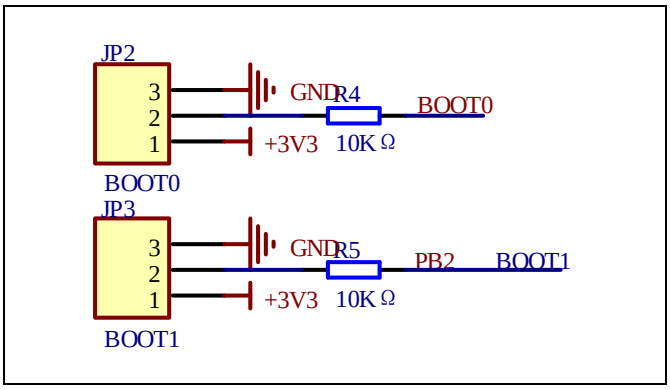
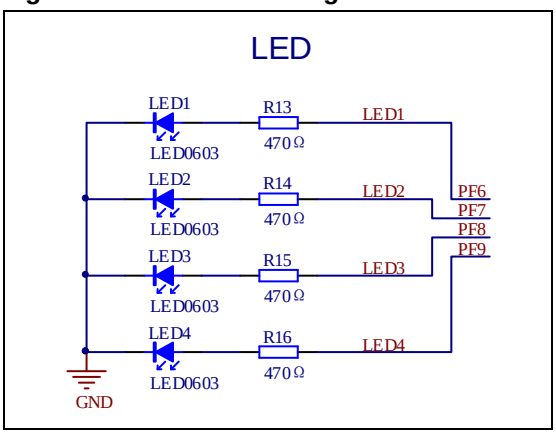


Table 4-1. Boot configuration

BOOT1	BOOT0	Boot Mode
Any	2-3	User memory
2-3	1-2	System memory
1-2	1-2	SRAM memory

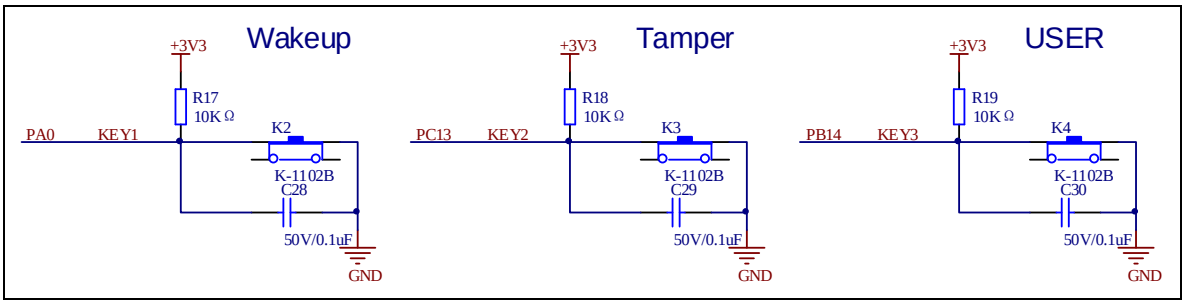
4.3. LED

Figure 4-3. Schematic diagram of LED function



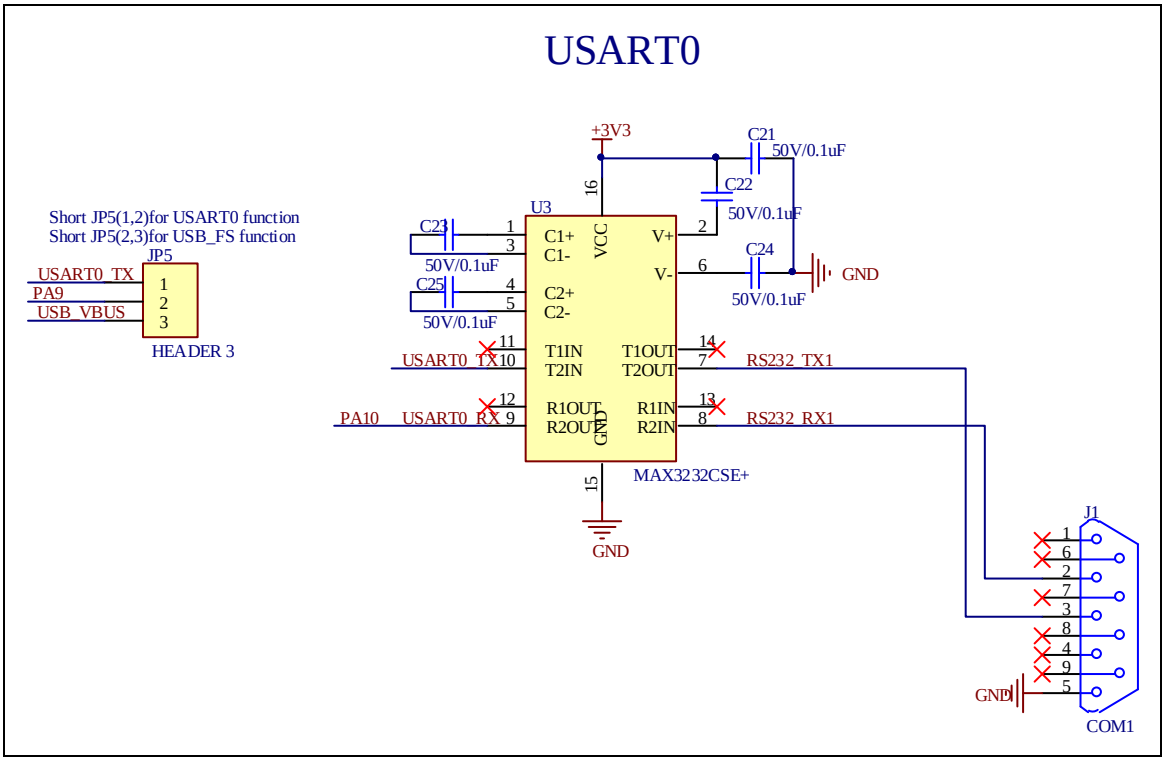
4.4. Key

Figure 4-4. Schematic diagram of Key function



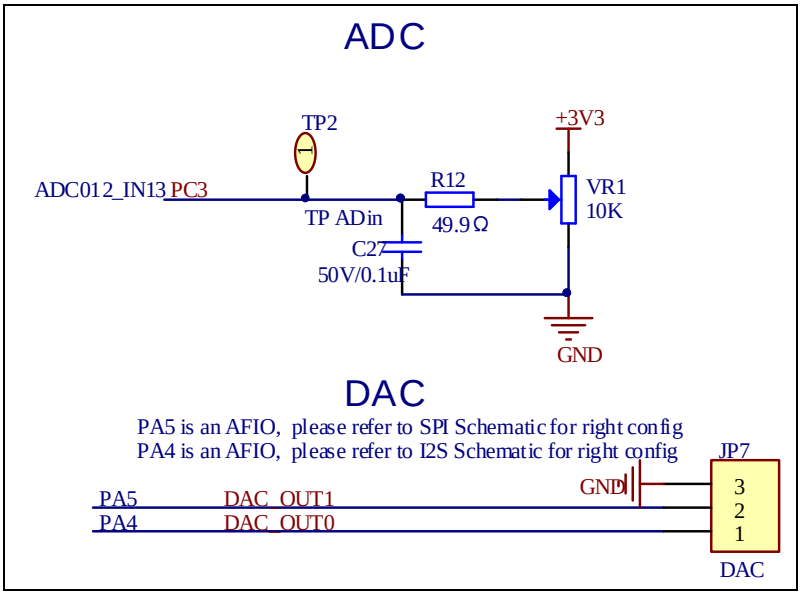
4.5. USART

Figure 4-5. Schematic diagram of USART0 function



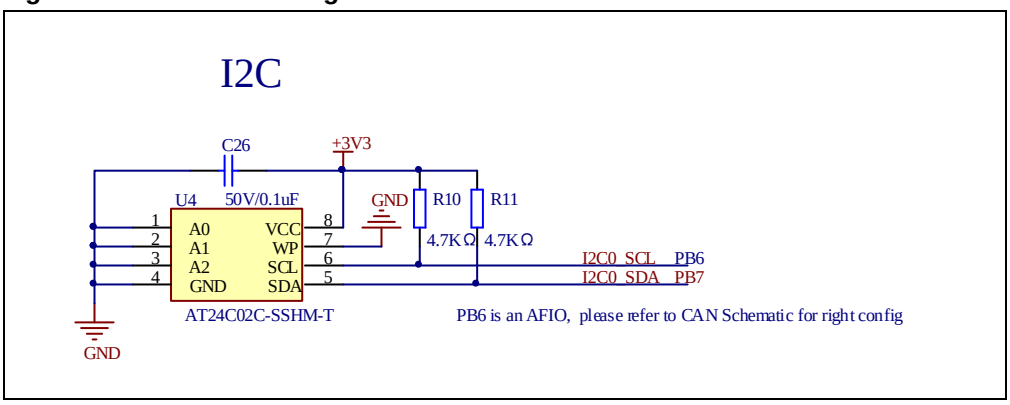
4.6. ADC/DAC

Figure 4-6. Schematic diagram of ADC/DAC function



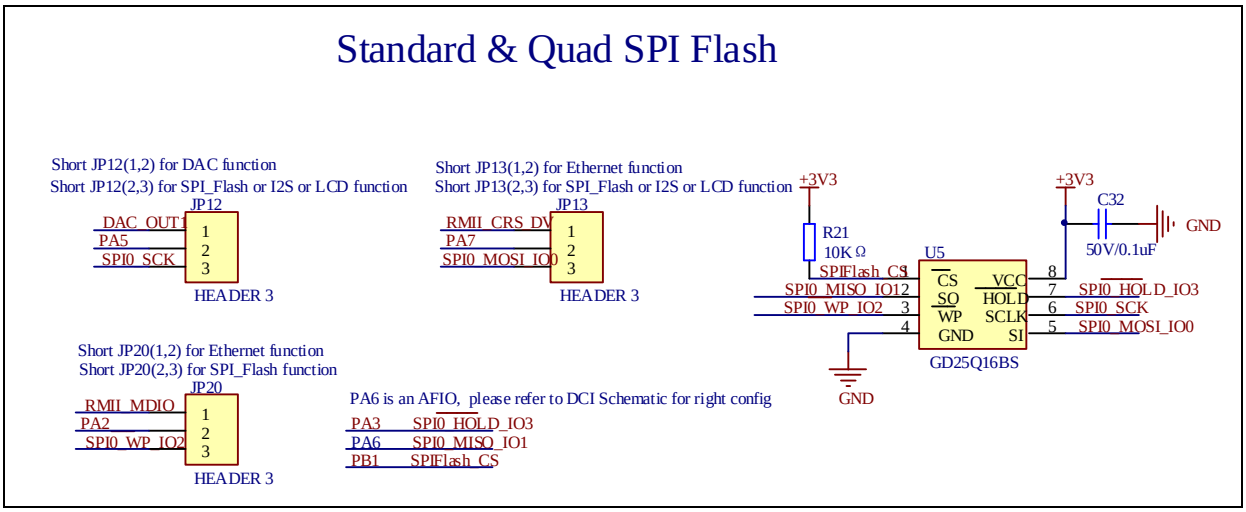
4.7. I2C

Figure 4-7. Schematic diagram of I2C function



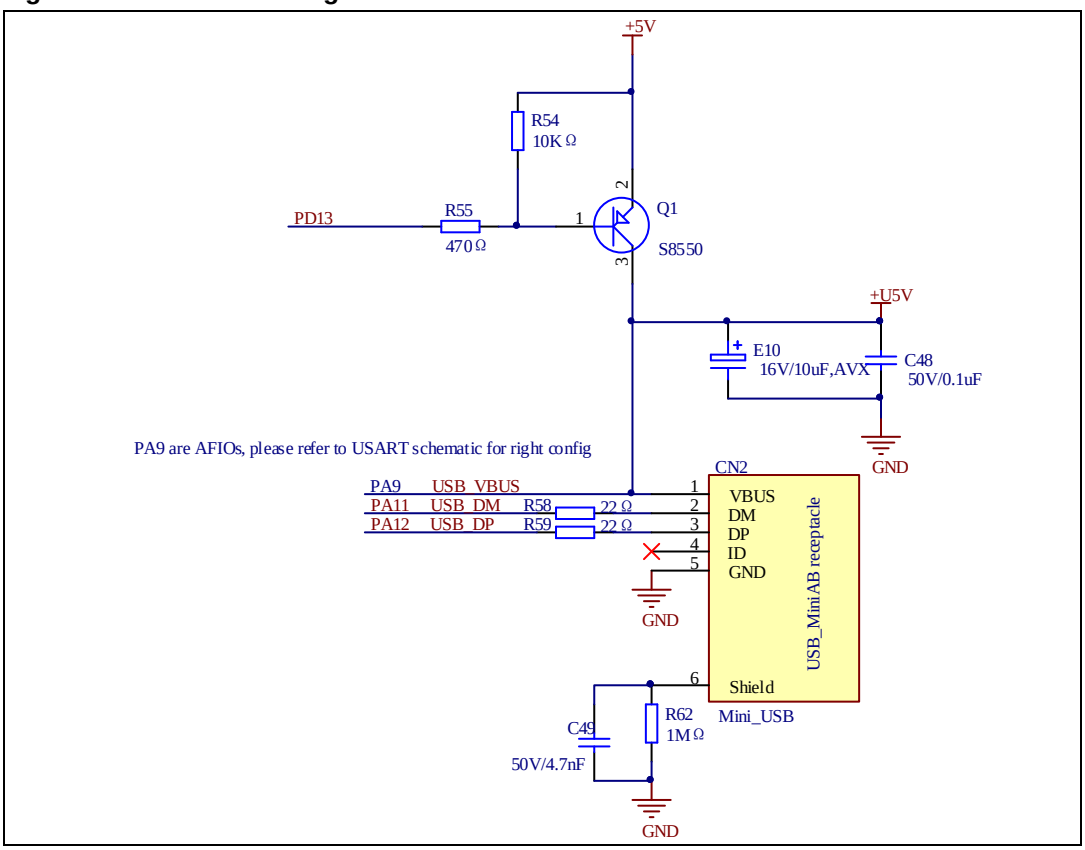
4.8. SPI-Serial Flash

Figure 4-8. Schematic diagram of SPI-Serial Flash function



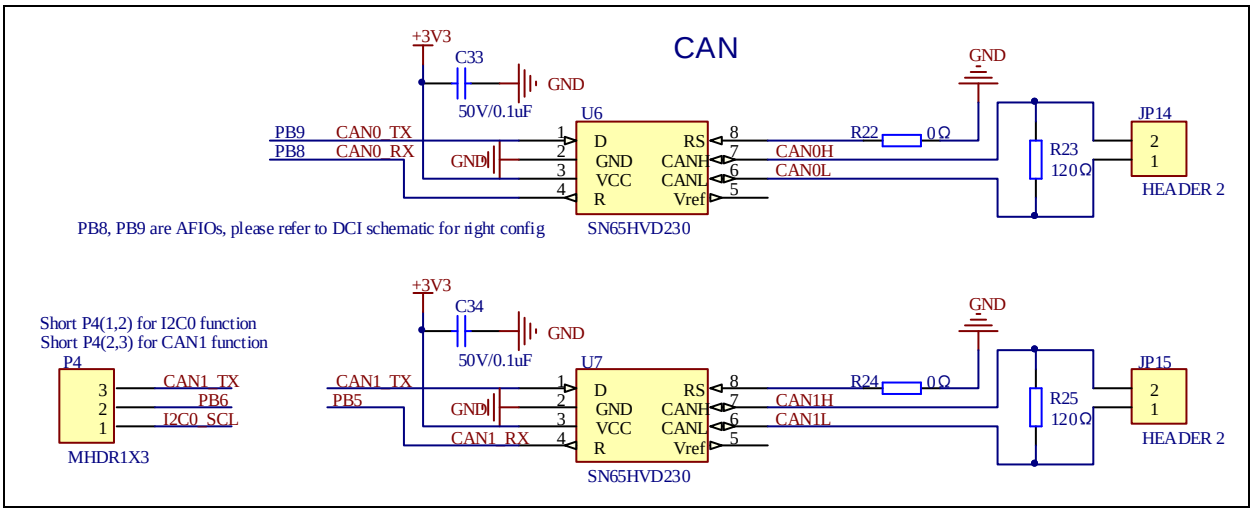
4.9. USB

Figure 4-9. Schematic diagram of USB function



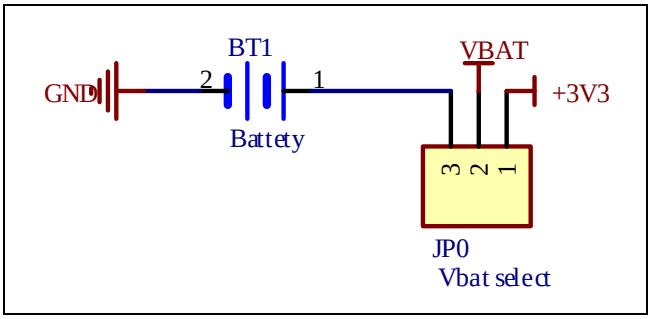
4.10. CAN

Figure 4-10. Schematic diagram of CAN function



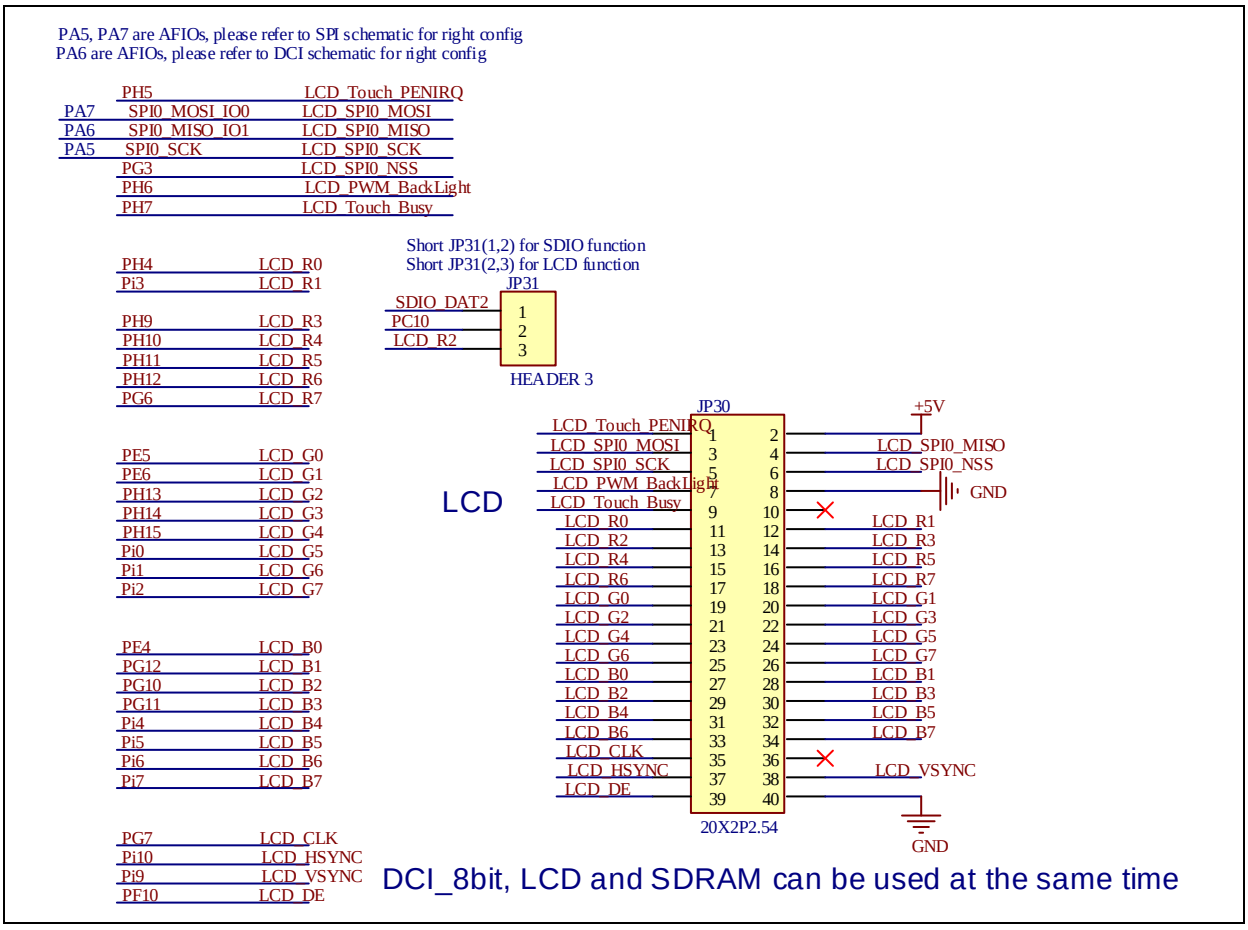
4.11. RTC

Figure 4-11 Schematic diagram of RTC function



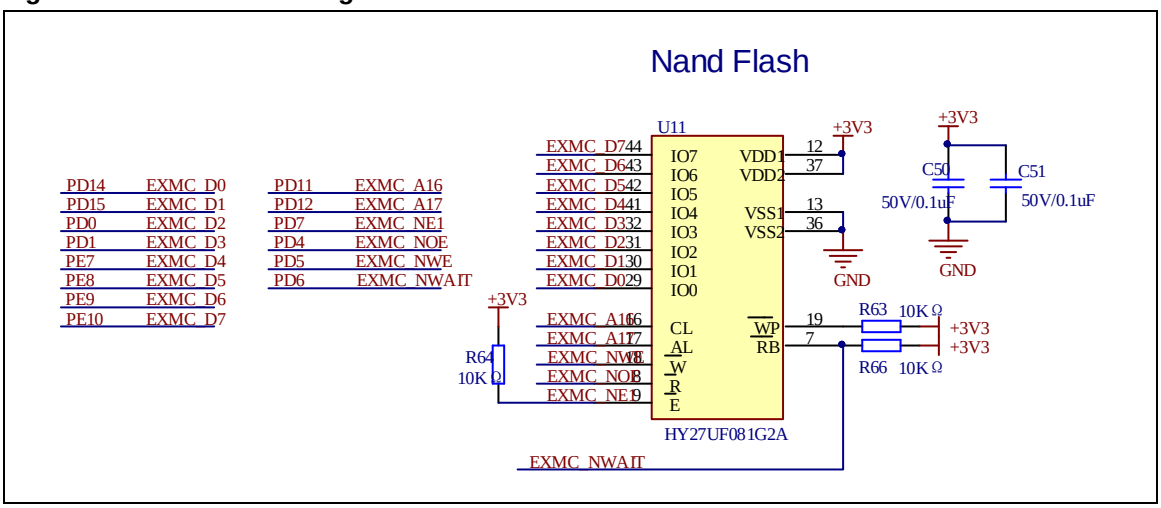
4.12. LCD

Figure 4-12. Schematic diagram of LCD function



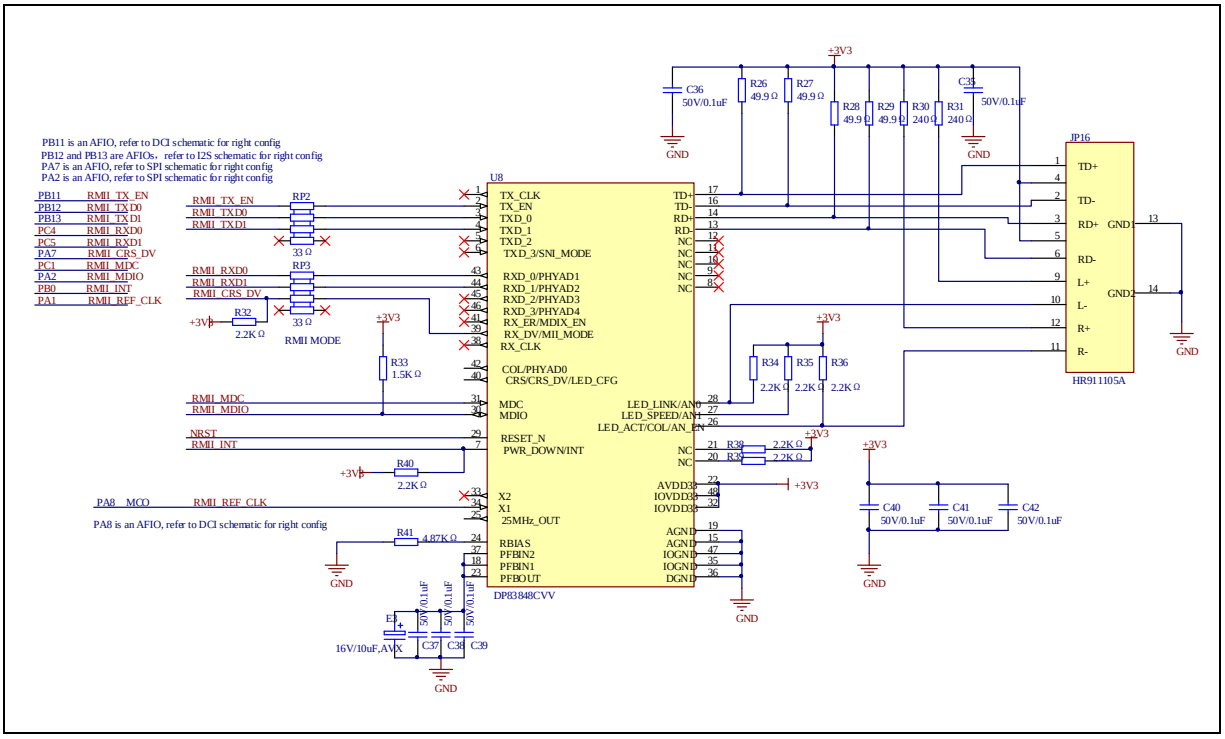
4.13. EXMC-NAND Flash

Figure 4-13. Schematic diagram of EXMC-NAND Flash function



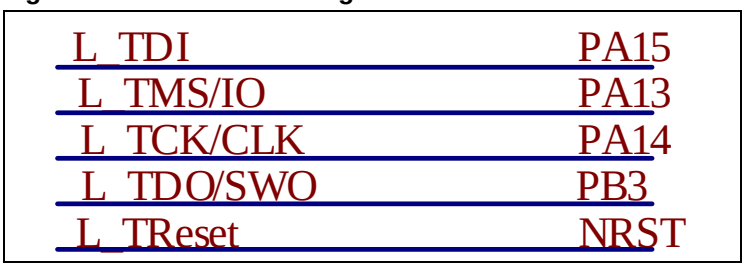
4.14. ENET

Figure 4-14. Schematic diagram of ENET



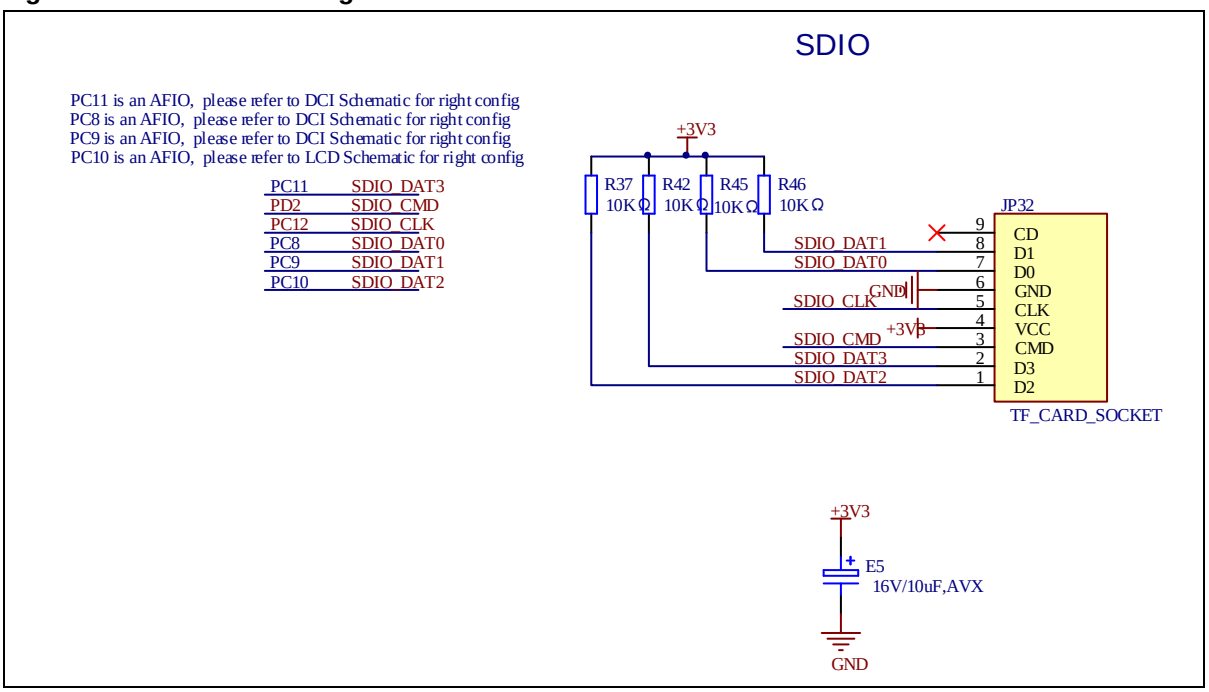
4.15. GD-Link

Figure 4-15. Schematic diagram of GD-Link



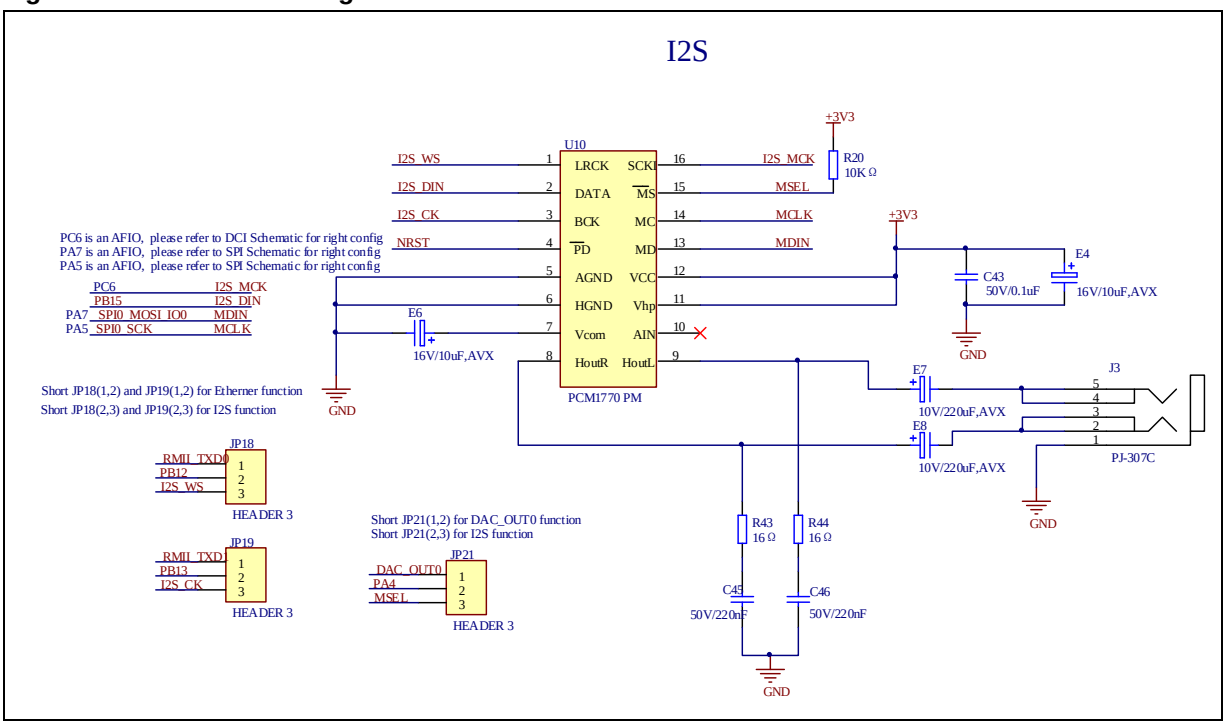
4.16. SDIO

Figure 4-16. Schematic diagram of SDIO



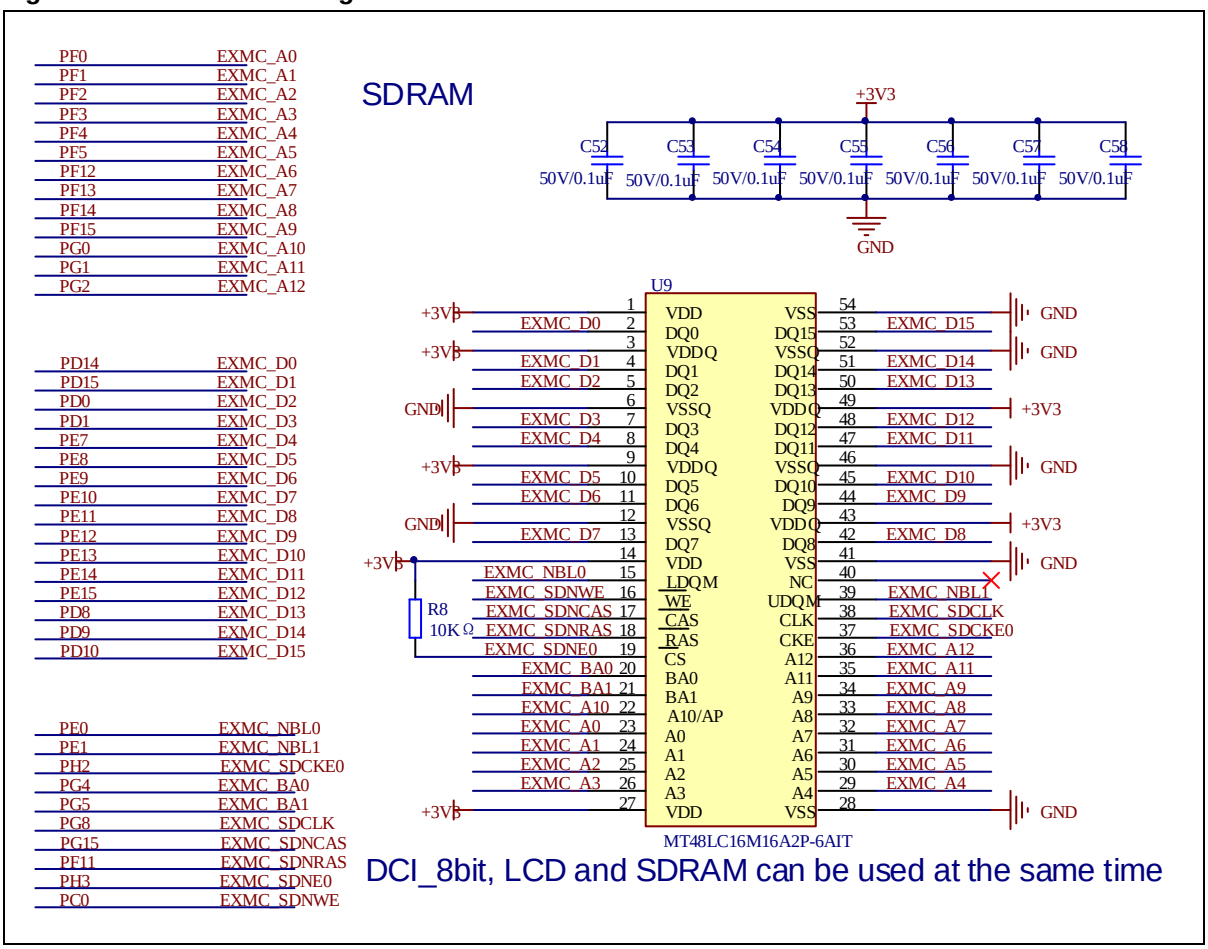
4.17. I2S

Figure 4-17. Schematic diagram of I2S



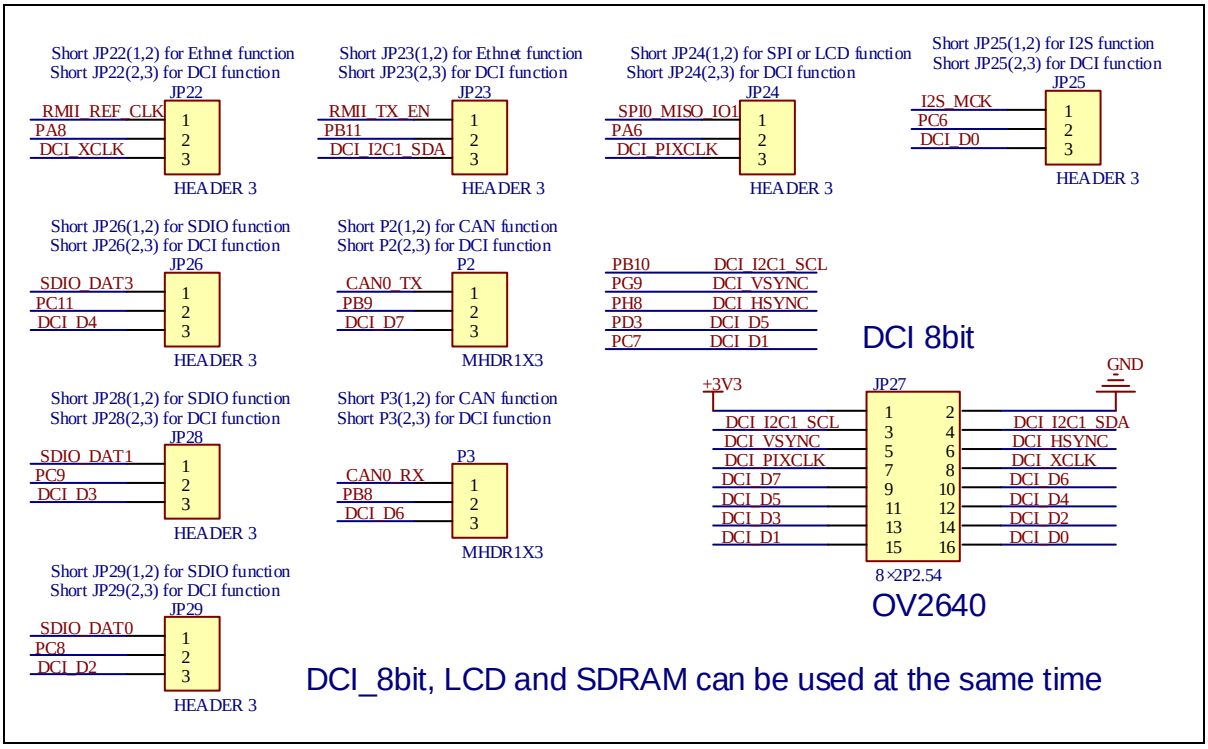
4.18. SDRAM

Figure 4-18. Schematic diagram of SDRAM



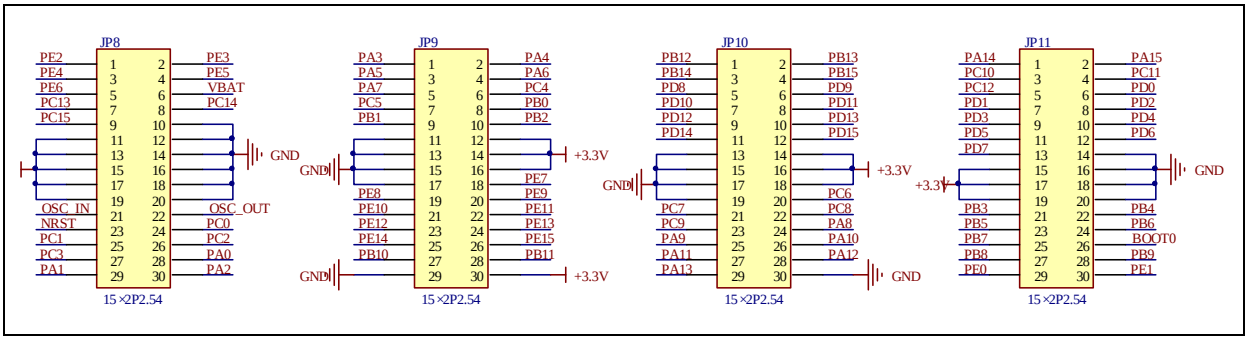
4.19. DCI

Figure 4-19. Schematic diagram of DCI



4.20. Extension

Figure 4-20. Schematic diagram of Extension Pin



4.21. Pin jumper comparison table

The GD32207I-EVAL evaluation boards involved in this paper all mean to the GD32207I-EVAL-V1.2 evaluation board, the pin jumpers involved in this paper are based on the GD32207I-EVAL-V1.2 evaluation board hardware schematic, the following table is a pin jumper comparison table.

Table 4-2. Pin jumper comparison table

Hardware Schematic	User Manual	PCB Screen Printing

JP5(1,2)for USART0	JP5(1,2)for USART0	JP5(1,2)for USART0
P4(1,2) for I2C0	P4(1,2) for I2C0	P4(1,2) for I2C0
P4(2,3) for CAN1	P4(2,3) for CAN1	P4(2,3) for CAN1
JP12(1,2) for DAC	JP12(1,2) for DAC	JP12(1,2) for DA1
JP12(2,3) for SPI_Flash or I2S or LCD	JP12(2,3) for SPI_Flash or I2S or LCD	JP12(2,3) for SPI
JP13(1,2) for Ethernet	JP13(1,2) for Ethernet	JP13(1,2) for Eth
JP13(2,3) for SPI_Flash or I2S or LCD	JP13(2,3) for SPI_Flash or I2S or LCD	JP13(2,3) for SPI
JP20(1,2) for Ethernet	JP20(1,2) for Ethernet	JP20(1,2) for Eth
JP20(2,3) for SPI_Flash	JP20(2,3) for SPI_Flash	JP20(2,3) for SPI
JP7 pin1 for DAC0	JP7 pin1 for DAC0	JP7 pin1 for DAC0
JP7 pin2 for DAC1	JP7 pin2 for DAC1	JP7 pin2 for DAC1
JP18(1,2)for Ethernet	JP18(1,2)for Ethernet	JP18(1,2)for Eth
JP19(1,2)for Ethernet	JP19(1,2)for Ethernet	JP19(1,2)for Eth
JP22(1,2) for Ethernet	JP22(1,2) for Ethernet	JP22(1,2) for Eth
JP23(1,2) for Ethernet	JP23(1,2) for Ethernet	JP23(1,2) for Eth
JP14 for CAN0	JP14 for CAN0	JP14 for CAN0
JP15 for CAN1	JP15 for CAN1	JP15 for CAN1

5. Routine use guide

5.1. GPIO_Runing_Led

5.1.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use GPIO control the LED
- Learn to use SysTick to generate 1ms delay

GD32207I-EVAL evaluation board has four LEDs: LED1~LED4. The LEDs are controlled by GPIO. This demo will show how to light the LEDs.

5.1.2. DEMO Running Result

Download the program <01_GPIO_Runing_Led> to the EVAL board, LED1, LED2, LED3, LED4 will turn on in sequence with interval of 1000ms, firstly, LED1 on, then, LED2 on, four LEDs can light periodically.

5.2. GPIO_KeyBoard_Polling_mode

5.2.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use GPIO control the LED and the KEY
- Learn to use SysTick to generate 1ms delay

GD32207I-EVAL evaluation board has three keys and four LEDs. The three keys are Tamper key, Wakeup key and User key. LED1~LED4 are controlled by GPIO.

This demo will show how to use the Tamper key to control the LED2. When press down the Tamper Key, it will check the input value of the IO port. If the value is 0 and will wait for 100ms. Check the input value of the IO port again. If the value still is 0, it indicates that the button is pressed successfully and toggle LED2.

5.2.2. DEMO Running Result

Download the program <02_GPIO_KeyBoard_Polling_mode> to the EVAL board, press down the Tamper Key, LED2 will be turned on. Press down the Tamper Key again, LED2 will be turned off.

5.3. EXTI_Key_Interrupt_mode

5.3.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use GPIO control the LED and the KEY
- Learn to use EXTI to generate external interrupt

GD32207I-EVAL evaluation board has three keys and four LEDs. The three keys are Tamper key, Wakeup key and User key. LED1~LED4 are controlled by GPIO.

This demo will show how to use the EXTI interrupt line to control the LED2.When press down the Tamper Key, it will produce an interrupt. In the interrupt service function, the demo will toggle LED2.

5.3.2. DEMO Running Result

Download the program <03_EXTI_Key_Interrupt_mode> to the EVAL board, press down the Tamper Key, LED2 will be turned on. Press down the Tamper Key again, LED2 will be turned off.

5.4. USART_Printf

5.4.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use GPIO control the LED
- Learn to retarget the C library printf function to the USART

5.4.2. DEMO Running Result

Download the program < 04_USART_Printf > to the EVAL board, fit the JP5 to USART and connect serial cable to USART. Firstly, all the LEDs flash 2 times for test. Then, this implementation outputs “USART printf example: please press the Tamper key” on the HyperTerminal using USART. Press the Tamper key, the serial port will output “USART printf example”.

The output information via the serial port is as following.

```
USART printf example: please press the Tamper key
USART printf example
```

5.5. USART_HyperTerminal_Interrupt

5.5.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use the USART transmit and receive interrupts to communicate with the serial terminal tool

5.5.2. DEMO Running Result

Download the program <05_USART_HyperTerminal_Interrupt> to the EVAL board, fit the JP5 to USART and connect serial cable to USART0. Firstly, all the LEDs are turned on and off for test. Then, the USART sends the tx_buffer array (from 0x00 to 0xFF) to the hyperterminal and waits for receiving data from the hyperterminal that you must send. The string that you have sent is stored in the rx_buffer array. The receive buffer have a BUFFER_SIZE bytes as maximum. After that, compare tx_buffer with rx_buffer. If tx_buffer is same with rx_buffer, LED1, LED2, LED3, LED4 flash by turns. Otherwise, LED1, LED2, LED3, LED4 toggle together.

The output information via the HyperTerminal is as following:

```
00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 10 11 12 13 14 15 16 17 18 19 1A 1B
1C 1D 1E 1F 20 21 22 23 24 25 26 27 28 29 2A 2B 2C 2D 2E 2F 30 31 32 33 34 35 36 37
38 39 3A 3B 3C 3D 3E 3F 40 41 42 43 44 45 46 47 48 49 4A 4B 4C 4D 4E 4F 50 51 52 53
54 55 56 57 58 59 5A 5B 5C 5D 5E 5F 60 61 62 63 64 65 66 67 68 69 6A 6B 6C 6D 6E 6F
70 71 72 73 74 75 76 77 78 79 7A 7B 7C 7D 7E 7F 80 81 82 83 84 85 86 87 88 89 8A 8B
8C 8D 8E 8F 90 91 92 93 94 95 96 97 98 99 9A 9B 9C 9D 9E 9F A0 A1 A2 A3 A4 A5 A6 A7
A8 A9 AA AB AC AD AE AF B0 B1 B2 B3 B4 B5 B6 B7 B8 B9 BA BB BC BD BE BF C0 C1 C2 C3
C4 C5 C6 C7 C8 C9 CA CB CC CD CE CF D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 DA DB DC DD DE DF
E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 EA EB EC ED EE EF F0 F1 F2 F3 F4 F5 F6 F7 F8 F9 FA FB
FC FD FE FF
```

5.6. USART_DMA

5.6.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use the USART transmit and receive data using DMA

5.6.2. DEMO Running Result

Download the program <06_USART_DMA> to the EVAL board, fit the JP5 to USART and connect serial cable to USART0. Firstly, the USART sends “USART DMA interrupt receive and transmit example, please input 10 bytes:” to hyperterminal and waits for receiving 10 bytes data from the hyperterminal that you must send. After MCU receives the data, the USART will continue to output the received data to the hyper terminal.

The output information via the HyperTerminal is as following:

5.7. ADC_Temperature_Vrefint

5.7.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use the ADC to convert analog signal to digital data
- Learn to get the value of inner channel 16 (temperature sensor channel) and channel 17 (V_{REFINT} channel)

5.7.2. DEMO Running Result

The computer serial port line connected to the COM1 port of development board, set the baud rate of HyperTerminal software to 115200, 8 bits data bit, 1 bit stop bit. At the same time you should jump the JP5 to USART0.

Download the program <07_ADC_Temperature_Vrefint> to the EVAL board, the HyperTerminal software can observe the operation condition. When the program is running,

HyperTerminal will display the value of temperature and internal voltage reference (VREFINT).

Notice: because there is an offset, when inner temperature sensor is used to detect accurate temperature, an external temperature sensor part should be used to calibrate the offset error.

The following is the experimental results.

```
the temperature data is 49 degrees Celsius
the reference voltage data is 1.187V

the temperature data is 50 degrees Celsius
the reference voltage data is 1.187V

the temperature data is 50 degrees Celsius
the reference voltage data is 1.188V

the temperature data is 50 degrees Celsius
the reference voltage data is 1.186V

the temperature data is 50 degrees Celsius
the reference voltage data is 1.186V

the temperature data is 50 degrees Celsius
the reference voltage data is 1.187V

the temperature data is 50 degrees Celsius
the reference voltage data is 1.187V

the temperature data is 50 degrees Celsius
the reference voltage data is 1.186V
```

5.8. ADC0_ADC1_Follow_up_mode

5.8.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use the ADC to convert analog signal to digital data
- Learn to use ADC0 and ADC1 follow-up mode

5.8.2. DEMO Running Result

The computer serial port line connected to the COM1 port of development board, set the baud rate of HyperTerminal software to 115200, 8 bits data bit, 1 bit stop bit. At the same time you should jump the JP5 to USART0.

Download the program <08_ADC0_ADC1_Follow_up_mode> to the EVAL board, the HyperTerminal software can observe the operation condition. When the program is running, HyperTerminal display the regular value of ADC0 and ADC1 by adc_value.

TIMER0_CH0 is the trigger source of ADC0 and ADC1. When the rising edge of TIMER0_CH0 coming, ADC0 starts immediately and ADC1 starts after a delay of several ADC clock cycles. The values of ADC0 and ADC1 are transmitted to array adc_value by DMA.

When the rising edge of TIMER0_CH0 coming, the value of the ADC0 conversion of PC3 pin is stored into the low half word of adc_value, and after a delay of several ADC clock cycles the value of the ADC1 conversion of PC3 pin is stored into the high half word of adc_value.

The following is the experimental results.

```
the data adc_value is 0A200A20
the data adc_value is 0A200A1F
the data adc_value is 0A200A1F
the data adc_value is 0A200A20
the data adc_value is 0A200A20
the data adc_value is 0A200A21
the data adc_value is 0A200A20
the data adc_value is 0A200A20
the data adc_value is 0A200A1F
the data adc_value is 0A200A20
```

5.9. ADC0_ADC1_Regular_Parallel_mode

5.9.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use the ADC to convert analog signal to digital data
- Learn to use ADC0 and ADC1 regular parallel mode

5.9.2. DEMO Running Result

The computer serial port line connected to the COM1 port of development board, set the baud rate of HyperTerminal software to 115200, 8 bits data bit, 1 bit stop bit. At the same time you should jump the JP5 to USART1.

Download the program <09_ADC0_ADC1_Regular_Parallel_mode> to the EVAL board, the HyperTerminal software can observe the operation condition. When the program is running, HyperTerminal display the regular value of ADC0 and ADC1 by adc_value[0] and adc_value[1].

TIMER0_CH0 is the trigger source of ADC0 and ADC1. When the rising edge of TIMER0_CH0 coming, ADC0 and ADC1 starts immediately. The values of ADC0 and ADC1 are transmitted to array adc_value[] by DMA.

When the first rising edge of TIMER0_CH0 coming, the value of the ADC0 conversion of PC3 pin is stored into the low half word of adc_value[0], the value of the ADC1 conversion of PC5 pin is stored into the high half word of adc_value[0]. When the second rising edge of

TIMER0_CH0 coming, the value of the ADC0 conversion of PC5 pin is stored into the low half word of adc_value[1], the value of the ADC1 conversion of PC3 pin is stored into the high half word of adc_value[1].

The following is the experimental results.

```
the data adc_value[0] is 00010A20
the data adc_value[1] is 0A210000

the data adc_value[0] is 00000A1F
the data adc_value[1] is 0A210000

the data adc_value[0] is 00000A20
the data adc_value[1] is 0A210000

the data adc_value[0] is 00030A1F
the data adc_value[1] is 0A210000

the data adc_value[0] is 00020A20
the data adc_value[1] is 0A210000

the data adc_value[0] is 00000A1F
the data adc_value[1] is 0A210001

the data adc_value[0] is 00010A1F
the data adc_value[1] is 0A210000

the data adc_value[0] is 00020A20
the data adc_value[1] is 0A210000
```

5.10. DAC_Output_Voltage_Value

5.10.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use DAC to output voltage on DAC0 output

5.10.2. DEMO Running Result

Download the program <10_DAC_Output_Voltage_Value> to the EVAL board and run, all the LEDs will turn on and turn off for test. The digital value is 0x7FF0, its converted analog voltage should be 1.65V (VREF/2), using the voltmeter to measure PA4 or DA0 on JP7, its value is 1.65V.

5.11. I2C_EEPROM

5.11.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use the master transmitting mode of I2C module
- Learn to use the master receiving mode of I2C module
- Learn to read and write the EEPROM with I2C interface

5.11.2. DEMO Running Result

Jump the JP5 to USART0 with the jumper cap, and download the program <11_I2C_EEPROM> to the EVAL board and run. Connect serial cable to COM1, and open the HyperTerminal to show the print message.

Firstly, the data of 256 bytes will be written to the EEPROM from the address 0x00 and printed by the serial port. Then, reading the EEPROM from address 0x00 for 256 bytes and the result will be printed. Finally, compare the data that were written to the EEPROM and the data that were read from the EEPROM. If they are the same, the serial port will output "I2C-AT24C02 test passed!" and the four LEDs lights flashing, otherwise the serial port will output "Err: data read and write aren't matching." and all the four LEDs light.

The output information via the serial port is as following.

```
I2C-24C02 configured....

The I2C0 is hardware interface
The speed is 400000
AT24C02 writing...
0x00 0x01 0x02 0x03 0x04 0x05 0x06 0x07 0x08 0x09 0x0A 0x0B 0x0C 0x0D 0x0E 0x0F
0x10 0x11 0x12 0x13 0x14 0x15 0x16 0x17 0x18 0x19 0x1A 0x1B 0x1C 0x1D 0x1E 0x1F
0x20 0x21 0x22 0x23 0x24 0x25 0x26 0x27 0x28 0x29 0x2A 0x2B 0x2C 0x2D 0x2E 0x2F
0x30 0x31 0x32 0x33 0x34 0x35 0x36 0x37 0x38 0x39 0x3A 0x3B 0x3C 0x3D 0x3E 0x3F
0x40 0x41 0x42 0x43 0x44 0x45 0x46 0x47 0x48 0x49 0x4A 0x4B 0x4C 0x4D 0x4E 0x4F
0x50 0x51 0x52 0x53 0x54 0x55 0x56 0x57 0x58 0x59 0x5A 0x5B 0x5C 0x5D 0x5E 0x5F
0x60 0x61 0x62 0x63 0x64 0x65 0x66 0x67 0x68 0x69 0x6A 0x6B 0x6C 0x6D 0x6E 0x6F
0x70 0x71 0x72 0x73 0x74 0x75 0x76 0x77 0x78 0x79 0x7A 0x7B 0x7C 0x7D 0x7E 0x7F
0x80 0x81 0x82 0x83 0x84 0x85 0x86 0x87 0x88 0x89 0x8A 0x8B 0x8C 0x8D 0x8E 0x8F
0x90 0x91 0x92 0x93 0x94 0x95 0x96 0x97 0x98 0x99 0x9A 0x9B 0x9C 0x9D 0x9E 0x9F
0xA0 0xA1 0xA2 0xA3 0xA4 0xA5 0xA6 0xA7 0xA8 0xA9 0xAA 0xAB 0xAC 0xAD 0xAE 0xAF
0xB0 0xB1 0xB2 0xB3 0xB4 0xB5 0xB6 0xB7 0xB8 0xB9 0xBA 0xBB 0xBC 0xBD 0xBE 0xBF
0xC0 0xC1 0xC2 0xC3 0xC4 0xC5 0xC6 0xC7 0xC8 0xC9 0xCA 0xCB 0xCC 0xCD 0xCE 0xCF
0xD0 0xD1 0xD2 0xD3 0xD4 0xD5 0xD6 0xD7 0xD8 0xD9 0xDA 0xDB 0xDC 0xDD 0xDE 0xDF
0xE0 0xE1 0xE2 0xE3 0xE4 0xE5 0xE6 0xE7 0xE8 0xE9 0xEA 0xEB 0xEC 0xED 0xEE 0xEF
0xF0 0xF1 0xF2 0xF3 0xF4 0xF5 0xF6 0xF7 0xF8 0xF9 0xFA 0xFB 0xFC 0xFD 0xFE 0xFF
AT24C02 reading...
0x00 0x01 0x02 0x03 0x04 0x05 0x06 0x07 0x08 0x09 0x0A 0x0B 0x0C 0x0D 0x0E 0x0F
0x10 0x11 0x12 0x13 0x14 0x15 0x16 0x17 0x18 0x19 0x1A 0x1B 0x1C 0x1D 0x1E 0x1F
0x20 0x21 0x22 0x23 0x24 0x25 0x26 0x27 0x28 0x29 0x2A 0x2B 0x2C 0x2D 0x2E 0x2F
0x30 0x31 0x32 0x33 0x34 0x35 0x36 0x37 0x38 0x39 0x3A 0x3B 0x3C 0x3D 0x3E 0x3F
0x40 0x41 0x42 0x43 0x44 0x45 0x46 0x47 0x48 0x49 0x4A 0x4B 0x4C 0x4D 0x4E 0x4F
0x50 0x51 0x52 0x53 0x54 0x55 0x56 0x57 0x58 0x59 0x5A 0x5B 0x5C 0x5D 0x5E 0x5F
0x60 0x61 0x62 0x63 0x64 0x65 0x66 0x67 0x68 0x69 0x6A 0x6B 0x6C 0x6D 0x6E 0x6F
0x70 0x71 0x72 0x73 0x74 0x75 0x76 0x77 0x78 0x79 0x7A 0x7B 0x7C 0x7D 0x7E 0x7F
0x80 0x81 0x82 0x83 0x84 0x85 0x86 0x87 0x88 0x89 0x8A 0x8B 0x8C 0x8D 0x8E 0x8F
0x90 0x91 0x92 0x93 0x94 0x95 0x96 0x97 0x98 0x99 0x9A 0x9B 0x9C 0x9D 0x9E 0x9F
0xA0 0xA1 0xA2 0xA3 0xA4 0xA5 0xA6 0xA7 0xA8 0xA9 0xAA 0xAB 0xAC 0xAD 0xAE 0xAF
0xB0 0xB1 0xB2 0xB3 0xB4 0xB5 0xB6 0xB7 0xB8 0xB9 0xBA 0xBB 0xBC 0xBD 0xBE 0xBF
0xC0 0xC1 0xC2 0xC3 0xC4 0xC5 0xC6 0xC7 0xC8 0xC9 0xCA 0xCB 0xCC 0xCD 0xCE 0xCF
0xD0 0xD1 0xD2 0xD3 0xD4 0xD5 0xD6 0xD7 0xD8 0xD9 0xDA 0xDB 0xDC 0xDD 0xDE 0xDF
0xE0 0xE1 0xE2 0xE3 0xE4 0xE5 0xE6 0xE7 0xE8 0xE9 0xEA 0xEB 0xEC 0xED 0xEE 0xEF
0xF0 0xF1 0xF2 0xF3 0xF4 0xF5 0xF6 0xF7 0xF8 0xF9 0xFA 0xFB 0xFC 0xFD 0xFE 0xFF
I2C-AT24C02 test passed!
```

5.12. SPI_QSPI_Flash

5.12.1. DEMO Purpose

This Demo use SPI0 interface of GD32207I-EVAL evaluation board to read and write SPI

NOR FLASH at quad SPI mode. The SPI NOR FLASH is a serial FLASH memory chip GD25Q16B which size is 16Mbit. The chip supports standard SPI and quad SPI operation instructions.

5.12.2. DEMO Running Result

Ensure GD32207I-EVAL evaluation board JP4/JP12/JP13/JP19/JP27 jumper cap jump to SPI, computer serial port line connected to the COM1 port of development board, set the baud rate of HyperTerminal software to 115200, 8 bits data bit, 1 bit stop bit. Download the program <12_SPI_QSPI_Flash> to the EVAL board, then the ID of the flash and 256 bytes data which write to and read from flash will be displayed on the HyperTerminal. The following is the experimental a part of results. If the data written to and read from the flash is the same, then we can see " SPI-GD25Q16 Test Passed! ".

5.13. I2S_Audio_Player

5.13.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use I2S module to output audio file
- Parsing audio files of wav format

GD32207I-EVAL evaluation board integrates the I2S (Inter-IC Sound) module, and the module can communicate with external devices using the I2S audio protocol. This demo mainly shows how to use the I2S interface of the board for audio output.

5.13.2. DEMO Running Result

Ensure GD32207I-EVAL evaluation board JP18/JP19/JP21/JP25 jumper cap jump to I2S, JP12/JP13 to SPI.

Download the program <13_I2S_Audio_Player> to the EVAL board, insert the headphone

into the audio port, and then listen to the audio file.

5.14. EXMC_SDRAM

5.14.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use EXMC control the SDRAM

5.14.2. DEMO Running Result

GD32207I-EVAL evaluation board has EXMC module to control SDRAM. Before running the demo, JP5 must be fitted to USART0. Download the program <14_EXMC_SDRAM> to the EVAL board. This demo shows the write and read operation process of SDRAM memory by EXMC module. If the test succeed, LED1 will be turned on. Otherwise, turn on the LED3. Information via a HyperTerminal output as following:

```
SDRAM initialized!
SDRAM write data completed!
SDRAM read data completed!
Check the data!
SDRAM test successed!
The data is:
00 01 02 03 04 05 06 07 08 09 0a 0b 0c 0d 0e 0f
10 11 12 13 14 15 16 17 18 19 1a 1b 1c 1d 1e 1f
20 21 22 23 24 25 26 27 28 29 2a 2b 2c 2d 2e 2f
30 31 32 33 34 35 36 37 38 39 3a 3b 3c 3d 3e 3f
40 41 42 43 44 45 46 47 48 49 4a 4b 4c 4d 4e 4f
50 51 52 53 54 55 56 57 58 59 5a 5b 5c 5d 5e 5f
60 61 62 63 64 65 66 67 68 69 6a 6b 6c 6d 6e 6f
70 71 72 73 74 75 76 77 78 79 7a 7b 7c 7d 7e 7f
80 81 82 83 84 85 86 87 88 89 8a 8b 8c 8d 8e 8f
90 91 92 93 94 95 96 97 98 99 9a 9b 9c 9d 9e 9f
a0 a1 a2 a3 a4 a5 a6 a7 a8 a9 aa ab ac ad ae af
b0 b1 b2 b3 b4 b5 b6 b7 b8 b9 ba bb bc bd be bf
c0 c1 c2 c3 c4 c5 c6 c7 c8 c9 ca cb cc cd ce cf
d0 d1 d2 d3 d4 d5 d6 d7 d8 d9 da db dc dd de df
e0 e1 e2 e3 e4 e5 e6 e7 e8 e9 ea eb ec ed ee ef
f0 f1 f2 f3 f4 f5 f6 f7 f8 f9 fa fb fc fd fe ff
00 01 02 03 04 05 06 07 08 09 0a 0b 0c 0d 0e 0f
10 11 12 13 14 15 16 17 18 19 1a 1b 1c 1d 1e 1f
20 21 22 23 24 25 26 27 28 29 2a 2b 2c 2d 2e 2f
30 31 32 33 34 35 36 37 38 39 3a 3b 3c 3d 3e 3f
40 41 42 43 44 45 46 47 48 49 4a 4b 4c 4d 4e 4f
50 51 52 53 54 55 56 57 58 59 5a 5b 5c 5d 5e 5f
60 61 62 63 64 65 66 67 68 69 6a 6b 6c 6d 6e 6f
70 71 72 73 74 75 76 77 78 79 7a 7b 7c 7d 7e 7f
80 81 82 83 84 85 86 87 88 89 8a 8b 8c 8d 8e 8f
90 91 92 93 94 95 96 97 98 99 9a 9b 9c 9d 9e 9f
a0 a1 a2 a3 a4 a5 a6 a7 a8 a9 aa ab ac ad ae af
b0 b1 b2 b3 b4 b5 b6 b7 b8 b9 ba bb bc bd be bf
c0 c1 c2 c3 c4 c5 c6 c7 c8 c9 ca cb cc cd ce cf
d0 d1 d2 d3 d4 d5 d6 d7 d8 d9 da db dc dd de df
e0 e1 e2 e3 e4 e5 e6 e7 e8 e9 ea eb ec ed ee ef
f0 f1 f2 f3 f4 f5 f6 f7 f8 f9 fa fb fc fd fe ff
00 01 02 03 04 05 06 07 08 09 0a 0b 0c 0d 0e 0f
10 11 12 13 14 15 16 17 18 19 1a 1b 1c 1d 1e 1f
20 21 22 23 24 25 26 27 28 29 2a 2b 2c 2d 2e 2f
30 31 32 33 34 35 36 37 38 39 3a 3b 3c 3d 3e 3f
40 41 42 43 44 45 46 47 48 49 4a 4b 4c 4d 4e 4f
50 51 52 53 54 55 56 57 58 59 5a 5b 5c 5d 5e 5f
60 61 62 63 64 65 66 67 68 69 6a 6b 6c 6d 6e 6f
70 71 72 73 74 75 76 77 78 79 7a 7b 7c 7d 7e 7f
80 81 82 83 84 85 86 87 88 89 8a 8b 8c 8d 8e 8f
90 91 92 93 94 95 96 97 98 99 9a 9b 9c 9d 9e 9f
a0 a1 a2 a3 a4 a5 a6 a7 a8 a9 aa ab ac ad ae af
b0 b1 b2 b3 b4 b5 b6 b7 b8 b9 ba bb bc bd be bf
c0 c1 c2 c3 c4 c5 c6 c7 c8 c9 ca cb cc cd ce cf
d0 d1 d2 d3 d4 d5 d6 d7 d8 d9 da db dc dd de df
e0 e1 e2 e3 e4 e5 e6 e7 e8 e9 ea eb ec ed ee ef
f0 f1 f2 f3 f4 f5 f6 f7 f8 f9 fa fb fc fd fe ff
00 01 02 03 04 05 06 07 08 09 0a 0b 0c 0d 0e 0f
10 11 12 13 14 15 16 17 18 19 1a 1b 1c 1d 1e 1f
20 21 22 23 24 25 26 27 28 29 2a 2b 2c 2d 2e 2f
30 31 32 33 34 35 36 37 38 39 3a 3b 3c 3d 3e 3f
40 41 42 43 44 45 46 47 48 49 4a 4b 4c 4d 4e 4f
50 51 52 53 54 55 56 57 58 59 5a 5b 5c 5d 5e 5f
60 61 62 63 64 65 66 67 68 69 6a 6b 6c 6d 6e 6f
70 71 72 73 74 75 76 77 78 79 7a 7b 7c 7d 7e 7f
80 81 82 83 84 85 86 87 88 89 8a 8b 8c 8d 8e 8f
90 91 92 93 94 95 96 97 98 99 9a 9b 9c 9d 9e 9f
a0 a1 a2 a3 a4 a5 a6 a7 a8 a9 aa ab ac ad ae af
b0 b1 b2 b3 b4 b5 b6 b7 b8 b9 ba bb bc bd be bf
c0 c1 c2 c3 c4 c5 c6 c7 c8 c9 ca cb cc cd ce cf
d0 d1 d2 d3 d4 d5 d6 d7 d8 d9 da db dc dd de df
e0 e1 e2 e3 e4 e5 e6 e7 e8 e9 ea eb ec ed ee ef
f0 f1 f2 f3 f4 f5 f6 f7 f8 f9 fa fb fc fd fe ff
```

5.15. EXMC_SDRAM_DeepSleep

5.15.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use EXMC control the SDRAM
- Learn to use deepsleep mode

5.15.2. DEMO Running Result

GD32207I-EVAL evaluation board has EXMC module to control SDRAM. Before running the demo, JP5 must be fitted to USART0. Download the program <15_EXMC_SDRAM_DeepSleep> to the EVAL board. This demo shows how to use SDRAM in the deepsleep mode. Firstly, MCU works in the normal mode, SDRAM auto-refresh cycles are performed by MCU, we write the specified data to the SDRAM. Secondly, we make the MCU to deepsleep mode, at the time, SDRAM auto-refresh cycles are performed by itself and LED2 will light on. Thirdly, press the user key to wake up MCU, compare the data which read from SDRAM with the write data, if the test pass, LED1 will be turned on. Otherwise, turn on the LED3. Information via a HyperTerminal output as following:

```
SDRAM initialized!
SDRAM write data completed!
Enter deepsleep mode!
Press the user key to wakeup the MCU!

User key has been pressed!
SDRAM read data completed!
Check the data!
SDRAM test successed!
The data is:
00  01  02  03  04  05  06  07  08  09  0a  0b  0c  0d  0e  0f
10  11  12  13  14  15  16  17  18  19  1a  1b  1c  1d  1e  1f
20  21  22  23  24  25  26  27  28  29  2a  2b  2c  2d  2e  2f
30  31  32  33  34  35  36  37  38  39  3a  3b  3c  3d  3e  3f
40  41  42  43  44  45  46  47  48  49  4a  4b  4c  4d  4e  4f
50  51  52  53  54  55  56  57  58  59  5a  5b  5c  5d  5e  5f
60  61  62  63  64  65  66  67  68  69  6a  6b  6c  6d  6e  6f
70  71  72  73  74  75  76  77  78  79  7a  7b  7c  7d  7e  7f
80  81  82  83  84  85  86  87  88  89  8a  8b  8c  8d  8e  8f
90  91  92  93  94  95  96  97  98  99  9a  9b  9c  9d  9e  9f
a0  a1  a2  a3  a4  a5  a6  a7  a8  a9  aa  ab  ac  ad  ae  af
b0  b1  b2  b3  b4  b5  b6  b7  b8  b9  ba  bb  bc  bd  be  bf
c0  c1  c2  c3  c4  c5  c6  c7  c8  c9  ca  cb  cc  cd  ce  cf
d0  d1  d2  d3  d4  d5  d6  d7  d8  d9  da  db  dc  dd  de  df
e0  e1  e2  e3  e4  e5  e6  e7  e8  e9  ea  eb  ec  ed  ee  ef
f0  f1  f2  f3  f4  f5  f6  f7  f8  f9  fa  fb  fc  fd  fe  ff
00  01  02  03  04  05  06  07  08  09  0a  0b  0c  0d  0e  0f
10  11  12  13  14  15  16  17  18  19  1a  1b  1c  1d  1e  1f
20  21  22  23  24  25  26  27  28  29  2a  2b  2c  2d  2e  2f
30  31  32  33  34  35  36  37  38  39  3a  3b  3c  3d  3e  3f
40  41  42  43  44  45  46  47  48  49  4a  4b  4c  4d  4e  4f
50  51  52  53  54  55  56  57  58  59  5a  5b  5c  5d  5e  5f
60  61  62  63  64  65  66  67  68  69  6a  6b  6c  6d  6e  6f
70  71  72  73  74  75  76  77  78  79  7a  7b  7c  7d  7e  7f
80  81  82  83  84  85  86  87  88  89  8a  8b  8c  8d  8e  8f
90  91  92  93  94  95  96  97  98  99  9a  9b  9c  9d  9e  9f
a0  a1  a2  a3  a4  a5  a6  a7  a8  a9  aa  ab  ac  ad  ae  af
b0  b1  b2  b3  b4  b5  b6  b7  b8  b9  ba  bb  bc  bd  be  bf
c0  c1  c2  c3  c4  c5  c6  c7  c8  c9  ca  cb  cc  cd  ce  cf
d0  d1  d2  d3  d4  d5  d6  d7  d8  d9  da  db  dc  dd  de  df
e0  e1  e2  e3  e4  e5  e6  e7  e8  e9  ea  eb  ec  ed  ee  ef
f0  f1  f2  f3  f4  f5  f6  f7  f8  f9  fa  fb  fc  fd  fe  ff
00  01  02  03  04  05  06  07  08  09  0a  0b  0c  0d  0e  0f
10  11  12  13  14  15  16  17  18  19  1a  1b  1c  1d  1e  1f
20  21  22  23  24  25  26  27  28  29  2a  2b  2c  2d  2e  2f
30  31  32  33  34  35  36  37  38  39  3a  3b  3c  3d  3e  3f
40  41  42  43  44  45  46  47  48  49  4a  4b  4c  4d  4e  4f
50  51  52  53  54  55  56  57  58  59  5a  5b  5c  5d  5e  5f
60  61  62  63  64  65  66  67  68  69  6a  6b  6c  6d  6e  6f
70  71  72  73  74  75  76  77  78  79  7a  7b  7c  7d  7e  7f
80  81  82  83  84  85  86  87  88  89  8a  8b  8c  8d  8e  8f
90  91  92  93  94  95  96  97  98  99  9a  9b  9c  9d  9e  9f
a0  a1  a2  a3  a4  a5  a6  a7  a8  a9  aa  ab  ac  ad  ae  af
b0  b1  b2  b3  b4  b5  b6  b7  b8  b9  ba  bb  bc  bd  be  bf
c0  c1  c2  c3  c4  c5  c6  c7  c8  c9  ca  cb  cc  cd  ce  cf
```

5.16. EXMC_NandFlash

5.16.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use EXMC control the NAND flash

5.16.2. DEMO Running Result

GD32207I-EVAL evaluation board has EXMC module to control NAND flash. Before running the demo, JP5 must be fitted to USART0. Download the program <16_EXMC_NandFlash> to the EVAL board. This demo shows the write and read operation process of NAND flash memory by EXMC module. If the test pass, LED2 will be turned on. Otherwise, turn on the LED4. Information via a HyperTerminal output as following:

```
read NAND ID
Nand flash ID:0xAD 0xF1 0x80 0x1D

write data successfully!
read data successfully!
the result to access the nand flash:
access NAND flash successfully!
printf data to be read:
0x00 0x01 0x02 0x03 0x04 0x05 0x06 0x07 0x08 0x09 0x0A 0x0B 0x0C 0x0D 0x0E 0x0F 0x10
0x11 0x12 0x13 0x14 0x15 0x16 0x17 0x18 0x19 0x1A 0x1B 0x1C 0x1D 0x1E 0x1F 0x20 0x21
0x22 0x23 0x24 0x25 0x26 0x27 0x28 0x29 0x2A 0x2B 0x2C 0x2D 0x2E 0x2F 0x30 0x31 0x32
0x33 0x34 0x35 0x36 0x37 0x38 0x39 0x3A 0x3B 0x3C 0x3D 0x3E 0x3F 0x40 0x41 0x42 0x43
0x44 0x45 0x46 0x47 0x48 0x49 0x4A 0x4B 0x4C 0x4D 0x4E 0x4F 0x50 0x51 0x52 0x53 0x54
0x55 0x56 0x57 0x58 0x59 0x5A 0x5B 0x5C 0x5D 0x5E 0x5F 0x60 0x61 0x62 0x63 0x64 0x65
0x66 0x67 0x68 0x69 0x6A 0x6B 0x6C 0x6D 0x6E 0x6F 0x70 0x71 0x72 0x73 0x74 0x75 0x76
0x77 0x78 0x79 0x7A 0x7B 0x7C 0x7D 0x7E 0x7F 0x80 0x81 0x82 0x83 0x84 0x85 0x86 0x87
0x88 0x89 0x8A 0x8B 0x8C 0x8D 0x8E 0x8F 0x90 0x91 0x92 0x93 0x94 0x95 0x96 0x97 0x98
0x99 0x9A 0x9B 0x9C 0x9D 0x9E 0x9F 0xA0 0xA1 0xA2 0xA3 0xA4 0xA5 0xA6 0xA7 0xA8 0xA9
0xAA 0xAB 0xAC 0xAD 0xAE 0xAF 0xB0 0xB1 0xB2 0xB3 0xB4 0xB5 0xB6 0xB7 0xB8 0xB9 0xBA
0xBB 0xBC 0xBD 0xBE 0xBF 0xC0 0xC1 0xC2 0xC3 0xC4 0xC5 0xC6 0xC7 0xC8 0xC9 0xCA 0xCB
0xCC 0xCD 0xCE 0xCF 0xD0 0xD1 0xD2 0xD3 0xD4 0xD5 0xD6 0xD7 0xD8 0xD9 0xDA 0xDB 0xDC
0xDD 0xDE 0xDF 0xE0 0xE1 0xE2 0xE3 0xE4 0xE5 0xE6 0xE7 0xE8 0xE9 0xEA 0xEB 0xEC 0xED
0xEE 0xEF 0xF0 0xF1 0xF2 0xF3 0xF4 0xF5 0xF6 0xF7 0xF8 0xF9 0xFA 0xFB 0xFC 0xFD 0xFE
0xFF
```

5.17. TRNG_Get_Random

5.17.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use TRNG to generate the random number
- Learn to communicate with PC by USART

5.17.2. DEMO Running Result

Jump the JP5 to USART0 with the jumper cap, and download the program

<17_TRNG_Get_Random> to the EVAL board and run. Connect serial cable to COM1, open the serial terminal tool supporting hex format communication. When the program is running, the serial terminal tool will display the initial information. User can use the serial terminal tool to input the minimum and maximum values (for example, the minimum value is 0x03, the maximum value is 0x77), then application will generate random number in the input range and display it by the serial terminal tool.

Information via a serial port output as following:

```
/==============Gigadevice TRNG test==============/
TRNG init ok
Please input min num (hex format):
Please input max num (hex format):
Input min num is 3
Input max num is 119
Generate random num1 is 21
Generate random num2 is 38
Please input min num (hex format):
```

5.18. CAU

5.18.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn DES, Triple-DES and AES algorithm
- Learn Electronic codebook (ECB) mode, Cipher block chaining (CBC) mode and Counter mode (CTR) mode
- Learn to use CAU to encrypt and decrypt
- Learn to communicate with PC by USART

5.18.2. DEMO Running Result

Jump the JP5 to USART with the jumper cap, and download the program <18_CAU> to the EVAL board and run. Connect serial cable to COM1. When the program is running, the serial terminal tool will display the information, as shown in the following figure. Plaintext data value, the encryption algorithm, and the mode can be selected are shown. After the user setting the algorithm and mode according to the serial output information indicating, serial port will print out selected algorithm and mode, as shown below.

```
Plain data :
0x6B 0xC1 0xBE 0xE2 0x2E 0x40 0x9F 0x96 0xE9 0x3D 0x7E 0x11 0x73 0x93 0x17 0x2A  [Block 0]
0xAE 0x2D 0x8A 0x57 0x1E 0x03 0xAC 0x9C 0x9E 0xB7 0x6F 0xAC 0x45 0xAF 0x8E 0x51  [Block 1]
0x30 0xC8 0x1C 0x46 0xA3 0x5C 0xE4 0x11 0xE5 0xFB 0xC1 0x19 0x1A 0x0A 0x52 0xEF  [Block 2]
0xF6 0x9F 0x24 0x45 0xDF 0x4F 0x9B 0x17 0xAD 0x2B 0x41 0x7B 0xE6 0x6C 0x37 0x10  [Block 3]
========Choose CAU algorithm=======
1: DES algorithm
2: TDES algorithm
3: AES algorithm

You choose to use DES algorithm
========Choose CAU mode========
1: ECB mode
2: CBC mode
3: CTR mode only when choose AES algorithm

You choose to use ECB mode
```

After selection, the program starts encryption and decryption operations, the results are printed through the serial port.

```
Encrypted data with DES  Mode  ECB :

0x6E 0xDF 0xD1 0xB7 0xA0 0x01 0xCD 0x17 0xCD 0xC5 0x7F 0xF7 0x9C 0xF8 0x72 0xD0  [Block 0]
0x11 0x97 0xA6 0xD2 0x13 0x59 0x4F 0x7A 0x3D 0x7C 0x7C 0xEC 0xBC 0xDD 0xD2 0x20  [Block 1]
0x3A 0x75 0x8B 0x06 0x75 0x2E 0x18 0x0D 0x55 0x0F 0xDD 0x57 0x5A 0xF1 0x3B 0x94  [Block 2]
0x18 0x3D 0x4D 0xA1 0x1E 0x14 0x75 0x6B 0x0F 0xD9 0xD9 0x64 0x16 0xA0 0x60 0x14  [Block 3]

Decrypted data with DES  Mode  ECB :

0x6B 0xC1 0xBE 0xE2 0x2E 0x40 0x9F 0x96 0xE9 0x3D 0x7E 0x11 0x73 0x93 0x17 0x2A  [Block 0]
0xAE 0x2D 0x8A 0x57 0x1E 0x03 0xAC 0x9C 0x9E 0xB7 0x6F 0xAC 0x45 0xAF 0x8E 0x51  [Block 1]
0x30 0xC8 0x1C 0x46 0xA3 0x5C 0xE4 0x11 0xE5 0xFB 0xC1 0x19 0x1A 0x0A 0x52 0xEF  [Block 2]
0xF6 0x9F 0x24 0x45 0xDF 0x4F 0x9B 0x17 0xAD 0x2B 0x41 0x7B 0xE6 0x6C 0x37 0x10  [Block 3]

Example restarted...
```

And then restart for users to select a different algorithm and mode to repeat demo, as shown below.

```
Plain data :
0x6B 0xC1 0xBE 0xE2 0x2E 0x40 0x9F 0x96 0xE9 0x3D 0x7E 0x11 0x73 0x93 0x17 0x2A  [Block 0]
0xAE 0x2D 0x8A 0x57 0x1E 0x03 0xAC 0x9C 0x9E 0xB7 0x6F 0xAC 0x45 0xAF 0x8E 0x51  [Block 1]
0x30 0xC8 0x1C 0x46 0xA3 0x5C 0xE4 0x11 0xE5 0xFB 0xC1 0x19 0x1A 0x0A 0x52 0xEF  [Block 2]
0xF6 0x9F 0x24 0x45 0xDF 0x4F 0x9B 0x17 0xAD 0x2B 0x41 0x7B 0xE6 0x6C 0x37 0x10  [Block 3]
========Choose CAU algorithm=======
1: DES algorithm
2: TDES algorithm
3: AES algorithm
```

5.19. HAU

5.19.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn SHA-1, SHA-224, SHA-256 and MD5 algorithm
- Learn HASH mode and HMAC (keyed-hash message authentication code) mode

- Learn to use HAU to calculate digest for the input message
- Learn to communicate with PC by USART

5.19.2. DEMO Running Result

Jump the JP5 to USART with the jumper cap, and download the program <19_HAU> to the EVAL board and run. Connect serial cable to COM1. When the program is running, the serial terminal tool will display the information, as shown in the following figure. After the user setting the algorithm and mode according to the serial output information indicating, serial port will print out selected algorithm and mode, as shown below.

```
message to be hashed:

The GD32 F2 series is the result of a perfect symbiosis of the real-time control
capabilities of an MCU and the signal processing performance of a DSP, and thus
complements the GD32 portfolio with a new class of devices, digital signal
controllers (DSC).

=======Choose HAU algorithm=======
1: SHA1 algorithm
2: SHA224 algorithm
3: SHA256 algorithm
4: MD5 algorithm

You choose to use SHA1 algorithm


=======Choose HAU mode=======
1: HASH mode
2: HMAC mode

Choose error: please choose again!
You choose to use HASH mode


message digest with SHA-1  Mode  HASH (160 bits):
```

After selection, the program starts digest calculation, the results are printed through the serial port. And then restart for users to select a different algorithm and mode to repeat demo, as shown below.

```
message digest with SHA-1  Mode  HASH (160 bits):

0x74 0x91 0x90 0xEA
0xEC 0x35 0x11 0xF6
0x04 0xA2 0xDC 0x76
0x58 0x13 0x2A 0x09
0x8A 0x87 0x70 0xCC

 Example restarted...
message to be hashed:

The GD32 F2 series is the result of a perfect symbiosis of the real-time control
capabilities of an MCU and the signal processing performance of a DSP, and thus
complements the GD32 portfolio with a new class of devices, digital signal
controllers (DSC).

=======Choose HAU algorithm=======
1: SHA1 algorithm
2: SHA224 algorithm
3: SHA256 algorithm
4: MD5 algorithm

Choose error: please choose again!
```

5.20. Tamper_Waveform_Detection

5.20.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn BKP tamper function
- Learn BKP waveform detection function

5.20.2. DEMO Running Result

Download the program <20_Tamper_Waveform_Detection> to the EVAL board and run. If uncomment the TAMPER0_DETECT macro, it writes the data to all backup data registers, then check whether the data were correctly written. If yes, LED1 is on, otherwise LED2 is on. When the Tamper key (TAMPER0 pin) is pressed, the backup data registers are reset and the tamper0 interrupt is generated. In the corresponding ISR, it checks whether the backup data registers are cleared or not. If yes, LED3 is on, otherwise LED4 is on. If uncomment the WAVEFORM_DETECT macro and short PI8 and PC13, the program will write the data to all backup data registers, then check whether the data were correctly written. If yes, LED1 is on, otherwise LED2 is on. At this time, LED3 and LED4 are off, which means that waveform receiving and checking is right, tamper1 interrupt isn't happened. If PI8 and PC13 are disconnected, LED3 will light up, this means that waveform receiving and checking is wrong, tamper1 interrupt is happened.

Tamper and waveform detection only one can be used at the same time.

5.21. SDIO_SDCard Test

5.21.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use SDIO to single block or multiple block write and read
- Learn to use SDIO to erase, lock and unlock a SD card

EVAL board has a secure digital input/output interface (SDIO) which defines the SD/SD I/O /MMC CE-ATA card host interface. This demo will show how to use SDIO to operate on SD card.

5.21.2. DEMO Running Result

Jump JP26, JP28, JP29 and JP31 to SDIO, Jump the JP5 to USART0 to show the print message through HyperTerminal, and download the program <21_SDIO_SDCardTest> to the EVAL board and run. Connect serial cable to COM1, and open the HyperTerminal. Firstly,

all the LEDs flash once for test. Then initialize the card and print out the information of the card. After that, test the function of single block operation, lock and unlock operation, erase operation and multiple blocks operation. If any error occurs, print the error message and turn on LED1, LED3 and turn off LED2 and LED4. Otherwise, turn on all the LEDs.

Uncomment the macro DATA_PRINT to print out the data and display them through HyperTerminal. Set bus mode (1-bit or 4-bit) and data transfer mode (polling mode or DMA mode) by comment and uncomment the related statements.

Information via a serial port output as following.

```
Card init success!

Card information:
## Card version 3.0x ##
## SDHC card ##
## Device size is 15558144KB ##
## Block size is 512B ##
## Block count is 31116288 ##
## CardCommandClasses is: 5b5 ##
## Block operation supported ##
## Erase supported ##
## Lock unlock supported ##
## Application specific supported ##
## Switch function supported ##


Card test:
Block write success!
Block read success!
The card is locked!
Erase failed!
The card is unlocked!
Erase success!
Block read success!
Multiple block write success!
Multiple block read success!
```

5.22. CAN_Network

5.22.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

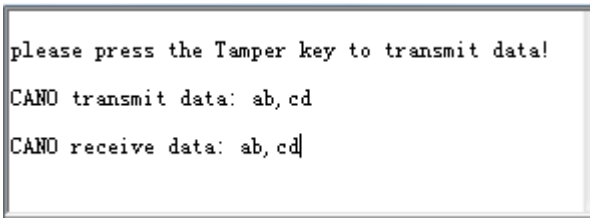
- Learn to use the CAN0 communication between two boards

GD32207I-EVAL development board integrates the CAN(Controller Area Network) bus controller, which is a common industrial control bus. CAN bus controller follows the CAN bus protocol of 2.0 A and 2.0 B. This demo mainly shows how to communicate two EVAL boards through CAN0.

5.22.2. DEMO Running Result

This example is tested with two GD32F207I-EVAL boards. Jump the JP5 to USART and P2, P3 to CAN with the jumper cap. Connect L pin to L pin and H pin to H pin of JP14 on the boards for sending and receiving frames. Download the program <22_CAN_Network> to the two EVAL boards, and connect serial cable to COM1. Firstly, the COM1 sends “please press the Tamper key to transmit data!” to the HyperTerminal. The frames are sent and the transmit data are printed by pressing Tamper Key push button. When the frames are received, the receive data will be printed and the LED2 will toggle one time.

The output information via the serial port is as following.



5.23. RCU_Clock_Out

5.23.1. DEMO Purpose

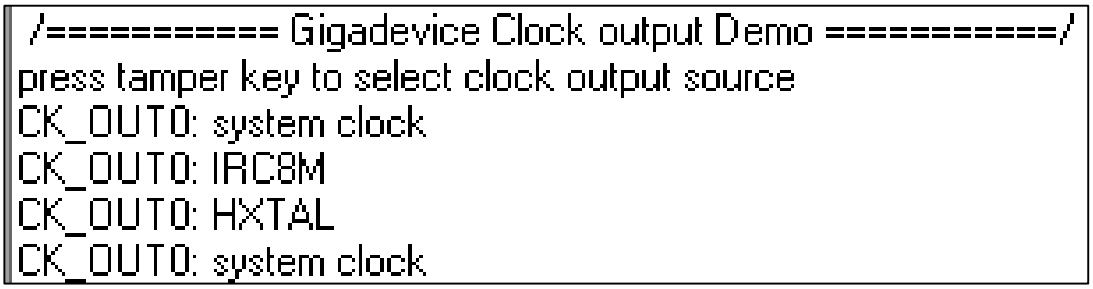
This demo includes the following functions of GD32 MCU:

- Learn to use GPIO control the LED
- Learn to use the clock output function of RCU
- Learn to communicate with PC by USART

5.23.2. DEMO Running Result

Jump the JP5 to USART0 with the jumper cap, and download the program <23_RCU_Clock_Out> to the EVAL board and run. Connect serial cable to EVAL_COM1, open the HyperTerminal. When the program is running, HyperTerminal will display the initial information. Then user can choose the type of the output clock by pressing the TAMPER button. After pressing, the corresponding LED will be turned on and HyperTerminal will display which mode be selected. The frequency of the output clock can be observed through the oscilloscope by PA8 pin.

Information via a serial port output as following:



5.24. PMU_sleep_wakeup

5.24.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use PMU deepsleep function
- Learn to use the EXTI interrupt to wakeup the MCU in the deepsleep mode

5.24.2. DEMO Running Result

Download the program <24_PMU_sleep_wakeup > to the EVAL board and run. It shows PMU how to enter deepsleep mode and wakeup it. Press Wakeup key to enter deepsleep mode, led stop flashing. When you press Tamper key to generate an exti interrupt, MCU will be wakeuped from deepsleep mode, led sparks again. But the led sparks slower, because at this time IRC8M is the system clock.

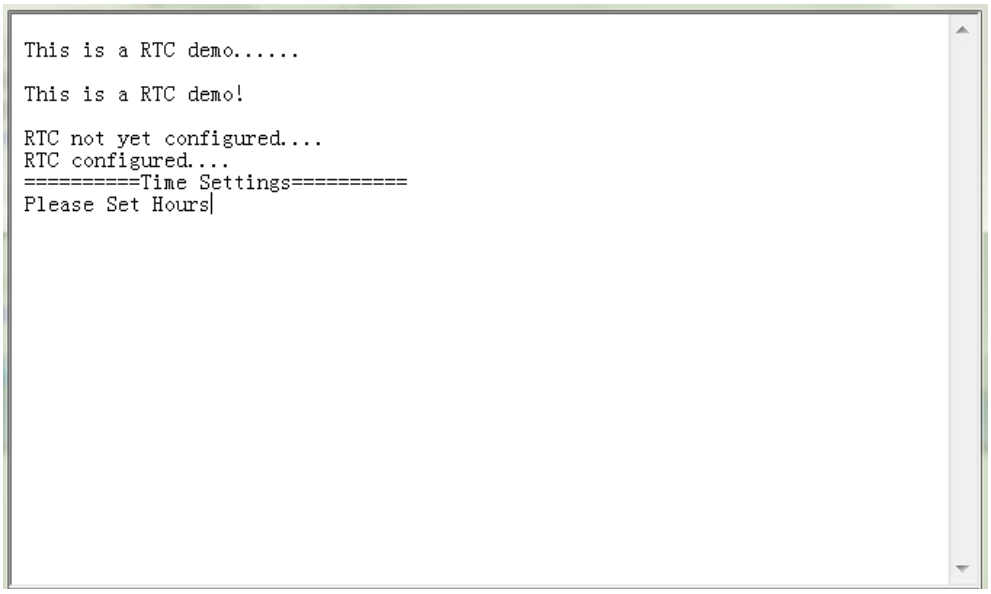
5.25. RTC_Calendar

5.25.1. DEMO Purpose

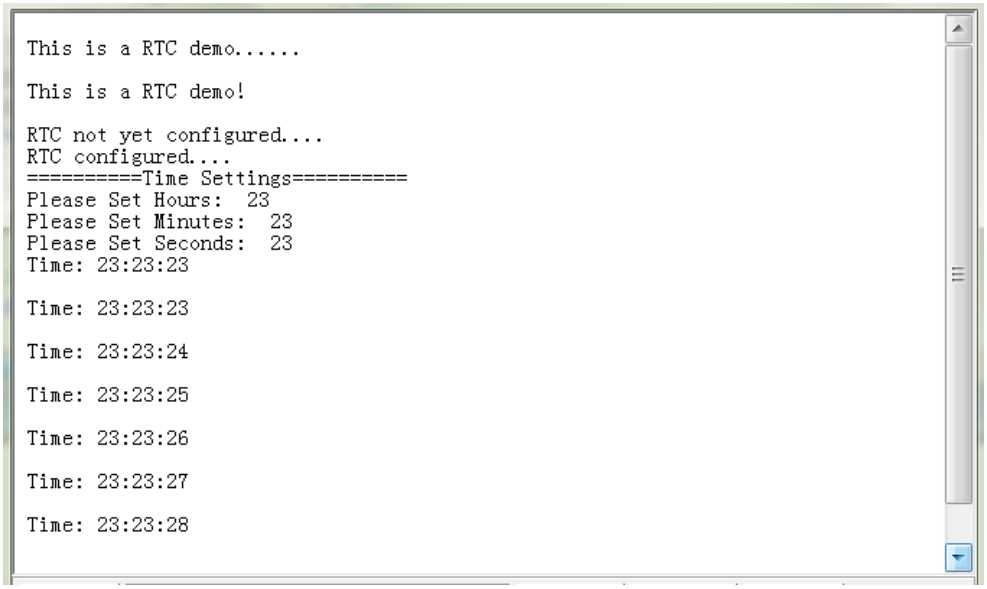
GD32207I-EVAL evaluation board integrated RTC (clock Real-time) real-time clock. If the battery has been installed, the accuracy of the current date and time can be guaranteed when the system is reset or power down RTC is essentially an independent timer, usually used for calendar clocks. This Demo is used to demonstrate the function and usage of the RTC module in the GD32207I-EVAL evaluation board.

5.25.2. DEMO Running Result

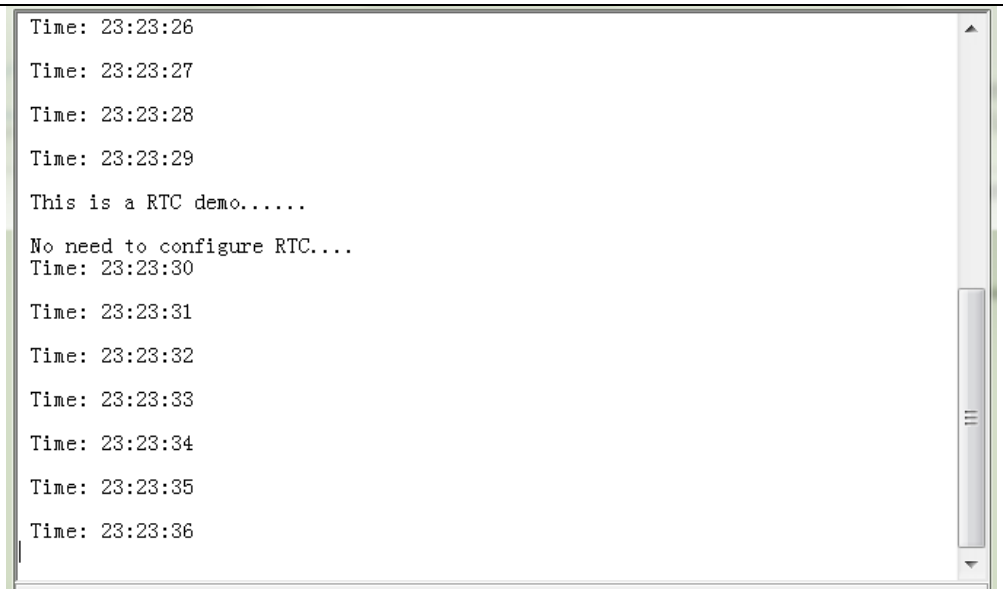
Download the program to the development board, serial port output information, as shown in the following figure. If the development board run the program for the first time, serial port output following information "RTC not yet configured…." It requires the user to set up hours、minutes and seconds.



According to the serial port output information prompt, setting time, serial port will print out the current time every second, as shown below.



If the development board is not the first run of the program, time has been set up in the last run, after the system reset or battery power restart, as shown below, serial port output following information " No need to configured RTC....", serial port continue printing time information.



5.26. TIMER_Breath_LED

5.26.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use Timer output PWM wave
- Learn to update channel value

5.26.2. DEMO Running Result

Use the DuPont line to connect the TIMER1 CH2 (PA2) and LED1 (PF6), and then download the program <26_TIMER_Breath_LED> to the board and run.

When the program is running, you can see LED1 lighting from dark to bright gradually and then gradually darken, ad infinitum, just like breathing as rhythm.

5.27. TLI_without_GUI

5.27.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use TLI to control LCD for displaying different images

5.27.2. DEMO Running Result

Jump the JP31 to LCD, and download the program <27_TLI_without_GUI> to the EVAL board and run. After downloading program to board, a running cheetah on the background of

GD logo is appeared on the LCD, which outputs as following.

5.28. DCI_OV2640

5.28.1. DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use DCI interface capture image from OV2640 camera
- Learn to use TLI interface display the captured image

5.28.2. DEMO Running Result

Connect jumper JP22, JP23, JP24, JP25, JP26, JP28, JP29, P2, P3 to DCI, jumper JP31 to LCD. Download the program <28_DCI_OV2640> to the GD32207I-EVAL evaluation board, then correct installation of LCD display and OV2640 camera to the development board. After power on, you can observe the capture image of camera displayed on the LCD screen, you can press the user key to take photo and press tamper key to display photo. You can also return to the camera capture state when press the wakeup key on the development board.

5.29. ENET

5.29.1. FreeRTOS_tcpudp

DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use Lwip stack

- Learn to use FreeRTOS operation system
- Learn to use netconn and socket API to handle with a task
- Learn how to realize a tcp server
- Learn how to realize a tcp client
- Learn how to realize a udp server/client
- Learn how to use DHCP to allocate ip address automatically

This demo is based on the GD32207I-EVAL evaluation board, it shows how to configure the enet peripherals to send and receive frames in normal mode and use lwip tcp/ip stack to realize ping, telnet and server/client functions.

JP13, JP18, JP19, JP20, JP22, JP23 must be fitted.

It is configured in RMII mode, and 25MHz oscillator is used, the system clock is configured to 120MHz.

This demo realizes three applications:

1) Telnet application, the eval board acts as tcp server. Users can link the client with the eval board server, using 8000 port. Users can see the reply from the server, and can send the name(should input enter key) to server.

2) tcp client application, the eval board acts as tcp client. Users can link the eval board client with the server, using 10260 port. Users can send information from server to client, then the client will send back the information.

3) udp application. Users can link the eval board with other station, using 1025 port. Users can send information to board from station, then the board will send back the information.

If users need dhcp function, it can be configured from the private defines in main.h. This function is closed by default.

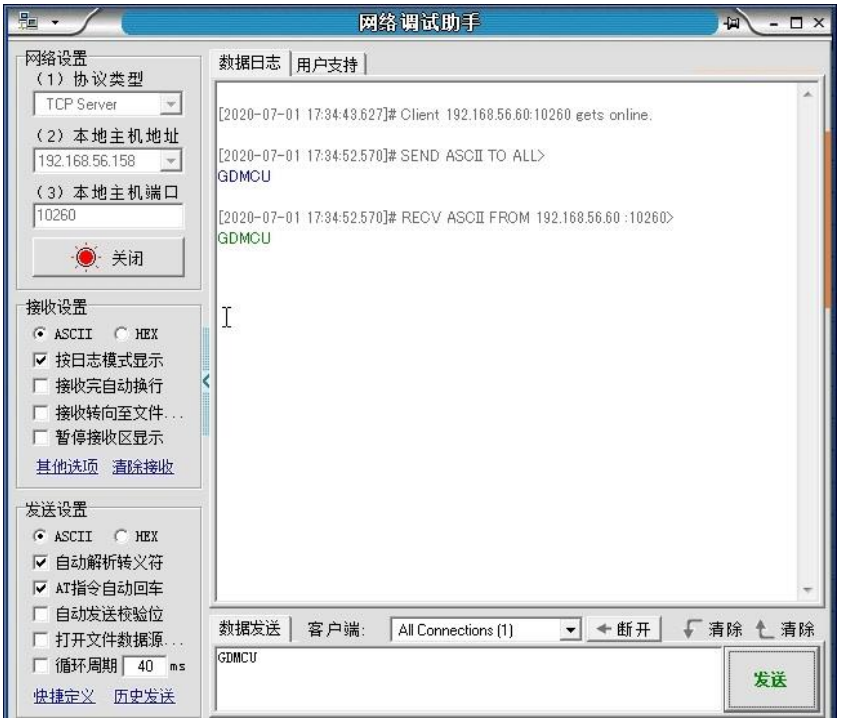
Note: Users should configure ip address, mask and gw of GD32207I-EVAL evaluation board or served according to the actual net situation from the private defines in main.h.

DEMO Running Result

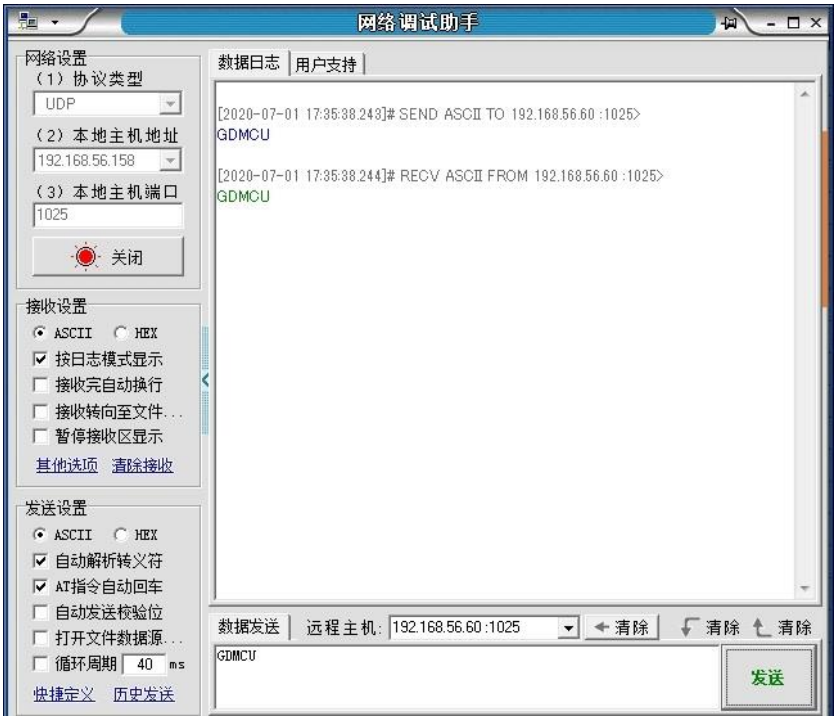
Download the program <FreeRTOS_tcpudp> to the EVAL board, LED3 will light every 500ms.

Using Network assistant software, configure the pc side to tcp client, using 8000 port, and when send something through the assistant, users can see the reply from the server:

Using Network assistant software, configure the pc side to tcp server, using 10260 port, and when send something through the assistant, users can see the echo reply from the client:



Using Network assistant software, configure to use udp protocol, using 1025 port, and when send something through the assistant, users can see the echo reply from the board:



Open the DHCP function in main.h, using a router to connect the board with the pc, users can see the automatic allocated ip address of the board from the HyperTerminal.

5.29.2. Raw_tcpudp

DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use Lwip stack
- Learn to use raw API to handle with a task
- Learn how to realize a tcp server
- Learn how to realize a tcp client
- Learn how to realize a udp server/client
- Learn how to use DHCP to allocate ip address automatically
- Learn to handle with received packet in polling mode and in interrupt mode

This demo is based on the GD32207I-EVAL evaluation board, it shows how to configure the enet peripherals to send and receive frames in normal mode and use lwip tcp/ip stack to realize ping, telnet and server/client functions.

JP13, JP18, JP19, JP20, JP22, JP23 must be fitted. JP5 jump to USART0.

It is configured in RMII mode, and 25MHz oscillator is used, the system clock is configured to 120MHz.

This demo realizes three applications:

1) Telnet application, the eval board acts as tcp server. Users can link the client with the eval

board server, using 8000 port. Users can see the reply from the server, and can send the name(should input enter key) to server.

2) tcp client application, the eval board acts as tcp client. Users can link the eval board client with the server, using 10260 port. Users can send information to client from server, then the client will send back the information. If the server is not online at first, or is break during process, when the server is ready again, users can press tamper key to reconnect with server, and communicate.

3) udp application, Users can link the eval board with other station, using 1025 port. Users can send information from station to board, then the board will send back the information.

By default, the packet reception is polled in while(1). If users want to receive packet in interrupt service, uncomment the macro defined USE_ENET_INTERRUPT in main.h.

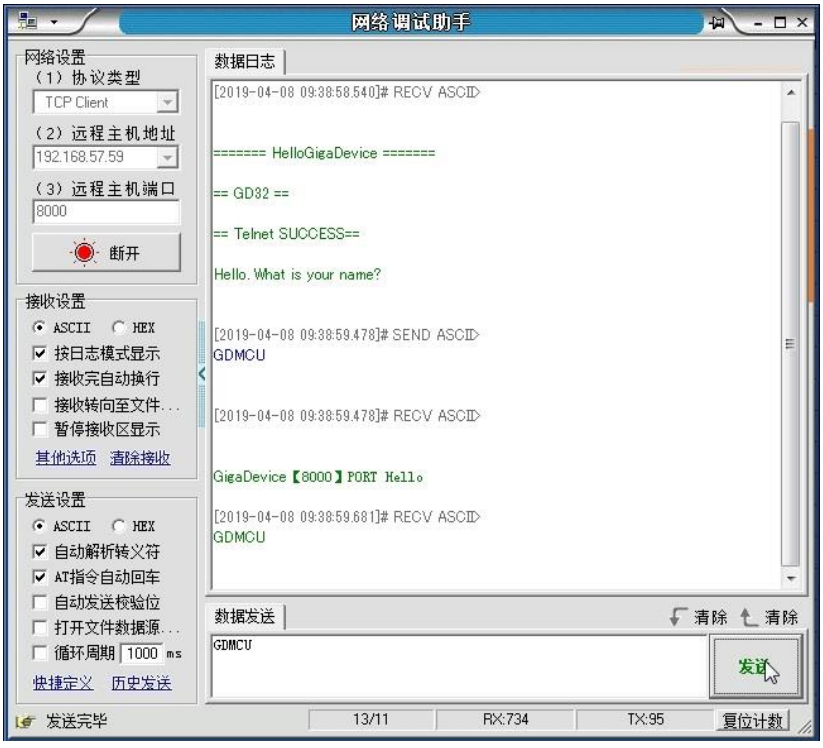
If users need dhcp function, it can be configured from the private defines in main.h. This function is closed in default.

Note: Users should configure ip address, mask and gw of GD32207I-EVAL evaluation board, or server according to the actual net situation from the private defines in main.h.

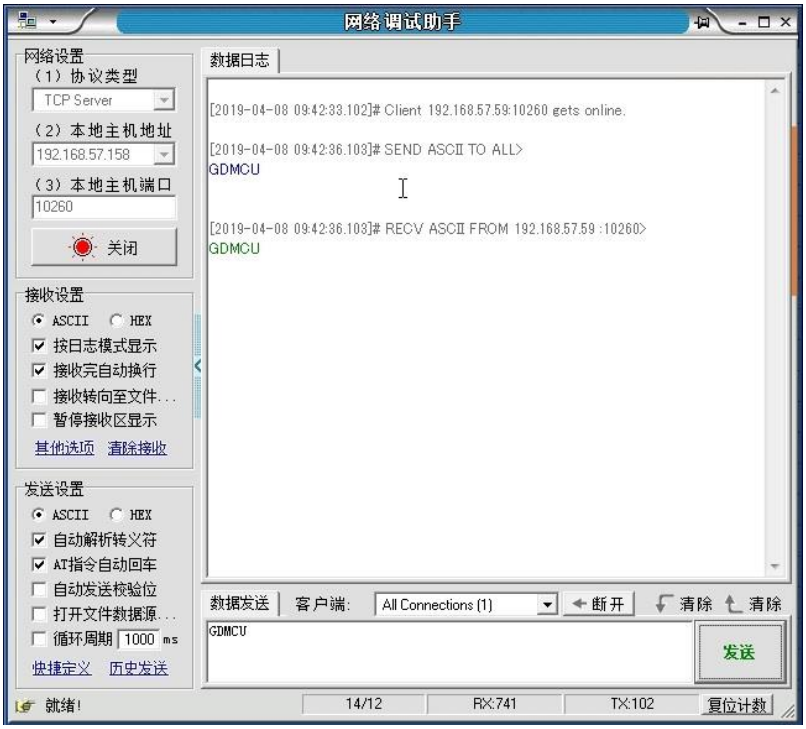
DEMO Running Result

Download the program <Raw_tcpudp> to the EVAL board.

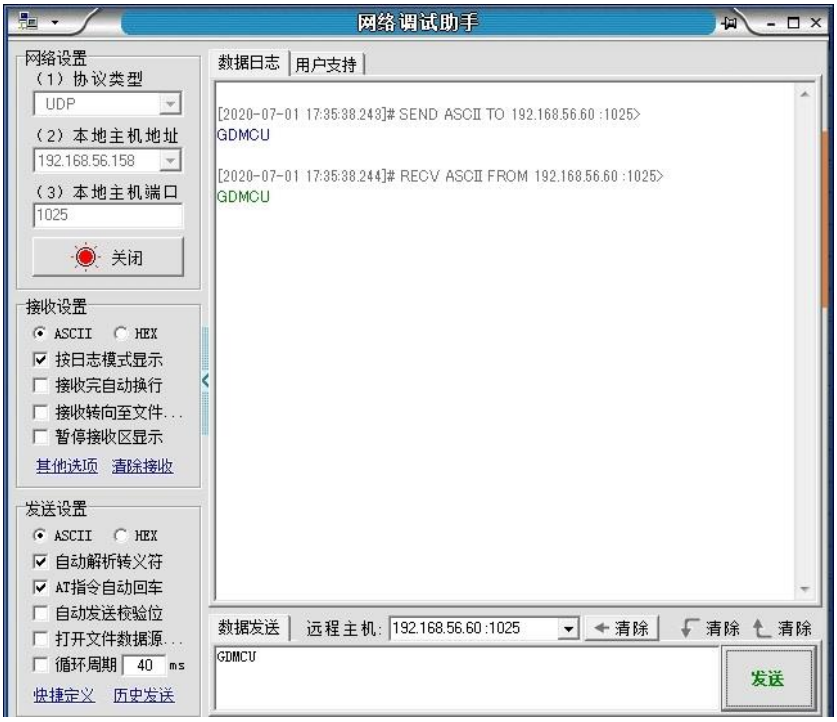
Using Network assistant software, configure the pc side to tcp client, using 8000 port, and when send something through the assistant, users can see the reply from the server:



Using Network assistant software, configure the pc side to tcp server, using 10260 port, press the Tamper key, and when send something through the assistant, users can see the echo reply from the client:



Using Network assistant software, configure to use udp protocol, using 1025 port, and when send something through the assistant, users can see the echo reply from the board:



Open the DHCP function in main.h, using a router to connect the board with the pc, users can see the automatic allocated ip address of the board from the HyperTerminal.

5.29.3. Raw_webserver

DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use Lwip stack
- Learn to use raw API to handle with a task
- Learn how to realize a web server
- Learn how to use a web server to control LEDs
- Learn how to use a web server to monitor the board V_{REFINT} voltage
- Learn how to use DHCP to allocate ip address automatically
- Learn to handle with received packet in polling mode and in interrupt mode

This demo is based on the GD32207I-EVAL evaluation board, it shows how to configure the enet peripherals to send and receive frames in normal mode and use lwip tcp/ip stack to realize webserver application.

JP13, JP18, JP19, JP20, JP22, JP23 must be fitted. JP5 jump to USART0.

It is configured in RMII mode, and 25MHz oscillator is used, the system clock is configured to 120MHz.

This demo realizes webserver application:

Users can visit the eval board through Internet Explorer, the eval board acts as a webserver, and the url is the local ip address of the eval board. There are two experiments realized, one is the LEDs control, the other one is the ADC monitoring VREFINT voltage in real-time.

If users need dhcp function, it can be configured from the private defines in main.h. This function is closed by default. Users can use a router to connect the eval board, and use the COM port to print the automatic allocated ip address, then connect your mobile phone to the wifi which the router send. Users can visit the eval board and control it on your mobile phone.

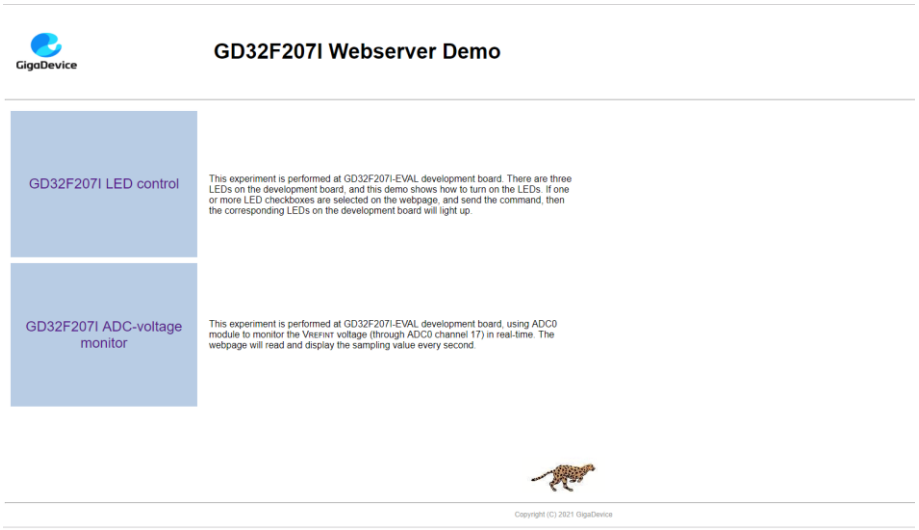
By default, the packet reception is polled in while(1). If users want to receive packet in interrupt service, uncomment the macro define USE_ENET_INTERRUPT in main.h.

Note: Users should configure ip address, mask and gw of GD32207I-EVAL evaluation board according to the actual net situation from the private defines in main.h.

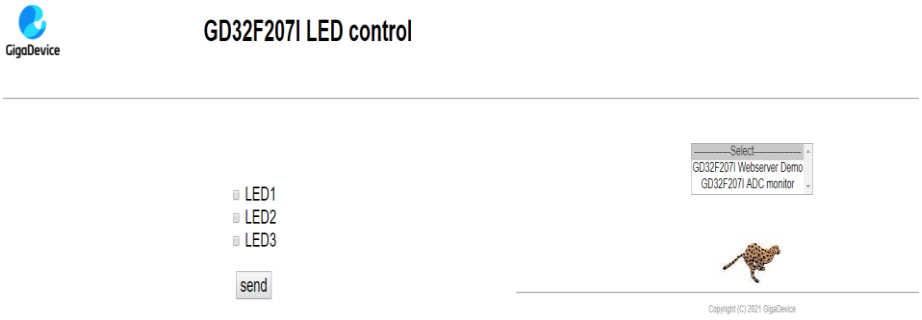
DEMO Running Result

Download the program <Raw_webserver> to the EVAL board, using Internet Explorer software, enter in the ip address of the board, click on the LED control linker, choose the LED checkboxes users want to light, and “send”, the corresponding LEDs will light. Click on the ADC monitor linker, the real-time VREFINT voltage is showed on the webpage, and the data refreshes every second automatically.

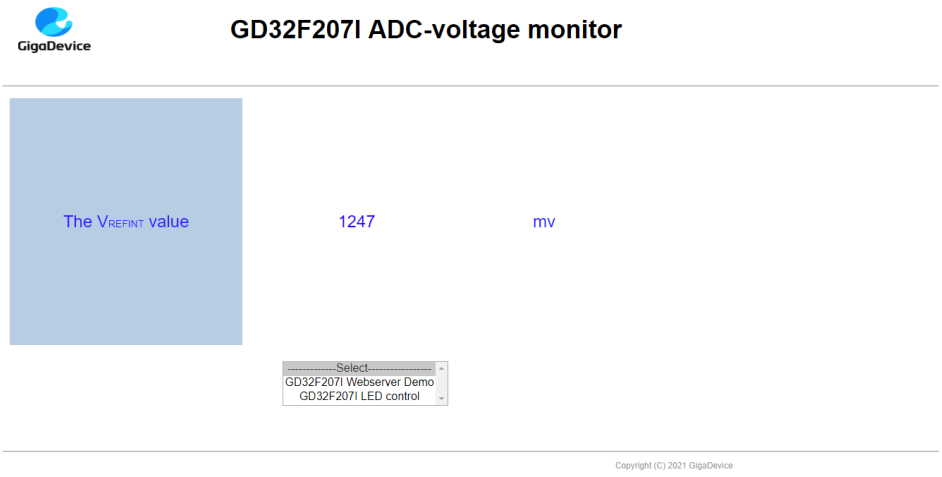
The web home page shows as below:



The LED control page shows as below:



The ADC monitor page shows as below:



Open the DHCP function in main.h, using a router to connect the board, and use the HyperTerminal to print the automatic allocated ip address, then connect your mobile phone to the wifi which the router send. Users can visit the eval board and control it on your mobile phone.

5.30. USBFS

5.30.1. USB_Device

1) HID_Keyboard

DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn how to use the USBFS peripheral mode
- Learn how to implement USB HID(human interface) device

GD32207i-EVAL evaluation board has four keys and one USB_FS interface. The four keys are Reset key, Wakeup key, Tamper key, User key. In this demo, the GD32207i-EVAL evaluation board is enumerated as an USB Keyboard, which uses the native PC Host HID driver, as shown below. The USB Keyboard uses three keys(wakeup key, tamper key and user key) to output three characters (‘b’, ‘a’ and ‘c’). In addition, the demo also supports remote wakeup which is the ability of a USB device to bring a suspended bus back to the active condition, and the wakeup key is used as the remote wakeup source.

DEMO Running Result

Jump the JP5 jump to USB, download the program <30_USBFS\USB_Device\HID_Keyboard> to the EVAL board and run. If user press the Wakeup key, will output ‘b’. If user press the User key, will output ‘c’. If user press the Tamper key, will output ‘a’.

If user want to test USB remote wakeup function, user can do as follows:

- Manually switch PC to standby mode

- Wait for PC to fully enter the standby mode

- Push the ‘wakeup’ key

- If PC is ON, remote wakeup is OK, else failed.

2) MSC_Udisk

DEMO Purpose

This demo includes the following functions of GD32 MCU:

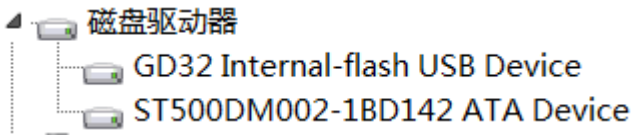
- Learn how to use the USB_FS peripheral mode
- Learn how to implement USB MSC(mass storage) device

This demo mainly implements a U disk. U disk is currently very widely used removable MSC devices. MSC, the Mass Storage device Class, is a transport protocol between a computer and mobile devices, which allow a universal serial bus (USB) equipment to access a host computing device, file transfer between them, mainly including mobile hard disk, mobile U disk drive, etc. The MSC device must have a storage medium, and this demo uses the MCU's internal flash as the storage medium. For more details of the MSC protocol please refer to the MSC protocol standard.

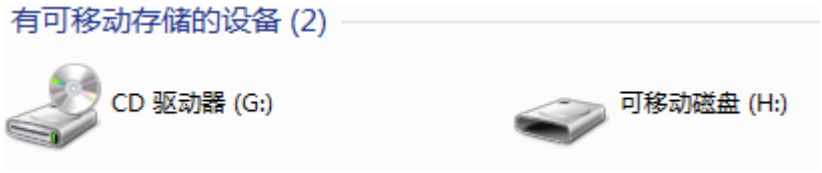
MSC device will use a variety of transport protocols and command formats for communication, so it need to choose the appropriate protocol and command format in the realization of the application. This demo selects the BOT (bulk only transport) protocol and the required SCSI (small computer interface) command, and is compatible with a wide variety of Window operating systems. Specific BOT protocol and SCSI command specification please refer to the standard of their agreement.

DEMO Running Result

Jump the JP5 to USB, download the program <30_USBFS\USB_Device\MSC_Udisk> to the EVAL board and run. When the EVAL-board connect to the PC, user will find a USB large capacity storage device is in the universal serial bus controller, and there is 1 more disk drives in the equipment manager of PC.



Then, after opening the resource manager, you will see more of the 1 disk, as shown in the following diagram:



At this point, the write/read/formatting operation can be performed as the other mobile devices.

5.30.2. USB_Host

1) Host_HID

DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use the USBFS as a HID host
- Learn the operation between the HID host and the mouse device
- Learn the operation between the HID host and the keyboard device

GD32207i-EVAL board integrates the USBFS module, and the module can be used as a USB device, a USB host or an OTG device. This demo mainly shows how to use the USBFS as a USB HID host to communicate with external USB HID device.

DEMO Running Result

Jump the JP5 to USB, download the program <30_USBFS\USB_Host\Host_HID> to the EVAL board and run.

If a mouse has been attached, the user will see the information of mouse enumeration. Firstly, pressing the User key will see the inserted device is mouse, and then moving the mouse will show the position of mouse and the state of button in the screen.

If a keyboard has been attached, the user will see the information of keyboard enumeration. Firstly, pressing the User key will see the inserted device is keyboard, and then pressing the keyboard will show the state of the button in the screen.

2) Host_MSC

DEMO Purpose

This demo includes the following functions of GD32 MCU:

- Learn to use the USBFS as a MSC host
- Learn the operation between the MSC host and the Udisk

GD32207i-EVAL board integrates the USBFS module, and the module can be used as a USB device, a USB host or an OTG device. This demo mainly shows how to use the USBFS as a USB MSC host to communicate with external Udisk.

DEMO Running Result

Jump the JP5 to USB, download the program <30_USBFS\USB_Host\Host_MSC> to the EVAL board and run.

If an Udisk has been attached, the user will see the information of Udisk enumeration. First

pressing the User key will see the Udisk information, next pressing the Tamper key will see the root content of the Udisk, then press the Wakeup key will write file to the Udisk, finally the user will see information that the MSC host demo is end.

6. Revision history

Table 6-1. Revision history

Revision No	Description	Date
1.0	Initial version	Jul. 15th, 2015
2.0	firmware update	Jun. 5th, 2017
2.1	Update EVAL board	Apr. 1st, 2019
2.2	Rebase version	Oct. 31st, 2021

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