# BASIC SENSOR BOARD v2 ASSEMBLY INSTRUCTIONS

BurgessWorld Custom Electronics

<https://www.tindie.com/products/cburgess129/battery-powered-wifi-temphumidity-sensor-v2/>

Contents

[BASIC SENSOR BOARD v2 ASSEMBLY INSTRUCTIONS 1](#_Toc502827814)

[INSTALLATION STEPS 1](#_Toc502827815)

[SENSOR BOARD OPERATION 4](#_Toc502827816)

[POWER and Voltage Sources 4](#_Toc502827817)

[VCC Power Rail and VCC\_SRC jumper 4](#_Toc502827818)

[3V3\_SHDN Jumper 4](#_Toc502827819)

[ESP8266 Operations 4](#_Toc502827820)

[Uploading Sketches/Debugging 5](#_Toc502827821)

[PWR\_OUT Header 6](#_Toc502827822)

[Monitoring Battery Voltage 6](#_Toc502827823)

***NOTE: All surface-mount components are pre-assembled, prior to shipping.***

***NOTE: ALL COMPONENTS AND HEADERS WITH THE EXCEPTION OF THE BATTERY HOLDER ARE MOUNTED TO THE TOP SIDE OF THE SENSOR BOARD. THERE ARE NO COMPONENTS OR HEADERS ON THE BOTTOM SIDE OF SENSOR BOARD. ALL PINS ARE SOLDERED FROM THE BOTTOM SIDE OF BOARD*.**

All headers should be installed with short side of pins through the board, with the long side of the header pins sticking up and the plastic spacer resting on top side of the sensor board, unless otherwise indicated.

**USE PHOTOS ON MY TINDIE PRODUCT PAGE FOR REFERENCE:**

[**Basic Sensor Board v2**](https://www.tindie.com/products/cburgess129/battery-powered-wifi-temphumidity-sensor-v2/)

## INSTALLATION STEPS

1. Install 28-pin socket into space marked ATMEGA328P with notch oriented to the top of the board, solder all pins.
2. Install 16Mhz crystal into position Q1, located to the left of the ATMEGA328P socket. Orientation of crystal does not matter
3. Open package containing 3.3V boost converted U1V11F3, remove and install 4-pin straight header into space on main sensor board marked U1V11F3. Install header through top side of board. **The LONG side of pins should go through the sensor board, with the short side of pins sticking up. The plastic spacer should rest on top side of sensor board.** Discard 4-pin 90-degree male header, it is not used in this application.
4. Remove 3.3v boost converter and mount onto 4-pin header installed in previous step, in footprint marked U1V11F3. The bare side of the boost converter (printed side) should face down toward the sensor board, the side with the components should face up. Make sure boost converted rests within the footprint on the board. Solder all pins.
5. Install 3-pin slide switch into space marked PWR\_SW on left edge of board. The slide actuator of the switch should extend over the side of the board. Solder all pins.
6. Install 6-pin slide switch in space marked RUN/PROG, to the left of the ESP8166-01 footprint. You may have to squeeze the pins together slightly before inserting. Orientation of the switch does not matter. Solder all pins
7. Install (2) momentary switches into locations marked FLASH and RESET. Orientation does not matter. Make sure all pins protrude through the sensor board and the switch base is flush with the board. Solder all pins.
8. Install 2-pin MOLEX connector into space marked MOLEX on right-edge of board. Orient the connected to match the footprint, with the notch facing the center of the board.
9. Install 6-pin MALE header into space marked ICSP in bottom-right corner on sensor board. Solder all pins.
10. Install 2x4 FEMALE header into space marked ESP8266-1. Orientation does not matter. Solder all pins.
11. Install 3-pin MALE header into space marked VCC\_SRC. Solder all pins. Install jumper onto header, setting the voltage to either 3.3v or 5v, depending on your requirements. [SEE VCC\_SRC OPERATION SECTION](#_VCC_Power_Rail)
12. Install 3-pin MALE header into space marked 3v3\_SHDN. Solder all pins. Install jumper onto header, bridging the center pin and pin marked D3. [SEE 3V3\_SHDN SECTION](#_3V3_SHDN_Jumper)
13. Install remaining MALE headers into spaces marked PROG\_ESP and PROG/DEBUG along right edge of board, and space marked PWR\_OUT along the left edge of board.
14. **OPTIONAL:** Install DHT-22 sensor into SENS1 location on the left edge of the sensor board using the 4-pin port. The sensor grill should face outward, AWAY from the board. Solder all pins. Install 4.7K resistor into resistor footprint marked SENS1\_PU (R13).
15. **OPTIONAL:** Install HC-SR04 sensor into the SENS1 location on the left edge of the sensor board using the 4-pin port. The sensor should face away from the board. **DO NOT INSTALL PULL-UP RESISTOR IN SENS1\_PU(R13) POSITION.**

***NOTE:*** *The HC-SR04 sensor is a 5V device. Range and accuracy will suffer is power source is less than 5V. It is recommended to use an external 5V power source and set VCC\_SRC to +5V when using HC-SR04 sensor.*

1. **OPTIONAL:** Install 3-pin MALE header OR 3-pin FEMALE headers into sensor ports 2 and 3 at the bottom-left corner of board.

***NOTE:*** *You can also connect additional sensors directly to sensor ports 2 and 3 without using headers if preferred.*

1. **OPTIONAL:** Install 4-pin MALE header OR 4-pin FEMALE header into I2C port on the right-edge of the sensor board.
2. **OPTIONAL:** Install 6-pin MALE of 6-pin FEMALE header into SPI port on the right edge of the sensor board.
3. Insert ATMEGA328P IC into header installed in step 1. Ensure the notch is oriented towards the top of the sensor board.
4. Install ESP8266 into 2x4 FEMALE header inside the footprint marked on the sensor board. The antenna end of the ESP8266 should be oriented to the top of the board.

***IMPORTANT! ONCE ALL COMPONENTS ARE SOLDERED YOU MUST CLIP THE PINS AND LEADS PROTRUDING THROUGH THE BOTTOM OF THE SENSOR BOARD IN ORDER TO MOUNT THE BATTERY HOLDER ONTO THE BOTTOM OF THE BOARD.***

**Failure to clip the pins and leads on the bottom side of the board will prevent the solder tabs of the battery holder from protruding through the top of the board.**

**OPTIONAL:** Install dual battery holder to bottom of sensor board. The battery holder should be oriented with the positive terminals to the top of the sensor board (the end with the ESP8266 on it). Insert the solder tabs through all 4 slots and solder battery holder tightly to board. If battery holder does not sit level against the bottom of the sensor board, trim the header pins and leads further and retry. **ENSURE POSITIVE TERMINALS ARE ORIENTED TO TOP OF SENSOR BOARD.**

**OPTIONAL:** Install MicroSD module into SPI header. Refer to signal markings for header pins printed on sensor board and MicroSD module, ensure they are oriented correctly. The GND pin should be oriented to the top of the header, nearest the I2C header. You can either mount a FEMALE header into the SPI port and plug the MicroSD module into it, or solder the MicroSD module directly into the SPI sensor port. Trim all pins after soldering.

**OPTIONAL:** Install/connect additional sensors into sensor ports 2 and 3, observing correct polarity of VCC and GND signals.

**OPTIONAL:** Install pull-up resistors into spaces marked SENS2-PU and SENSE3-PU (R11 and R4). Refer to datasheet for sensors installed in these ports for correct pull-up resistor values.

## SENSOR BOARD OPERATION

### POWER and Voltage Sources

The sensor board can be powered from (2) 18650 batteries installed in the OPTIONAL dual-battery holder, or by supplying 5V@.75A external voltage.

When installing 18650 batteries, observe polarity marked on the battery holder. **BATTERIES MUST BE INSTALLED IN PARALLEL WITH BOTH POSITIVE LEADS ORIENTED TO THE TOP OF THE BATTERY HOLDER.**

External power can be provided via the 2-pin MOLEX connector (observing polarity printed on the board near the connector), or directly to the 5V pins.

**NEVER CONNECT VOLTAGE GREATER THAN 5V TO SENSOR BOARD OR DAMAGE COULD OCCUR.**

**NEVER CONNECT EXTERNAL VOLTAGE TO THE 3V3 PINS OR DAMAGE COULD OCCUR.**

The ESP8266 is powered from the 3.3V boost regulator at all times.

The ATMEGA328 and all sensors are powered via the VCC power rail, allowing for 3.3v or 5v operation.

The BATT\_PWR switch on the left edge of the board enables and disables battery power. This switch has no effect on voltage applied via the 2-pin MOLEX connector or directly the 5V rail.

### VCC Power Rail and VCC\_SRC jumper

The VCC power rail can be set to 3.3v or 5v, by setting jumper VCC\_SRC in the appropriate position.

During battery operation, setting VCC\_SRC to 5V results in the ATMEGA328 and all sensors running from battery voltage. In most cases this is fine, as the ATMEGA328 and DHT-22 sensors will run on voltage as low as 3V DC, which is the recommended cutoff for 18650 batteries.

While being powered from a 5V external voltage source, the 5V power rail operates at 5V. Setting VCC\_SRC to 5V results in the VCC power rail operating at 5V, regardless if batteries are installed.

***NOTE: There is a battery-protection diode between the 5V power rail and positive battery terminal (VIN+), preventing back-feeding 5V to the 18650 batteries. The voltage drop across this diode is ~.2v.***

### 3V3\_SHDN Jumper

Setting the 3V3\_SHDN jumper to D3 allows the ATMEGA328 to shut down the 3v3 boost regulator pulling digital pin 3 low. This allows the ESP8266 to be shut down for maximum efficiency. **VCC\_SRC MUST BE SET TO 5V TO USE THIS OPTION OR THE ATMEGA328 WILL REBOOT WHEN THE 3V3 BOOST REGULATOR IS SHUT DOWN.**

Setting 3V3\_SHDN jumper to SHDN disables the 3.3v boost regulator and ESP8266. This is useful in situations where WIFI is not required, such as when logging data locally to a MicroSD card. **VCC\_SRC MUST BE SET TO 5V IN ORDER FOR THE ATMEGA328 TO BE ENABLED WHEN THIS OPTION IS USED.**

### ESP8266 Operations

The CH\_PD pin on ESP8266 is pulled to the 3.3v rail with a 1K resistor. It is also connected to digital pin 17 on the ATMEGA328. This allows for the ESP8266 to be disabled by bringing digital pin 17 LOW. Bringing it HIGH reenables the ESP8266

The RESET pin on the ESP8266 is pulled to the 3.3v rail with a 1K resistor. It is also connected to digital pin D2 on the ATMEGA328. This allows the ESP8266 to be disabled by bringing digital pin 2 low for 100ms and then bringing it HIGH again, or allowing it to float.

The default BAUD rate for the ESP8266 module has been set to 56700. This is the maximum speed for Software Serial operations. Setting the BAUD rate higher will prevent the ATMEGA328 from communicating with the ESP8266.

The TX line on the ESP8266 is connected to ATMEGA328 digital pin 7(D7).

The RX line on the ESP8266 is connected to ATMEGA328 digital pin 6(D6).

SoftwareSerial protocol must be used to allow the ATMEGA328 to communicate with the ESP8266. This is so the hardware serial port is available for debugging and monitoring during operations and sketch to prevent the ESP8266 from interfering with sketch uploads. **MAXIMUM SUPPORTED SPEED FOR SOFTWARESERIAL PROTOCOL IS 57600.**

The 3-pin PROG\_ESP connector allows you to debug/monitor ESP8266 operations and interact with the radio module. It also allows you to flash firmware updates. The TX pin is connected to the TX pin on the ESP8266 and the RX pin is connected to the RX pin. When programming/debugging ESP8266, follow the connection diagram below:

**Connection Diagram**

USB-Serial Adapter PROG\_ESP Port

GND GND

TX RX

RX TX

The RUN/PROG switch allows you to switch the RX pin on the ESP8266 from communicating with the ATMEGA328 to the 3-pin PROG\_ESP header. To program the ESP8266 or flash new firmware, the switch must be in the PROG position. The communicate with the ESP8266 from the ATMEGA328, the switch must be in the RUN position.

The FLASH momentary switch allows you to put the ESP8266 into FLASH mode to upload new firmware. You must hold the FLASH button down while powering the board, and then releasing it to put the ESP8266 into flash mode.

### Uploading Sketches/Debugging

The Sensor Board is compatible with the Arduino IDE. When programming the sensor board, select Arduino UNO/Genuino as the board type.

You will need a USB-serial adapter or AVRISP programmer to upload sketches to the sensor board. The sensor board is pre-loaded with the Arduino bootloader, allowing the board to auto-reboot during sketch uploads.

Connect your USB-serial adapter to the 5-pin PROG/DEBUG port on the right edge of the board. Ensure you connect the pins on the serial port to the correct pins on your programmer. The TX pin on the PROG/DEBUG port is connected to the TX pin on the Atmega328 and the RX pin is connected to the RX pin on the Atmega328.

**Connection Diagram**

USB-Serial Adapter PROG/DEBUG Port

5V 5V

GND GND

RESET/DTR RST

TX RX

RX TX

If you need to reburn the bootloader onto the sensor board for any reason, you will need a 6-pin AVRISP programmer (or a 10-pin programmer with adapter cable), connected to the ICSP header. When burning a new bootloader, select board type Arduino UNO/Genuino and select the appropriate serial port for your AVRISP programmer.

### PWR\_OUT Header

The 3-pin PWR\_OUT header on the left edge of the sensor board allows you to draw 3.3v and 5v power from the board.

The 5V ad 3.3V power rails are protected by resettable poly-fuses. The limits for these fuses determine the current output limits for each power rail. Keep in mind that the 3.3V power rail provides power for the ESP8266, which can consume up to 300ma during startup and transmission. Drawing too much power from either power rail will result in unstable operation.

Current limits for the poly-fuses are listed below:

**Poly-fuse Limits**

5V 700ma

3.3V 500ma

***WARNING: DO NO CONNECT A 3.3V EXTERNAL POWER SOUCE TO THE PWR\_OUT HEADER OR DAMAGE COULD OCCUR.***

### Monitoring Battery Voltage

There is a voltage sense circuit on the Sensor Board to allow you to monitor battery voltage. The output of the voltage sense circuit is connected to Atmega328 pin A0 to allow for measurement of the battery voltage using the Atmega328 internal voltage references. When powering the sensor board from batteries, it is recommended that you use the 1.1v internal voltage reference.

**Version 2.0**

On version 2.0 of the sensor board, the battery voltage is tapped AFTER the battery protection diode, so battery measurements will be ~200ma lower than the voltage measured at the battery terminal. You can also measure external voltage sources applied to the 2-pin MOLEX connect or directly to the 5V power rail with the battery sense circuit.

**Version 2.1 and Later**

On version 2.1 and later of the sensor board, the battery voltage is tapped BEFORE the battery protection diode, so measurements reflect true battery voltage. Because of this change, you can not measure external voltage sources with the battery sense circuit.