

ASSEMBLING THE BOARD

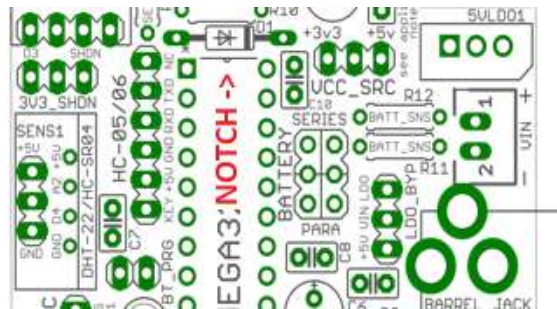
The component list can be found on the last 2 pages of this document. Refer to it when installing components on the board. All components locations are numbered and the component list shows the corresponding values and identifying markings.

COMPONENT INSTALLATION NOTES:

ALL components will be installed on the top of the board with the exception of the OPTIONAL dual-18650 battery holder.

ATMEGA328P

The notch of the Atmega328 IC and DIP socket should be oriented towards the top of the board. Pin 1 is the upper-left pin on footprint. The Atmega328P can be soldered directly to the board or can be installed in the provided 28-pin DIP socket. Installing the Atmega328 in the DIP socket is recommended to allow for future removal and replacement if required. **ENSURE CORRECT ORIENTATION BEFORE YOU SOLDER THE PINS**

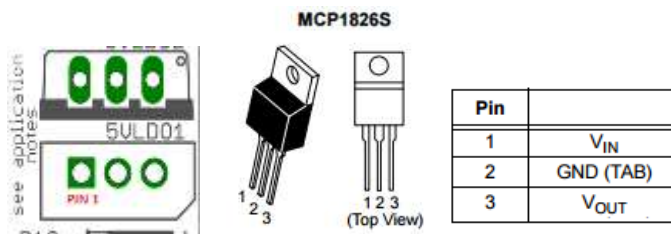


5V LDO Voltage Regulator

There are two 5-volt LDO options. **ONLY INSTALL 1 5V LDO.**

(OPTION1) PN# MCP1826S-5002E/AB

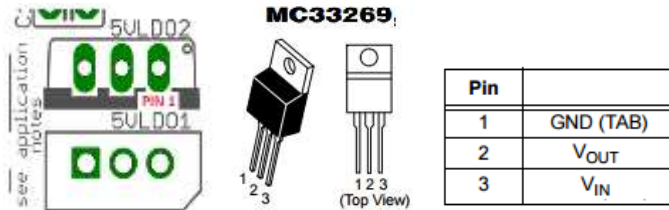
- Install this LDO at location 5VLDO1 ONLY, facing towards the bottom end of the board
- Pin 1 on the board is identified as a square pin hole on the left of the footprint. Refer to image below-left:



- Refer to the image above-right to identify pin 1 on the 5V LDO IC. Make sure it is oriented to pin 1 on the board before soldering.

(OPTION2) PN# MC33269T-5.0

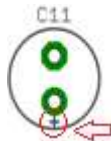
- Install this LDO in 5VDLO2 ONLY, facing towards the TOP of the board.
- Pin 1 on the board is identified by a small circle next to it on the right-side of the footprint. Refer to image below-left:



- Refer to the image above-right to identify pin 1 on the 5V LDO IC. Make sure it is oriented to pin 1 on the board before soldering.

Electrolytic Capacitors

There are 2 electrolytic capacitors on the board: c2 (470uf), and c9(100uf). These capacitors are polarized and need to be installed with the correct polarity. The case of the capacitor is marked on the **NEGATIVE** pin. The footprint of the capacitor on the board is marked with a + sign on the positive pin:



Make sure you orient the **NEGATIVE** pin of the capacitor **AWAY from the + sign** when installing the component

Diode (D1) - 1N4148

The 1N4148 diode included in this kit is a small orange component marked with a black line to indicate the **CATHODE** end. The cathode of the diode footprint on the board is marked with a line as well. Ensure that you orient the line on the diode with the line on the footprint when before soldering.

Red/Green LED (LD1)

LD1 is a red/green dual-LED with 3 pins. One side of the LED is flattened, the other side is round. The flattened side indicates the RED side of the LED. Ensure that you align the RED pin of the LED with the pin marked with the R on the board near the LEDs footprint.

NRF24L01+ and ESP8266

The NRF24L01+ and ESP8266 radio modules can be soldered directly to the board or using the included 4x2 female headers. Using the female headers allows for easy remove/replacement of the radio modules if desired. The headers are not directional and can be installed in any orientation.

Capacitor (C13) – 10uf Tantalum

Capacitor c13 is a polarized 10uf Tantalum capacitor. The case of the capacitor is marked with a + sign on the positive lead. Install this capacitor with the positive lead oriented towards the top of the board.

Crystal Oscillator (Q1) – A160j2

The crystal oscillator is a silver lozenge-shaped device with two pins on the bottom. It can be installed in the Q1 footprint in either orientation

Tactile Switches - RESET & FLASH

The leads of the reset and flash tactile switches should be installed through the 4 holes in the footprints and soldered. They will only fit in the vertical orientation. You may need to squeeze the pins together slightly to make them snap into place. If they don't fit, rotate the switch 90 degrees and try again.

FLASH/RUN Switch – 2-position slide switch

You may need to squeeze the pins of the slide switch together slightly to get it to fit in the footprint. Ensure that you solder all 6 pins.

Female Pin Headers – SPI, I2C, HC-05/06, NRF24L01+ (optional), ESP8266-01 (optional)

Female pin headers with the appropriate dimensions and pin-counts are provided for the following ports:

- SPI – 1x6 header
- I2C – 1x5 header
- HC-05/06 – 1x6 header
- NRF24L01+ (optional) – 2x4 header
- ESP8266-01 (optional) – 2x4 header

Male Pin Headers – various

Male pin headers are provided for the following jumper and port locations. In most cases, you will need to break off the appropriate number of pins for each location:

- BT_PRG: 2-pin (optional)*
- PWR: 3-pin
- PROG_ESP: 3-pin
- VCC_SRC: 3-pin*
- LDO_BYP: 3-pin*
- PROG/DEBUG: 5-pin
- ICSP: 2x3 pin male header provided
- BATTERY: 2x3 male header provided*

***NOTE:** Jumpers are provided for each jumper location. The BATTERY jumper location requires 2 jumpers installed vertically.

Male pin headers should be installed from the top of the board, with the longer end of the header sticking up.

Remaining Components – various resistors and capacitors

The remaining components are not polarized – they can be installed in any orientation in their footprint on the board. Verify that you have the correct values for each prior to soldering the pins.

- **RESISTOR** component locations are identified with an R (R1, R2...)
- **CAPACITOR** component locations are identified with a C (C1, C2...)

NOTE: Bend the leads of the components outwards once you have pushed them through the holes on the board. This will help hold them in place while you solder them. Ensure that you clip the leads to within 1/8 inch of the bottom of the board after soldering.

(OPTIONAL) Sensor Pull-Up Resistors – R1, R4, R13

Resistors R1, R4 and R13 are optional pull-up resistors for sensors mounted at SENSOR1 and SENSOR3 and SENSOR4. 4.7K ohms resistors are provided but can be left out or replaced with a sensor more suited to your sensors as required. Sensor2 does have a pull-up resistor.

(OPTIONAL) Voltage-Sense Resistors – R12, R11

Resistors are not provided for R12 and R11. These OPTIONAL resistors create a voltage divider for measuring battery voltage and their values will be determined by your source voltage. See operational notes for more information.

(OPTIONAL) Dual-18650 Battery Holder

Make sure to install the OPTIONAL dual-18650 battery holder in the correct orientation. POSITIVE (+) Terminals are installed at the top of the board in the VIN+ slots. Installing the battery holder in any other position can cause damage to the board when batteries are installed.

NOTE: Install all of your sensors and components before installing the OPTIONAL dual-18650 battery holder. You will not have access to the bottom of the board once it is installed, making sensor installation difficult.

Clip the leads of all installed components to less than 1/8 inch once you have completed the assembly. This will allow for proper connection of the OPTIONAL dual-18650 battery holder.

WHEN INSTALLING BATTERIES IN THE OPTIONAL DUAL-18650 BATTERY HOLDER, THE POSITIVE ENDS OF BOTH BATTERIES GO TO THE TOP OF THE HOLDER AS INDICATED BY THE POLARITY MARKINGS INSIDE THE HOLDER – EVEN IF YOU PLAN TO USE THEM IN SERIES MODE. THE BATTERY JUMPER ON THE BOARD DETERMINES THE PARALLEL/SERIES CONFIGURATION OF THE BATTERIES.

ENSURE ALL JUMPERS ARE IN THE CORRECT POSITION AFTER INSTALLATION IS COMPLETE AND PRIOR TO APPLYING POWER TO THE BOARD. SEE THE OPERATIONAL NOTES BELOW FOR PROPER JUMPER OPERATION.

OPERATIONAL NOTES

Powering the board

The board can be power via the VIN Molex connector, the 2.1mm barrel jack, the OPTIONAL dual-18650 battery holder, or by applying +5V to any +5V pin on the board (such as with a USB-Serial converter).

Supply voltage will depend on the physical configuration of the board:

- Without a 5VLDO installed or with LDO_BYP set to +5V: **2.5 - 5VDC, jumper LDO_BYP to +5V**

WARNING! Do not supply > 5Vdc in this configuration or damage to components can occur

- 5V LDO MCP1826S-5002E/AB installed at 5VLDO1: **5.2 - 6VDC, jumper LDO_BYP to LDO**
- 5V LDO MC33269T-5.0 installed at 5VLDO2: **6.3 – 20VDC, jumper LDO_BYP to LDO**

WARNING! DO NOT SUPPLY > 5Vdc WITH JUMPER LDO_BYP IN THE +5V POSITION. DAMAGE TO COMPONENTS CAN OCCUR. **ENSURE THIS JUMPER IS IN THE CORRECT POSITION BEFORE APPLYING POWER TO THE BOARD**

Programming the Atmega328 – Requires a USB-Serial converter

The included Atmega328 is pre-configured with the Arduino bootloader.

Connect a USB-Serial converter to your PC. Connect cables so that the pins on the USB-Serial module align to the pins on the pins on the PROG/DEBUG port on the right side of the board.

NOTE: Connect the TX pin on the serial converter to the RX pin on the board. RX on the serial converter goes to TX on the board. Ensure you have made these connections correctly.

If using the USB 2.0 to TTL UART USB-Serial converter available in my store, simply align the same color wire with DRT on the module and the RESET pin on the board, the other pins are in corresponding order. The USB-Serial converter can provide the required 5Vdc power to run the board. The 3v3 pin on the serial converter is not used.

Once connected, open the IDE and select the correct serial port from the ports list to correspond with your USB-Serial converter. Select UNO/Genuino from the boards menu. Click the upload button and the sketch should upload to your board. If the sketch upload fails, check all of your connections and try again.

Using the OPTIONAL USBasp AVRISP Programmer

NOTE: This module requires installation of a driver in Windows

To install the driver for the USBasp programmer:

1. Visit link for product and driver information: www.fischl.de
2. Download Zadig USB driver installation tool: [Zadig USB Driver Tool](#)
3. Run Zadig tool
4. Plug USBasp device into USB port and allow Windows to discover it

5. From the OPTION menu of the Zadig tool, select 'List All Devices'
6. From the list of discovered devices, select 'USBasp'
7. Select 'libusbK (v3.0.7.0)' in the driver selection field
8. Click the 'Replace Driver' button
9. Remove USBasp device and plug back into USB port

Connect the cable from the USBasp programmer to the ICSP connector on the board. Ensure that the ARROW on the cable's connector is oriented with PIN 1 on the ICSP connector on the board.

From within the Arduino IDE, Select 'USBasp' from the PROGRAMMERS menu. You don't need to select a serial port. Select UNO/Genuino from the boards menu of the IDE. Click "Burn Bootloader". Ignore any warnings about SPI speed, the USBasp module selects the SPI speed automatically.

The USBasp can also be used to upload sketches or HEX files to the Atmega328, using the AVR IDE of your choice. Simply connect the USBasp to the ICSP connector of the board, ensuring the correct orientation of pin 1. If using the Arduino IDE, select 'USBasp' from the PROGRAMMERS menu and then click 'Upload Using Programmer'.

NOTE: This programming method overwrites the Arduino bootloader, meaning that you will not be able to upload sketches using a USB-Serial converter until you burn a new bootloader to the Atmega328.

Programming/Debugging the OPTIONAL ESP8266

The OPTIONAL ESP8266 radio module has a dedicated 3-pin program/debug port labeled as PROG_ESP. This port can be used to upload firmware, issue AT commands, or debug the radio module.

Connect the TX pin of a USB-Serial converter to the RX pin of the PROG_ESP header. Connect the RX pin of the serial converter to the TX pin of the PROG_ESP header.

To issue AT commands to the ESP module move the RUN/FLASH switch to the FLASH position. This connects the RX pin from the radio module to the TX pin PROG_ESP header.

NOTE: This disconnects the RX pin of the ESP module from the Atmega328. The RUN/FLASH switch must be in the RUN position for the Atmega328 to communicate with the ESP8266.

NOTE: THE TX pin of the ESP8266 is always connected to the RX pin of the PROG_ESP header, regardless of the position of the RUN/FLASH switch. This allows for debugging of the module during operation.

Use your preferred Terminal Emulation program (including the Serial Monitor of the Arduino IDE) to issue AT commands or debug the ESP radio module.

To flash firmware to the ESP8266 module, make the connections listed above and place the RUN/FLASH switch into the FLASH position. Hold down the FLASH button while applying power to the board to put the ESP8266 into flash mode.

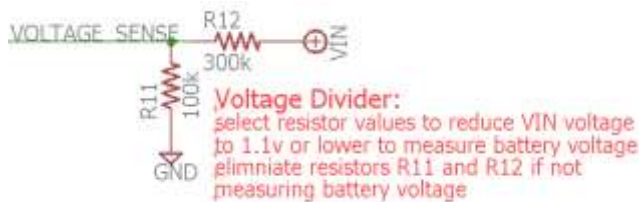
NOTE: If you are getting garbage from the TX pin of the ESP8266, try changing the BAUD rate of your terminal program. All ESP8266 modules I sell are pre-set to a UART speed of 57600, but may use a speed of 38400 in certain debug modes.

Measuring VIN/Battery Voltage

Resistors R11 and R12 form a voltage divider for measuring VIN/battery voltage with **Atmega328 pin D14/A0**. Select resistor values to reduce source voltage to ~1.1Vdc at Atmega328 pin.

R12 connects to VIN (voltage divider UPPER resistor)

R11 connects to GND (voltage divider LOWER resistor)



Program OPTIONAL HC-05 Bluetooth Module

When using an OPTIONAL HC-05 Bluetooth, you can modify the settings of the device by putting it into AT mode and issuing AT commands. You will need a USB-Serial converter in order program the HC-05.

The SCL (TX) and SDA (RX) pins on the I2C connector can be configured as a softwareserial port with their input/output redirected to the hardware serial port RX/TX lines (the HC-05 is tied to the hardware serial port). SCL is pin D19 in the Arduino IDE, and SDA is pin D20.

Follow the steps below:

- Upload a software serial sketch to the board with the following settings:
 - SERIAL PORT SPEED: 38400
 - Software serial pin config: TX = 19, RX = 20
 - Software serial speed: 38400
 - Redirect IO from the serial port to the software serial port and vice-versa
- Remove power from the board
- Connect the TX pin of your USB-Serial device to the SDA pin;
- Connect the RX pin of your USB-Serial device to the SCL pin;
- Connect GND of your USB-Serial device to any GND connection on the board;
- Put the HC-05 module into AT mode by holding the small button on the side of the module while you apply power to the board. The LED will begin to blink slowly
- Issue AT commands to configure the Bluetooth module
- When finished, remove power from the board and disconnect your USB-Serial converter

JUMPER CONFIGURATION

LDO_BYP Jumper

The LDO_BYP jumper can be used to bypass the installed 5V LDO. You might want to do this if you are providing ~5V via the barrel connector, or one of the 5V pins.

You would also use this jumper to bypass the 5V LDO if you are using the dual-18650 battery holder in PARALLEL mode as this provides ~4.2Vdc and is sufficient to run the board in some instances.

JUMPER

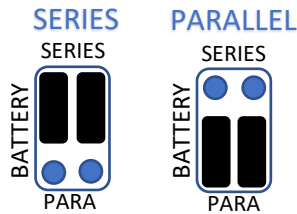
POSITION	RESULT
+5	VIN voltage is applied directly to the 5V rail
LDO	VIN voltage is routed to the 5V LDO

WARNING! DO NOT SUPPLY > 5Vdc WITH THE JUMPER IN THE +5V POSITION. DAMAGE TO COMPONENTS CAN OCCUR. **ENSURE THIS JUMPER IS IN THE CORRECT POSITION BEFORE APPLYING POWER TO THE BOARD**

BATTERY Jumper

The BATTERY jumper can be used in conjunction with the dual-18650 battery holder to put the batteries into SERIES or PARALLEL configuration.

This connector requires 2 physical jumpers, installed vertically, side-by-side. See diagram below.



JUMPER

POSITION	RESULT
SERIES	Batteries connected in SERIES, provides ~8.4Vdc* *ENSURE LDO_BYP IS IN "LDO" POSITION PRIOR TO INSTALLING BATTERIES OR DAMAGE COULD OCCUR
PARA	Batteries connected in PARALLEL, provides ~4.3Vdc* *ENSURE LDO_BYP IS IN "+5+" POSITION PRIOR TO INSTALLING BATTERIES
NO JUMPERS	if no jumpers are installed, battery voltage will not be connected to VIN

VCC_SRC Jumper

The VCC_SRC jumper can be used to set the voltage of the VCC_SRC rail. This rail provides power to the Atmega328, SENSOR2, SENSOR3, and SPI port.

JUMPER

POSITION	RESULT
+5V	Voltage on +5V rail is applied to VCC power rail
3v3	3.3Vdc is applied to VCC power rail
NO JUMPER	VCC power rail is not powered (floating)

NOTE: **SENSOR1**, **DTH-22/HC-SR04**, **I2C**, **HC05/06** are powered from the 5V rail.
NRF24L01+ and **ESP8255** radio modules are powered from the 3.3V rail.
SENSOR2, **SENSOR3**, **SPI**, and the **ATMEGA328P** are powered from VCC rail

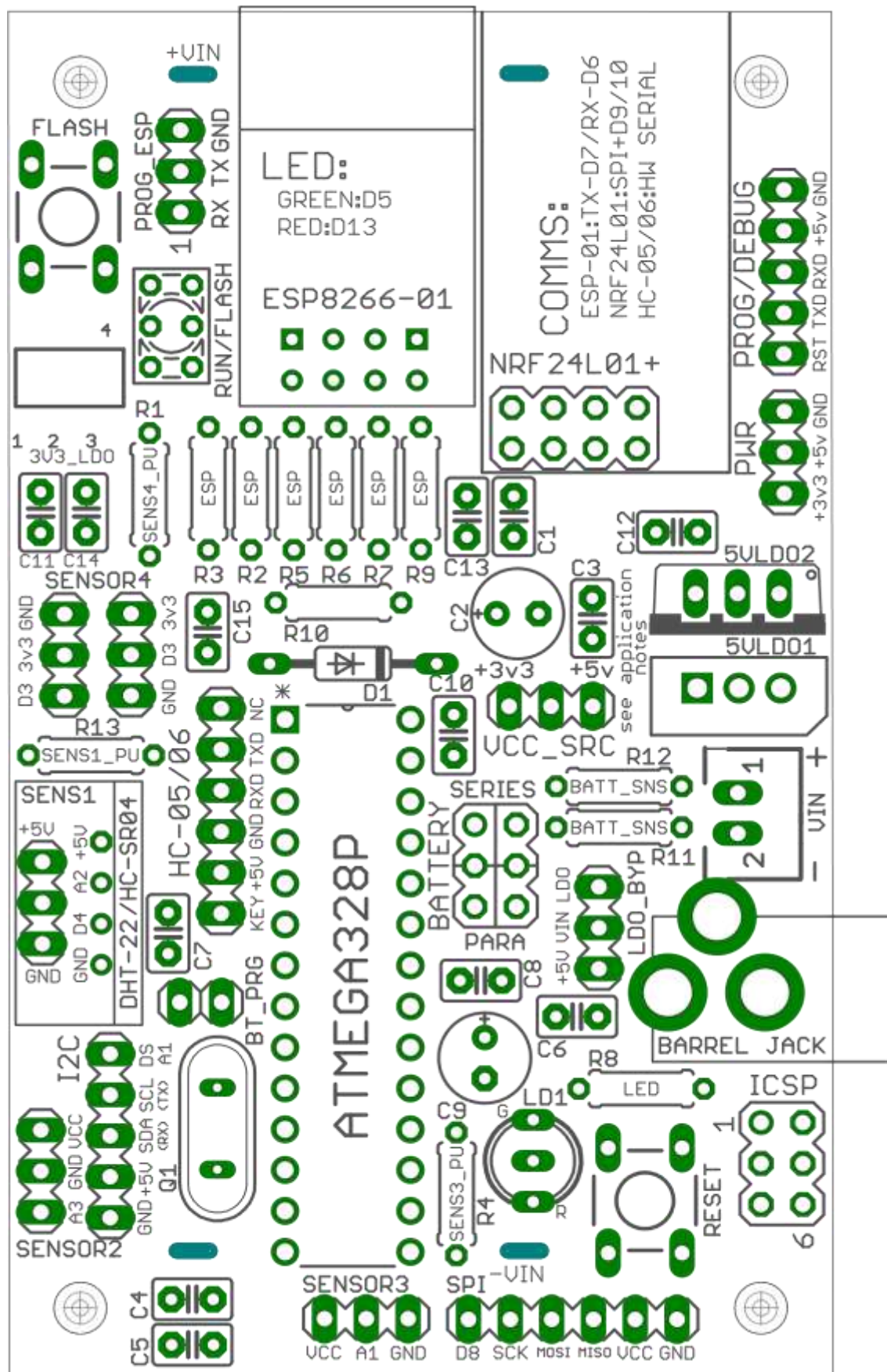
BT_PRG

The BT_PRG jumper is used to put certain supported HC-05/06 Bluetooth modules into programming (AT) mode. Closing the jumper applies 3.3Vdc to the KEY/ENABLE pin of the Bluetooth module. This is required in order to force certain modules to enter programming mode and must be done prior to applying power to the board.

JUMPER

<u>POSITION</u>	<u>RESULT</u>
CLOSED	3.3v applied to KEY/ENABLE pin of Bluetooth module
NO JUMPER	No connection

NOTE: Most sensors sold in my shop have a small button on the Bluetooth module itself that is used to put the module into programming(AT) mode. The BT_PROG jumper is not required to be closed for these modules.





Partlist

Assembly variant: advanced_sensor_platform_v3_3v3BOOST

Component	Value	Identification
3V3_LDO	AP2114H-3.3TRG1	
(OPT) 5VLD01	MCP1826S-5002E/AB	MCP1826S
(OPT) 5VLD02	MC33269T-5.0	33269T-5
ATMEGA328P	ATMEGA328P-PU	ATMEGA328P-PU
BARREL_JACK	2.1MMJACKTHM	PJ-102A
BT_PRG	1x2 male pin header, 2.54mm	N/A
C1	.1uf ceramic	104
C2	470uF electrolytic	470uf
C3	4.7uf ceramic	475
C4	18pf ceramic	18J
C5	18pf ceramic	18J
C6	.1uf ceramic	104
C7	.1uf ceramic	104
C8	.1uf ceramic	104
C9	100uF electrolytic	100uf
C10	.1uf ceramic	104
C11	4.7uf ceramic	475
C12	1uf ceramic (MCP1826S-5002E/AB) or .33uf ceramic (MC33269T-5.0G)	105k 334
C13	10uf tantalum	10u
C14	4.7uf ceramic	475
C15	1uf ceramic	
D1	1N4148 DO35-10	4148
(OPT)ESP1	2x4 female pin header, 2.54mm	N/A
FLASH	DTS-6 tactile switch, through-hole	N/A
(OPT)HC-05/06	1x6 female pin header, 2.54mm	N/A
(OPT)I2C	1x5 female pin header, 2.54mm	N/A
ICSP	2x3 male pin header, 2.54mm	N/A
LD1	2.3v red/green (red side is FLAT)	None
LDO_BYF	1x3 male pin header, 2.54mm	N/A
(OPT)NRF24L01+	2x4 female pin header, 2.54mm	N/A
PROG/DEBUG	1x5 male pin header, 2.54mm	N/A
PROG_ESP	1x3 male pin header, 2.54mm	N/A
PWR	1x3 male pin header, 2.54mm	N/A
Q1	16MHZ Crystal	M16000C4 or A160J2x
R1	4.7K 5%	YW/VLT/RED/GOLD
R2	340 1%	OR/YW/BLK/BLK/BRN
R3	340 1%	OR/YW/BLK/BLK/BRN
R4	4.7k 5%	YW/VLT/RED/GOLD
R5	1K 5%	BRN/BLK/RED/GOLD
R6	1K 5%	BRN/BLK/RED/GOLD
R7	2.7K 5%	RED/VLT/RED/GOLD
R8	220 5%	RED/RED/BRN/GOLD
R9	0 ohms	BLK
R10	10K	BRN/BLK/OR/GOLD
(OPT)R11	depends on source battery voltage	N/A
(OPT)R12	depends on source battery voltage	N/A

R13	4.7k 5%	YW/VLT/RED/GOLD
RESET	DTS-6 tactile switch, through-hole	N/A
RUN/FLASH	slide switch, JS202011CQN, 6v 2x3	N/A
SERIES/PARALLEL	2x3 male pin header, 2.54mm	N/A
SPI	1x6 female pin header, 2.54mm	N/A
VCC_SRC	1x3 male pin header, 2.54mm	N/A
VIN	MOLEX, 6410-02, 2.54mm	N/A