

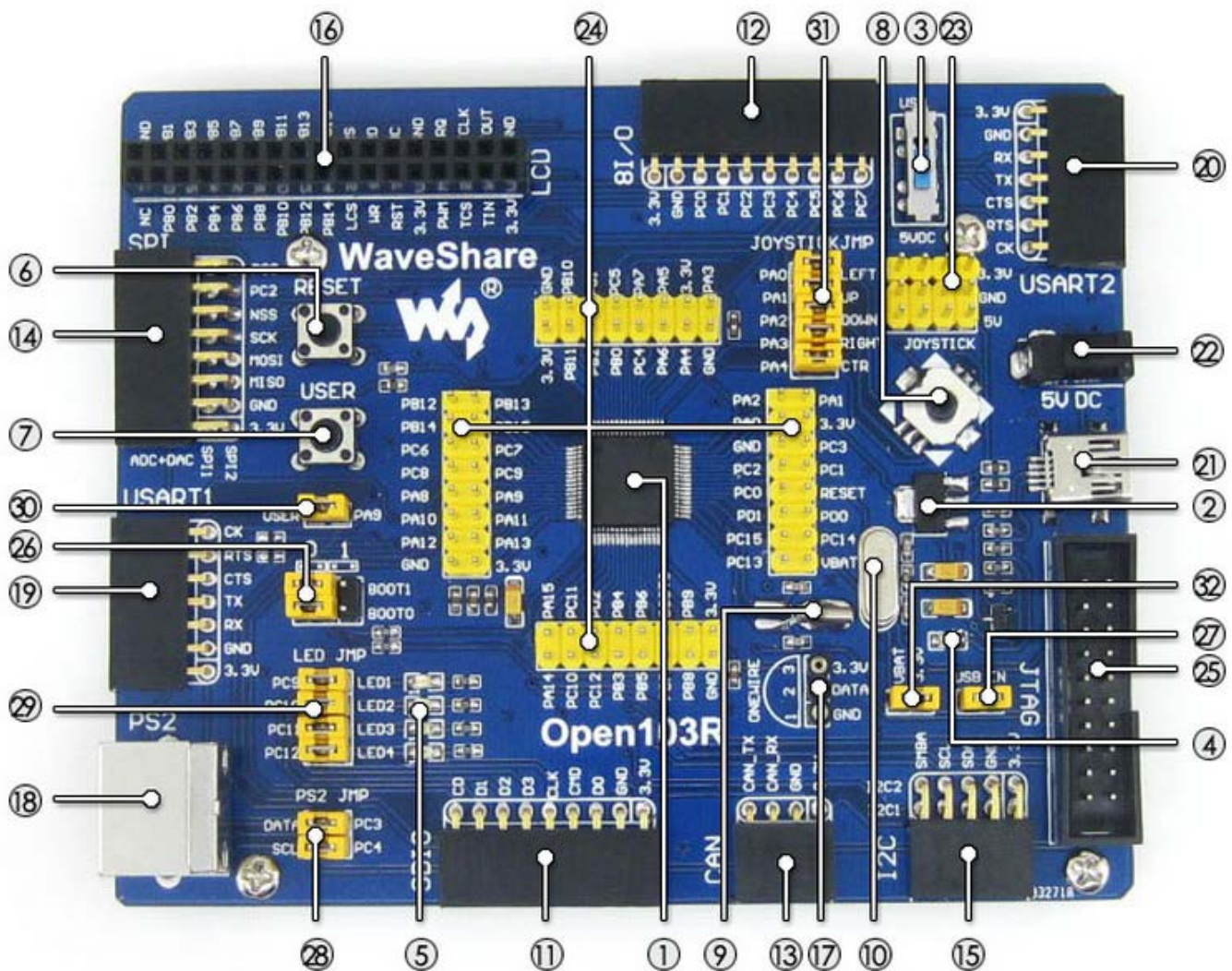
# Open103R User Manual

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# 1. Overview

## 1.1. What's on board



[ MCU ]

1. **STM32F103RCT6**  
the high performance STM32 MCU which features:  
**Core:** Cortex-M3 32-bit RISC;

[ Component ]

3. **Power supply switch**  
5V DC or USB;
4. **Power indicator**
5. **LEDs**

**Operating Frequency:** 72MHz, 1.25 DMIPS/MHz;  
**Operating Voltage:** 2-3.6V;  
**Package:** LQFP64; **I/Os:** 51;  
**Memories:** 256kB Flash, 48kB RAM;  
**Communication Interfaces:** 2 x SPI, 5 x USART, 2 x I2S, 2 x I2C;  
 1 x SDIO, 1 x USB, 1 x CAN;  
**AD & DA converters:** 3 x AD (12-bit, 1μs, shares 16 channels); 2 x DA (12-bit);  
**Debugging/Programming:** supports JTAG/SWD (serial wire debug) interfaces, supports IAP;

2. **AMS1117-3.3**  
3.3V voltage regulator;

[ Interface ]

11. **SDIO interface**  
connects to the Micro SD adapter easily, It is much faster to read/write the Micro SD card via SDIO than via SPI;
12. **8 I/O Interface**  
easily connects to keypad, motor, etc.;
13. **CAN interface**  
communicates with accessory board which features the CAN device conveniently;
14. **SPI1 / SPI2 interface**  
Easily connects to SPI peripherals such as FLASH (AT45DBxx), SD card, MP3, etc.; Convenient for connecting AD, DA module, thanks to the SPI1 alternative function - AD&DA;
15. **I2C1 / I2C2 interface**  
easily connects to I2C peripherals such as I/O expander (PCF8574), EEPROM (AT24Cxx), etc.;
16. **LCD interface**  
easily connects to the touch screen LCD;
17. **ONE-WIRE interface**  
easily connects to ONE-WIRE devices (TO-92 package), such as temperature sensor (DS18B20), electronic registration number (DS2401), etc.

Convenient for indicating I/O status or program debugging running state;

6. **Reset button**
7. **User key**  
for I/O input test
8. **Joystick**  
for I/O input test (five positions)
9. **32.768K crystal oscillator**  
used for internal RTC, also supports clock calibration
10. **8M crystal oscillator**  
enables the MCU run at 72M frequency by frequency multiplication

[ Other interface ]

22. **5V DC jack**
23. **5V/3.3 V power input/output**  
usually used for power output, or common ground with other user board
24. **MCU pins connector**  
all the MCU pins are accessible on expansion connectors for further expansion
25. **JTAG/SWD interface**  
for debugging/programming

[ Jumper ]

26. **Boot mode selection**  
for configuring the BOOT0 and BOOT1 pins
27. **USB enable jumper**  
short the jumper to enable the PC auto detection while USB connecting  
open the jumper to disable
28. **PS/2 interface jumper**  
Short the jumper to connect the PS/2 device to I/Os used in example code;  
Open the jumper to connect the PS/2 device to other custom pins via jumper wires;

**18. PS/2 interface**

easily connects to PS/2 keyboard or mouse;

**19. USART1 interface**

easily connects to RS232, RS485, USB TO 232;

**20. USART2 interface**

easily connects to RS232, RS485, USB TO 232;

**21. USB port**

USB communication between board and PC;

**29. LEDs jumper**

Short the jumper to connect the user key to I/Os used in example code;

Open the jumper to connect the user key to other custom pins via jumper wires;

**30. User key jumper**

Short the jumper to connect the user key to I/Os used in example code;

Open the jumper to connect the user key to other custom pins via jumper wires;

**31. Joystick jumper**

Short the jumper to connect the user key to I/Os used in example code;

Open the jumper to connect the user key to other custom pins via jumper wires;

**32. VBAT selection jumper**

Short the jumper to use system power supply;

Open the jumper to connect the VBAT to external power, such as battery;

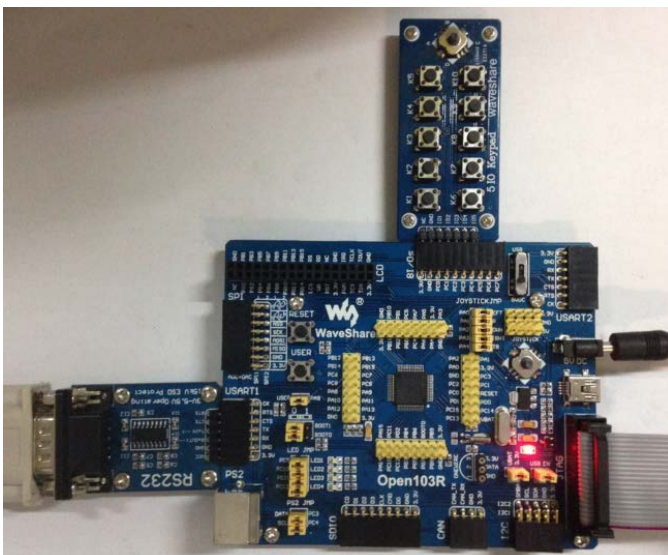
## 2. Demo

- KEIL MDK Version: 4.54
- Programmer/Debugger: ULINK/V2
- Programming/Debugging interface: SWD
- Serial port settings:

Select a proper COM port	
Baud rate	115200
Data bits	8
Stop bits	1
Parity bits	None
Flow control	None

### 2.1. 5IOs

- ◆ Overview  
5I/Os demo
- ◆ Hardware connection



- Connect the board to 5V power via 5VDC interface
- Connect the ULINK board to the board via SWD interface
- Connect the "5IO Keypad" to the onboard 8I/Os interface (make sure the G pin on the module connects to the GND pin on the 8I/Os)
- Connect a serial port converter(RS232) to the onboard USART1 interface

- ◆ Operation and result

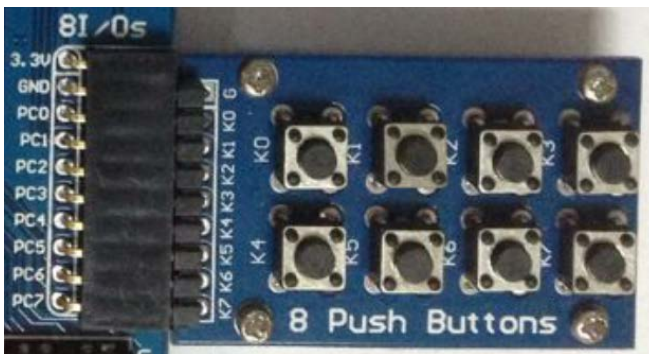
The below information will be printed on the serial debugging assistant:

```

eyValue is : -K1.
KeyValue is : -K2.
KeyValue is : -K3.
KeyValue is : -K4.
KeyValue is : -K5.
KeyValue is : -K5. |
KeyValue is : -K7.
KeyValue is : -K8.
KeyValue is : -K9.
KeyValue is : -K10.
KeyValue is : -Right.
KeyValue is : -Up.
KeyValue is : -Left.
KeyValue is : -Down.
KeyValue is : -Press.
    
```

## 2.2. 8I/Os

- ◆ Overview
  - 8I/Os demo
- ◆ Hardware connection



- Connect the board to 5V power via 5VDC interface
- Connect the ULINK board to the board via SWD interface
- Connect the "8 Push Button" to the onboard 8I/Os interface (make sure the G pin on the module connects to the GND pin on the 8I/Os)

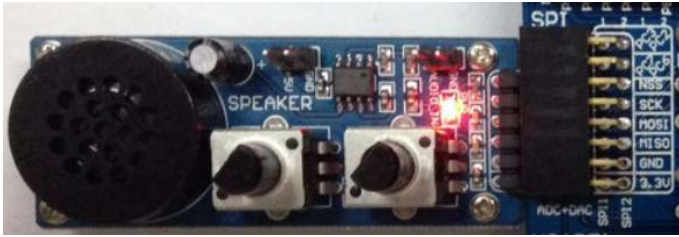
- ◆ Operation and result
  - Push the button, the LED will keep blinking accordingly.

```

*****
The current AD value = 2.36V
The current AD value = 2.36V
The current AD value = 3.30V
The current AD value = 2.83V
The current AD value = 0.72V
The current AD value = 0.01V |
The current AD value = 0.01V
    
```

## 2.3. ADC+DMA

- ◆ Overview
  - ADC+DMA demo
- ◆ Hardware connection



- Connect the board to 5V power via 5VDC interface
- Connect the ULINK board to the board via SWD interface
- Connect a serial port converter(RS232) to the onboard USART1 interface
- Connect the Analog Test Board to the board via SPI1 (ADC+DAC) interface

◆ Operation and result

- Rotate the potentiometer on the Analog Test Board, the below information will be printed on the serial debugging assistant:

```
*****
The current AD value = 0.0008V
The current AD value = 0.0000V
The current AD value = 0.3021V
The current AD value = 0.3722V
The current AD value = 0.8008V
The current AD value = 1.3833V
The current AD value = 1.9368V
The current AD value = 3.2992V
The current AD value = 3.2952V
The current AD value = 3.2992V
```

## 2.4. CAN-LoopBack

◆ Overview

CAN demo in LoopBack mode

◆ Hardware connection

- Connect the board to 5V power via 5VDC interface
- Connect the ULINK2 board to the board via SWD interface
- USART2 Connect a serial port converter(RS232) to the onboard USART2 interface

◆ Operation and result

- LED keep blinking;
- The below information will be printed on the serial debugging assistant:

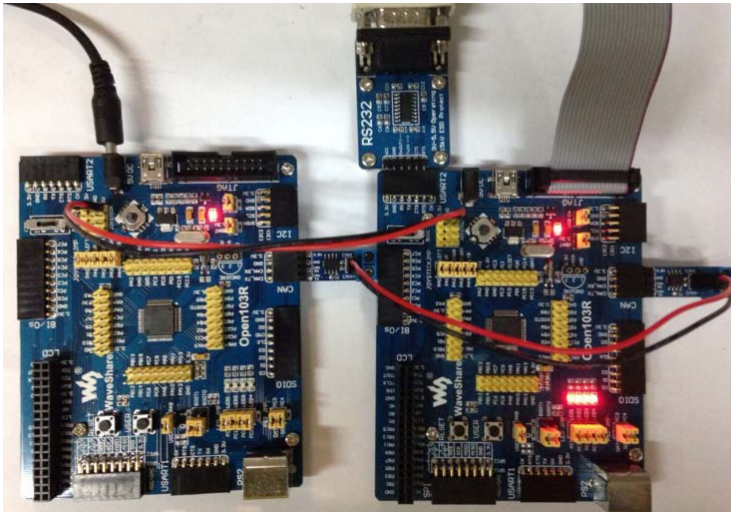
```
*****
CAN-Bus Test
CAN-Bus by polling in loopback mode is OK
CAN-Bus by interrupt in loopback mode is OK
```

## 2.5. CAN-Normal

◆ Overview

CAN demo in Normal mode

◆ Hardware connection



- Connect the board to 5V power via 5VDC interface
- Connect the ULINK2 board to the board via SWD interface
- Connect a serial port converter(RS232) to the onboard USART2 interface
- Two "SN65HVD230 CAN Board" are required, connect them to two Open103R board respectively

◆ Operation and result

- The below information will be printed on the serial debugging assistant:

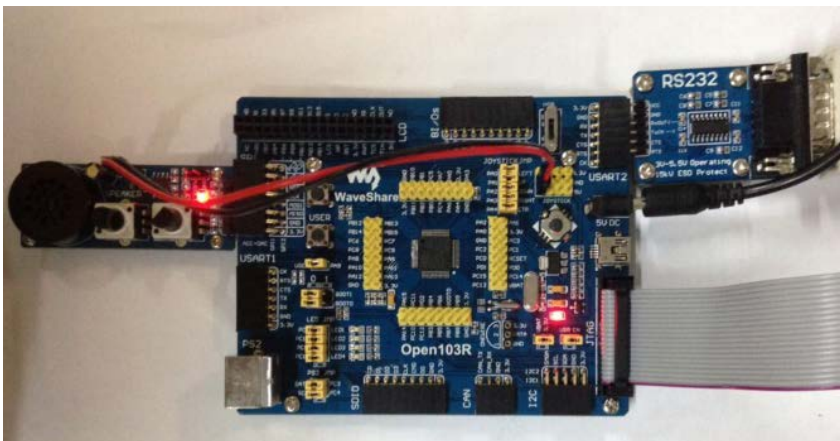
```
*****
CAN-Bus Test
CAN-Bus Speed 100kdtz
CAN Receive Data
CAN ID 5a5
CAN_DATA0 ee
CAN_DATA1 de
CAN_DATA2 b8
CAN_DATA3 5f
CAN_DATA4 f3
CAN_DATA5 65
CAN_DATA6 3c
CAN_DATA7 c
CAN Receive Data
CAN ID 5a5
CAN_DATA0 84
CAN_DATA1 b8
CAN_DATA2 d5
```

## 2.6. ADC

◆ Overview

ADC analog voltage acquisition demo

◆ Hardware connection



- Connect the board to 5V power via 5VDC interface
- Connect the ULINK2 board to the board via SWD interface
- Connect the Analog Test Board to the board via SPI1 (ADC+DAC) interface
- Connect the 5V pin headers on both the main board and the Analog Test Board via jumper



wire

- ◆ Operation and result
  - You should hear sound from the Analog Test Board

## 2.4. ENC28J60

- ◆ Overview
  - "ENC28J60 Ethernet Board" demo
- ◆ Hardware connection



- Connect the board to 5V power via 5VDC interface
- Connect the ULINK2 board to the board via SWD interface
- Connect the ENC28J60 Ethernet Board to the board via SPI1 (ADC+DAC) interface

- ◆ The IP of the PC configuring as 192.168.0.xxx; for example:  
Configuring IP of both the PC and the module on the same network:  
Right click the **【Internet】** -» **【Attribute】** -» Click **【Local connection】** -» Click **【Attribute】** -» Find Internet Protocol Version4 (TCP/IP V4, the following dialog box will pop up, set the appropriate IP address, subnet mask, and default gateway:
 

IP addresses :	192.168.0.11
Subnet Mask:	255.255.255.0
Default Gateway:	192.168.0.1

- ◆ Operation and result  
Open the browser; enter 192.168.0.100/888; press the Enter key:

```
Sent data to ENC28J60 : 0x3
```

[\[refresh\]](#)

[+1](#)

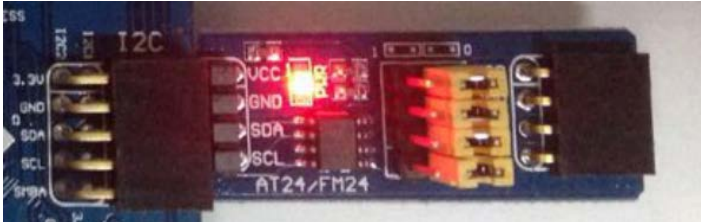
Open103R WEB test

## 2.7. GPIO LED JOYSTICK

- ◆ Overview
  - LED, joystick demo
- ◆ Hardware connection
  - Short the LED JMP, JOYSTICK JMP
- ◆ Operation and result
  - Push the button or joystick, the LED status should keep changing accordingly

## 2.8. I2C

- ◆ Overview
  - I2C EEPROM demo
- ◆ Hardware connection



- Connect the board to 5V power via 5VDC interface
- Connect the ULINK2 board to the board via SWD interface
- Connect a serial port converter to the onboard USART1 interface
- Connect the AT24/FM24 Board to the board via I2CX interface( connect to I2C1 or I2C2 depends on the program)

- ◆ Operation and result

- The below information will be printed on the serial debugging assistant:

```
*****
EEPROM 24C02 Write Test
EEPROM 24C02 Write Test OK
EEPROM 24C02 Read Test
EEPROM 24C02 Read Test OK
```

## 2.9. LCD

- ◆ Overview
  - LCD demo
- ◆ Hardware connection



- Connect the board to 5V power via 5VDC interface
- Connect the ULINK2 board to the board via SWD interface
- Connect the 3.2inch 320x240 Touch LCD (A) to the board

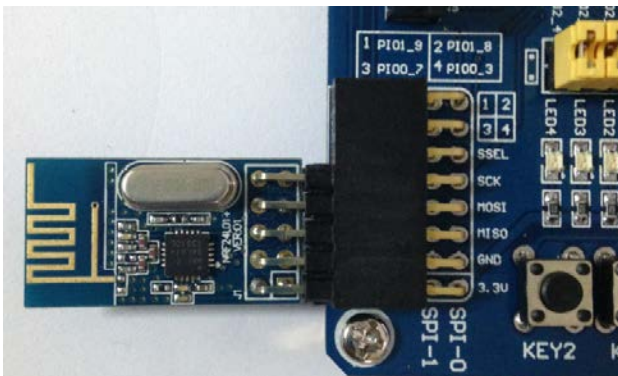
- ◆ Operation and result

- Display image on the LCD:



## 2.10. NRF24L01

- ◆ Overview  
NRF24L01 demo
- ◆ Hardware connection



- Connect the board to 5V power via 5VDC interface
- Connect the ULINK2 board to the board via SWD interface
- Connect a serial port converter to the onboard USART1 interface
- Connect the NRF24L01 Board to the board via SPI interface

- ◆ Software configuration

Two NRF24L01 are needed for this demo, the software configuring as below:

When configuring as mode of transmitting, enabled: `#define T_O_R 1`, comment out: `//#define T_O_R 0`;

When configuring as mode of receiving, enable: `#define T_O_R 0`, comment out: `//#define T_O_R 0`

- ◆ Operation and result

Message will be printed on the serial debugging assistant.

## 2.11. One-Wire

- ◆ Overview  
One-Wire demo
- ◆ Hardware connection

Connect the board to 5V power via 5VDC interface

Connect the ULINK2 board to the board via SWD interface

Connect a serial port converter to the onboard USART1 interface

Connect the DS18B20 to the onboard One-wire socket.

- ◆ Operation and result

The below information will be printed on the serial debugging assistant:

```
*****
DS18B20's ID :0x28 0x76 0xfe 0x49 0x5 0x2 0x0 0x20 Temperture:8 'C
Temperature:30 'C
Temperature:29 'C
Temperature:30 'C
Temperature:29 'C
Temperature:30 'C
Temperature:29 'C
Temperature:30 'C
```

## 2.12. PS2

- ◆ Overview
  - PS2 keyboard demo
- ◆ Hardware connection



- Connect the board to 5V power via 5VDC interface
- Connect the ULINK2 board to the board via SWD interface
- Connect a serial port converter to the onboard USART1 interface
- Connect the PS2 keyboard to the board via PS2 interface
- Short the PS2 JMP.

- ◆ Operation and result

The below key value will be printed on the serial debugging assistant while connect the PS2 keyboard:

```
Please Input Keyboard!
Keyboard Input : u
Keyboard Input : y
Keyboard Input : h
Keyboard Input : g
Keyboard Input : f
```

## 2.13. RTC

- ◆ Overview
  - RTC demo
- ◆ Hardware connection
  - Connect the board to 5V power via 5VDC interface
  - Connect a serial port converter to the onboard USART2 interface
  - Connect the ULINK2 board to the board via SWD interface

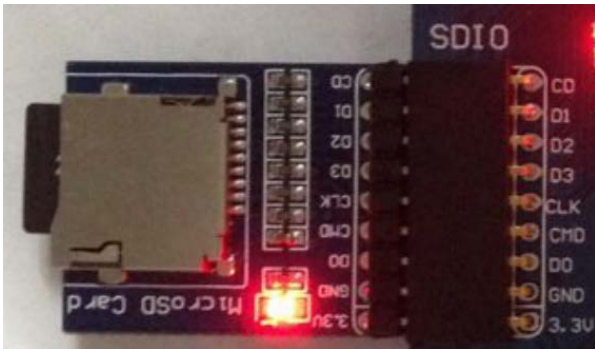
- ◆ Operation and result

The below information will be printed on the serial debugging assistant:

```
*****
External Reset occurred...
No need to configure RTC...
Time: 2012-1-1 00:00:08
Time: 2012-1-1 00:00:09
Time: 2012-1-1 00:00:10
Time: 2012-1-1 00:00:11
```

## 2.14. SD\_FatFS

- ◆ Overview  
SD\_FatFS demo
- ◆ Hardware connection

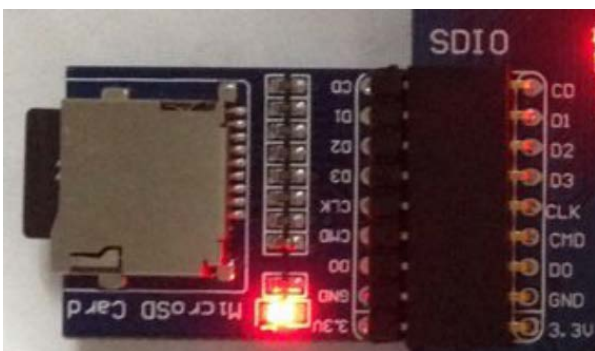


- Connect the board to 5V power via 5VDC interface
- Connect the ULINK2 board to the board via SWD interface
- Connect a serial port converter to the onboard USART1 interface
- Connect the Micro SD Storage Board (with SD card) to the board via SPI1 interface

- ◆ Operation and result  
Message will be printed on the serial debugging assistant.

## 2.15. SDIO

- ◆ Overview  
SDIO demo
- ◆ Hardware connection



- Connect the board to 5V power via 5VDC interface
- Connect the ULINK2 board to the board via SWD interface
- Connect a serial port converter to the onboard USART1 interface
- Connect the Micro SD Storage Board (with SD card) to the board via SPI1 interface

- ◆ Operation and result  
The below information will be printed on the serial debugging assistant:

```

WARNING: THIS PROCESS WILL ERASE THE SD CARD!
Press 'y' to continue.y

01. ---- SD_Init Status:42
      Initialize SD card successfully!

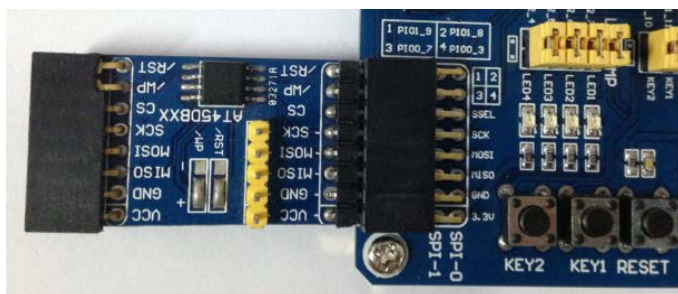
02. ---- SD_GetCardInfo Status:42
      Get SD card infomation successfully!
      Block size:400, Card type:1

03. ---- SD_SelectDeselect Status:42
      Select SD card successfully!

04. ---- SD_EnableWideBusOperation Status:42
      Enable wide bus operation successfully!
  
```

## 2.16. SPI

- ◆ Overview
  - SPI demo
- ◆ Hardware connection



- Connect the board to 5V power via 5VDC interface
- Connect the ULINK2 board to the board via SWD interface
- Connect the AT45DBXX DataFlash Board to the board via SPI2 interface
- Connect a serial port converter to the onboard USART2 interface

- ◆ Software connection
  - Serial assistant configuration:
  - Launch the serial debugging assistant SSCOM32, choose related COM port, set baud rate as 115200, click to open it.

- ◆ Operation and result
  - The below information will be printed on the serial debugging assistant:

```

*****
SPI is ready!
AT45DBXX had been Init!
AT45DBXX ID is 0x1f 0x24 0x0 0x0
  
```

## 2.17. TouchPanel

- ◆ Overview
  - LCD demo
- ◆ Hardware connection



- Connect the board to 5V power via 5VDC interface
- Connect the ULINK2 board to the board via SWD interface
- Connect the 3.2inch 320x240 Touch LCD (A) to the board

◆ Operation and result

Calibrate the LCD first, then touch it, draw any line on it.

## 2.18. uCOSII2.91+UCGUI3.90A

◆ Overview

UcosII+GUI demo

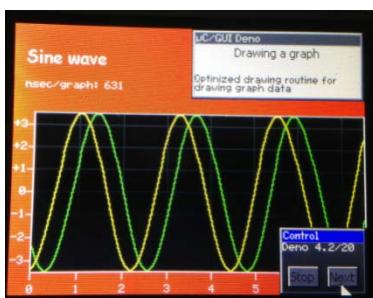
◆ Hardware connection



- Connect the board to 5V power via 5VDC interface
- Connect the ULINK2 board to the board via SWD interface
- Connect the 3.2inch 320x240 Touch LCD (A) to the board

◆ Operation and result

- Display image on the LCD



## 2.19. USART

- ◆ Overview
  - USART demo
- ◆ Hardware connection
  - Connect the board to 5V power via 5VDC interface
  - Connect the ULINK2 board to the board via SWD interface
- ◆ Operation and result
  - The below information will be printed on the serial debugging assistant:

```
Waveshare!  
Waveshare!  
Waveshare!
```

## 2.20. USB-JoyStick Mouse

- ◆ Overview
  - USB mouse demo
- ◆ Hardware connection
  - Connect the board to 5V power via 5VDC interface
  - Connect the board to 5V power via 5VDC interface
  - Connect the board to 5V power via 5VDC interface
- ◆ Software connection
- ◆ Operation and result
  - An USB device will appear on the PC device manager:
  - Control the computer cursor by joystick

## 2.21. VS1003B

- ◆ Overview
  - MP3 record/play demo
- ◆ Hardware connection



- Connect the board to 5V power via 5VDC interface
- Connect the ULINK2 board to the board via SWD interface
- Connect the "VS1003B MP3 Board" to the onboard SPI1 interface



## ◆ Operation and result

- .VS1003 (GPIO): P0 LED keep blinking
- .VS1003 (line in): can hear music from the PC
- .VS1003 (line out): can hear music from the MCU FLASH
- .VS1003 (record): can hear sound from the microphone

### 3. Revision history

Version	Description	Date	Author
V1.0	Initial revision	2014/05/17	Waveshare team