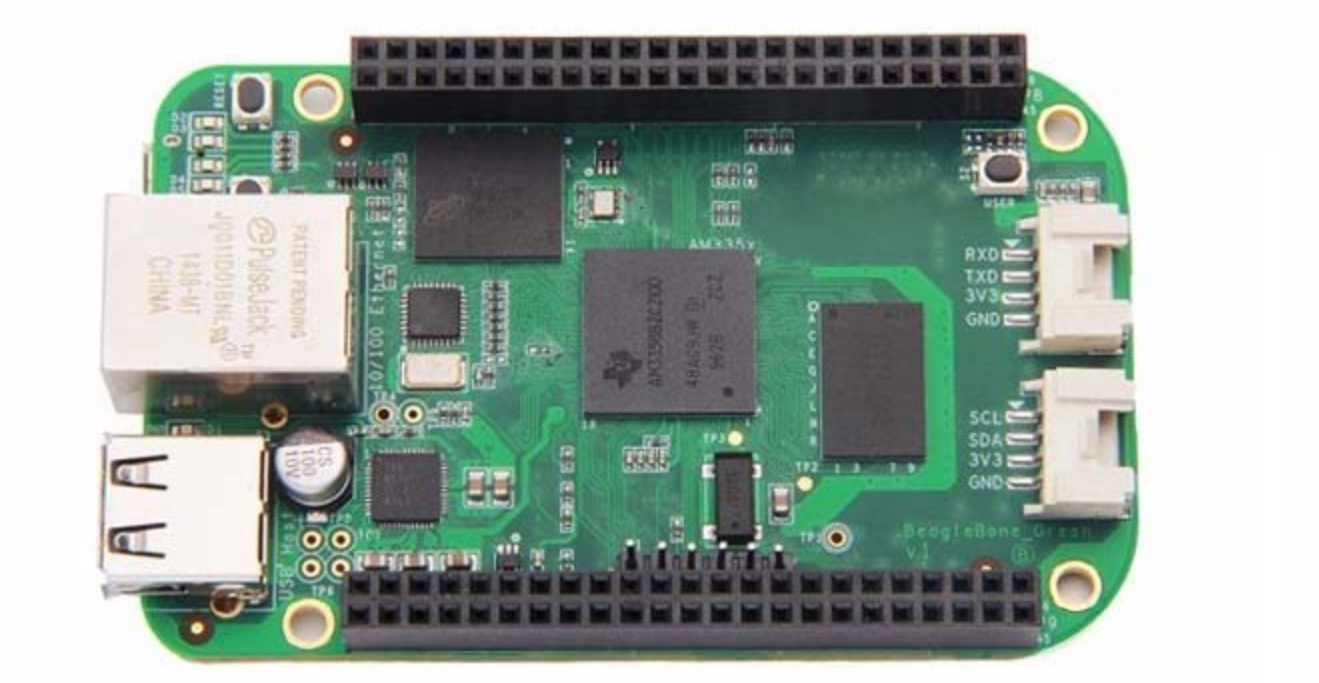
BeagleBone Green



SeeedStudio BeagleBone Green (BBG) is a low cost, open-source, community supported development platform for developers and hobbyists. It is a joint effort by BeagleBoard.org and Seeed Studio. It is based on the classical open-source hardware design of BeagleBone Black and developed into this differentiated version. The BBG includes two Grove connectors, making it easier to connect to the large family of Grove sensors. The on-board HDMI is removed to make room for these Grove connectors.

Boot Linux in under 10 seconds and get started on development in less than 5 minutes with just a single USB cable.

Features

- **Fully Compatible with BeagleBone Black**
- **Processor: AM335x 1GHz ARMR Cortex-A8**
  - 512MB DDR3 RAM
  - 4GB 8-bit eMMC on-board flash storage
  - 3D graphics accelerator
  - NEON floating-point accelerator
  - 2x PRU 32-bit microcontrollers
- **Connectivity**
  - USB client for power & communications
  - USB host
  - Ethernet
  - 2x 46 pin headers
  - 2x Grove connectors (I2C and UART)
- **Software Compatibility**
  - Debian
  - Android
  - Ubuntu
  - Cloud9 IDE on Node.js w/ BoneScript library
  - plus much more

Specification

Item	Value
Processor	AM335x 1GHz ARMR Cortex-A8
RAM	512MB DDR3
on-board Flash Storage	4GB eMMC
CPU Supports	NEON floating-point & 3D graphics accelerator
Micro USB Supports	powering & communications
USB	Host 1
Grove Connectors	2 (One I2C and One UART)
GPIO	2 x 46 pin headers
Ethernet	1
Operating Temperature	0 ~ 75

Application Ideas

- Internet of Things
- Smart House
- Industrial
- Automation & Process Control
- Human Machine Interface
- Sensor Hub
- Robot

Here are some funny projects for your reference.

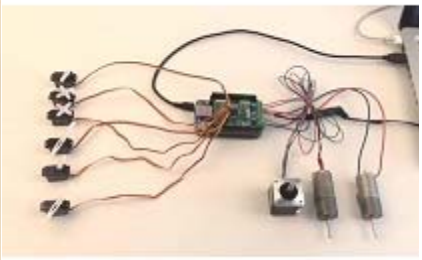
Home Center

MAKE IT NOW!

Retro Lamp

MAKE IT NOW!

Drive a Motor



MAKE IT NOW!

BBG Acrylic Case

MAKE IT NOW!

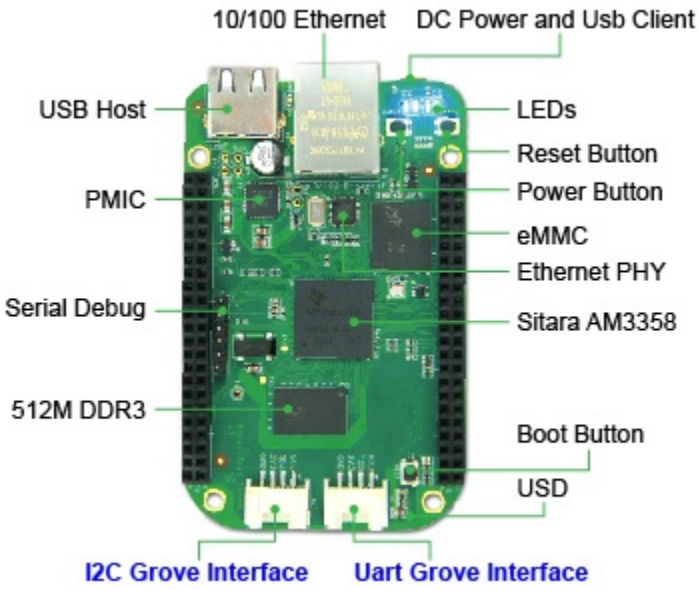
GPIO Control

MAKE IT NOW!

Smart Light

MAKE IT NOW!

Hardware Overview



- **USB Host** - USB Host
- **DC Power and USB Client** - Power the board and act as client
- **LEDs**
  - **D2** is configured at boot to blink in a heartbeat pattern
  - **D3** is configured at boot to light during microSD card accesses
  - **D4** is configured at boot to light during CPU activity
  - **D5** is configured at boot to light during eMMC accesses
- **Boot button**
  - When there's a SD card insert, the system will boot from SD card first, if you want to boot from eMMC, press this button and then power on.
  - Use as a normal button after boot, connect to **GPIO_72**
- **I2C Grove Interface** - Connected to **I2C2**
- **Uart Grove Interface** - Connected to **UART2**
- **Serial Debug** - Connect to **UART0**, PIN1~PIN6: GND, NC, NC, RX, TX, NC, note that pin1 is near to the USB.

Pin map

Each digital I/O pin has 8 different modes that can be selected, including GPIO.

65 Possible Digital I/Os

Note

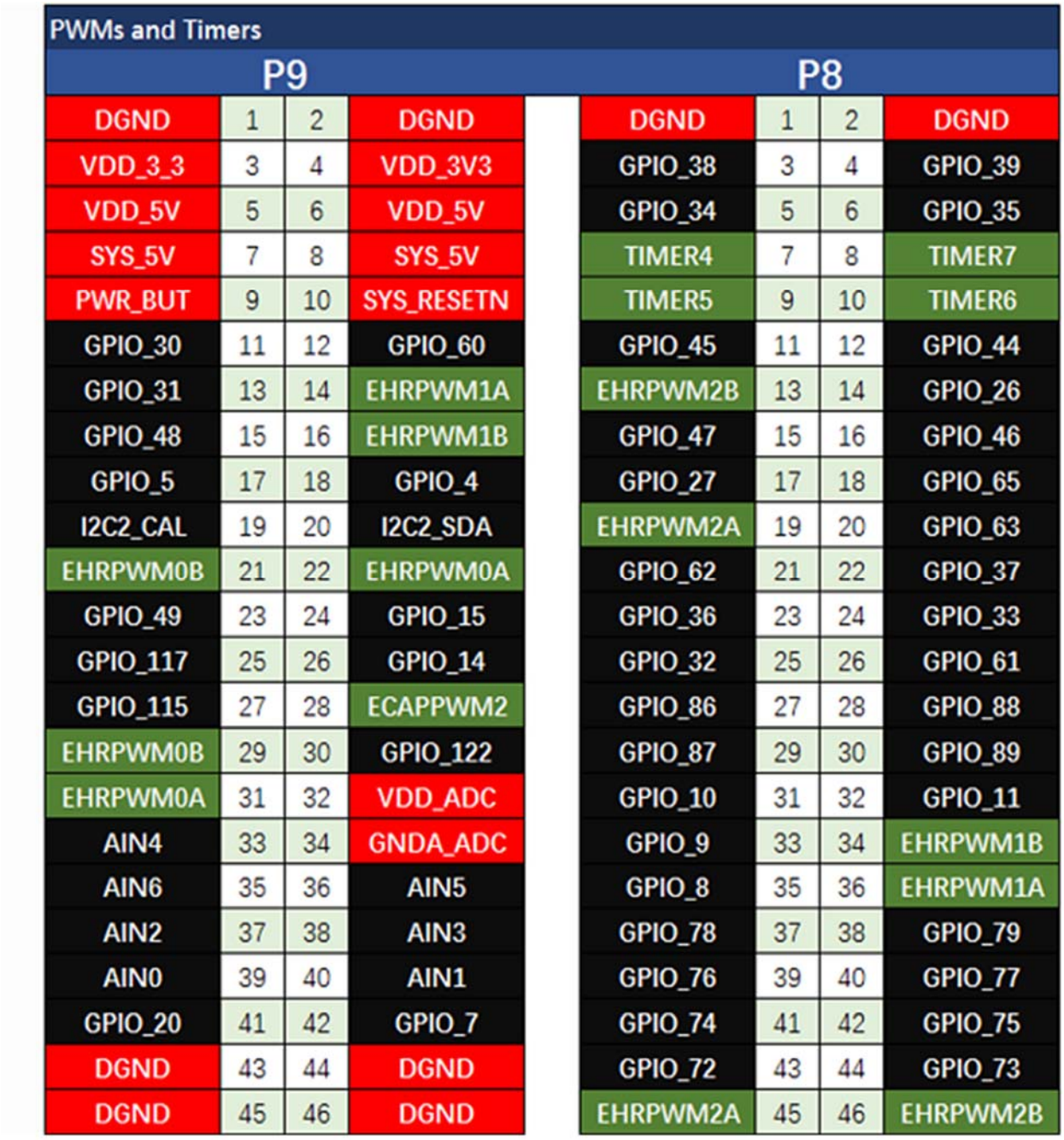
In GPIO mode, each digital I/O can produce interrupts.

65 POSSIBLE DIGITAL I/OS							
P9				P8			
DGND	1	2	DGND	DGND	1	2	DGND
VDD_3_3	3	4	VDD_3V3	GPIO_38	3	4	GPIO_39
VDD_5V	5	6	VDD_5V	GPIO_34	5	6	GPIO_35
SYS_5V	7	8	SYS_5V	GPIO_66	7	8	GPIO_67
PWR_BUT	9	10	SYS_RESETN	GPIO_69	9	10	GPIO_68
GPIO_30	11	12	GPIO_60	GPIO_45	11	12	GPIO_44
GPIO_31	13	14	GPIO_50	GPIO_23	13	14	GPIO_26
GPIO_48	15	16	GPIO_51	GPIO_47	15	16	GPIO_46
GPIO_5	17	18	GPIO_4	GPIO_27	17	18	GPIO_65
I2C2_CAL	19	20	I2C2_SDA	GPIO_22	19	20	GPIO_63
GPIO_3	21	22	GPIO_2	GPIO_62	21	22	GPIO_37
GPIO_49	23	24	GPIO_15	GPIO_36	23	24	GPIO_33
GPIO_117	25	26	GPIO_14	GPIO_32	25	26	GPIO_61
GPIO_115	27	28	GPIO_123	GPIO_86	27	28	GPIO_88
GPIO_121	29	30	GPIO_122	GPIO_87	29	30	GPIO_89
GPIO_120	31	32	VDD_ADC	GPIO_10	31	32	GPIO_11
AIN4	33	34	GNDA_ADC	GPIO_9	33	34	GPIO_81
AIN6	35	36	AIN5	GPIO_8	35	36	GPIO_80
AIN2	37	38	AIN3	GPIO_78	37	38	GPIO_79
AIN0	39	40	AIN1	GPIO_76	39	40	GPIO_77
GPIO_20	41	42	GPIO_7	GPIO_74	41	42	GPIO_75
DGND	43	44	DGND	GPIO_72	43	44	GPIO_73
DGND	45	46	DGND	GPIO_70	45	46	GPIO_71

PWMs and Timers

Note

Up to 8 digital I/O pins can be configured with pulse-width modulators (PWM) to produce signals to control motors or create pseudo analog voltage levels, without taking up any extra CPU cycles.



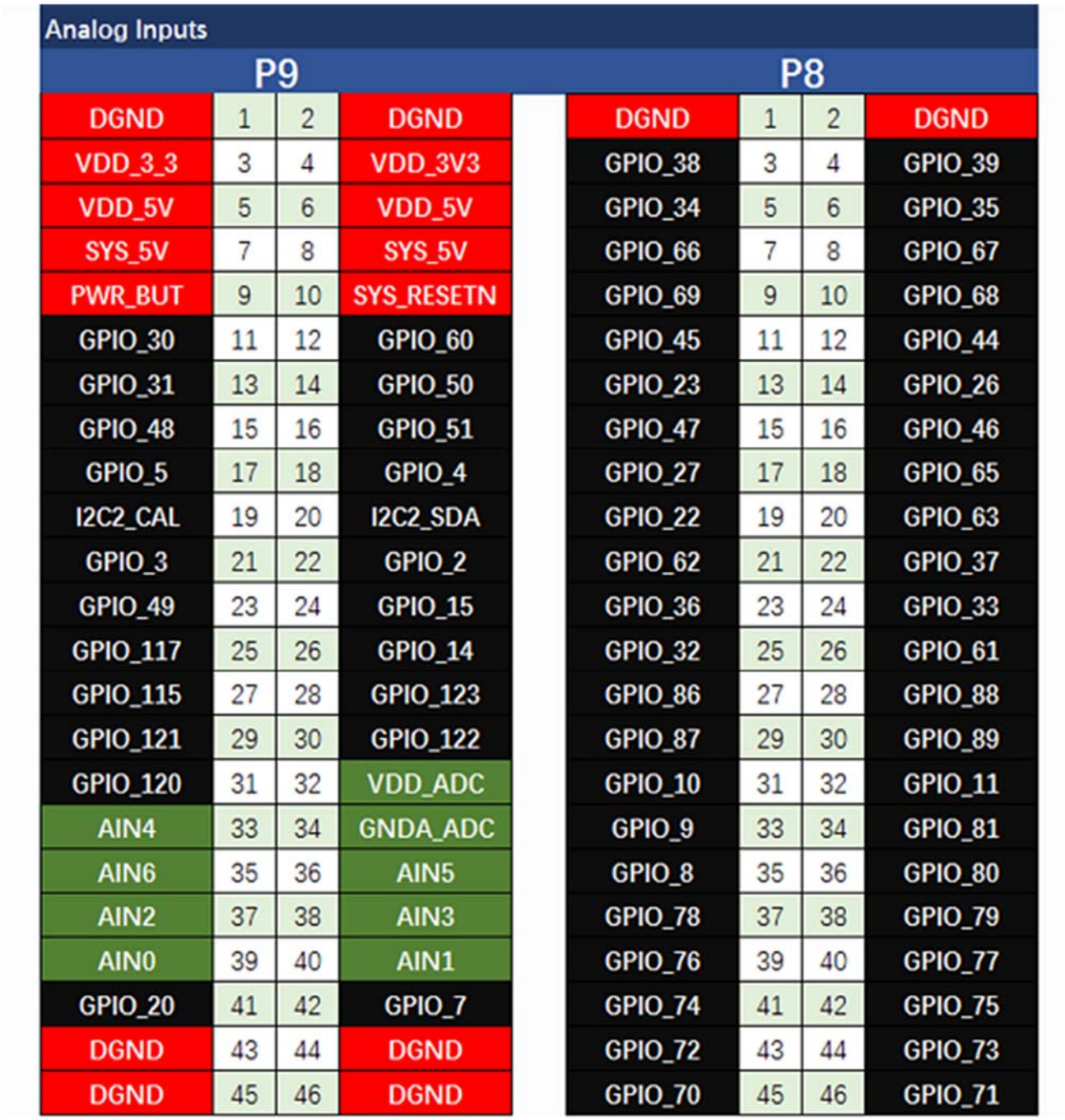
PWMs and Timers

P9				P8			
DGND	1	2	DGND	DGND	1	2	DGND
VDD_3_3	3	4	VDD_3V3	GPIO_38	3	4	GPIO_39
VDD_5V	5	6	VDD_5V	GPIO_34	5	6	GPIO_35
SYS_5V	7	8	SYS_5V	TIMER4	7	8	TIMER7
PWR_BUT	9	10	SYS_RESETN	TIMER5	9	10	TIMER6
GPIO_30	11	12	GPIO_60	GPIO_45	11	12	GPIO_44
GPIO_31	13	14	EHRPWM1A	EHRPWM2B	13	14	GPIO_26
GPIO_48	15	16	EHRPWM1B	GPIO_47	15	16	GPIO_46
GPIO_5	17	18	GPIO_4	GPIO_27	17	18	GPIO_65
I2C2_CAL	19	20	I2C2_SDA	EHRPWM2A	19	20	GPIO_63
EHRPWM0B	21	22	EHRPWM0A	GPIO_62	21	22	GPIO_37
GPIO_49	23	24	GPIO_15	GPIO_36	23	24	GPIO_33
GPIO_117	25	26	GPIO_14	GPIO_32	25	26	GPIO_61
GPIO_115	27	28	ECAPPWM2	GPIO_86	27	28	GPIO_88
EHRPWM0B	29	30	GPIO_122	GPIO_87	29	30	GPIO_89
EHRPWM0A	31	32	VDD_ADC	GPIO_10	31	32	GPIO_11
AIN4	33	34	GNDA_ADC	GPIO_9	33	34	EHRPWM1B
AIN6	35	36	AIN5	GPIO_8	35	36	EHRPWM1A
AIN2	37	38	AIN3	GPIO_78	37	38	GPIO_79
AIN0	39	40	AIN1	GPIO_76	39	40	GPIO_77
GPIO_20	41	42	GPIO_7	GPIO_74	41	42	GPIO_75
DGND	43	44	DGND	GPIO_72	43	44	GPIO_73
DGND	45	46	DGND	EHRPWM2A	45	46	EHRPWM2B

Analog Inputs

Note

Make sure you don't input more than 1.8V to the analog input pins. This is a single 12-bit analog-to-digital converter with 8 channels, 7 of which are made available on the headers.



Analog Inputs

P9				P8			
DGND	1	2	DGND	DGND	1	2	DGND
VDD_3_3	3	4	VDD_3V3	GPIO_38	3	4	GPIO_39
VDD_5V	5	6	VDD_5V	GPIO_34	5	6	GPIO_35
SYS_5V	7	8	SYS_5V	GPIO_66	7	8	GPIO_67
PWR_BUT	9	10	SYS_RESETN	GPIO_69	9	10	GPIO_68
GPIO_30	11	12	GPIO_60	GPIO_45	11	12	GPIO_44
GPIO_31	13	14	GPIO_50	GPIO_23	13	14	GPIO_26
GPIO_48	15	16	GPIO_51	GPIO_47	15	16	GPIO_46
GPIO_5	17	18	GPIO_4	GPIO_27	17	18	GPIO_65
I2C2_CAL	19	20	I2C2_SDA	GPIO_22	19	20	GPIO_63
GPIO_3	21	22	GPIO_2	GPIO_62	21	22	GPIO_37
GPIO_49	23	24	GPIO_15	GPIO_36	23	24	GPIO_33
GPIO_117	25	26	GPIO_14	GPIO_32	25	26	GPIO_61
GPIO_115	27	28	GPIO_123	GPIO_86	27	28	GPIO_88
GPIO_121	29	30	GPIO_122	GPIO_87	29	30	GPIO_89
GPIO_120	31	32	VDD_ADC	GPIO_10	31	32	GPIO_11
AIN4	33	34	GNDA_ADC	GPIO_9	33	34	GPIO_81
AIN6	35	36	AIN5	GPIO_8	35	36	GPIO_80
AIN2	37	38	AIN3	GPIO_78	37	38	GPIO_79
AIN0	39	40	AIN1	GPIO_76	39	40	GPIO_77
GPIO_20	41	42	GPIO_7	GPIO_74	41	42	GPIO_75
DGND	43	44	DGND	GPIO_72	43	44	GPIO_73
DGND	45	46	DGND	GPIO_70	45	46	GPIO_71

UART

Note

There is a dedicated header for getting to the UART0 pins and connecting a debug cable. Five additional serial ports are brought to the expansion headers, but one of them only has a single direction brought to the headers.

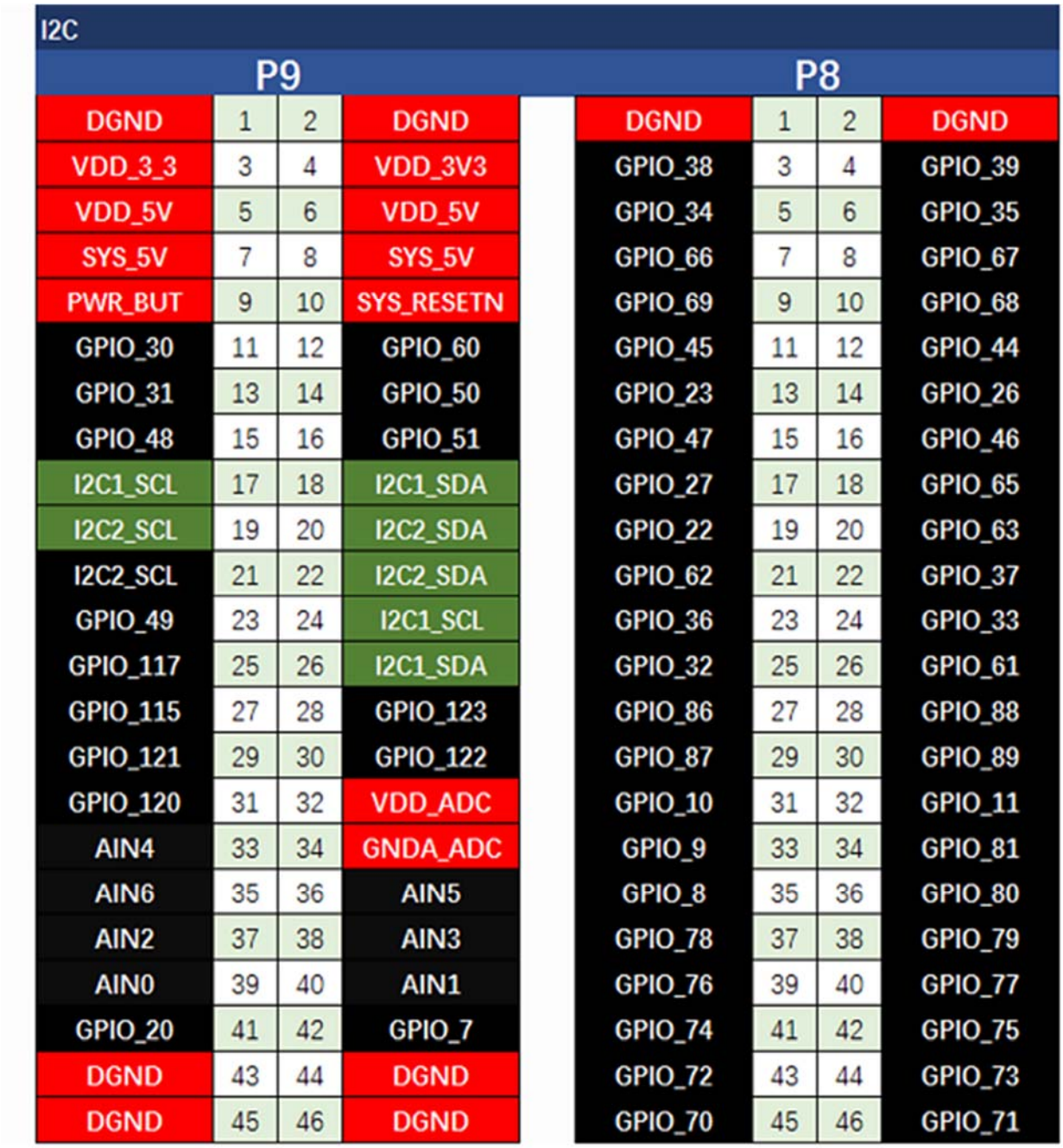
UART

P9				P8			
DGND	1	2	DGND	DGND	1	2	DGND
VDD_3_3	3	4	VDD_3V3	GPIO_38	3	4	GPIO_39
VDD_5V	5	6	VDD_5V	GPIO_34	5	6	GPIO_35
SYS_5V	7	8	SYS_5V	GPIO_66	7	8	GPIO_67
PWR_BUT	9	10	SYS_RESETN	GPIO_69	9	10	GPIO_68
UART4_RXD	11	12	GPIO_60	GPIO_45	11	12	GPIO_44
UART4_TXD	13	14	GPIO_50	GPIO_23	13	14	GPIO_26
GPIO_48	15	16	GPIO_51	GPIO_47	15	16	GPIO_46
GPIO_5	17	18	GPIO_4	GPIO_27	17	18	GPIO_65
UART1_RTSN	19	20	UART1_CTSN	GPIO_22	19	20	GPIO_63
UART2_TXD	21	22	UART2_RXD	GPIO_62	21	22	GPIO_37
GPIO_49	23	24	UART1_TXD	GPIO_36	23	24	GPIO_33
GPIO_117	25	26	UART1_RXD	GPIO_32	25	26	GPIO_61
GPIO_115	27	28	GPIO_123	GPIO_86	27	28	GPIO_88
GPIO_121	29	30	GPIO_122	GPIO_87	29	30	GPIO_89
GPIO_120	31	32	VDD_ADC	UART5_CTSN+	31	32	UART5_RTSN
AIN4	33	34	GNDA_ADC	UART4_RTSN	33	34	UART3_RTSN
AIN6	35	36	AIN5	UART_4_CTSN	35	36	UART3_CTSN
AIN2	37	38	AIN3	UART5_TXD+	37	38	UART5_RXD+
AIN0	39	40	AIN1	GPIO_76	39	40	GPIO_77
GPIO_20	41	42	GPIO_7	GPIO_74	41	42	GPIO_75
DGND	43	44	DGND	GPIO_72	43	44	GPIO_73
DGND	45	46	DGND	GPIO_70	45	46	GPIO_71

I2C

Note

The first I2C bus is utilized for reading EEPROMS on cape add-on boards and can't be used for other digital I/O operations without interfering with that function, but you can still use it to add other I2C devices at available addresses. The second I2C bus is available for you to configure and use.



P9				P8			
DGND	1	2	DGND	DGND	1	2	DGND
VDD_3_3	3	4	VDD_3V3	GPIO_38	3	4	GPIO_39
VDD_5V	5	6	VDD_5V	GPIO_34	5	6	GPIO_35
SYS_5V	7	8	SYS_5V	GPIO_66	7	8	GPIO_67
PWR_BUT	9	10	SYS_RESETN	GPIO_69	9	10	GPIO_68
GPIO_30	11	12	GPIO_60	GPIO_45	11	12	GPIO_44
GPIO_31	13	14	GPIO_50	GPIO_23	13	14	GPIO_26
GPIO_48	15	16	GPIO_51	GPIO_47	15	16	GPIO_46
I2C1_SCL	17	18	I2C1_SDA	GPIO_27	17	18	GPIO_65
I2C2_SCL	19	20	I2C2_SDA	GPIO_22	19	20	GPIO_63
I2C2_SCL	21	22	I2C2_SDA	GPIO_62	21	22	GPIO_37
GPIO_49	23	24	I2C1_SCL	GPIO_36	23	24	GPIO_33
GPIO_117	25	26	I2C1_SDA	GPIO_32	25	26	GPIO_61
GPIO_115	27	28	GPIO_123	GPIO_86	27	28	GPIO_88
GPIO_121	29	30	GPIO_122	GPIO_87	29	30	GPIO_89
GPIO_120	31	32	VDD_ADC	GPIO_10	31	32	GPIO_11
AIN4	33	34	GNDA_ADC	GPIO_9	33	34	GPIO_81
AIN6	35	36	AIN5	GPIO_8	35	36	GPIO_80
AIN2	37	38	AIN3	GPIO_78	37	38	GPIO_79
AIN0	39	40	AIN1	GPIO_76	39	40	GPIO_77
GPIO_20	41	42	GPIO_7	GPIO_74	41	42	GPIO_75
DGND	43	44	DGND	GPIO_72	43	44	GPIO_73
DGND	45	46	DGND	GPIO_70	45	46	GPIO_71

SPI

Note

For shifting out data fast, you might consider using one of the SPI ports.

SPI							
P9				P8			
DGND	1	2	DGND	DGND	1	2	DGND
VDD_3_3	3	4	VDD_3V3	GPIO_38	3	4	GPIO_39
VDD_5V	5	6	VDD_5V	GPIO_34	5	6	GPIO_35
SYS_5V	7	8	SYS_5V	GPIO_66	7	8	GPIO_67
PWR_BUT	9	10	SYS_RESETN	GPIO_69	9	10	GPIO_68
GPIO_30	11	12	GPIO_60	GPIO_45	11	12	GPIO_44
GPIO_31	13	14	GPIO_50	GPIO_23	13	14	GPIO_26
GPIO_48	15	16	GPIO_51	GPIO_47	15	16	GPIO_46
SPI0_CS0	17	18	SPI0_D1	GPIO_27	17	18	GPIO_65
SPI1_CS1	19	20	SPI1_CS0	GPIO_22	19	20	GPIO_63
SPI0_D0	21	22	SPI0_SCLK	GPIO_62	21	22	GPIO_37
GPIO_49	23	24	GPIO_15	GPIO_36	23	24	GPIO_33
GPIO_117	25	26	GPIO_14	GPIO_32	25	26	GPIO_61
GPIO_115	27	28	SPI1_CS0	GPIO_86	27	28	GPIO_88
SPI1_D0	29	30	SPI1_D1	GPIO_87	29	30	GPIO_89
SPI1_SCLK	31	32	VDD_ADC	GPIO_10	31	32	GPIO_11
AIN4	33	34	GNDA_ADC	GPIO_9	33	34	GPIO_81
AIN6	35	36	AIN5	GPIO_8	35	36	GPIO_80
AIN2	37	38	AIN3	GPIO_78	37	38	GPIO_79
AIN0	39	40	AIN1	GPIO_76	39	40	GPIO_77
GPIO_20	41	42	SPI1_CS1	GPIO_74	41	42	GPIO_75
DGND	43	44	DGND	GPIO_72	43	44	GPIO_73
DGND	45	46	DGND	GPIO_70	45	46	GPIO_71

Getting Started

Note

This chapter is writing under Win10. The steps are familiar for the other operate systems.

STEP1. Plug in your BBG via USB

Use the provided micro USB cable to plug your BBG into your computer. This will both power the board and provide a development interface. BBG will boot Linux from the on-board 2GB or 4GB eMMC.

BBG will operate as a flash drive providing you with a local copy of the documentation and drivers. Note that this interface may not be used to re-configure the microSD card with a new image, but may be used to update the boot parameters using the uEnv.txt file.

You'll see the PWR LED lit steadily. Within 10 seconds, you should see the other LEDs blinking in their default configurations.

- D2 is configured at boot to blink in a heartbeat pattern

- D3 is configured at boot to light during microSD card accesses
- D4 is configured at boot to light during CPU activity
- D5 is configured at boot to light during eMMC accesses

STEP2. Install Drivers

Install the drivers for your operating system to give you network-over-USB access to your Beagle. Additional drivers give you serial access to your board.

Operating System	USB Drivers	Comments
Windows (64-bit)	64-bit installer	
Windows (32-bit)	32-bit installer	
Mac OS X	Network Serial	Install both sets of drivers.
Linux	mkudevrule.sh	Driver installation isn't required, but you might find a few udev rules helpful.

Note

For Windows system, please note that:

- Windows Driver Certification warning may pop up two or three times. Click "Ignore", "Install" or "Run"
- To check if you're running 32 or 64-bit Windows see this.
- On systems without the latest service release, you may get an error (0xc000007b). In that case, please install and retry:
- You may need to reboot Windows.
- These drivers have been tested to work up to Windows 10

Note

Additional FTDI USB to serial/JTAG information and drivers are available from https://www.ftdichip.com/Drivers/VCP.htm.

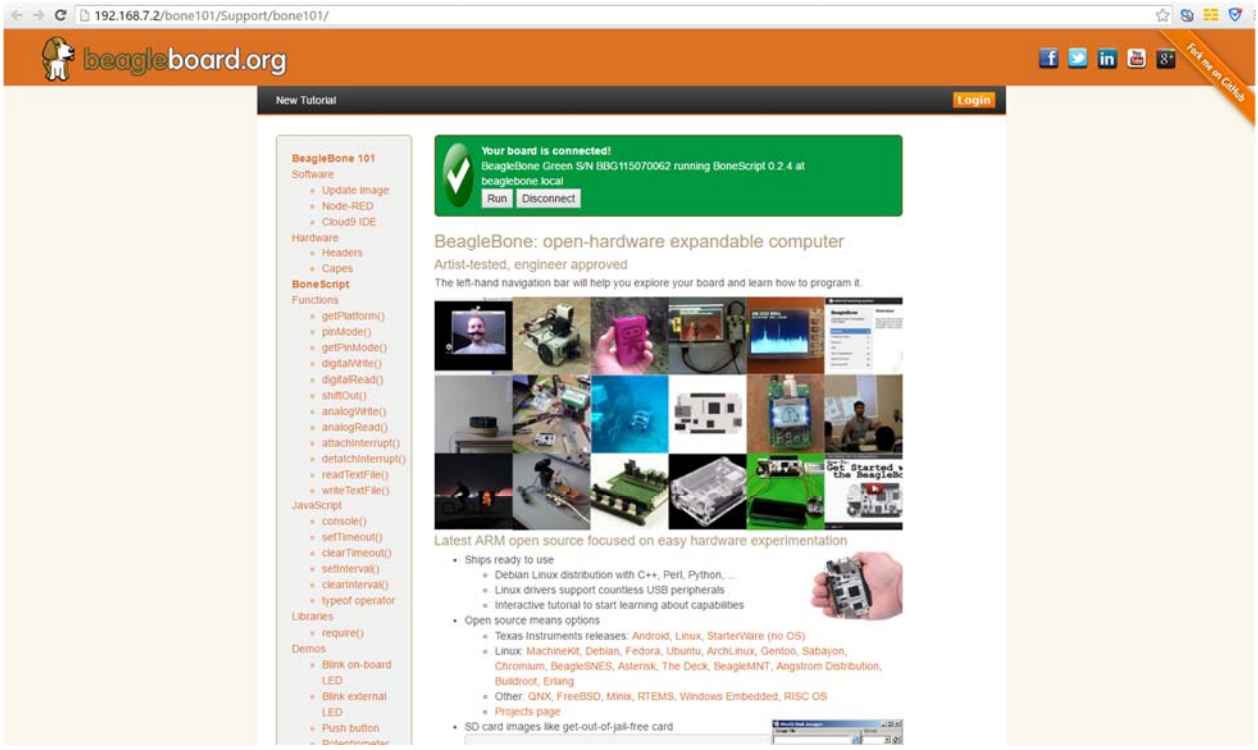
Note

Additional USB to virtual Ethernet information and drivers are available from https://www.linux-usb.org/gadget/ and https://joshuawise.com/horndis.

STEP3. Browse to your Beagle

Using either Chrome or Firefox (Internet Explorer will NOT work), browse to the web server running on your board. It will load a presentation showing you the capabilities of the board. Use the arrow keys on your keyboard to navigate the presentation.

Click http://192.168.7.2 to launch to your BBG. Older software images require you to EJECT the BEAGLE_BONE drive to start the network. With the latest software image, that step is no longer required.



STEP4. Cloud9 IDE

To begin editing programs that live on your board, you can use the Cloud9 IDE by click

Open Cloud9 IDE of BBG

Update to latest software

You need to update the board to latest software to keep a better performance, here we will show you how to make it step by step.

STEP1. Download the latest software image

First of all, you have to download the suitable image here.

Download the latest image of BBG

Note

Due to sizing necessities, this download may take about 30 minutes or more.

The file you download will have an **.img.xz** extension. This is a compressed sector-by-sector image of the SD card.

STEP2. Install compression utility and decompress the image

Download and install 7-zip.

Note

Choose a version that suitable for your system.

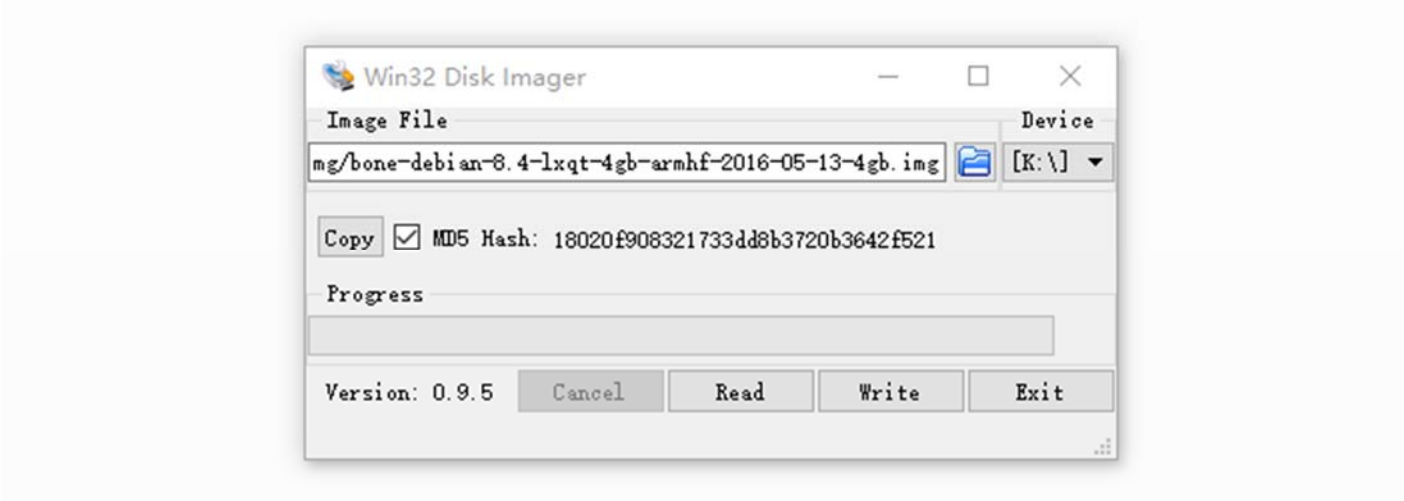
Use 7-zip to decompress the SD card **.img file**

STEP3. Install SD card programming utility

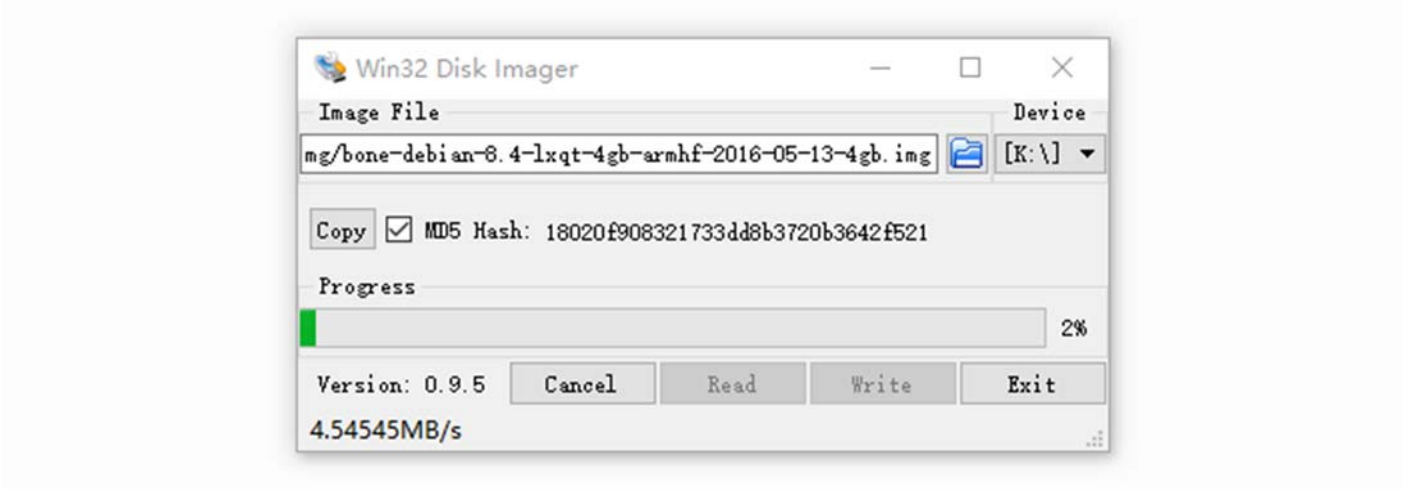
Download and install Image Writer for Windows. Be sure to download the binary distribution.

STEP4. Write the image to your SD card

You need a SD adapter to connect your microSD card to your computer at the first. Then use the software Image Write for Windows to write the decompressed image to your SD card.



Click on **Write** button, then the process is started.



Note

- You may see a warning about damaging your device. This is fine to accept as long as you are pointing to your SD card for writing.
- You should not have your BeagleBone connected to your computer at this time.
- This process may need up to 10 minutes.

STEP5. Boot your board off of the SD card

Insert SD card into your (powered-down first) board. Then the board will boot from the SD card.

Note

If you don't need to write the image to your on-board eMMC, you don't need to read the last of this chapter. Otherwise please go ahead.

If you desire to write the image to your on-board eMMC, you need to launch to the board, and modify a file.

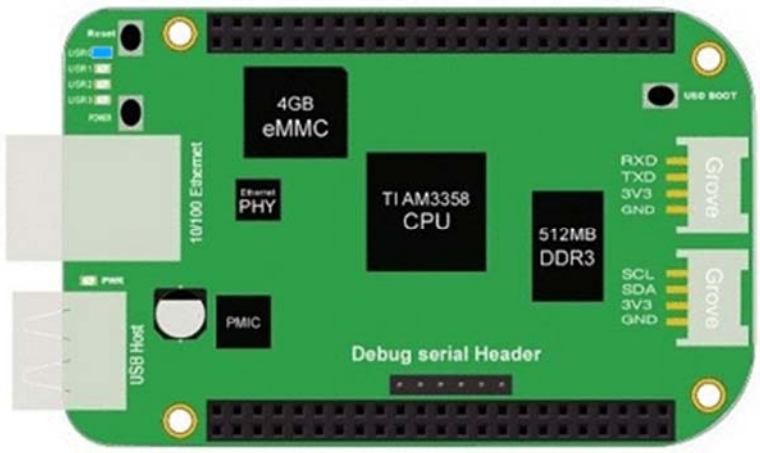
In **/boot/uEnv.txt**:

```
##enable BBB: eMMC Flasher:
#cmdline=init=/opt/scripts/tools/eMMC/init-eMMC-flasher-v3.sh
```

Change to:

```
##enable BBB: eMMC Flasher:
cmdline=init=/opt/scripts/tools/eMMC/init-eMMC-flasher-v3.sh
```

Then you will find the 4 user led light as below



Note

If you don't find the upper tracing light, please press the RESET button to reset the board.

When the flashing is complete, all 4 USRx LEDs will be **off**. The latest Debian flasher images automatically power down the board upon completion. This can take up to **10 minutes**. Power-down your board, remove the SD card and apply power again to be complete.

Grove for BBG

Grove is a modular, standardized connecter prototyping system. Grove takes a building block approach to assembling electronics. Compared to the jumper or solder based system, it is easier to connect, experiment and build and simplifies the learning system, but not to the point where it becomes dumbed down. Some of the other prototype systems out there takes the level down to building blocks. Good stuff to be learned that way, but the Grove system allows you to build real systems. It requires some learning and expertise to hook things up.

Below listed the Grove modules that work well with BBG.

SKU	Name	Interface	link
101020054	Grove - 3-Axis Digital Accelerometer(+16g)	I2C	link
101020071	Grove - 3-Axis Digital Accelerometer(+400g)	I2C	link
101020034	Grove - 3-Axis Digital Compass	I2C	link
101020050	Grove - 3-Axis Digital Gyro	Analog	link
101020081	Grove - 6-Axis Accelerometer&Compass v2.0	I2C	link
101020072	Grove - Barometer Sensor(BMP180)	I2C	link
104030010	Grove - Blue LED	I/O	link
101020003	Grove - Button	I/O	link
111020000	Grove - Button(P)	I/O	link
107020000	Grove - Buzzer	I/O	link
104030006	Grove - Chainable RGB LED	I2C	link
101020030	Grove - Digital Light Sensor	I2C	link
103020024	Grove - Finger-clip Heart Rate Sensor	I2C	link
101020082	Grove - Finger-clip Heart Rate Sensor with shell	I2C	link
113020003	Grove - GPS	UART	link
104030007	Grove - Green LED	I/O	link
103020013	Grove - I2C ADC	I2C	link
103020006	Grove - I2C Hub	I2C	link
101020079	Grove - IMU 10DOF	I2C	link
101020080	Grove - IMU 9DOF v2.0	I2C	link
101020040	Grove - IR Distance Interrupter	I/O	link
104030011	Grove - OLED Display 0.96''	I2C	link

SKU	Name	Interface	link
104030008	Grove - OLED Display 1.12''	I2C	link
104030005	Grove - Red LED	I/O	link
103020005	Grove - Relay	I/O	link
316010005	Grove - Servo	I/O	link
101020023	Grove - Sound Sensor	Analog	link
101020004	Grove - Switch(P)	I/O	link
101020015	Grove - Temperature Sensor	Analog	link
101020019	Grove - Temperature&Humidity Sensor Pro	Analog	link

Cape for BBG

You will need some expansion board when you start a project. There're many cape for BBG already, they include LCD display, motor driver as well as HDMI expansion etc. Below is some of them recommend.

Grove Cape

GET ONE NOW!

Grove Cape

Motor Bridge Cape

GET ONE NOW!

5 Inch LCD

HDMI Cape

GET ONE NOW!

7 Inch LCD

Grove Cape | Motor Bridge Cape | HDMI Cape

GET ONE NOW! | GET ONE NOW! | GET ONE NOW!

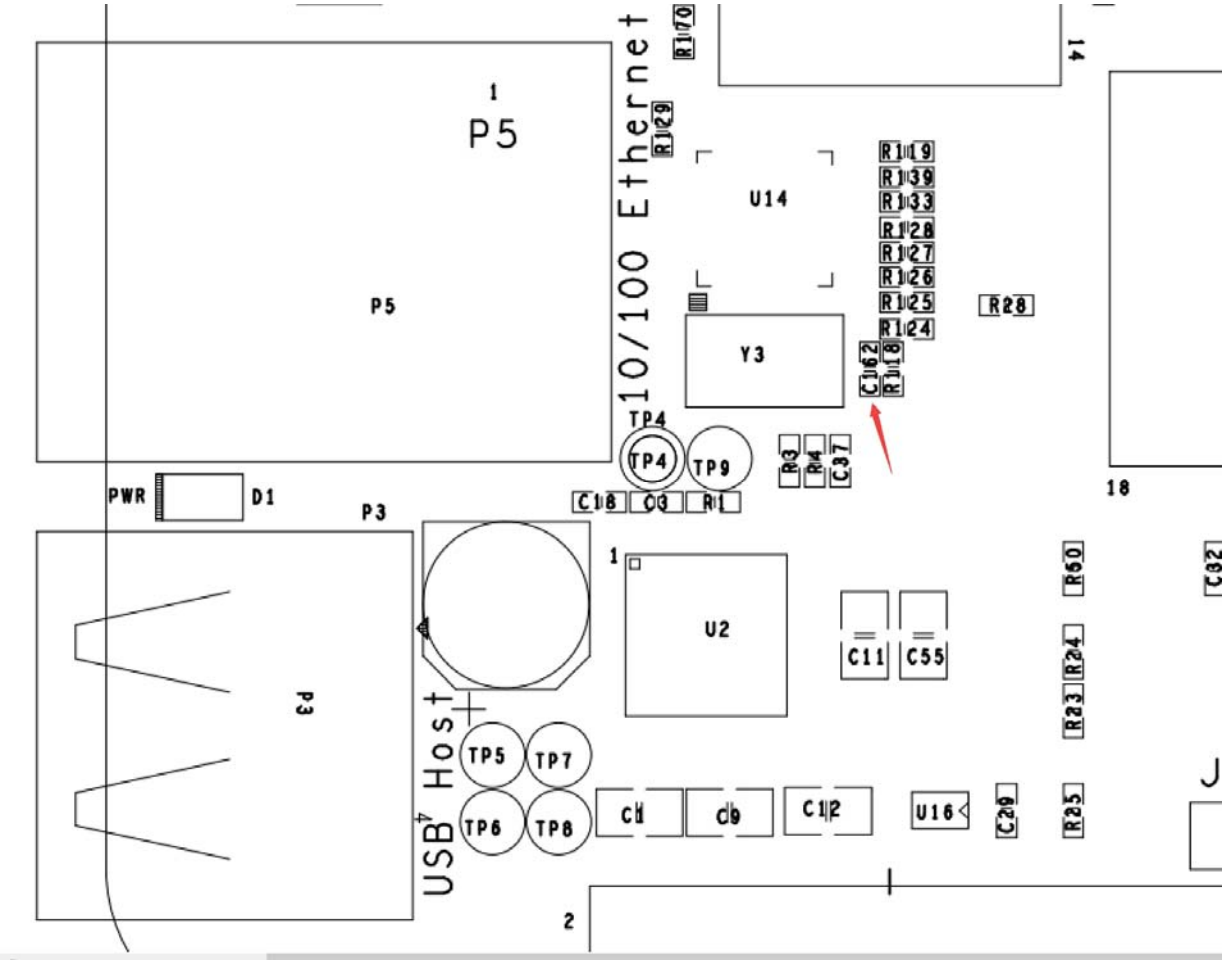
FAQ

1. What is the different between BBG 1 and BBG 2?

We have updated the eMMC on Beaglebone Green in 2016. So the previous firmware for BBG1 is not workable on BBG2, but the new firmware is ok on BBG1 and BBG2.

2. Sometimes the BBG's network port does not work and must be restarted to resume work. Occasionally this happens.

Please replace a stable power supply and try again. Usually mobile phone USB power adapter is more stable than that computer USB. Or you can remove the capacitor C162.



References

There're many references to help you to get more information about the board.

- BeagleBoard Main Page
- BeagleBone Green info at BeagleBoard page
- BeagleBoard Getting Started
- Troubleshooting
- Hardware documentation
- Projects of BeagleBoard
- CE certification of BBG
- FCC certification of BBG

Resources

- **[PDF]** BEAGLEBONE_GREEN SRM(v1a)(pdf)
- **[PDF]** BEAGLEBONE_GREEN SRM(v3)(pdf)
- **[PDF]** BEAGLEBONE_GREEN Schematic(pdf)
- **[RAR]** BEAGLEBONE_GREEN Schematic(OrCAD)
- **[RAR]** BEAGLEBONE_GREEN PCB(OrCAD)
- **[Zip]** AM335X Datasheet

Tech Support

Please do not hesitate to contact techsupport@seeed.cc if you have any technical issue. Or submit the issue into our forum.