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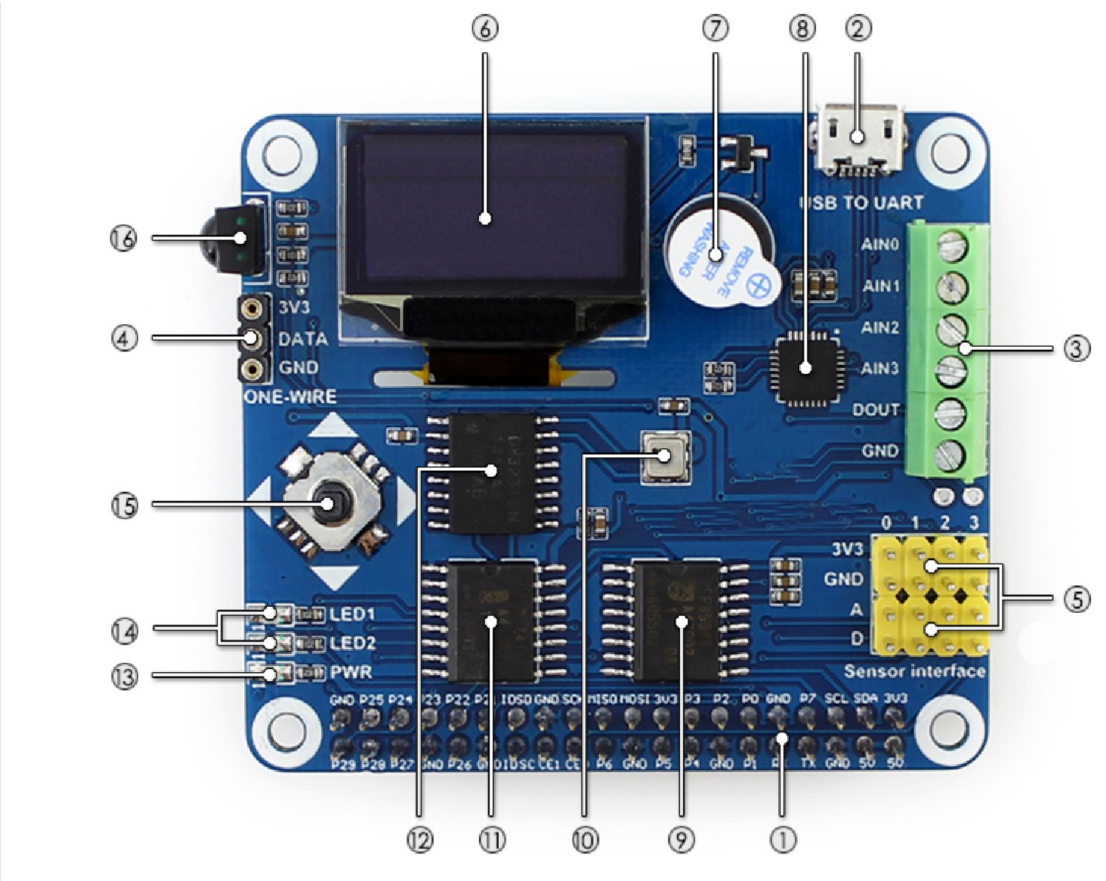
RPi - Explorer700



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1. Connections



1. Raspberry Pi GPIO interface: to connect with Raspberry Pi
2. USB to UART: control the Pi with serial terminal
3. AD/DA IO interface: screw terminal
4. 1-WIRE interface: to connect 1-WIRE devices like DS18B20
5. Sensor interface: to connect various sensors
6. 0.96 inch OLED: SSD1306 driver, 128x64 resolution, SPI interface
7. Buzzer
8. CP2102: USB to UART converter
9. PCF8591: 8 bit AD/DA converter I2C interface
10. BMP180: pressure sensor, I2C interface
11. PCF8574: I/O expansion chip, I2C interface
12. DS3231: Real-Time-Clock chip, I2C interface
13. Power indicator
14. User LED
15. Joystick
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2. Introduction

Raspberry Pi Expansion Board, Miscellaneous Components, All-in-One

3. Connecting the expansion board and the RPI

The Explorer700 expansion board supports the Raspberry Pi A+ / B+ / 2 / 3 Model B. Before running the sample programs, please make sure the Explorer700 is connected to the RPI and the RPI is powered up by the USB power supply. Without the RPI main board, the sample programs cannot be used on the expansion board.



Connected to Raspberry Pi Model A+:



Connected to Raspberry Pi B+/2/
3 Model B

4. LED sample programs - Changing the LED status

- **bcm2835 program:**

Open the Linux terminal and enter to the corresponding path and run the following commands:
The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/LED/bcm2835 $ make
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/LED/bcm2835 $ sudo ./led
```

Expected result: The LED1 is blinking.
Press the keys **Ctrl+C** to end the program.

- **wiringPi program:**

Enter the Linux terminal, and run the following commands:
The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/LED/wiringPi $
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/LED/wiringPi $ sudo ./led
```

Expected result: The LED1 is blinking.
Press the keys **Ctrl+C** to end the program.

Enter the Linux terminal, and run the following commands:
The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/LED/wiringPi $
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/LED/wiringPi $ sudo ./pwm
```

Expected result: The brightness of the LED1 is changing gradually.
Press the keys **Ctrl+C** to end the program.

- **sysfs program:**

Enter the Linux terminal, and run the following commands:
The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/LED/fs $ make
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/LED/fs $ sudo ./led
```

Expected result: The LED1 blinks 10 times and then the program will automatically quit.

Press the keys **Ctrl+C** to end the program.

- **python program:**

Enter the Linux terminal, and run the following commands:
The command for executing the program:

```
pi@raspberrypi ~/Explorer700/LED/python $ sudo python led.py
```

Expected result: The LED1 is blinking.
Press the keys **Ctrl+C** to end the program.

Enter the Linux terminal, and run the following commands:

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/LED/python $ sudo python pwm.py
```

Expected result: The brightness of the LED1 is changing gradually.
Press the keys **Ctrl+C** to end the program.

5. Key sample programs

- **bcm2835 program:**

Enter the Linux terminal, and run the following commands:
The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/KEY/bcm2835 $ make
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/KEY/bcm2835 $ sudo ./key
```

Expected result:

Press the center key of the joystick, and the terminal will display the following information:

```
Key Test Program!!!!  
KEY PRESS  
KEY PRESS  
KEY PRESS
```

Press the keys **Ctrl+C** to end the program.

- **wiringPi program:**

Enter the Linux terminal, and run the following commands:
The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/KEY/wiringPi $
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/KEY/wiringPi $ sudo ./key
```

Expected result:

Press the center key of the joystick, and the terminal will display the following information:

```
Key Test Program!!!  
KEY PRESS  
KEY PRESS  
KEY PRESS
```

Press the keys **Ctrl+C** to end the program.

- ***python program:***

Enter the Linux terminal, and run the following commands:

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/KEY/python $ sudo ./key.py
```

Expected result:

Press the center key of the joystick, and the terminal will display the following information:

```
Key Test Program  
KEY PRESS  
KEY PRESS  
KEY PRESS
```

Press the keys **Ctrl+C** to end the program.

6. PCF8574 sample programs - I/O expansion demos

- **bcm2835 program:**

Enter the Linux terminal, and run the following commands:

The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/PCF8574/bcm2835 $ make
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/PCF8574/bcm2835 $ sudo ./led
```

Expected result: The LED2 is blinking.

Press the keys **Ctrl+C** to end the program.

Enter the Linux terminal, and run the following commands:

The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/PCF8574/bcm2835 $ make5
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/PCF8574/bcm2835 $ sudo ./pcf8574
```

Expected result: Press the direction keys, then the LED2 will light up, the buzzer will sound, and the terminal will display the following information:

```
PCF8574 Test Program !!!  
up  
left  
down  
right
```

Press the keys **Ctrl+C** to end the program.

- **python program:**

Enter the Linux terminal, and run the following commands:
The command for executing the program:

```
pi@raspberrypi ~/Explorer700/PCF8574/python $ sudo python led.py
```

Expected result: The LED2 is blinking.
Press the keys **Ctrl+C** to end the program.

Enter the Linux terminal, and run the following commands:
The command for executing the program:

```
pi@raspberrypi ~/Explorer700/PCF8574/python $ sudo python pcf8574.py
```

Expected result: Press the direction keys, then the LED2 will light up, the buzzer will sound, and the terminal will display the following information:

```
PCF8574 Test Program !!!  
up  
left  
down  
right
```

Press the keys **Ctrl+C** to end the program.

- **fs program:**

Enter the Linux terminal, and run the following commands:
The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/PCF8574/fs $ make
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/PCF8574/fs $ sudo ./led
```

Expected result: The LED2 is blinking.
Press the keys **Ctrl+C** to end the program.

- **wiringPi program:**

Enter the Linux terminal, and run the following commands:
The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/PCF8574/wiringPi $ make
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/PCF8574/wiringPi $ sudo ./led
```

Expected result: The LED2 is blinking.
Press the keys **Ctrl+C** to end the program.

Enter the Linux terminal, and run the following commands:
The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/PCF8574/wiringPi $ make
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/PCF8574/wiringPi $ sudo ./LED
```

Expected result: The LED2 is blinking.
Press the keys **Ctrl+C** to end the program.

7. BMP180 sample programs- Barometer Demos

- **bcm2835 program:**

Enter the Linux terminal, and run the following commands:
The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/BMP180/bcm2835 $ make
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/BMP180/bcm2835 $ sudo ./BMP180
```

Expected result: The terminal will display the following information:

```
BMP180 Test Program ...  
Temperature: 34.20 C  
Pressure: 1005.12 Pa  
Altitude: 67.66 m
```

Press the keys **Ctrl+C** to end the program.

- **wiringPi program:**

Enter the Linux terminal, and run the following commands:
The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/BMP180/wiringPi $ make
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/BMP180/wiringPi $ sudo ./BMP180
```

Expected result: The terminal will display the following information:

```
BMP180 Test Program ...  
Temperature: 34.20 C  
Pressure: 1005.12 Pa  
Altitude: 67.66 m
```

Press the keys **Ctrl+C** to end the program.

- **python program:**

Enter the Linux terminal, and run the following commands to execute the program:

```
pi@raspberrypi ~/Explorer700/BMP180/python $ sudo python BMP180_example.py
```

Expected result: The terminal will display the following information:

```
Temperature: 34.20 C  
Pressure: 1005.12 Pa  
Altitude: 67.66 m
```

Press the keys **Ctrl+C** to end the program.

8. DS3231 sample programs - High precision RTC Demos

- **bcm2835 program:**

Enter the Linux terminal, and run the following commands:

The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/DS3231/bcm2835 $ make
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/DS3231/bcm2835 $ sudo ./ds3231
```

Expected result: The terminal will display the following information:

```
start.....  
2015/08/12 18:00:00 Wed  
2015/08/12 18:00:01 Wed  
2015/08/12 18:00:02 Wed  
2015/08/12 18:00:03 Wed
```

Press the keys **Ctrl+C** to end the program.

- **wiringPi program:**

Enter the Linux terminal, and run the following commands:
The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/DS3231/wiringPi $ make
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/DS3231/wiringPi $ sudo ./ds3231
```

Expected result: The terminal will display the following information:

```
start.....  
2015/08/12 18:00:00 Wed  
2015/08/12 18:00:01 Wed  
2015/08/12 18:00:02 Wed  
2015/08/12 18:00:03 Wed
```

Press the keys **Ctrl+C** to end the program.

- **python program:**

Enter the Linux terminal, and run the following commands to execute the program:

```
pi@raspberrypi ~/Explorer700/DS3231/python $ sudo python ds3231.py
```

Expected result: The terminal will display the following information:

```
2015/08/12 18:00:00 Wed  
2015/08/12 18:00:01 Wed  
2015/08/12 18:00:02 Wed  
2015/08/12 18:00:03 Wed  
2015/08/12 18:00:04 Wed
```

Press the keys **Ctrl+C** to end the program.

9. DS18B20 sample programs - Temperature sensor Demos

(Notes: To use the DS18B20 program, you should add a line `dtoverlay=w1-gpio-pullup` to the end of the Raspberry Pi boot file `/boot/config.txt`, and restart the RPI to make it take effect. For more detailed information, please refer to the relative Raspberry Pi documents.)

- **sysfs program:**

Enter the Linux terminal, and run the following commands to execute the program:

```
pi@raspberrypi ~/Explorer700/DS18B20/fs $ sudo ./ds18b20
```

Expected result: The terminal will display the following information:

```
rom: 28-00000674869d
temp: 30.437 °C
temp: 30.375 °C
```

Press the keys **Ctrl+C** to end the program.

- **python program:**

Enter the Linux terminal, and run the following commands to execute the program:

```
pi@raspberrypi ~/Explorer700/DS18B20/python $ sudo python ds18b20.py
```

Expected result: The terminal will display the following information:

```
rom: 28-00000674869d
C=29.687 F=85.437
C=29.687 F=85.437
C=29.687 F=85.437
```

Press the keys **Ctrl+C** to end the program.

10. IRM sample programs - Infrared reflective sensor

- **bcm2835 program:**

Enter the Linux terminal, and run the following commands:

The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/IRM/bcm2835 $ make
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/IRM/bcm2835 $ sudo ./irm
```

Expected result: Press the keys on the infrared remote controller, and the terminal will display the relative value of the pressed key.

```
irm test start:  
Get the key: 0x0c  
Get the key: 0x18  
Get the key: 0x5e
```

Press the keys **Ctrl+C** to end the program.

- **wiringPi program:**

Enter the Linux terminal, and run the following commands:

The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/IRM/wiringPi $ make
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/IRM/wiringPi $ sudo ./
```

Expected result: Press the keys on the infrared remote controller, and the terminal will display the relative value of the pressed key.

```
irm test start:  
Get the key: 0x0c  
Get the key: 0x18  
Get the key: 0x5e
```

Press the keys **Ctrl+C** to end the program.

- **python program:**

Enter the Linux terminal, and run the following commands to execute the program:

```
pi@raspberrypi ~/Explorer700/IRM/python $ sudo python irm.py
```

Expected result: Press the keys on the infrared remote controller, and the terminal will display the relative value of the pressed key.

```
IRM Test Start ...  
Get the key: 0x0c  
Get the key: 0x18  
Get the key: 0x5e
```

Press the keys **Ctrl+C** to end the program.

11. UART sample programs - Transmitting the serial data received

Notices: The serial port of RPi is set to terminal debugging mode by default. However, in order to run this sample program, you should disable the terminal debugging function, which means you cannot debug the RPi via the serial port communication any more. In this case, you should employ other methods to debug the RPi before running this program. For example, you can connect an external HDMI displayer to the RPi or use SSH.

- **wiringPi program:**

Enter the Linux terminal, and run the following commands:

The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/UART/wiringPi $ make
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/UART/wiringPi $ sudo ./
```

Expected result: Connect the expansion board to the PC via the USB TO UART interface, and configure the serial communication software on the PC (Here, you can use the software PuTTY to monitor the serial port), selecting the right serial port number and setting the Baud rate to 115200. Then, you can use your PC to send data to the RPi via the serial communication. After the data is received by the RPi, it will be echoed to the serial monitor on the PC.

- **python program:**

Enter the Linux terminal, and run the following commands to execute the program:

```
pi@raspberrypi ~/Explorer700/UART/python $ sudo python uart.py
```

Expected result: It is the same as in the above case.

12. OLED sample programs

- **bcm2835 program:**

Enter the Linux terminal, and run the following commands:
The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/OLED/bcm2835 $
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/OLED/bcm2835 $ sudo ./main
```

Expected result: The OLED shows the LOGO of Waveshare for 2 seconds, and then it will switch to display the current system time.

Press the keys **Ctrl+C** to end the program.

- **wiringPi program:**

Enter the Linux terminal, and run the following commands:
The command for compiling the program:

```
pi@raspberrypi ~/Explorer700/OLED/wiringPi $
```

The command for executing the program:

```
pi@raspberrypi ~/Explorer700/OLED/wiringPi $ sudo ./main
```

Expected result: The OLED shows the LOGO of Waveshare for 2 seconds, and then it will switch to display the current system time.

Press the keys **Ctrl+C** to end the program.

- **python program:**

When using this python program to control the OLED, you need to install another library python-imaging. To install the python-imaging library, you should connect the RPi to the network, and use the line below:

```
sudo apt-get python-imaging
```

Expected result: Entering the following commands under the Terminal to execute the program, you will get different displayed information.

```
pi@raspberrypi ~/Explorer700/OLED/python $ sudo python oled.py
```

```
pi@raspberrypi ~/Explorer700/OLED/python $ sudo python dispchar.py
```

```
pi@raspberrypi ~/Explorer700/OLED/python $ sudo python image.py
```

```
pi@raspberrypi ~/Explorer700/OLED/python $ sudo python animate.py
```

```
pi@raspberrypi ~/Explorer700/OLED/python $ sudo python waveshare.py
```

For more detailed information, please refer to the relative Raspberry Pi documents.

13. Libraries Installation for RPi

In order to use the API examples we provide, related libraries are required, which should be installed manually.

[bcm2835 libraries](#)

[wiringPi libraries](#)

13.1 Install WiringPi Library

[Click to download the wiringPi libraries](#), or you can also obtain the latest version from the WiringPi website:

<https://projects.drogon.net/raspberry-pi/wiringpi/download-and-install/>

Copy the installation package into your own system via a USB flash drive, enter the WiringPi folder, then do this to install:

```
chmod 777 build
./build
```

Run the following command to check the installation:

```
gpio -v
```

13.2 Install C Library bcm2835

Click to download the [bcm2835-1.50 libraries](#). You can also obtain the latest version from the bcm2835 website: <http://www.airspayce.com/mikem/bcm2835/>

Copy the installation package into your own system, enter the bcm2835 libraries folder, then do this to install:

```
./configure
make
sudo make check
sudo make install
```

13.3 Install Python Library

Python Libraries for Raspbian (contain RPi.GPIO and spidev installation packages. See: <https://pypi.python.org/pypi/RPi.GPIO> <https://pypi.python.org/pypi/spidev>) get it by apt-get commands. Please take a note, your Raspberry Pi should be connected to the network when using the command apt-get to install the library. Before the installation, you can run the following command to update your software list.

```
sudo apt-get update
```

1. Run the following command to install the package python-dev

```
sudo apt-get install python-dev
```

2. Installing the RPi.GPIO package (GPIO interface functions). Copy the installation package RPi.GPIO to your RPi board, and unzip it. Enter the unzipped file under the terminal, and run the following command to install the library:

```
sudo python setup.py install
```

3. Run the following command to install the library smbus (I2C interface functions)

```
sudo apt-get install python-smbus
```

4. Run the following command to install the library serial, which contains UART interface functions

```
sudo apt-get install python-serial
```

5. Installing the library spidev (SPI functions). Copy the installation package spidev to your RPi board, and unzip it. Enter the unzip file under the terminal, and run the following command to install the library:

```
sudo python setup.py install
```

13.4 Configuring the interfaces

(Before running the API codes we provided, you should start up the corresponding core drivers of the interfaces. In the ready-to-use system image file, both I2C and SPI are set to Enable by default, but the serial port is still in the terminal debugging function mode.)

1. **Enable the I2C function.** Run the following command to configure your Raspberry Pi board:

```
sudo raspi-config
```

Select Advanced Options -> I2C -> yes, to start up the I2C core driver. Then you also need to modify the configuration file. Run the following command to open the configuration file:

```
sudo nano /etc/modules
```

Add the following two lines to the configuration file

```
i2c-bcm2708
```

```
i2c-dev
```

Press the keys Ctrl+X to exit, and input Y to save the settings. Then, reboot the module to make the settings take effect.

2. **Enable the serial function.** The serial port of RPi is set to serial terminal debugging function mode by default. If you want the serial port services as a common IO, you should modify the settings on the RPi. When the terminal debugging function is disabled, you cannot access RPi board via the serial port any more. If you want to control the RPi, you may need to enable the debugging function of the serial port again.

```
sudo raspi-config
```

Select Advanced Options -> Serial. Select the option no can disable the serial debugging function. And then, the serial port can be used for serial communication. And select the option yes can enable the serial debugging function. You should reboot the module to make the settings take effect.

Note: the serial port on Raspberry Pi 3 Model B is unusable, because Pin 14 and Pin 15 is connected to the on-board Bluetooth model.

1. **Start up the spi function,** run the following command:

```
sudo raspi-config
```

Select Advanced Options -> I2C -> yes, to start up I2C core driver.

14. Code example download

[Code examples](#)

15. Support

If you have any questions , or problems please contact us via e-mail, phone or support system.

E-Mail: service@joy-it.net

Support-System: <http://support.joy-it.net>

Phone: +49 (0)2845 98469 – 66 (11 AM - 6 PM)

Please visit our website for more information:

www.joy-it.net