

Board for XIAO LoRa V2 020123 – Build

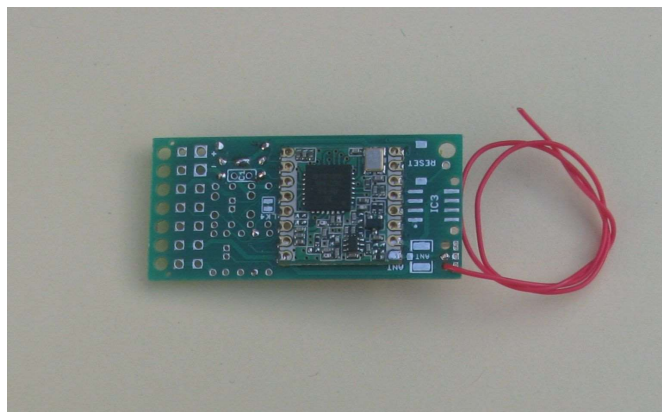
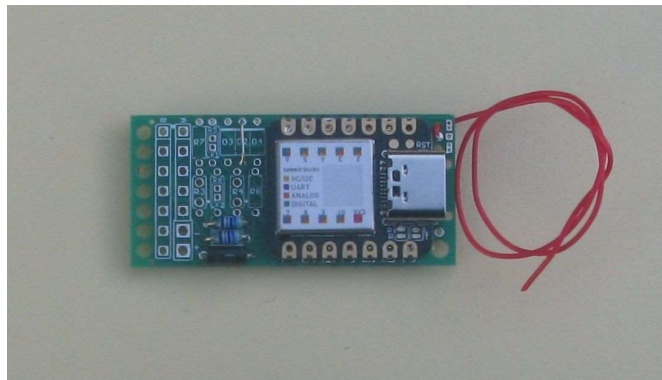
It makes sense to build this board up in stages. It can be difficult to identify what is at fault if you assemble it all and the end construction fails. There are choices to be made during the build also, which components to fit and why you might need them. There is a series of test programs in the device repository and they will help to test the board in stages as you build.

Note: Be sure to close the Arduino IDE Serial monitor before programming or applying power to the XIAO.

Carry out visual check on both sides of the PCB, a loupe or magnifying glass is needed for this. Do a basic multimeter short test on the pads for the XIAO and LoRa devices. Put the multimeter on a pad in one corner and test for continuity for each of the adjacent pads. When finished move the multimeter probe to the next pad and repeat the test on each of the other pads. What you looking for is shorts when there should not be, these would be faults. Note the LoRa module does have several pads connected to GND so expect these to be connected.

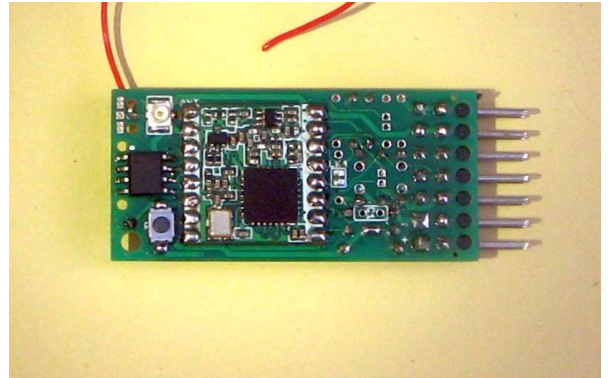
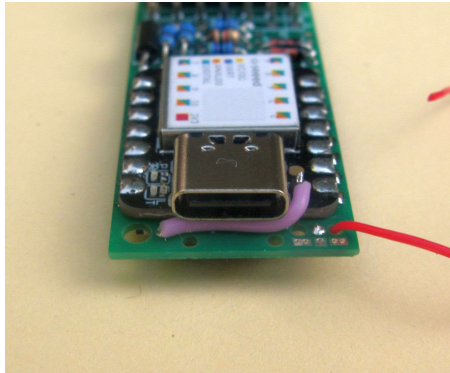
Before soldering the XIAO SAMD21 into place, load up program 1_LED_Blink to check that the XIAO itself is working. The program should make the yellow user LED and the blue TX and RX LEDs flash.

Pictures of the top and bottom of the board when built as a basic sensor node are below.



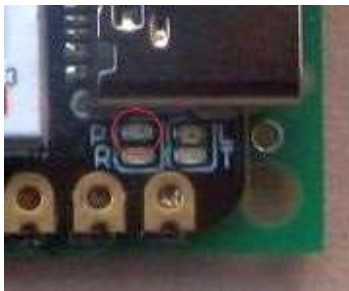
Solder the XIAO in place, the USB connector is at the antenna end of the board, see picture above.

Optional. If fitting the (small) reset switch on the bottom (LoRa module side) of the PCB solder it in place now. Solder a short wire from the XIOA RESET pad to the P1 pad on the PCB, see picture.

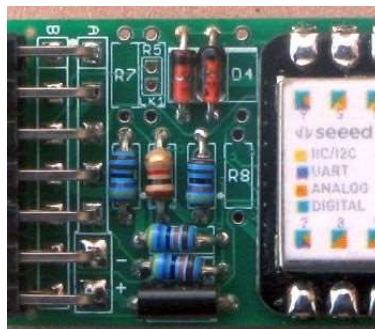


Optional. If fitting U.FL antenna socket do it now, see pictures of fully assembled board above. Fit diode D1 in place and connect a battery of no more than 5V to the battery pads on CONB, they are labelled + and -.

Run the RTC wakeup and test sleep current program; **2_RTC_Alarm_Sleep_Wakeup** Remove the USB cable and check the board runs on battery. The yellow LED on the XIAO will flash when it wakes up. With the green power LED removed, its the top left white oblong shaped part labelled P in the picture below, the deep sleep current should be circa 5uA.

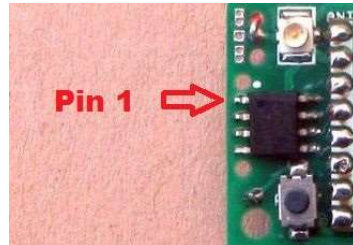


If fitting battery voltage read resistor divider circuit, R1 and R2, do so now and make link LK3 with a bit of wire or a solder blob. Load program **3_Battery_Voltage_Read** and check that the battery voltage is correct. If not make adjustments to the ADMultiplier value in the sketch. If your fitting the FRAM later or will be adding other I2C devices such as external sensors then fit the I2C pullup resistors R3 and R4. Note that at the R3 and R4 locations, there are also two large pads within the white silk screen outline of the resistor. These large pads can be used for LEDs or pin headers, see L1 and L2 on the schematic. The picture below shows the correct locations for R3 and R4.



If fitting the FRAM then solder it in place now, see the previous picture of bottom of PCB. Pin 1 of the FRAM is next to the end of the PCB, and there will either be a small indent on the top of the FRAM indicating pin 1 or that edge is chamfered. Get the orientation correct, the board won't work if the FRAM is the wrong way around, also see file;

Board_for_XIAO_LoRa_V2_PCB_BOTTOM.pdf, and the picture below;



Then load program **13_I2C_Scanner**. A MB85RC16PNF FRAM should be detected as addresses 0x50, 0x51, 0x52, 0x53, 0x54, 0x55, 0x56 and 0x57. An FM24CL64 FRAM should be detected as address 0x50. Next load the FRAM test program **4_FRAM_Memory_Test** which will tell you if the FRAM is working correctly.

If you're not using the U.FL antenna socket, fit a wire antenna now, normally $\frac{1}{4}$ wavelength at the frequency in use. There is a hole beside the antenna wire pad you can use this to loop the antenna wire back through to act as a strain relief.

Fit wire link in place of D2 if you're using LoRa point to point. If you're using the board for a TTN\LoRaWAN sensor node see the separate instructions.

Fit LoRa device, note the orientation, the bottom of the LoRa module has a pad labelled 'ANT' be sure that goes next to the antenna connection of the PCB. Be sure to check the picture of the bottom of the PCB above to ensure you solder the LoRa module in the correct orientation.

Load program **5_LoRa_Register_Test** that will confirm if the LoRa device can be read over the SPI interface. The notes to that program show what the register print should look like.

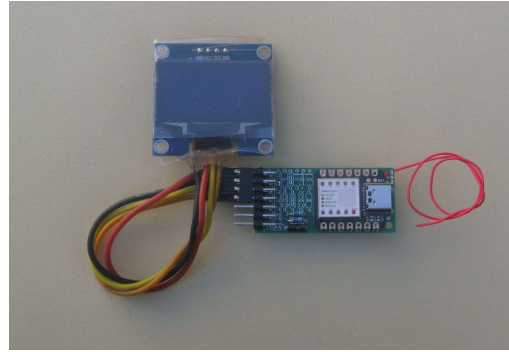
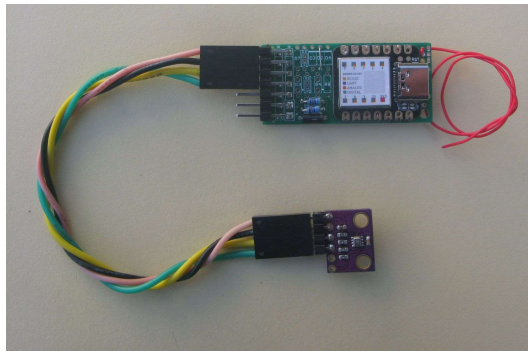
At this point we can proceed to check if the LoRa module is transmitting. Unfortunately to receive the transmitted packets you need a working LoRa receiver so you will need to build the receiver you intend to use.

Load program **6_LoRa_Transmitter** and be sure the receiver has the same LoRa settings which are;

```
Frequency = 434000000;      //frequency of transmissions in hertz
Offset = 0;                  //offset frequency for calibration purposes
Bandwidth = LORA_BW_125;    //LoRa bandwidth
SpreadingFactor = LORA_SF7; //LoRa spreading factor
CodeRate = LORA_CR_4_5;     //LoRa coding rate
Optimisation = LDRO_AUTO;   //low data rate optimisation setting, normally set to auto
```

The receiver which could be another Board for XIAO LoRa V2 020123 using program **7_LoRa_Receiver** should report the packets received.

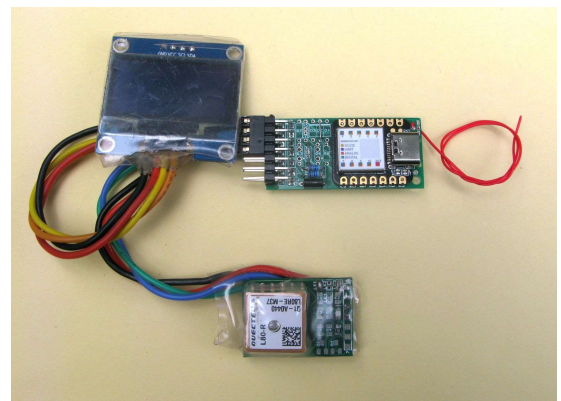
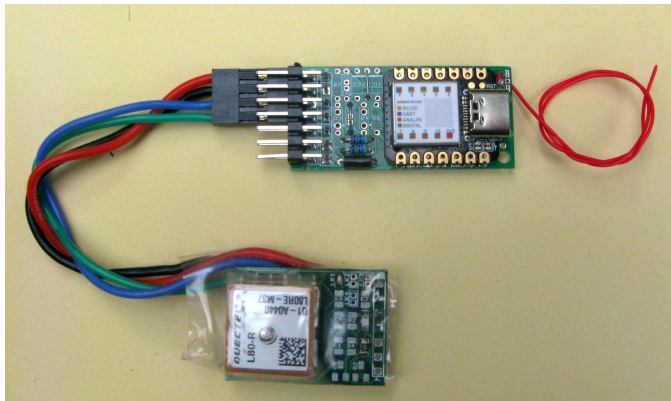
BME280 Sensor transmitter and receiver



If your going to fit an I2C sensor, such as the BME280, then either fit pin headers for CONA and use DuPont connectors for the wiring to the BME280, or you can solder the BME280 directly onto the PCB. Check the wiring of your BME280 does match the pinout of CONA. Load program **11_BME280_Sensor_Test** to check the sensor is working.

If your going to use the Board for XIAO LoRa V2 020123 for a BME280 sensor node than you can use another Board for XIAO LoRa V2 020123 as the receiver which can drive a small OLED connected to CONA. First Connect the OLED, an SSD1307 or SH1107 to CONA and run program **9_SSD1306_SH1106_OLED_Checker** to confirm the OLED is working before proceeding. Then load up **23_BME280_Sensor_Receiver_With_Display** to see the sensor information the BME280 transmitter is sending.

GPS Tracker transmitter and receiver



If your going to use the board as a GPS tracker fit R6 or put a wire link in its place or you wont be able to read the GPS. Then connect a GPS up to CONB and run program **8_GPS_Echo** which will copy characters from the GPS to the Arduino IDE Serial monitor. The GPS will not get a fix unless its outside with a good view of the sky. If you want to check the GPS is working with a portable display, first connect an an SSD1307 or SH1107 OLED to CONA then load program **9_SSD1306_SH1106_OLED_Checker** to confirm the OLED is working.

Then load program **10_GPS_Location_Checker_With_Display** which should display the current location on the OLED connected to CONA. Now you can load up program **20_GPS_Tracker_Transmitter** and you will need a matching receiver so you can use program **21_GPS_Tracker_Receiver_With_Display** which will receive the tracker packets and display the location on the receivers OLED display. Note that you can connect a GPS to the receiver, on CONB, and if that GPS gets a fix then the OLED will show the distance and direction from the receiver to the transmitter.

Parts and what do to with them

This is a list of the parts on the board, and the purpose behind fitting them. Many of the parts are optional, you don't have to fit them all.

ANT1 Pad for connection of a wire antenna, normally $\frac{1}{4}$ wavelength at the frequency being used.

C1 Can be fitted to smooth the voltage at the centre of the resistor divider formed by R1 and R2.

CONA Connector for I2C devices, i.e. sensors or displays.

CONB Connector for Serial devices, i.e. GPS.

D1 Reverse polarity protection for incoming battery supply.

D2 Used to allow DIO0 on LoRa module to be read on one IO pin of XIAO, A1. Used as pin saver for LoRaWAN nodes.

D3 Used to allow DIO1 on LoRa module to be read on one IO pin of XIAO, A1. Used as pin saver for LoRaWAN nodes.

D4 Used to allow DIO2 on LoRa module to be read on one IO pin of XIAO, A1. Used as pin saver for LoRaWAN nodes.

IC1 Seeeduino XIAO SAMD21 Microcontroller.

IC2 RFM9X LoRa module.

IC3 MB85RC16PNF or FM24CL64 FRAM.

L1 Can be 1.8mm LED, current limit resistor would be R1.

L2 Can be 1.8mm LED, current limit resistor would be R6.

LK1 Allows LoRa pin DIO1 to be directly connected to XIAO pin A6.

LK2 Allows LoRa pin DIO2 to be directly connected to XIAO pin A7.

LK3 Connects VIN of XIAO module to top of R1,R2 resistor divider.

LK4 SMT pad link that can be cut so that pin A2 of XIAO module is not connected to LoRa module pin NRESET.

P1 Single pad, used to connect wire between XIAO SAMD21 gold reset pad and reset switch on board.

R1 Select value to suit. Can be used to sense a high voltage, keep current to less than circa 500uA. Can be used together with R2 to form a resistor divider to read battery voltage on XIAO pin A0. For the resistor divider values as high as 470K seem to work OK and keep sleep current low.

R2 Select value to suit. Can be used together with R1 to form a resistor divider to read battery voltage on XIAO pin A0. For the resistor divider values as high as 470K seem to work OK and keep sleep current low.

R3 SDA pin for I2C interface pull up resistor, typically 4K7.

R4 SCL pin for I2C interface pull up resistor, typically 4K7.

R5 Pull up for MISO pin on SPI interface, not normally needed.

R6 Can be used to read a high voltage, say from a 5V serial device, but keep current to less than circa 500uA. Needed if you want to read a GPS or other serial device connected to CONB

R7 Pull up for SCK pin on SPI interface, not normally needed.

R8 Pull up for NSS pin on LoRa device, not normally needed.

RESET Small SMT switch that makes resetting the XIAO SAMD21 for programming heaps easier.

Stuart Robinson

February 2023