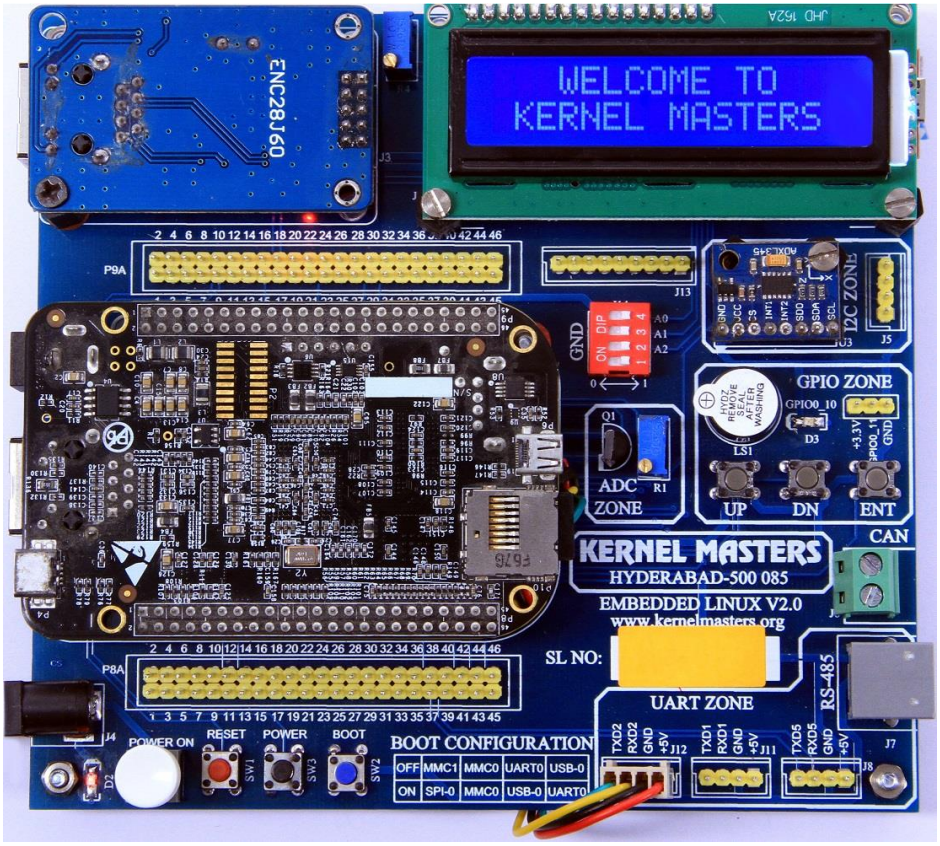
Kernel Masters BeagleBone Black Expansion Board User Manual Rev 4.0



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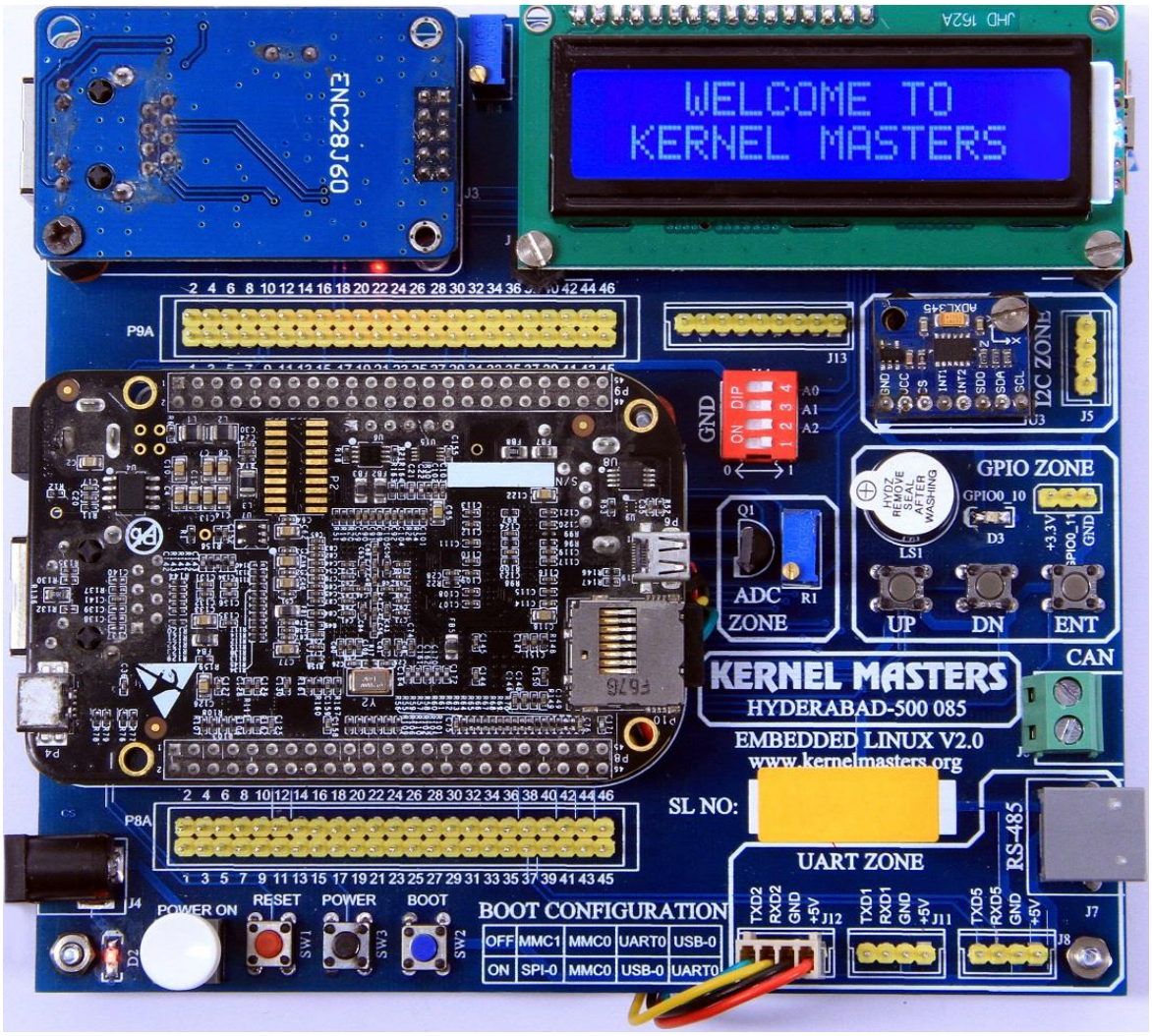
Contents

Chapter 1

1. Board Overview

The BeagleBone Black based Kernel Masters Expansion Board v4.0 is a development platform for developers and hobbyists, which includes a BeagleBone Black board. BeagleBone Black board uses an AM335x 1GHz ARM® Cortex-A8 processor. Kernel Masters BBB Expansion Board includes everything required either for beginners or experienced users to get started quickly. Figure 1-1 shows a photo of the Kernel Masters BBB Expansion Board v4.0.

Figure 1-1. Kernel Masters BBB Expansion Board v4.0



1.1. Kit Contents

The Kernel Masters BBB Expansion Board Kit contains the following items:

- Kernel Masters BBB Expansion Board
- BeagleBone Black board
- mini USB to USB Type A Cable
- Ethernet cable
- 5V dc power adaptor
- USB – TTL module
- Jumper wires

1.2. Getting Started

Refer the video in www.youtube.com/watch?v=RLneJhUjCn0&t=1186s to get started with Kernel Masters BBB Expansion Board.

1.3. Features

Kernel Masters BBB Expansion board includes the following features:

- BeagleBone Black board featuring a Sitara AM335x 1GHz ARM® Cortex-A8 32-bit RISC processor, with 512MB DDR3L 800MHZ SDRAM and an onboard flash memory of 4GB, 8bit Embedded MMC.
- On board LM35(temperature sensor) and DHT11(temperature and humidity sensor)
- Debug Interface Support
- On board 3-axis accelerometer with high resolution (13-bit) measurement.
- 16x2 Monochrome LCD interface.
- On-board Buzzer
- Power supply to the board – 5V DC Jack
- Up to 8-Kbytes of on – board EEPROM
- On board external RTC
- Switches – Power, User and System push buttons
- 3 onboard LEDs:
    - 1 Power LED and 1 User LEDs
- Supports Debian, Android, Ubuntu, Cloud9 IDE on Node.js w/ BoneScript library and much more.

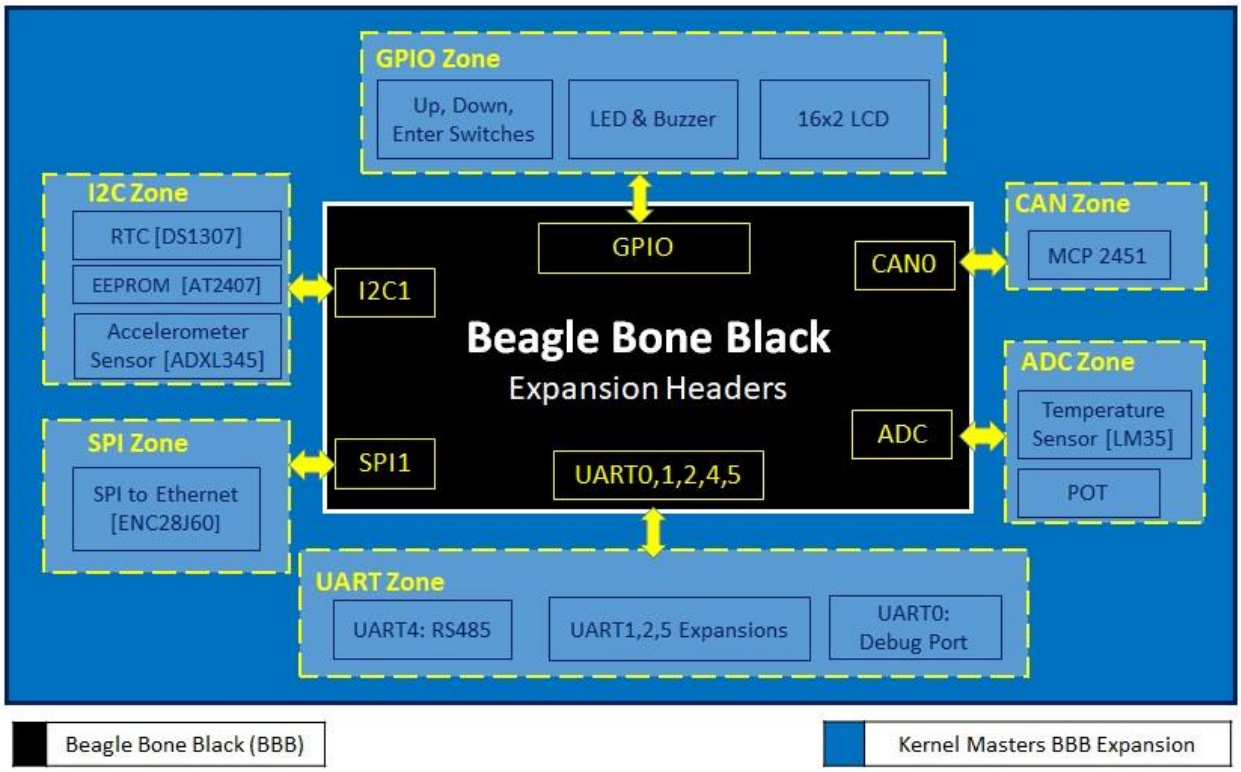
1.4. Specifications

Table 1-1 summarizes the specifications for the Kernel Masters BBB Expansion Board.

Table 1-1. Kernel Masters BBB Expansion Board Specifications

Parameter	Value
Board supply voltage	4.75 VDC to 5.25 VDC from 5V DC Power adaptor
Dimensions	(L x W x H)
Break-out power output	• 3.3 VDC (current rating) • 5.0 VDC (current rating)
RoHS status	Compliant

1.5. Kernel Masters BeagleBone Black Expansion Board Block Diagram



2. Beagle Bone Black Hardware Description

2.1. Overview

The BeagleBone Black is the latest addition to the BeagleBoard.org family. It is a low-cost, high-expansion focused BeagleBoard using a low cost Sitara XAM3359AZCZ100 Cortex A8 ARM processor from Texas Instruments. It is similar to the Beaglebone, but with some features removed and some features added.

It has been equipped with a minimum set of features to allow the user to experience the power of the processor and is not intended as a full development platform as many of the features and interfaces supplied by the processor are not accessible from the BeagleBone Black via onboard support of some interfaces. It is not a complete product designed to do any particular function. It is a foundation for experimentation and learning how to program the processor and to access the peripherals by the creation of your own software and hardware.

2.2. BeagleBone Black Features and Specification

This section covers the specifications and features of the board and provides a high level description of the major components and interfaces that make up the board. The following table lists the key features of the BeagleBone Black.

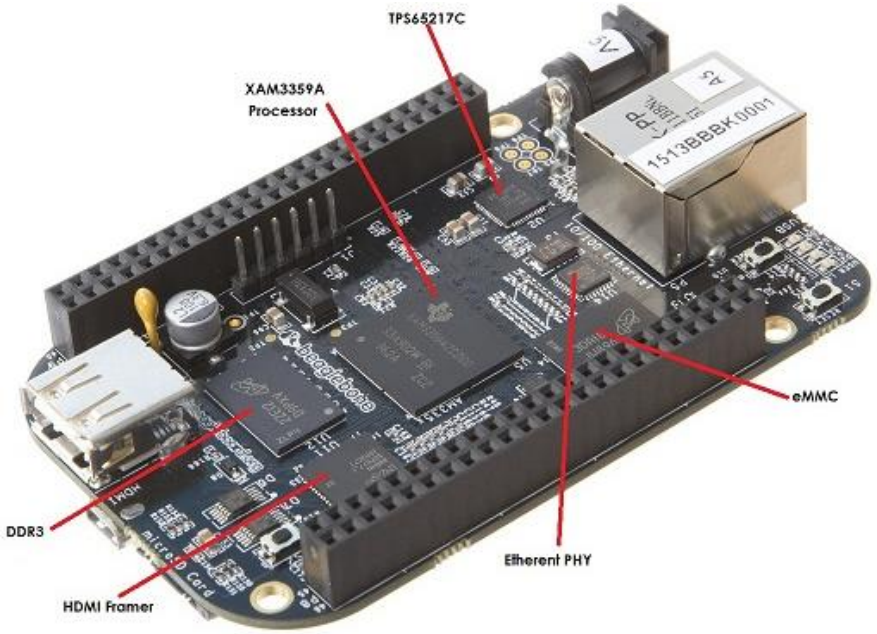
Table 2-1. BeagleBone Black features

	Feature	
Processor	Sitara AM3358BZCZ100 1GHz, 2000 MIPS	
Graphics Engine	SGX530 3D, 20M Polygons/S	
SDRAM Memory	512MB DDR3L 800MHZ	
Onboard Flash	4GB, 8bit Embedded MMC	
PMIC	TPS65217C PMIC regulator and one additional LDO.	
Debug Support	Optional Onboard 20-pin CTI JTAG, Serial Header	
Power Source	miniUSB USB or DC Jack	5VDC External Via Expansion Header
PCB	3.4" x 2.1"	6 layers
Indicators	1-Power, 2-Ethernet, 4-User Controllable LEDs	
HS USB 2.0 Client Port	Access to USB0, Client mode via miniUSB	
HS USB 2.0 Host Port	Access to USB1, Type A Socket, 500mA LS/FS/HS	
Serial Port	UART0 access via 6 pin 3.3V TTL Header. Header is populated	
Ethernet	10/100, RJ45	
SD/MMC Connector	microSD , 3.3V	
User Input	Reset Button Boot Button Power Button	
Video Out	16b HDMI, 1280x1024 (MAX) 1024x768,1280x720,1440x900 ,1920x1080@24Hz w/EDID Support	
Audio	Via HDMI Interface, Stereo	
Expansion Connectors	Power 5V, 3.3V , VDD_ADC(1.8V) 3.3V I/O on all signals McASP0, SPI1, I2C, GPIO(69 max), LCD, GPMC, MMC1, MMC2, 7 AIN(1.8V MAX), 4 Timers, 4 Serial Ports, CAN0, EHRPWM(0,2),XDMA Interrupt, Power button, Expansion Board ID (Up to 4 can be stacked)	
Weight	1.4 oz (39.68 grams)	
Power	Refer to Section 6.1.7	

2.3. Board Component Locations

This section describes the key components on the board. It provides information on their location and function. Below figure shows the locations of the key components on the PCB layout of the board.

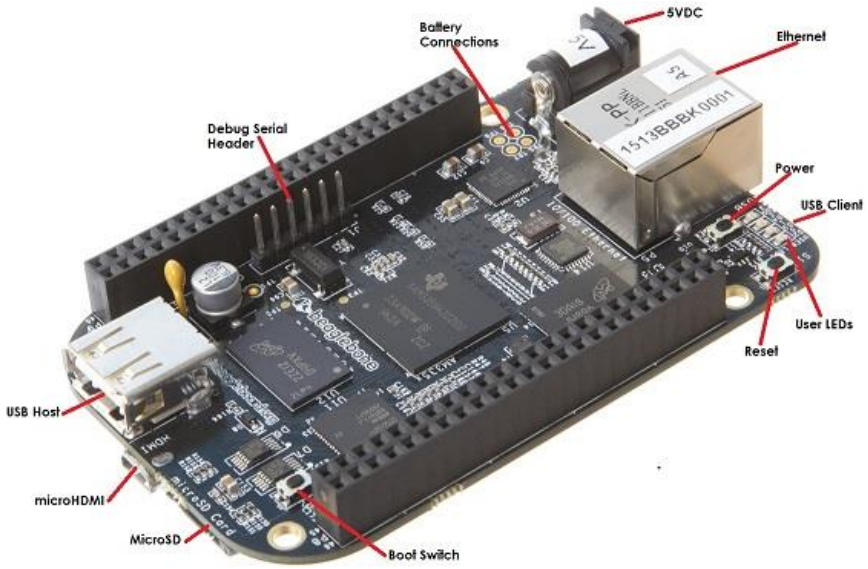
Figure 2-1. BeagleBone Black key components



- **Sitara AM3358BZCZ100** is the processor for the board.
- **Micron 512MB DDR3L** or **Kingston 512mB DDR3** is the Dual Data Rate RAM memory.
- **TPS65217C PMIC** provides the power rails to the various components on the board.
- **SMSC Ethernet PHY** is the physical interface to the network.
- **Micron eMMC** is an onboard MMC chip that holds up to 4GB of data.
- **HDMI** Framer provides control for an HDMI or DVI-D display with an adapter.

Below figure shows the locations of the connectors, LEDs, and switches on the PCB layout of the board.

Figure 2-2. BeagleBone Black Connectors, LEDs and Switches

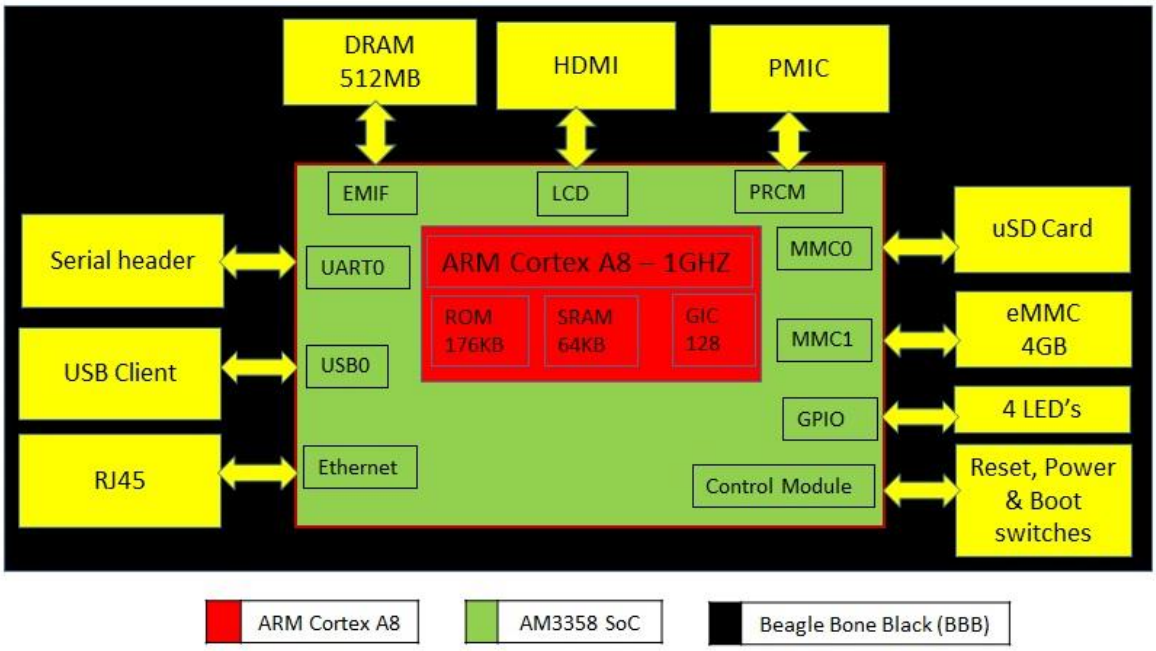


- **DC Power** is the main DC input that accepts 5V power.
- **Power Button** alerts the processor to initiate the power down sequence.
- **10/100 Ethernet** is the connection to the LAN.
- **Serial Debug** is the serial debug port.
- **USB Client** is a miniUSB connection to a PC that can also power the board.
- **BOOT switch** can be used to force a boot from the microSD card if the power is cycled on the board, removing power and reapplying the power to the board..
- There are four blue **LEDS** that can be used by the user.
- **Reset Button** allows the user to reset the processor.
- **microSD** slot is where a microSD card can be installed.
- **microHDMI** connector is where the display is connected to.
- **USB Host** can be connected different USB interfaces such as Wi-Fi, BT, Keyboard, etc.

2.4. Block diagram

The figure below is the high level block diagram of the BeagleBone Black.

Figure 2-3. BeagleBone Black Block diagram



3. Kernel Masters BBB Expansion board Hardware Description

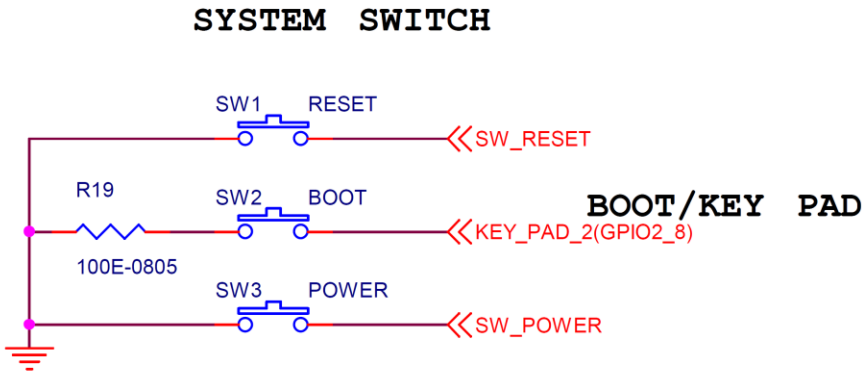
The Kernel Masters BBB Expansion Board includes a range of useful peripheral features.

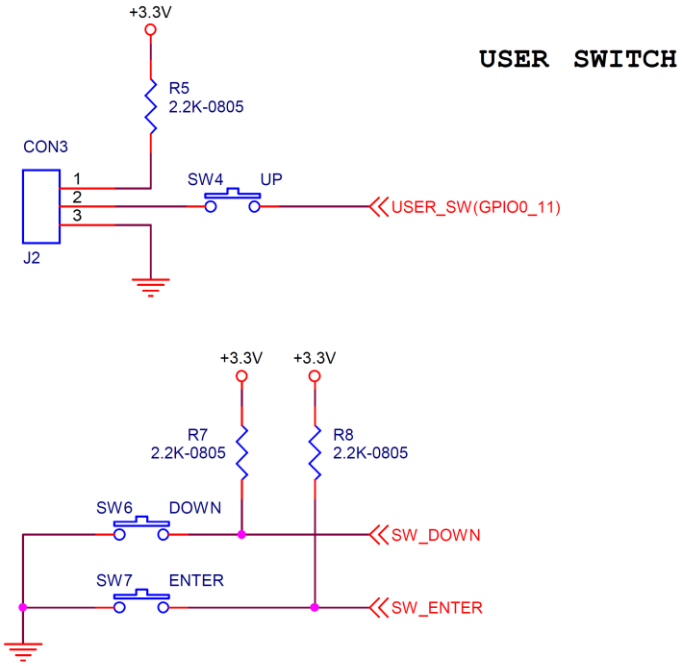
3.1. Switches, Buzzer and LEDs

- Reset button is located near the Power On switch. This is used to reset the board.
- A power button is provided near the reset button close to the Ethernet connector. This button takes advantage of the input to the PMIC for power down features. Some features of power button includes:
  - Interrupt is sent to the processor to facilitate an orderly shutdown to save files and to un-mount drives.
  - Provides ability to let processor put board into a sleep mode to save power.
  - Can alert processor to wake up from sleep mode and restore state before sleep was entered.
  - Allows board to enter the sleep mode, preserving the RTC clock

  If you hold the button down longer than 8 seconds, the BeagleBone Black board will power off if you release the button when the power LED turns off. If you continue to hold it, the board will power back up completing a power cycle.
- There are also three user switches UP, DN and ENTER. These switches are connected to GPIO pins on BeagleBone Black board.

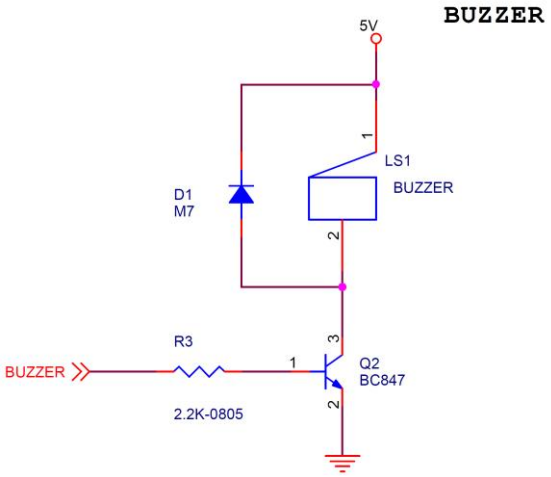
Figure 3-1. Kernel Masters BBB Expansion Board Switch schematics





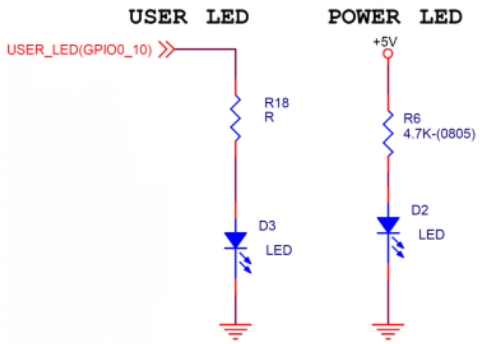
- A Buzzer is also provided on the expansion board that can be configured for custom applications. It is connected to GPIO pin on BeagleBone Black board.

Figure 3-2. Kernel Masters BBB Expansion Board Buzzer schematics



- The power LED will turn on once the expansion board is powered up with 5V DC. The connection of the LED is shown in Figure 3-3.
- There is one user LED on Kernel Masters BeagleBone Black expansion board which is connected to GPIO pin on the BeagleBone Black board. Figure 3-3 shows the interface for the user LED.

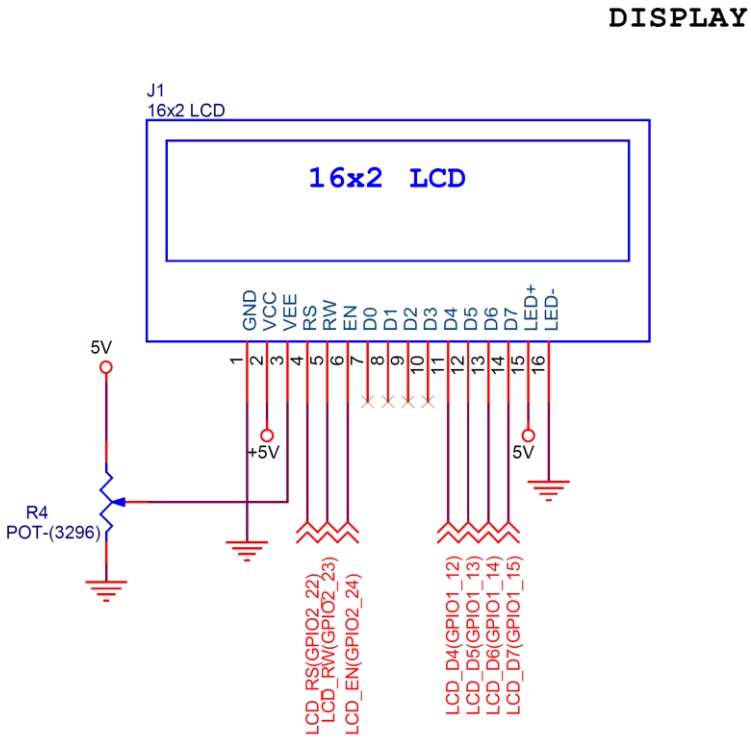
Figure 3-3. Kernel Masters BBB Expansion Board LED schematics



3.2. Display

The Kernel Masters BBB Expansion Board comes with a 16 x 2 Monochrome LCD display that can be used in custom user applications. The LCD can also be removed if it is not required for some application. It is also provided with an LCD trim pot to adjust the brightness of LCD screen.

Figure 3-4. Kernel Masters BBB Expansion Board LCD Display schematics



3.3. Boot configuration

As mentioned earlier, there are four boot modes:

- **eMMC Boot…**This is the default boot mode and will allow for the fastest boot time and will enable the board to boot out of the box using the pre-flashed OS image without having to purchase an microSD card or an microSD card writer.
- **SD Boot…**This mode will boot from the microSD slot. This mode can be used to override what is on the eMMC device and can be used to program the eMMC when used in the manufacturing process or for field updates.
- **Serial Boot…**This mode will use the serial port to allow downloading of the software direct. A separate USB to serial cable is required to use this port.
- **USB Boot…**This mode supports booting over the USB port.

A switch is provided to allow switching between the modes.

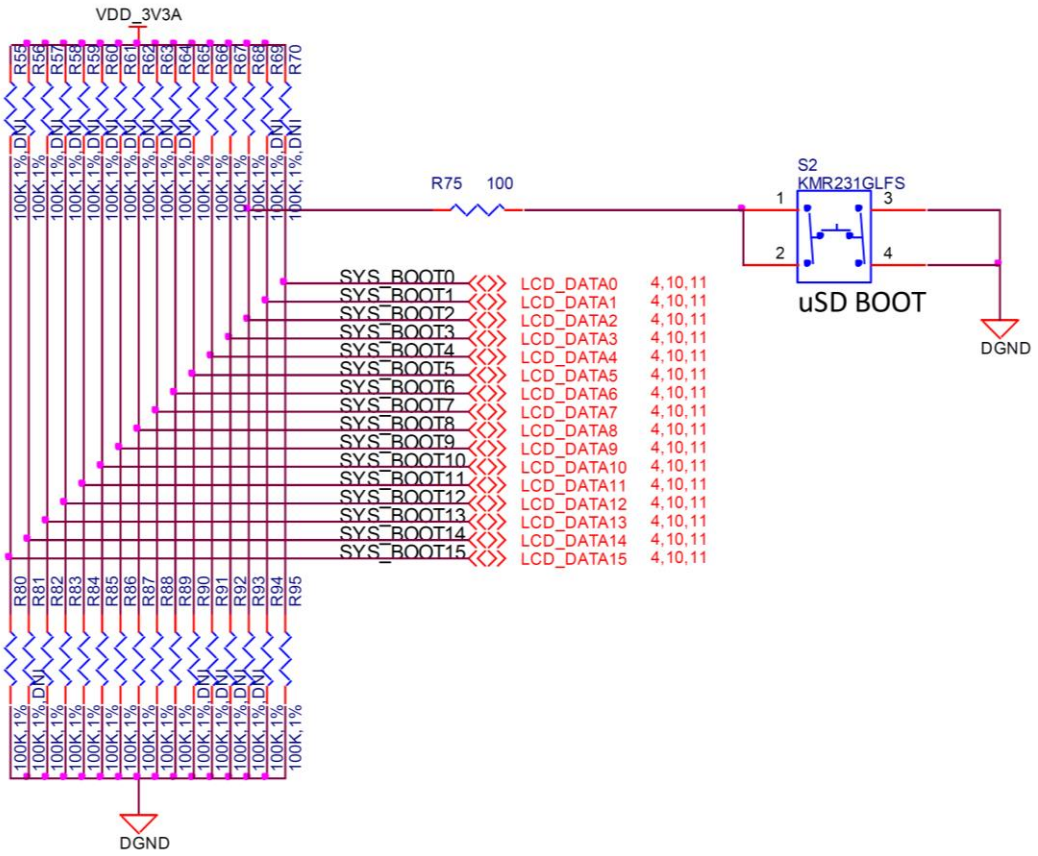
- Holding the boot switch down during a removal and reapplication of power without a microSD card inserted will force the boot source to be the USB port and if nothing is detected on the USB client port, it will go to the serial port for download.
- Without holding the switch, the board will boot try to boot from the eMMC. If it is empty, then it will try booting from the microSD slot, followed by the serial port, and then the USB port.
- If you hold the boot switch down during the removal and reapplication of power to the board, and you have a microSD card inserted with a bootable image, the board will boot from the microSD card.

3.3.1. Boot Configuration Design

On power up, these pins are read by the processor to determine the boot order. S2 is used to change the level of one bit from HI to LO which changes the boot order.

On boot, the processor will look for the eMMC on the MMC1 port first, followed by the microSD slot on MMC0, USB0 and UART0. In the event there is no microSD card and the eMMC is empty, UART0 or USB0 could be used as the board source.

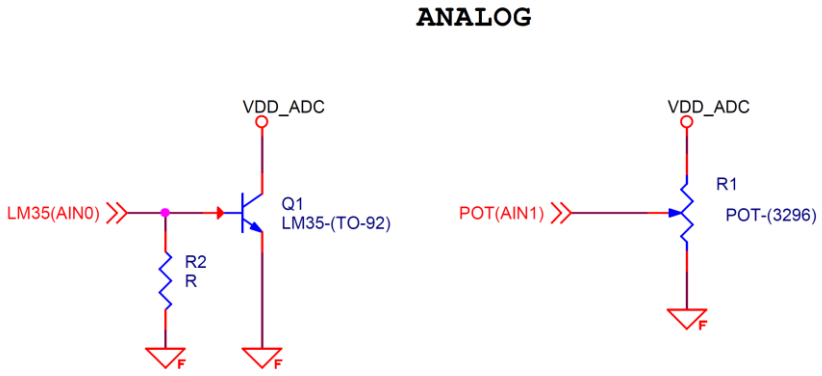
If you have a microSD card from which you need to boot from, hold the boot button down. On boot, the processor will look for the SPIO0 port first, then microSD on the
MMC0 port, followed by USB0 and UART0. In the event there is no microSD card and the eMMC is empty, USB0 or UART0 could be used as the board source.



3.4. ADC Zone

The Kernel Masters BBB Expansion Board is provided with two on-board analog devices which is an LM35 temperature sensor and a potentiometer. One 12-bit analog-to-digital converter is embedded and shares up to 8 external channels.

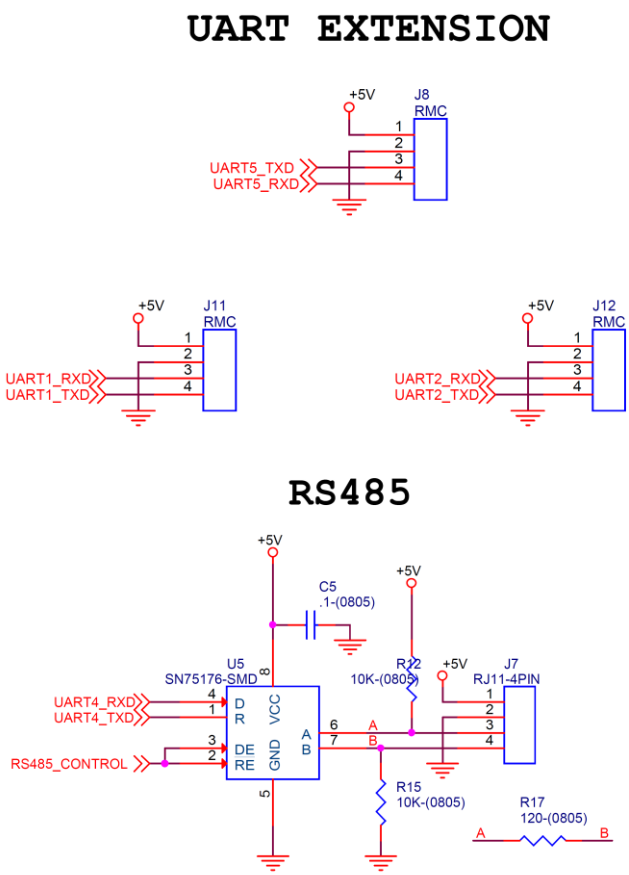
Figure 3-5. Kernel Masters BBB Expansion Board ADC schematics



3.5. UART Zone

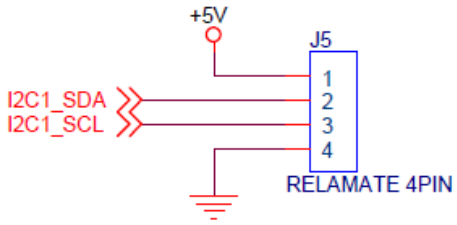
The Expansion Board provides three dedicated UART headers which helps in communicating various peripherals or sensors that may be used in your custom projects. UART headers are J8, J11 AND J12 respectively. J8 is UART5, J11 is UART1 and J12 is UART2 respectively. UART0 access via 6 pin 3.3V TTL Header for serial debug port.

Figure 3-6. Kernel Masters BBB Expansion Board UART schematics



3.6. I2C Zone

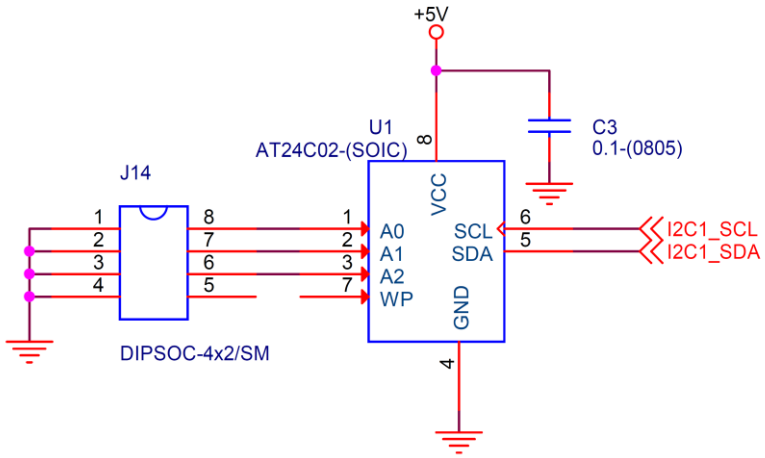
The Kernel Masters BBB Expansion Board uses I2C1 to connect slaves on the board. It is connected to EEPROM (slave address is 0X50H), RTC (slave address is 0X68H) and an accelerometer (slave address is 0x1D).



3.6.1. Electrically Erasable and Programmable Read-Only Memory (EEPROM)

The Kernel Masters BBB Expansion Board provides an EEPROM of size 8K with 2-wire serial interface bus, I2C compatible. It is internally Organized 128 x 8 (1K), 256 x 8 (2K), 512 x 8 (4K), 1024 x 8 (8K) or 2048 x 8 (16K). It also has a write Protect Pin for Hardware Data Protection. The BeagleBone Black Expansion Board uses I2C1 to interface EEPROM.

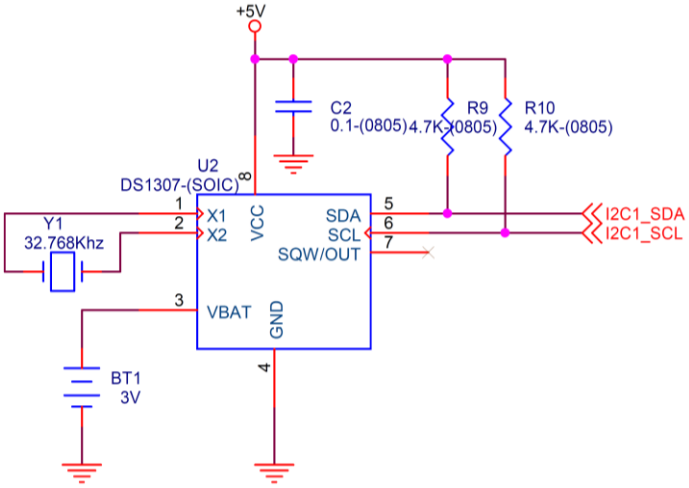
Figure 3-7. Kernel Masters BBB Expansion Board EEPROM schematics



3.6.2. Real Time clock (RTC)

The Kernel Masters BBB Expansion Board provides an external RTC. It is a low power, full binary-coded decimal (BCD) serial Real Time Clock. Address and data are transferred serially through an I2C, bidirectional bus. The clock/calendar provides seconds, minutes, hours, day, date, month, and year information. An external crystal Y1 (32.7 KHz) is also provided exclusively for RTC. The BeagleBone Black Expansion Board uses I2C1 to interface RTC.

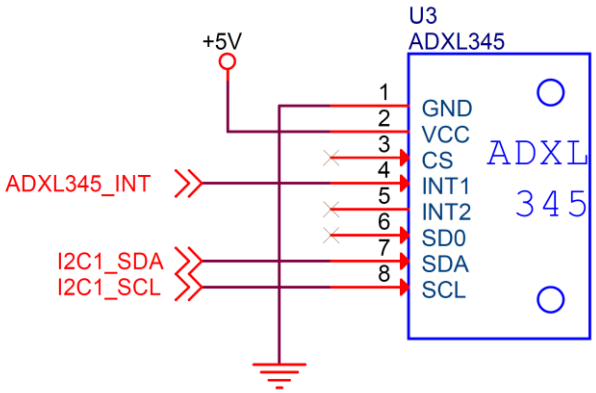
Figure 3-8. Kernel Masters BBB Expansion Board RTC schematics



3.6.3. Digital Accelerometer

The ADXL345 is an ultralow power, 3-axis accelerometer with high resolution (13-bit) measurement at up to ±16 g. Digital output data is formatted as 16-bit twos complement. It is accessed through I2C interface. It measures the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion or shock. The BeagleBone Black Expansion Board uses I2C1 to interface accelerometer.

Figure 3-9. Kernel Masters BBB Expansion Board Accelerometer schematics



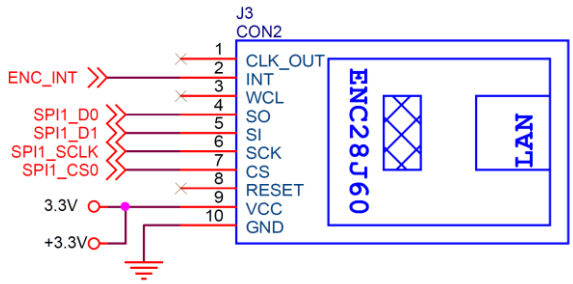
3.7. SPI Zone

The SPI interface can be configured for communication in master mode and slave mode. The BeagleBone Black expansion board uses SPI1 to interface the on-board Ethernet controller with BeagleBone Black Board.

3.7.1. Ethernet Controller with SPI Interface

The BeagleBone Black Expansion board interfaces an on-board Ethernet controller with an industry standard Serial Peripheral Interface (SPI). It is designed to serve as an Ethernet network interface for any controller equipped with SPI with Clock Speeds Up to 20 MHz. It is Fully Compatible with 10/100/1000 Base-T Networks, and also supports Full and Half-Duplex modes. SPI1 is used to interface Ethernet controller.

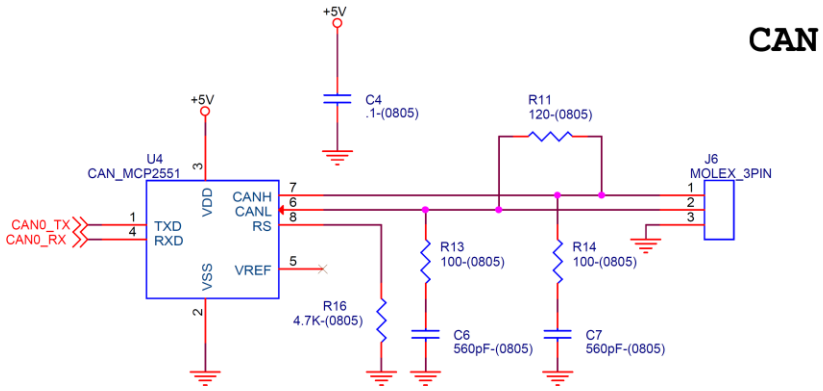
Figure 3-10. Kernel Masters BBB Expansion Board Ethernet controller schematics



3.8. CAN Zone

The Kernel Masters BBB Expansion Board has provided a Controller Area Network extension to interface any devices that works on CAN protocol.

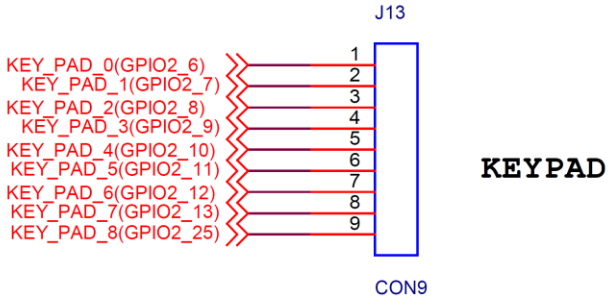
Figure 3-11. Kernel Masters BBB Expansion Board CAN controller schematics



3.9. Keypad

The BeagleBone Black expansion board provides a provision to interface a 5x4 matrix keypad that can be used for many custom projects. The connector uses a total of 9 pins that are connected to the GPIO pins of BeagleBone Black board as shown in the below figure.

Figure 3-12. Kernel Masters BBB Expansion Board Keypad schematics



3.10. Debug Port

Serial debug is provided via UART0 on the processor via a single 1x6 pin header. In order to use the interface a USB to TTL adapter will be required. Signals supported are TX and RX. None of the handshake signals are supported.

Figure 3-13. Kernel Masters BBB Expansion Board Debug port schematics

DEBUG PORT

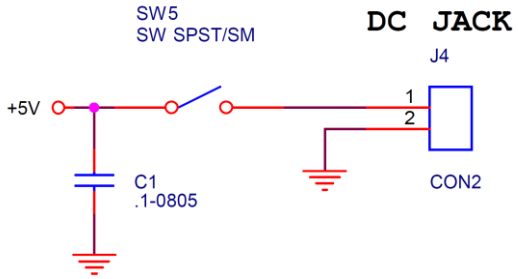
3.11. Power supply

The board can be powered from three different sources:

- A USB port on a PC
- A 5VDC 1A power supply plugged into the DC connector.
- A power supply with a USB connector.

DC power jack is most commonly used to supply power to the board. The board requires a regulated 5VDC +/-.25V supply at 1A.

Figure 3-14. Kernel Masters BBB Expansion Board Power supply schematics



3.12. Expansion Headers

The expansion interface on the board is comprised of two 46 pin connectors. All signals on the expansion headers are 3.3V unless otherwise indicated.

3.12.1. Connector P8

Table 1 shows the pin out of the P8 expansion header. There are some signals that have not been listed here. Refer to the processor documentation for more information on these pins

and detailed descriptions of all of the pins listed. In some cases there may not be enough signals to complete a group of signals that may be required to implement a total interface.

Table 3-1. P8 Expansion header

Kernel Masters Beagle Bone Black Pin Mapping					
P8 Header					
AM3358 Soc		BBB Pin Details		Kernel Masters	
Pin Name	Pin No	BBB Pin No	Function Name	Function Name	Mode
	DGND	P8_1	DGND	DGND	DGND
	DGND	P8_2	DGND	DGND	DGND
gpmc_ad6	R9	P8_3	MMC1_DATA6	-	-
gpmc_ad7	T9	P8_4	MMC1_DAT7	-	
gpmc_ad2	R8	P8_5	MMC1_DAT2	-	-
gpmc_ad3	T8	P8_6	MMC1_DAT3	-	-
gpmc_advn_ale	R7	P8_7	TIMER4	-	-
gpmc_oen_ren	T7	P8_8	TIMER7	-	-
gpmc_be0n_cle	T6	P8_9	TIMER5	-	-
gpmc_wen	U6	P8_10	TIMER6	-	-
gpmc_ad13	R12	P8_11	GPIO1_13	LCD_D5	7
GPMC_AD12	T12	P8_12	GPIO1_12	LCD_D4	7
gpmc_ad9	T10	P8_13	EHRPWM2B	-	-
gpmc_ad10	T11	P8_14	GPIO0_26	SW_UP	7
gpmc_ad15	U13	P8_15	GPIO1_15	LCD_D7	7
gpmc_ad14	V13	P8_16	GPIO1_14	LCD_D6	7
gpmc_ad11	U12	P8_17	GPIO0_27	SW_DOWN	7
gpmc_clk_mux0	V12	P8_18	GPIO2_1	-	-
gpmc_ad8	U10	P8_19	EHRPWM2A	-	-
gpmc_csn2	V9	P8_20	MMC1_CMD	-	-
gpmc_csn1	U9	P8_21	MMC1_CLK	-	-
gpmc_ad5	V8	P8_22	MMC1_DAT5	-	-
gpmc_ad4	U8	P8_23	MMC1_DAT4	-	-
gpmc_ad1	V7	P8_24	MMC1_DAT1	-	-
gpmc_ad0	U7	P8_25	MMC1_DAT0	-	-
gpmc_csn0	V6	P8_26	GPIO1_29	-	-
lcd_vsync	U5	P8_27	GPIO2_22	LCD_RS	7
lcd_pclk	V5	P8_28	GPIO2_24[]	LCD_EN	7
lcd_hsync	R5	P8_29	GPIO2_23[]	LCD_RW	7
lcd_ac_bias_en	R6	P8_30	GPIO2_25[]	KEY_PAD_8	7
lcd_data14	V4	P8_31	UART5_CTSN	USER_LED	7
lcd_data15	T5	P8_32	UART5_RTSN	USER_SW	7
lcd_data13	V3	P8_33	UART4_RTSN	BUZZER	7
lcd_data11	U4	P8_34	UART3_RTSN	-	-
lcd_data12	V2	P8_35	UART4_CTSN	-	-
lcd_data10	U3	P8_36	UART3_CTSN	-	-
lcd_data8	U1	P8_37	UART5_TXD	UART5_TXD	-
lcd_data9	U2	P8_38	UART5_RXD	UART5_RXD	-
lcd_data6	T3	P8_39	GPIO2_12	KEY_PAD_6	7
lcd_data7	T4	P8_40	GPIO2_13	KEY_PAD_7	7
lcd_data4	T1	P8_41	GPIO2_10	KEY_PAD_4	7
lcd_data5	T2	P8_42	GPIO2_11	KEY_PAD_5	7
lcd_data2	R3	P8_43	GPIO2_8	KEY_PAD_2	7
lcd_data3	R4	P8_44	GPIO2_9	KEY_PAD_3	7
lcd_data0	R1	P8_45	GPIO2_6	KEY_PAD_0	7
lcd_data1		P8_46	GPIO2_7	KEY_PAD_1	7

3.12.2. Connector P9

Table 2 shows the pin out of the P9 expansion header. There are some signals that have not been listed here. Refer to the processor documentation for more information on these pins and detailed descriptions of all of the pins listed. In some cases there may not be enough signals to complete a group of signals that may be required to implement a total interface.

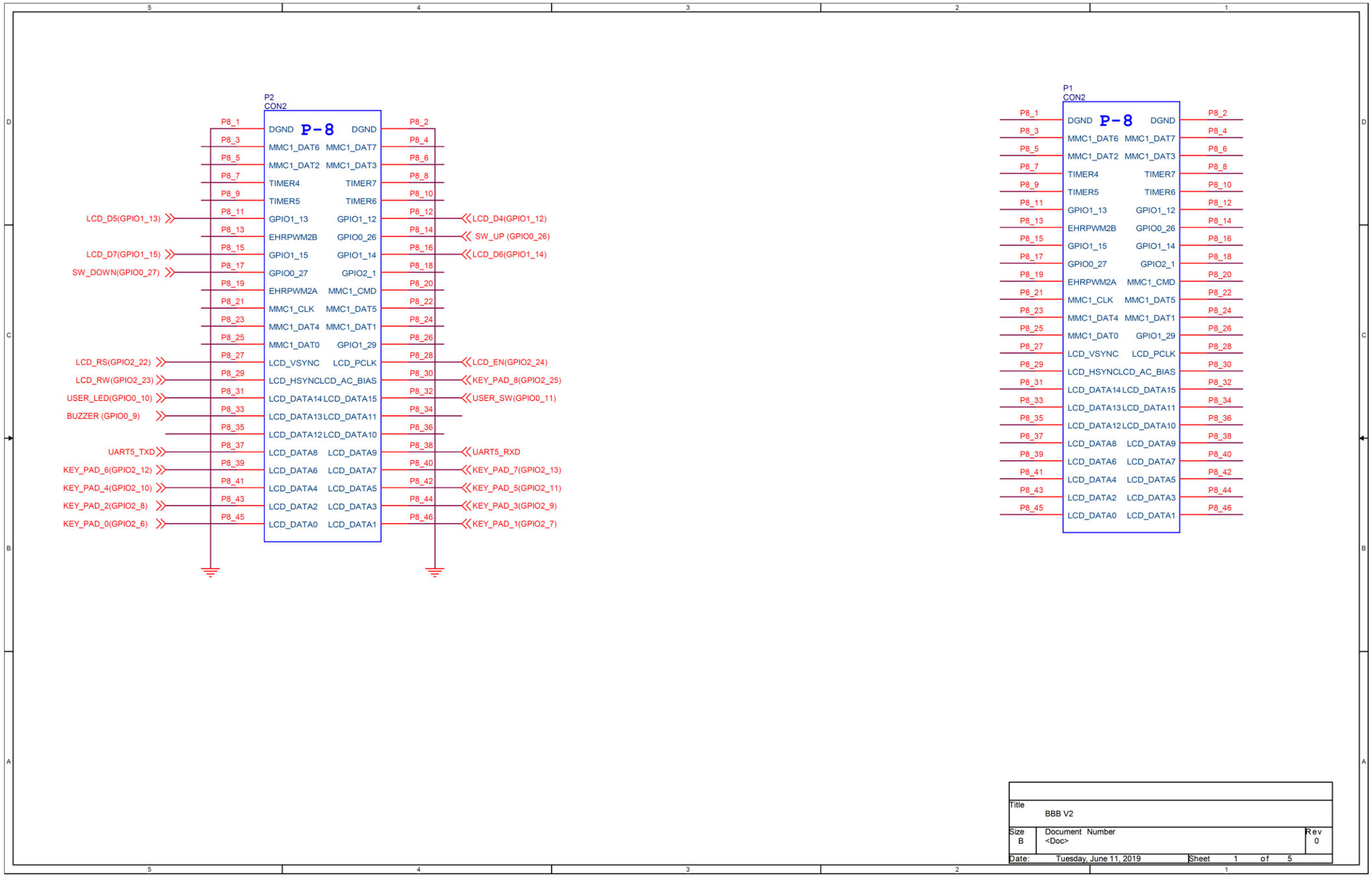
Table 3-1. P9 Expansion header

Kernel Masters Beagle Bone Black Pin Mapping					
P9 Header					
AM3358 Soc		BBB Pin Details		Kernel Masters	
Pin Name	Pin No	BBB Pin No	Function Name	Function Name	Mode
		P9_1	GND	GND	-
		P9_2	GND	GND	-
		P9_3	DC_3.3V	DC_3.3V	-
		P9_4	DC_3.3V	DC_3.3V	-
		P9_5	VDD_5V	VDD_5V	-
		P9_6	VDD_5V	VDD_5V	-
		P9_7	SYS_5V	SYS_5V	-
		P9_8	SYS_5V	SYS_5V	-
		P9_9	PWR_BUT	SW_POWER	-
RESET_OUT	A10	P9_10	SYS_RESETn	SW_RESET	-
gpmc_wait0	T17	P9_11	UART4_RXD	UART4_RXD	6
gpmc_be1n	U18	P9_12	GPIO1_28	RS485_CONTROL	7
gpmc_wpn	U17	P9_13	UART4_TXD	UART4_TXD	6
gpmc_a2	U14	P9_14	EHRPWM1A	-	
gpmc_a0	R13	P9_15	GPIO1_16	ADXL345_INT	
gpmc_a3	T14	P9_16	EHRPWM1B	-	
spi0_cs0	A16	P9_17	I2C1_SCL	I2C1_SCL	2
spi0_d1	B16	P9_18	I2C1_SDA	I2C1_SDA	2
uart1_rtsn	D17	P9_19	I2C2_SCL	CAN0_RX	2
uart1_ctsn	D18	P9_20	I2C2_SDA	CAN0_TX	2
spi0_d0	B17	P9_21	UART2_TXD	UART2_TXD	1
spi0_sclk	A17	P9_22	UART2_RXD	UART2_TXD	1
gpmc_a1	V14	P9_23	GPIO1_17	ENC_INT	
uart1_txd	D15	P9_24	UART1_TXD	UART1_TXD	0
mcasp0_ahclkx	A14	P9_25	GPIO3_21	UART1_CTL	-
uart1_rxd	D16	P9_26	UART1_RXD	UART1_RXD	0
mcasp0_fsr	C13	P9_27	GPIO3_19	UART2_CTL	-
mcasp0_ahclkr	C12	P9_28	SPI1_CS0	SPI1_CS0	3
mcasp0_fsx	B13	P9_29	SPI1_D0	SPI1_D0	3
mcasp0_axr0	D12	P9_30	SPI1_D1	SPI1_D1	3
mcasp0_aclkx	A13	P9_31	SPI1_SCLK	SPI1_SCLK	3
		P9_32	VDD_ADC	VDD_ADC	-
	C8	P9_33	AIN4	-	
		P9_34	GNDA_ADC	GNDA_ADC	-
	A8	P9_35	AIN6	-	
	B8	P9_36	AIN5	-	
	B7	P9_37	AIN2	-	
	A7	P9_38	AIN3	-	-
	B6	P9_39	AIN0	LM35	
	C7	P9_40	AIN1	POT(AIN1)	-
xdma_event_intr1	D14	P9_41	CLKOUT2	-	
mcasp0_axr1	D13	P9_42	GPIO0_7	-	
eCAP0_in_PWM0_out	C18	P9_43	DGND	-	
Mcasp0_aclkr	B12	P9_44	DGND	-	
		P9_45	DGND	-	
		P9_46	DGND	-	

4. Appendix A

Schematics

This section contains the complete schematics for the Kernel Masters BBB Expansion Board.


P2
CON2
P8_1 DGND P-8 DGND P8_2
P8_3 MMC1_DAT6 MMC1_DAT7 P8_4
P8_5 MMC1_DAT2 MMC1_DAT3 P8_6
P8_7 TIMER4 TIMER7 P8_8
P8_9 TIMER5 TIMER6 P8_10
P8_11 GPIO1_13 GPIO1_12 P8_12
P8_13 EHRPWM2B GPIO0_26 P8_14
P8_15 GPIO1_15 GPIO1_14 P8_16
P8_17 GPIO0_27 GPIO2_1 P8_18
P8_19 EHRPWM2A MMC1_CMD P8_20
P8_21 MMC1_CLK MMC1_DAT5 P8_22
P8_23 MMC1_DAT4 MMC1_DAT1 P8_24
P8_25 MMC1_DAT0 GPIO1_29 P8_26
P8_27 LCD_VSYNC LCD_PCLK P8_28
P8_29 LCD_HSYNC LCD_AC_BIAS P8_30
P8_31 LCD_DATA14 LCD_DATA15 P8_32
P8_33 LCD_DATA13 LCD_DATA11 P8_34
P8_35 LCD_DATA12 LCD_DATA10 P8_36
P8_37 LCD_DATA8 LCD_DATA9 P8_38
P8_39 LCD_DATA6 LCD_DATA7 P8_40
P8_41 LCD_DATA4 LCD_DATA5 P8_42
P8_43 LCD_DATA2 LCD_DATA3 P8_44
P8_45 LCD_DATA0 LCD_DATA1 P8_46
LCD_D5(GPIO1_13)
LCD_D7(GPIO1_15)
SW_DOWN(GPIO0_27)
LCD_RS(GPIO2_22)
LCD_RW(GPIO2_23)
USER_LED(GPIO0_10)
BUZZER (GPIO0_9)
UART5_TXD
KEY_PAD_6(GPIO2_12)
KEY_PAD_4(GPIO2_10)
KEY_PAD_2(GPIO2_8)
KEY_PAD_0(GPIO2_6)
LCD_D4(GPIO1_12)
SW_UP (GPIO0_26)
LCD_D6(GPIO1_14)
LCD_EN(GPIO2_24)
KEY_PAD_8(GPIO2_25)
USER_SW(GPIO0_11)
UART5_RXD
KEY_PAD_7(GPIO2_13)
KEY_PAD_5(GPIO2_11)
KEY_PAD_3(GPIO2_9)
KEY_PAD_1(GPIO2_7)
P1
CON2
P8_1 DGND P-8 DGND P8_2
P8_3 MMC1_DAT6 MMC1_DAT7 P8_4
P8_5 MMC1_DAT2 MMC1_DAT3 P8_6
P8_7 TIMER4 TIMER7 P8_8
P8_9 TIMER5 TIMER6 P8_10
P8_11 GPIO1_13 GPIO1_12 P8_12
P8_13 EHRPWM2B GPIO0_26 P8_14
P8_15 GPIO1_15 GPIO1_14 P8_16
P8_17 GPIO0_27 GPIO2_1 P8_18
P8_19 EHRPWM2A MMC1_CMD P8_20
P8_21 MMC1_CLK MMC1_DAT5 P8_22
P8_23 MMC1_DAT4 MMC1_DAT1 P8_24
P8_25 MMC1_DAT0 GPIO1_29 P8_26
P8_27 LCD_VSYNC LCD_PCLK P8_28
P8_29 LCD_HSYNC LCD_AC_BIAS P8_30
P8_31 LCD_DATA14 LCD_DATA15 P8_32
P8_33 LCD_DATA13 LCD_DATA11 P8_34
P8_35 LCD_DATA12 LCD_DATA10 P8_36
P8_37 LCD_DATA8 LCD_DATA9 P8_38
P8_39 LCD_DATA6 LCD_DATA7 P8_40
P8_41 LCD_DATA4 LCD_DATA5 P8_42
P8_43 LCD_DATA2 LCD_DATA3 P8_44
P8_45 LCD_DATA0 LCD_DATA1 P8_46
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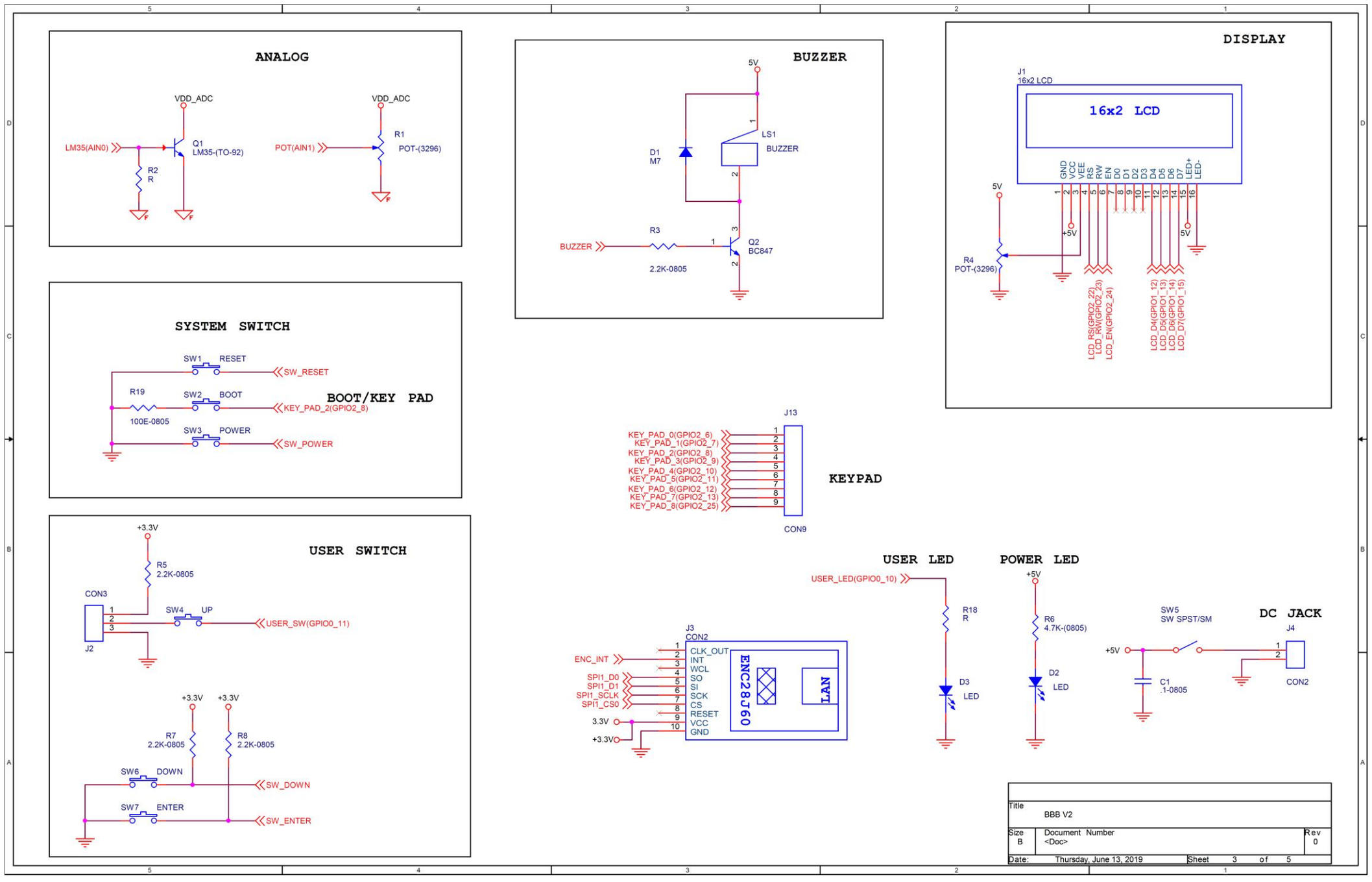
Sheet 1 of 5


ANALOG
VDD_ADC
LM35(AIN0)
Q1
LM35-(TO-92)
R2
R
POT(AIN1)
R1
POT-(3296)
BUZZER
5V
D1
M7
LS1
BUZZER
R3
2.2K-0805
Q2
BC847
DISPLAY
J1
16x2 LCD
16x2 LCD
GND
VCC
VEE
RS
RW
EN
D0
D1
D2
D3
D4
D5
D6
D7
LED+
LED-
R4
POT-(3296)
LCD_RS(GPIO2_22)
LCD_RW(GPIO2_23)
LCD_EN(GPIO2_24)
LCD_D4(GPIO1_12)
LCD_D5(GPIO1_13)
LCD_D6(GPIO1_14)
LCD_D7(GPIO1_15)
SYSTEM SWITCH
SW1 RESET
SW_RESET
R19
SW2 BOOT
BOOT/KEY PAD
KEY_PAD_2(GPIO2_8)
100E-0805
SW3 POWER
SW_POWER
J13
KEY_PAD_0(GPIO2_6)
KEY_PAD_1(GPIO2_7)
KEY_PAD_2(GPIO2_8)
KEY_PAD_3(GPIO2_9)
KEY_PAD_4(GPIO2_10)
KEY_PAD_5(GPIO2_11)
KEY_PAD_6(GPIO2_12)
KEY_PAD_7(GPIO2_13)
KEY_PAD_8(GPIO2_25)
KEYPAD
CON9
+3.3V
USER SWITCH
R5
2.2K-0805
CON3
SW4 UP
USER_SW(GPIO0_11)
J2
R7
2.2K-0805
R8
2.2K-0805
SW6 DOWN
SW_DOWN
SW7 ENTER
SW_ENTER
USER LED
USER_LED(GPIO0_10)
R18
R
D3
LED
POWER LED
R6
4.7K-(0805)
D2
LED
J3
CON2
ENC_INT
SPI1_D0
SPI1_D1
SPI1_SCLK
SPI1_CS0
3.3V
CLK_OUT
INT
WCL
SO
SI
SCK
CS
RESET
VCC
GND
ENC28J60
LAN
SW5
SW SPST/SM
C1
.1-0805
DC JACK
J4
CON2
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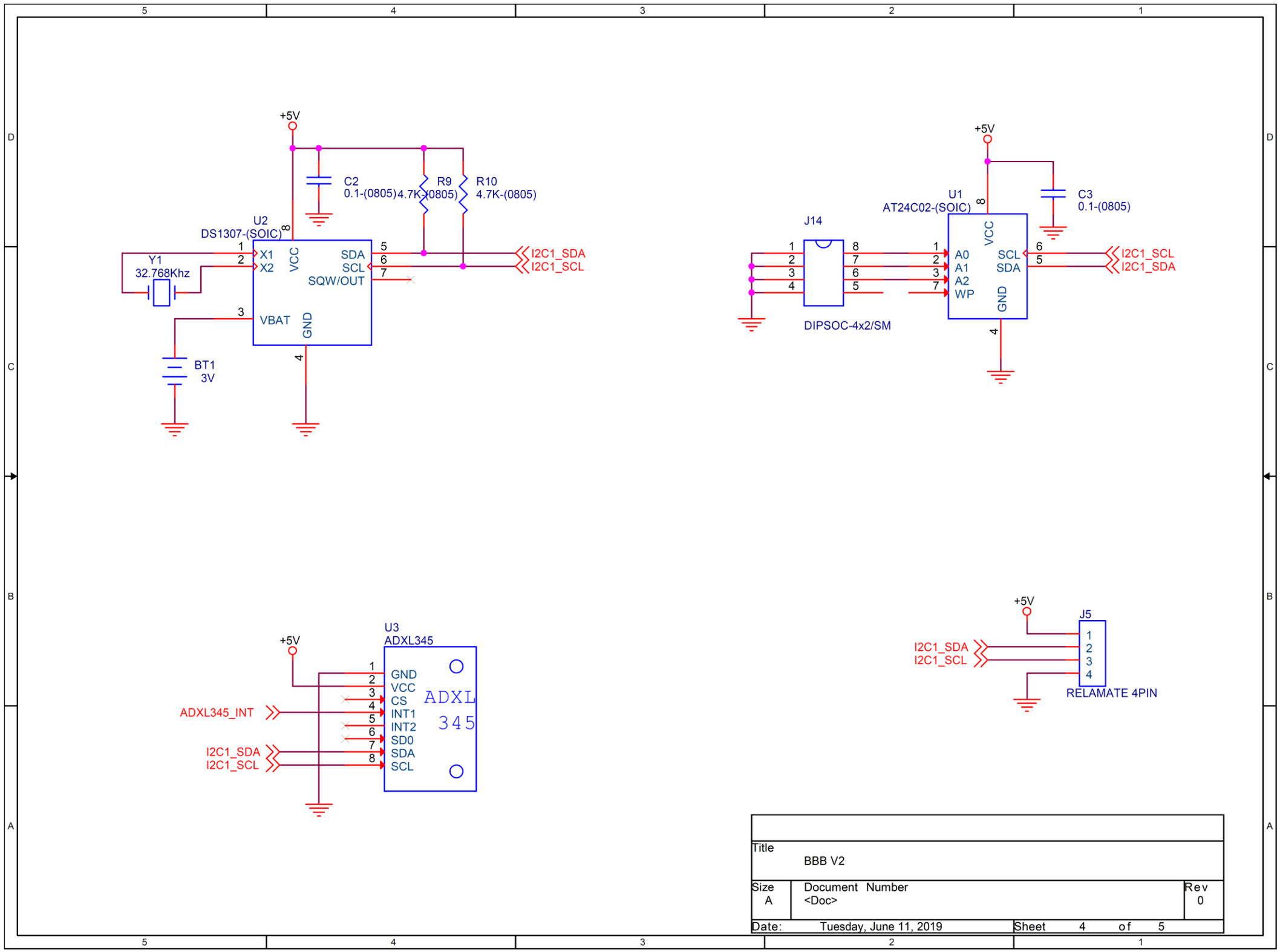
+5V
C2
0.1-(0805)
R9
4.7K-(0805)
R10
4.7K-(0805)
U2
DS1307-(SOIC)
Y1
32.768Khz
X1
X2
VCC
SDA
SCL
SQW/OUT
VBAT
GND
BT1
3V
I2C1_SDA
I2C1_SCL
U1
AT24C02-(SOIC)
C3
0.1-(0805)
J14
DIPSOC-4x2/SM
A0
A1
A2
WP
U3
ADXL345
ADXL345_INT
GND
VCC
CS
INT1
INT2
SD0
SDA
SCL
ADXL
345
J5
RELAMATE 4PIN
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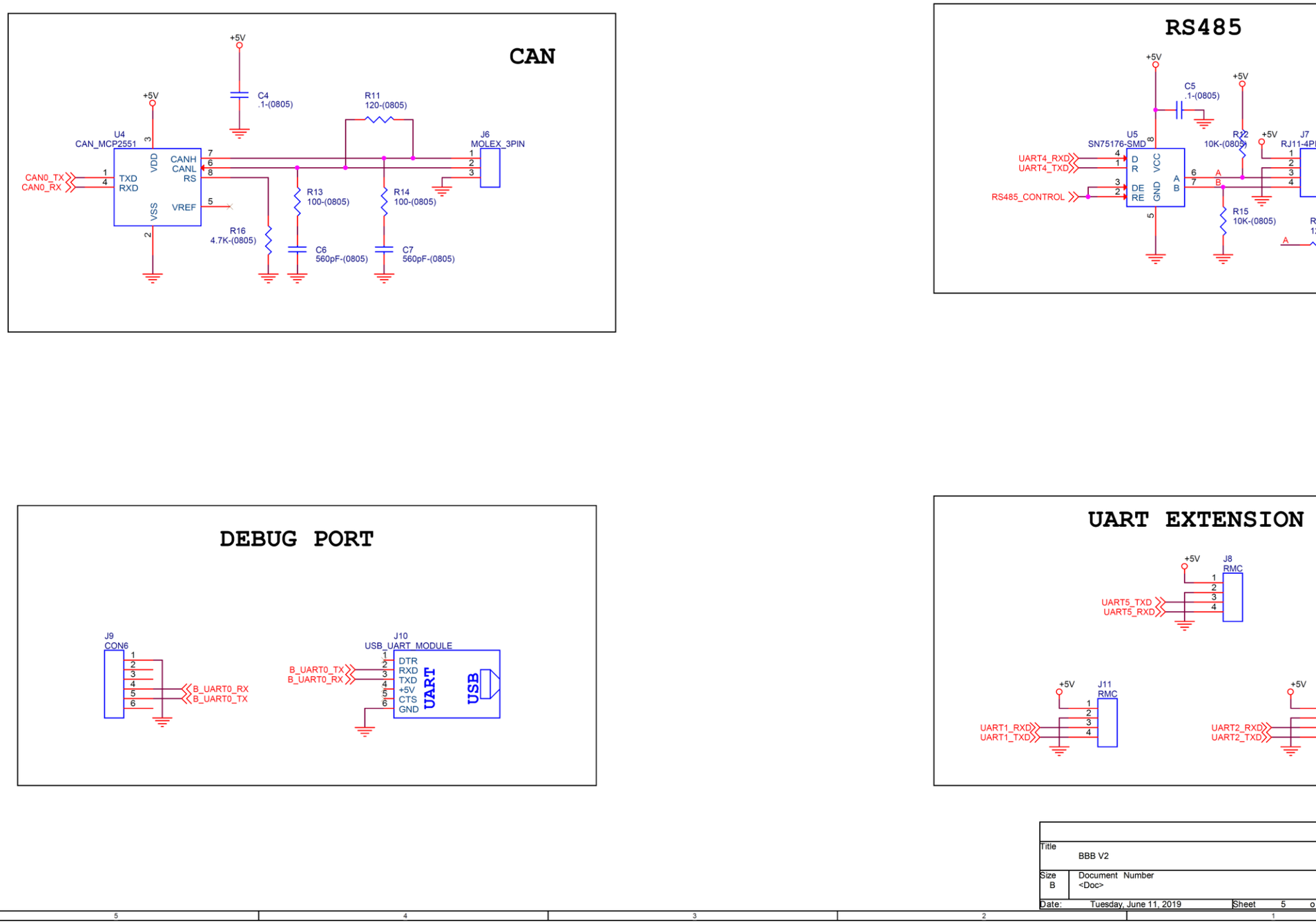
CAN
+5V
C4
.1-(0805)
R11
120-(0805)
U4
CAN_MCP2551
VDD
CANH
CANL
RS
TXD
RXD
VSS
VREF
CAN0_TX
CAN0_RX
R13
100-(0805)
R14
100-(0805)
R16
4.7K-(0805)
C6
560pF-(0805)
C7
560pF-(0805)
J6
MOLEX_3PIN
RS485
C5
.1-(0805)
U5
SN75176-SMD
D
R
DE
RE
VCC
GND
A
B
UART4_RXD
UART4_TXD
RS485_CONTROL
R12
10K-(0805)
R15
10K-(0805)
R17
120-(0805)
J7
RJ11-4PIN
DEBUG PORT
J9
CON6
B_UART0_RX
B_UART0_TX
J10
USB_UART_MODULE
DTR
RXD
TXD
+5V
CTS
GND
UART
USB
UART EXTENSION
J8
RMC
UART5_TXD
UART5_RXD
J11
RMC
UART1_RXD
UART1_TXD
J12
RMC
UART2_RXD
UART2_TXD
Title
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Size
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Document Number
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