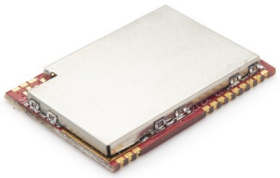


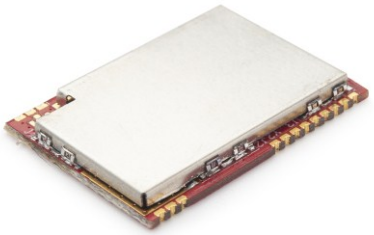
LM502 22dBm SX1262 LoRaWAN module User Manual

Document Version: 1.0

Version	Description	Date
1.0	Release	2019-Sep-10

1. Introduction

1.1 What is LM502 LoRaWAN End node



The LM502 is a general LoRa Wireless Communication module, with integrated LoRa Radio Transceiver, **SX1262 LoRa Modem** and **a 32-Bit RISC MCU** CY8C4147AXI-S445 from Cypress. The MCU uses **ARM Cortex M0+, with 48MHz operation frequency**. The LoRa Radio Transceiver has continuous frequency coverage from 150MHz to 960MHz. The LoRa Modem supports LoRa modulation for LPWAN use cases and (G)FSK modulation for legacy use cases.

LM502 use the newest LoRa Modem SX1262 which provide high transmit power for ultra long range, ultra low power communication for LPWAN application.

LM502 can achieve a **high sensitivity of over -140dBm** and the **maximum transmit power is higher than +21dBm**. This makes it suitable to be used in long range LPWAN and have high efficiency.

LM502 is provided with ready to use LoRaWAN Modem software. Developers only need to use AT Commands to control the module so to join the LoRaWAN network.

The LM502 also includes programmable and reconfigurable analog and digital blocks with flexible automatic routing. Developer can use the rich I/Os to connect to their sensors and provide a low cost / low power consumption / small size LoRaWAN End Node solution.

1.2 What is LM502 Demo Board

The LM502 demo board is a breakout board for LM502. It helps developers to rapidly evaluate the features and performances of LM502 and help to develop the software of LM502.

The LM502 demo board is 3.3v I/O base module. It can be powered by micro USB port or DC port.

The LM502 has a built-in STM32 chip with pre-load DAP-LINK firmware. Use can use the micro USB port to flash new firmware to LM502 or connect to the UART interface of LM502 by DAP-LINK.

1.3 Specifications

Micro Controller:

- Cypress CY8C4147AXI-S445 MCU
- ARM Cortex M0+
- Flash:128KB
- RAM:16KB
- Clock Speed: 48Mhz

Absolute Maximum Ratings (For LM502):

- VCC: -0.3 ~ 3.9v
- I/O pins: -0.3v ~ 3.9v
- RF Input Power: +10dBm

Common DC Characteristics (For LM502):

- Supply Voltage: 1.8v ~ 3.7v
- Operating Temperature: -40 ~ 85°C
- Deep sleep power: 3.4 uA
- TX: 112mA @22dBm
- I/O pins: Input High: > 0.7x VCC, Input Low: <0.3 x VCC

LoRa Spec:

- Frequency Range,
  - ✓ Band 1 (HF): 862 ~ 1020 Mhz

  or
  - ✓ Band 2 (LF): 410 ~ 528 Mhz
- LoRa Chip: sx1262
- 170 dB maximum link budget
- Max +22 dBm - 100 mW constant RF output
- Low RX current of 4.6 mA
- Programmable bit rate up to 62.5 kbps LoRa.
- High sensitivity: down to -148 dBm
- Built-in bit synchronizer for clock recovery
- Low RX current of 10.3 mA, 200 nA register retention.
- Automatic Channel Activity Detection (CAD) with ultra-fast AFC
- High Stability TCXO oscillator
- LoRaWAN 1.0.2 Specification

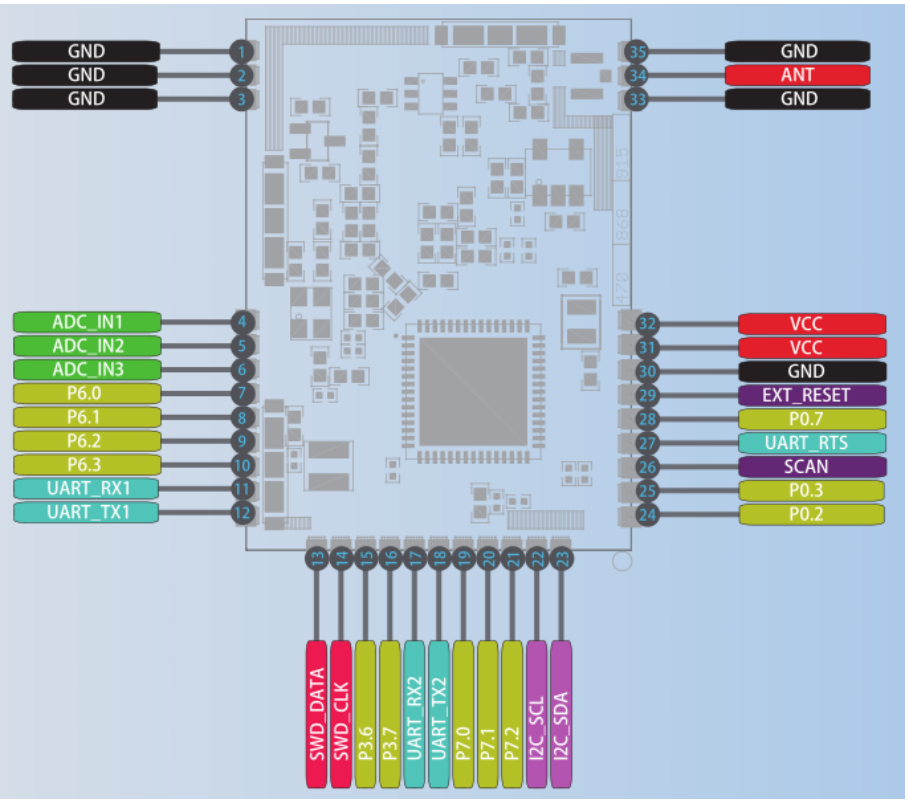
1.4 Features

- ✓ Small footprint: 20 mm x 27.5 mm x 2.5 mm.
- ✓ 48-MHz ARM Cortex-M0+ CPU
- ✓ LoRa Radio and LoRa Modem via SX1262
- ✓ 8-Channel DMA engine.
- ✓ Low power consumption
- ✓ Embedded 12-bit 1Msps SAR ADC
- ✓ SPI, 1xI2C, 2xUART, 1xSWD
- ✓ 3xADC, 1xCOMP.
- ✓ Baud rate configurable
- ✓ LoRa™ Modem
- ✓ Preamble detection
- ✓ FSK, GFSK, MSK and GMSK modulation
- ✓ Open source hardware / software
- ✓ Available Band:433/868/915/920 Mhz
- ✓ External Antenna via I-Pex connector
- ✓ ANT on SMD pad

1.5 Applications

- ✓ Wireless Alarm and Security Systems
- ✓ Home and Building Automation
- ✓ Automated Meter Reading
- ✓ Industrial Monitoring and Control
- ✓ Long range Irrigation Systems,etc.
- ✓ Smart Factory

1.6 Pin Definition



Pin Mapping:

Pin No.	Signal	Direction	Function	Remark
1	VCC(2.9V)	OUTPUT	VCC	Directly connect to main power for board
2	PA0	In/Out	Directly from STM32 chip	Used as ADC in LSN50 image
3	PA1	In/Out	Directly from STM32 chip	
4	PA2	In/Out	Directly from STM32 chip, 10k pull up to VCC	Used as UART_TXD in LSN50 image
5	PA3	In/Out	Directly from STM32 chip, 10k pull up to VCC	Used as UART_RXD in LSN50 image
6	PB6	In/Out	Directly from STM32 chip, 10k pull up to VCC	
7	PB7	In/Out	Directly from STM32 chip, 10k pull up to VCC	
8	PB3	In/Out	Directly from STM32 chip, 10k pull up to VCC	

9	PB4	In/Out	Directly from STM32 chip	
10	PA9	In/Out	Directly from STM32 chip, 10k pull up to VCC	
11	PA10	In/Out	Directly from STM32 chip, 10k pull up to VCC	
12	GND		Ground	
13	VCC(2.9V)	OUTPUT	VCC	Directly connect to main power for board
14	Jumper		Power on/off jumper	
15	PA4	In/Out	Directly from STM32 chip	
16	NRST	In	Reset MCU	
17	PA12	In/Out	Directly from STM32 chip	
18	PA11	In/Out	Directly from STM32 chip	
19	PA14	In/Out	Directly from STM32 chip	
20	PB13	In/Out	Directly from STM32 chip	
21	PB12	In/Out	Directly from STM32 chip	
22	PB15	In/Out	Directly from STM32 chip	
23	PB14	In/Out	Directly from STM32 chip	
24	PA13	In/Out	Directly from STM32 chip	
25	PA8	In/Out	Directly from STM32 chip	Default use to turn on/off LED1 in LSN50 image
26	GND		Ground	
27	+5V	Out	5v output power	Controlled by PB5(Low to Enable, High to Disable)
28	LED1		Controlled by PA8	Blink on transmit
29	BOOT MODE		Configure device in working mode or ISP program mode	
30	NRST	In	Reset MCU	

1.7 Software Change log

This section is for the pre-load software in LM502

1.8 Hardware Change log

LM502 v1.0:

✓ Release

1.9 LM502 Demo Kit Introduction

The LM502 demo board is a breakout board with LM502 pre-load. The demo board provides a rapid way to user to evaluate the feature of LM502. The demo board can be powered by 12v DC or USB port. The USB port of LM502 demo kit will be shown as one program port and one CDC port in computer, the program port is for flash firmware and CDC port is for serial access to LM502.

2. Use the stock firmware

2.1 How it works?

LM502 is shipped with pre-load LoRa Modem software. User can use AT-Command to configure the module to join the LoRaWAN network.

The AT Command User Manual is here: LM502 AT Command User Manual.

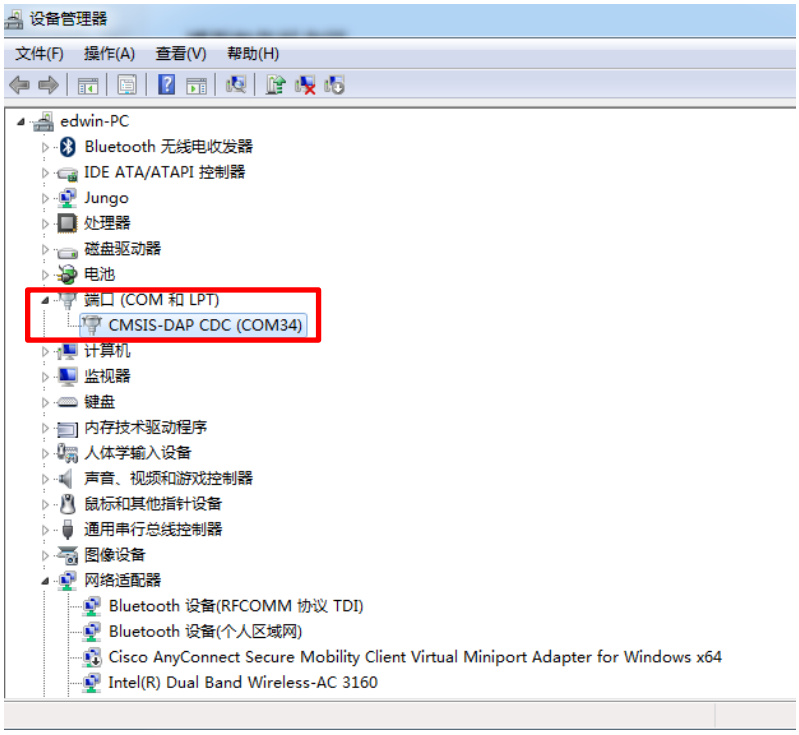
Below are some examples for how to use the AT commands. We test it with the LM502 demo board.

2.2 Install virtual CDC serial port for LM502 demo board

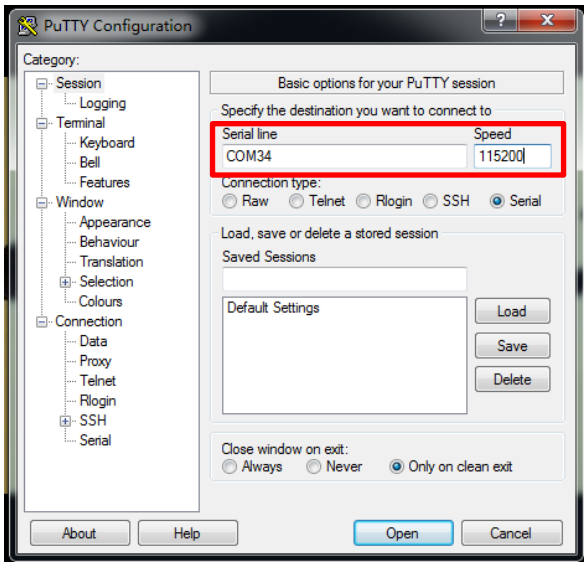
The LM502 demo board has a built-in **DAP-Link interface**. User can connect the LM502 UART interface via USB cable and this DAP-Link interface. User need to install the CDC driver from this link: http://www.dragino.com/downloads/index.php?dir=LM502/drivers/&file=CMSIS_DAP.inf

2.3 Send an AT Command to LM502

If the DAP CDC install correctly, user should see below screen shot:

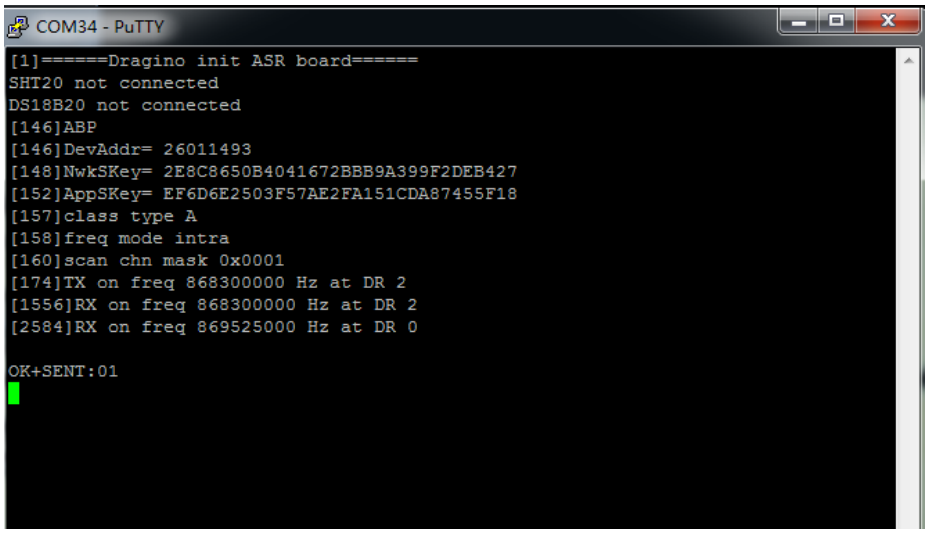


Configure Putty for serial access.



Baud Rate: 115200.

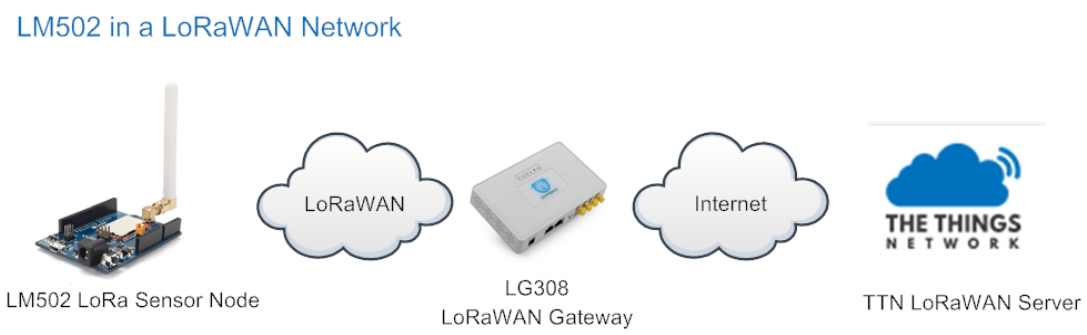
And after access, user can see the output from LM502:



3. Prepare LoRaWAN network

Most examples used below are based on LoRaWAN protocol. Before doing the testing, we need to set up a device in LoRaWAN server for LM502.

This section is an example for how to set up a LoRaWAN device in the TTN LoRaWAN Network. Below is the network structure, we use LG308 as LoRaWAN gateway here.



The LG308 is already set to connect to TTN network . Below is the set up photo for LG308. It generates a LoRaWAN network in our office and our industrial area.

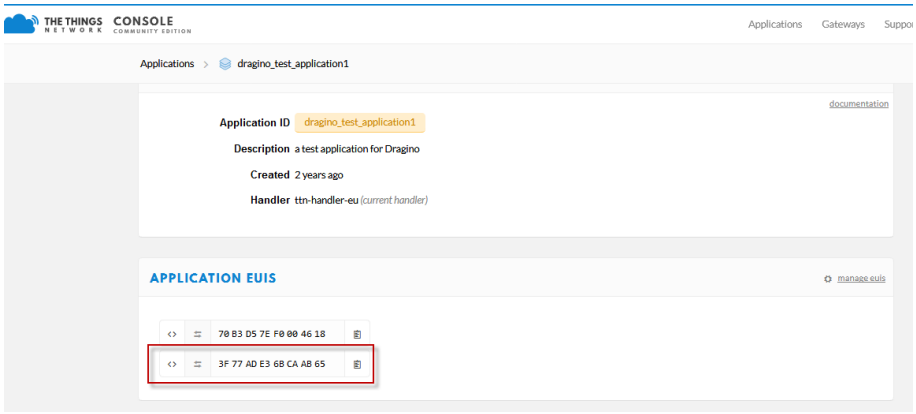
So what we need now is only add the device to the TTN, with the OTAA Keys from LM502

Step 1: Create a device in TTN with the OTAA keys from LM502.

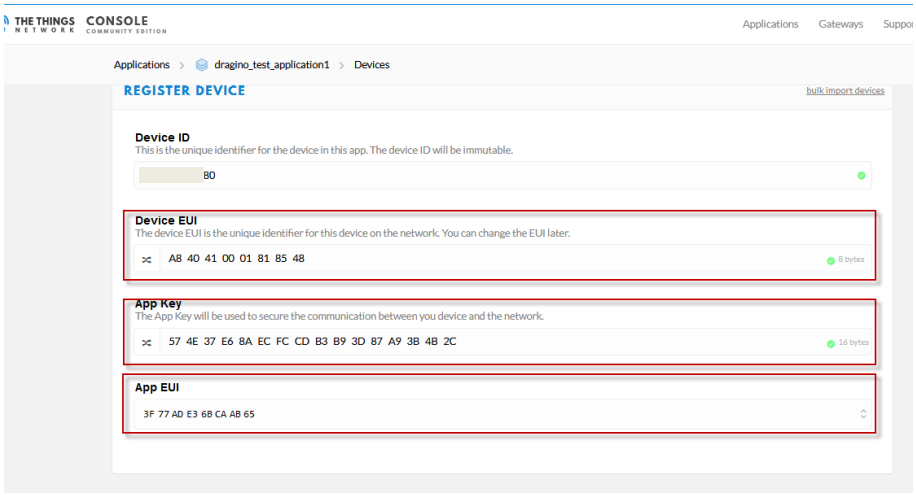
Each LM502 is shipped with a sticker with the worldwide unique device EUI as below:

User can enter this key in their LoRaWAN Server portal. Below is TTN screen shot:

Add APP EUI in the application



Add APP KEY and DEV EUI



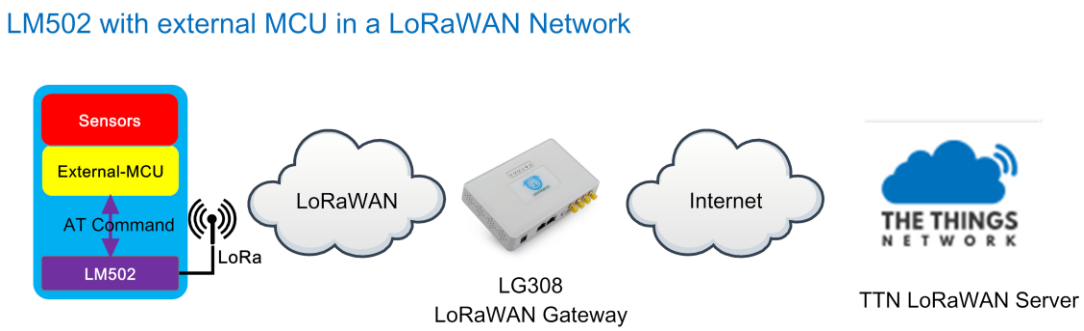
After above settings, we have an OTAA device for LM502 in TTN.

4. General Examples

4.1 Use AT Command & OTAA to Join LoRaWAN network

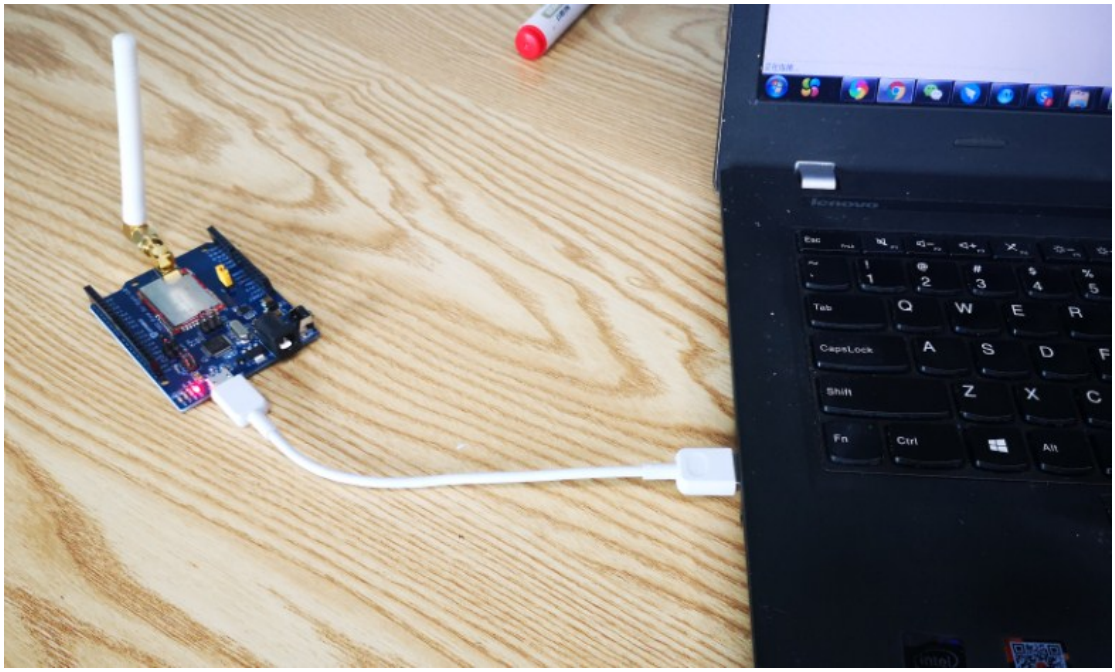
This shipped LM502 has a pre-installed the firmware which support LoRaWAN 1.0.3 protocol. Developer can use their familiar micro controller as the main MCU and use the LM502 as LoRaWAN module. The external mcu control LM502 via AT Commands for LoRaWAN transmission. System structure is as below figure.

In this example, we use Computer to simulate the micro control to send AT Commands for LoRaWAN communication.



Test set up:

- ✓ LoRaWAN Network. (How to Prepare LoRaWAN Network?)
- ✓ LM502-Demo-Board with AT Command works in PC (How to use AT Command?). Photo is as below



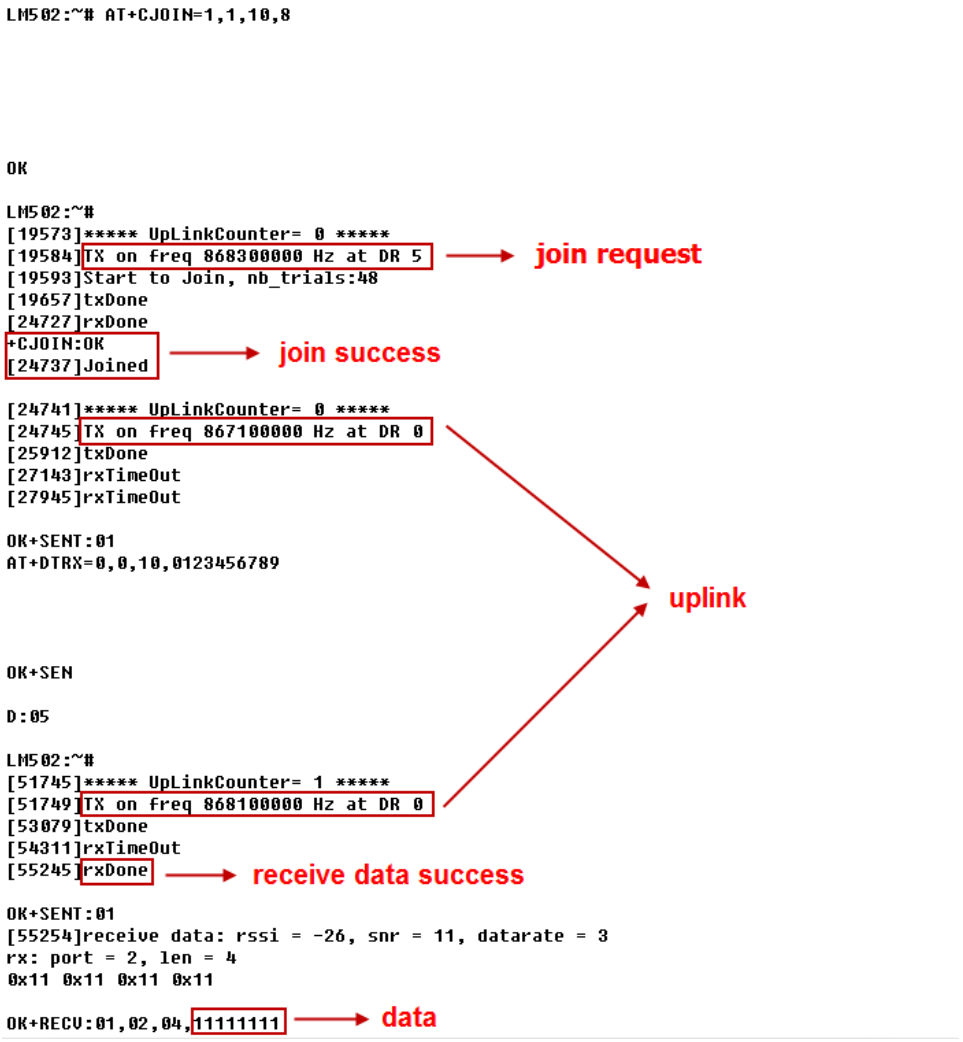
AT Commands:

AT+CRESTORE //Initiate LM502 module.

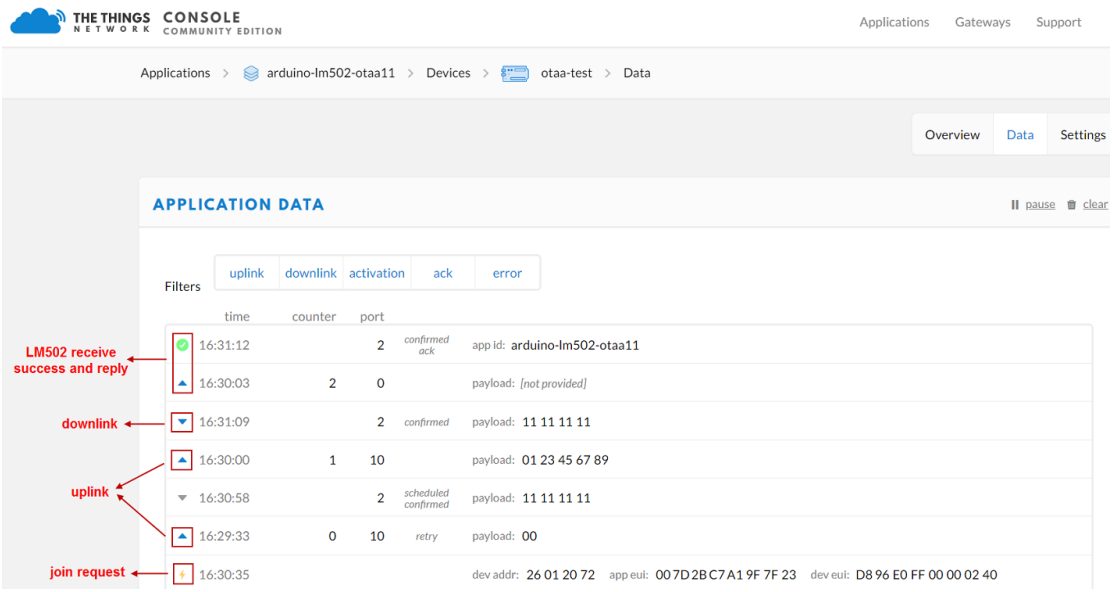
AT+CJOIN=1,1,10,8 // Enable OTAA Join to LoRaWAN network, join periodically 10s. max retry 8.If module is reboot, this command need to run again to join network,

AT+DTRX=0,0,10,0123456789 // Send a string 0123456789

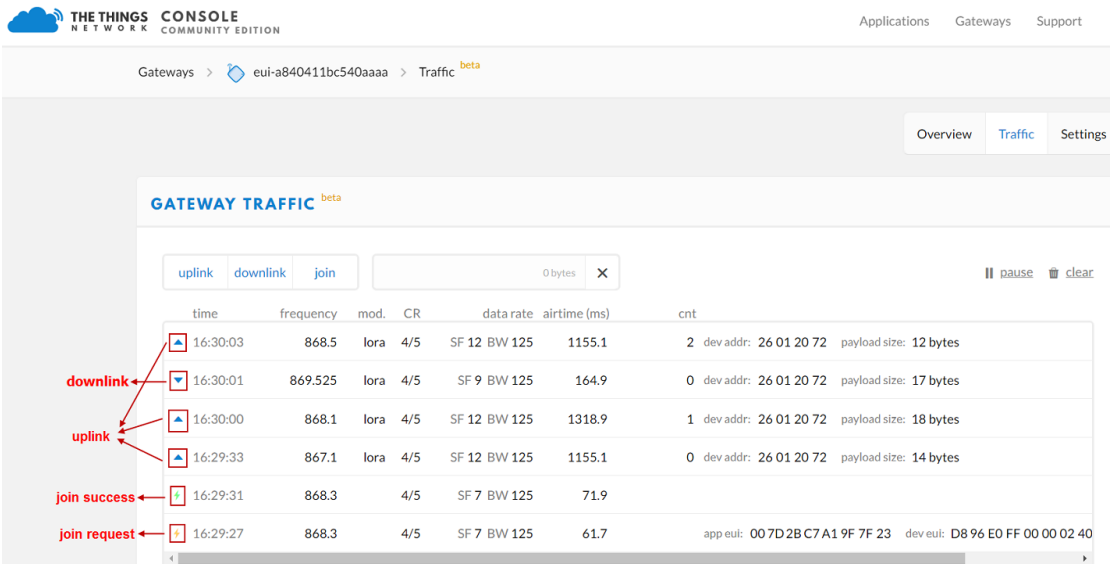
Serial Output in LM502 console:



Screen Shot in TTN- Device Page:



Screen Shot in TTN-Gateway-Traffic Page:



Video Demo:

LM502-Tutorial-1---Use AT Command to join LoRaWAN via OTAA

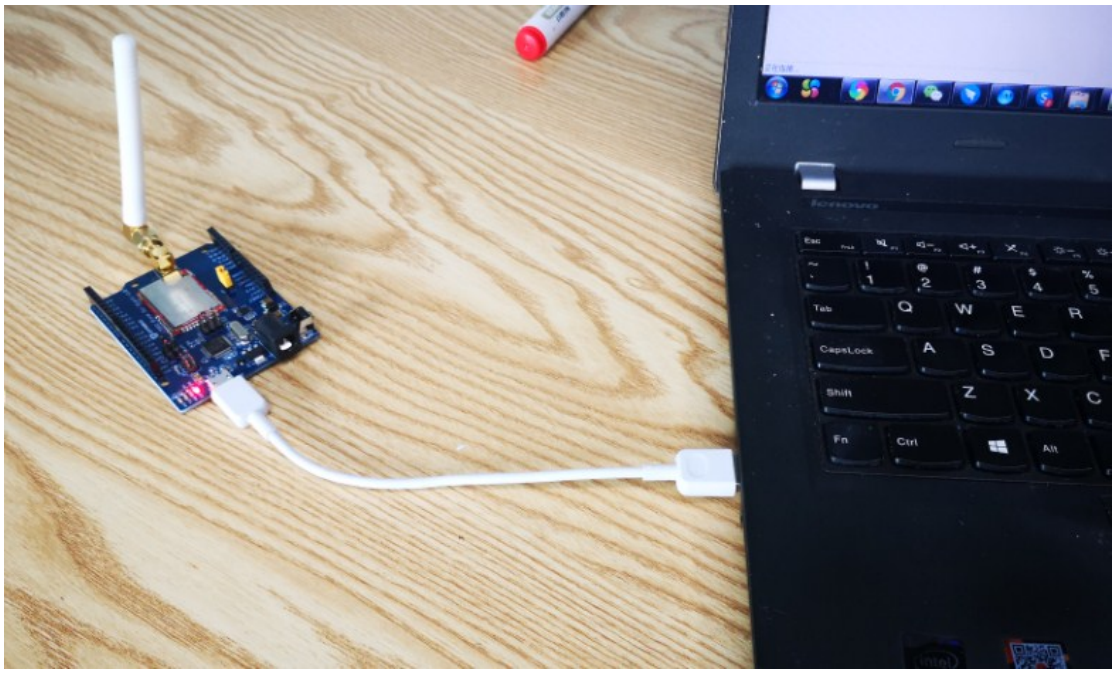
Link: https://youtu.be/xqUK-j4lGcE

4.2 Use AT Command & ABP to Join LoRaWAN network

The set up for this example is the same as the OTAA example as above. The difference is that there is no OTAA join. The LM502 will set uplink directly.

Test set up:

- ✓ LoRaWAN Network. (How to Prepare LoRaWAN Network?)
- ✓ LM502-Demo-Board with AT Command works in PC (How to use AT Command?). Photo is as below



AT Commands:

AT+CRESTORE // Initiate LM502 module.

AT+CJOINMODE=1 //Set to ABP join, (If LM502 is reboot, user need to run these command again)

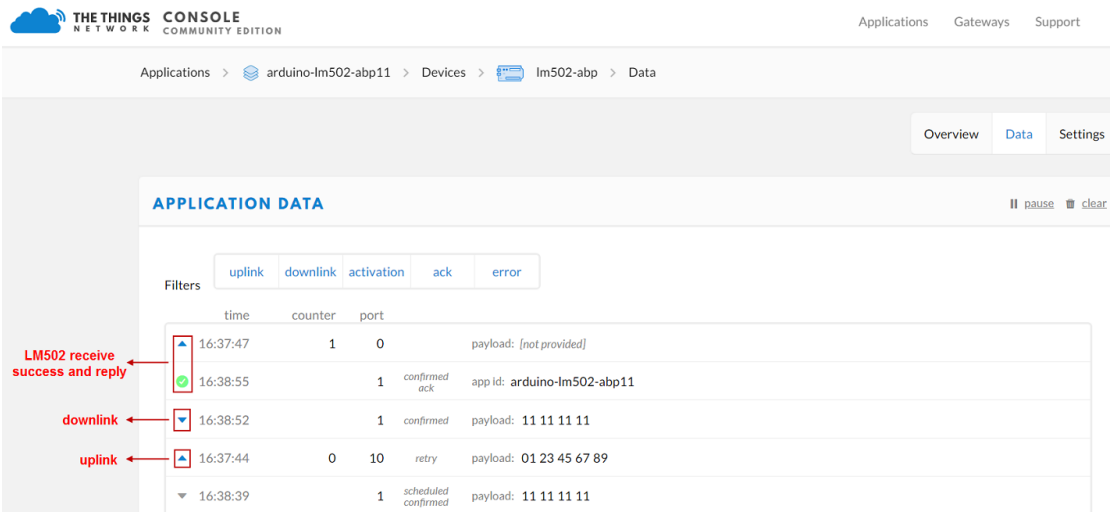
AT+DEVADDR=xxxxxxxx // xxxxxxxx is the Dev Addr from the TTN page.

AT+DTRX=0,0,10,0123456789 // Test command, send "0123456789" to LoRaWAN server.

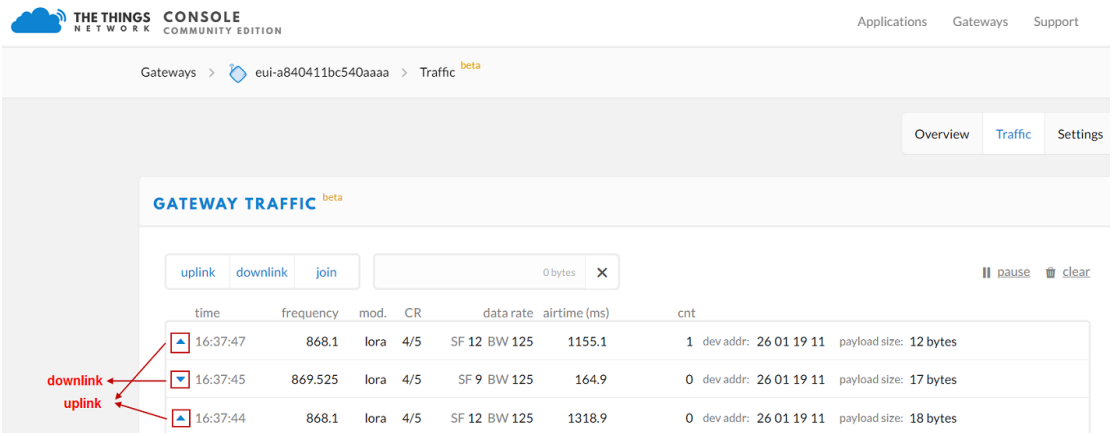
Screen capture in LM502:

```
LM502:~# AT+CJOINMODE=1



OK

LM502:~# AT+DTRX=0,0,10,0123456789



OK+SEN

D:05

LM502:~#
[94224]***** UpLinkCounter= 0 *****
[94235]TX on freq 868100000 Hz at DR 0 ──► uplink
[95565]txDone
[96797]rxTimeOut
[97731]rxDone ──► receive data success

OK+SENT:01
[97740]receive data: rssi = -27, snr = 11, datarate = 3
rx: port = 1, len = 4
0x11 0x11 0x11 0x11

OK+RECV:01,01,04,11111111 ──► data
```

Dataflow in TTN device page:



Traffic screen shot shows in the TTN --> Gateway:



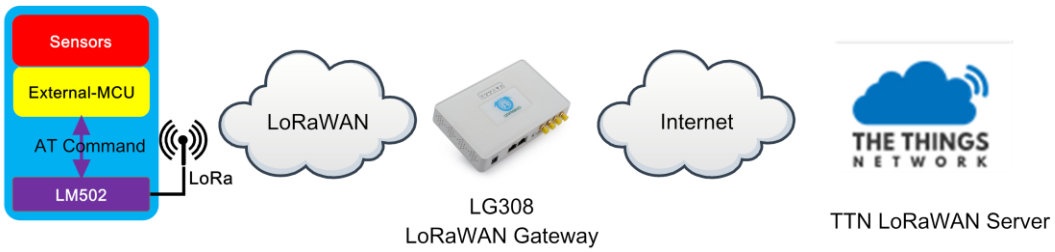
Video Instruction: LM502-Tutorial-2: Use AT Command & ABP to join LoRaWAN

Link: https://youtu.be/-Pk2SMQLVM0

4.3 Arduino & OTAA to Join LoRaWAN network

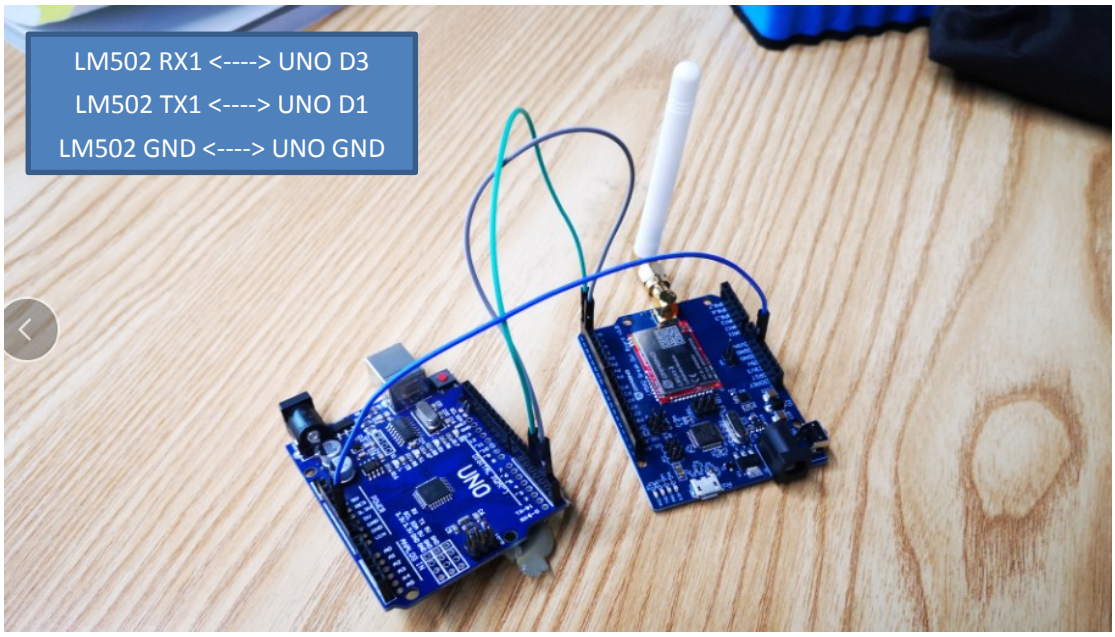
This example is basically similar with the example of AT Command OTAA example. But we use Arduino here (as external MCU) instead of Laptop.

LM502 with external MCU in a LoRaWAN Network



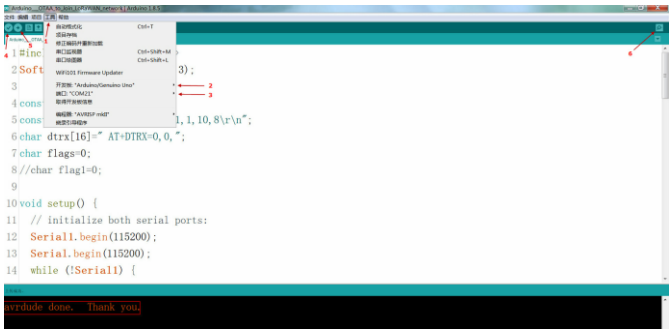
Test set up:

- ✓ LoRaWAN Network. (How to Prepare LoRaWAN Network?)
- ✓ LM502-Demo-Board with Arduino UNO connected. Photo is as below. The Arduino Sketch code is here:



Notice: The UNO 5V IO is now connecting to LM502 3.3v I/O. this example is ok for short time test but don't use it for long term. For long term connection, please use a level shift between two boards.

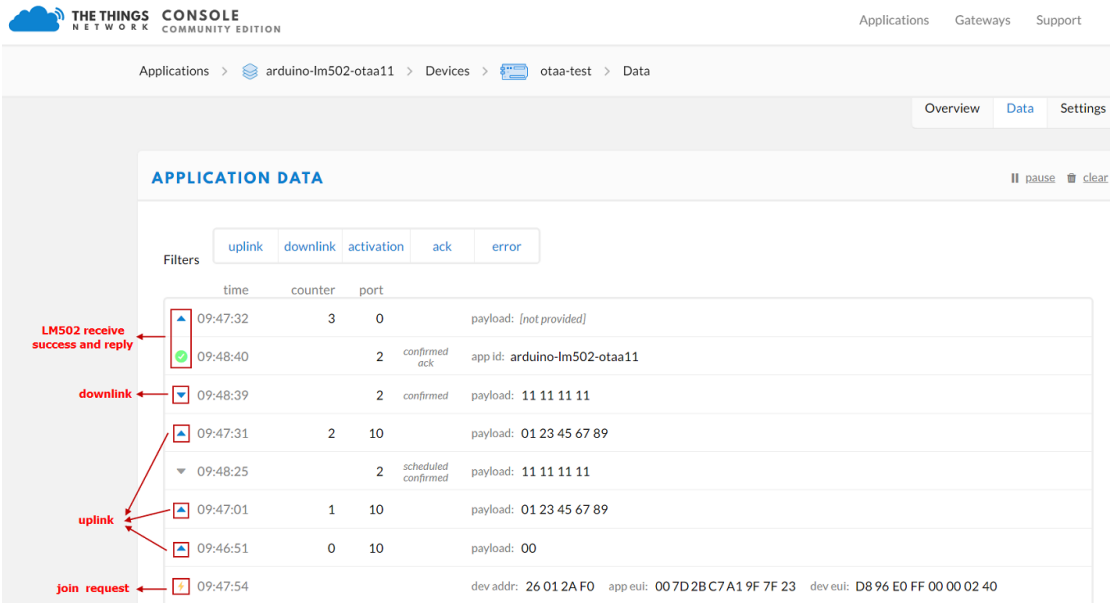
Upload code to Arduino:



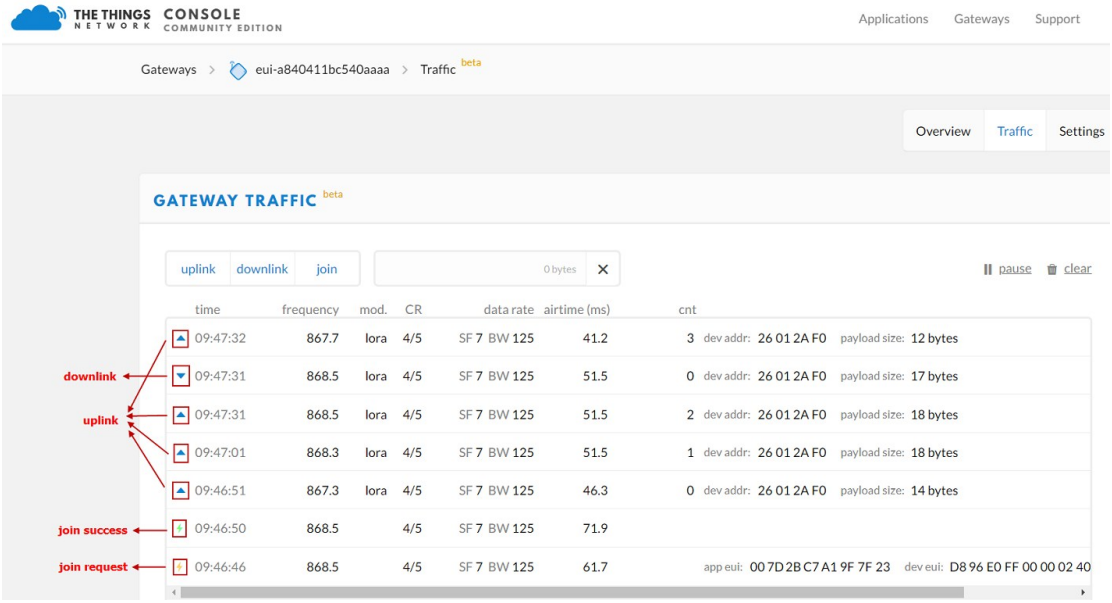
Check Arduino output for Join dataflow(Baud Rate: 115200):

```
LM502:~#
[1838412]***** UpLinkCounter= 0 *****
[1838423]TX on freq 868500000 Hz at DR 5      → join request
[1838433]Start to Join, nb_trials:48
[1838497]txDone
[1843567]rxDone
+CJOIN:OK                                     → join success
[1843577]Joined

[1843581]***** UpLinkCounter= 0 *****
[1843585]TX on freq 867300000 Hz at DR 5      → uplink
[1843644]txDone
[1844663]rxTimeOut
[1845676]rxTimeOut

OK+SENT:01
AT+DTRX=0, 0, 10, 0123456789

OK+SEND:05

LM502:~#
[1883518]***** UpLinkCounter= 2 *****
[1883523]TX on freq 868500000 Hz at DR 5
[1883586]txDone
[1884631]rxDone                               → receive data success

OK+SENT:01
[1884640]receive data: rssi = -51, snr = 14, datarate = 5
rx: port = 2, len = 4
0x11 0x11 0x11 0x11

OK+RECV:01, 02, 04, 11111111                  → data
```

Check device dataflow on TTN:



Check gateway – traffic on TTN:



Video: LM502-Tutorial-3: Arduino & OTAA to Join LoRaWAN network

Link: https://youtu.be/OlVXXyiuTH0

5. Upgrade Firmware to LM502

User can upgrade the firmware for LM502 for bug fix, change frequency bands or new feature added. There are some pre-compiled firmware which can be found at https://github.com/dragino/LM502/tree/master/Release

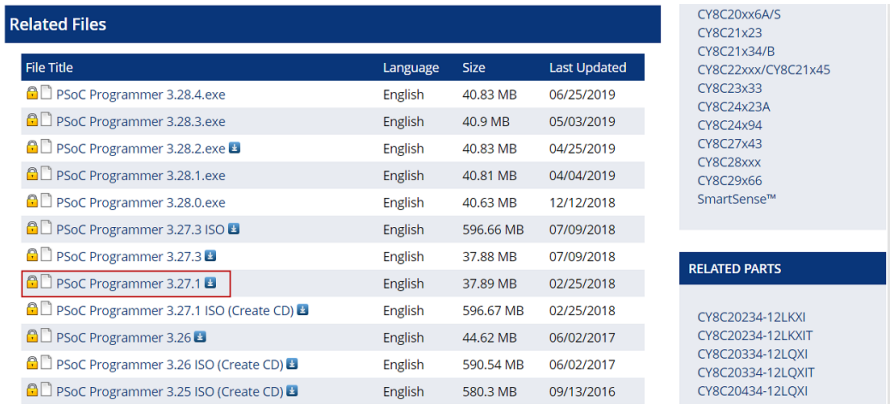
LM502 has a SWD interface which is used for upgrade firmware. User can use **DAP-Link tool** and **PSOC programmer** to upgrade firmware to LM502.

The LM502-Demo-Board has a build-in DAP-Link which connects to the LM502 SWD interface. User just need a USB cable and runs PSOC programmer to update LM502-Demo-Board. This example shows how to update LM502-Demo-Board with PSOC programmer.

Step 1: Download PSOC Programmer.

The download link is here: PSoC Programmer Download link .

IMPORTANT: Please use version (3.27.1), higher version will have compatible issue.



Related Files

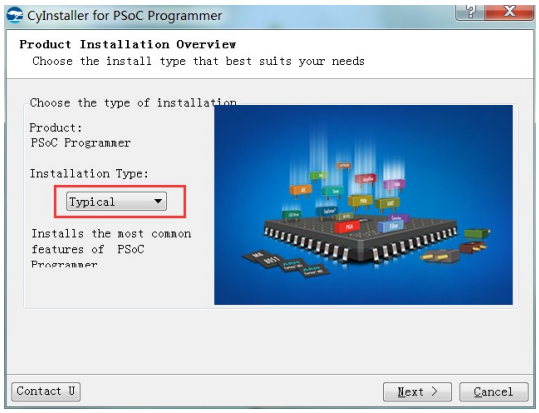
File Title	Language	Size	Last Updated
PSoC Programmer 3.28.4.exe	English	40.83 MB	06/25/2019
PSoC Programmer 3.28.3.exe	English	40.9 MB	05/03/2019
PSoC Programmer 3.28.2.exe	English	40.83 MB	04/25/2019
PSoC Programmer 3.28.1.exe	English	40.81 MB	04/04/2019
PSoC Programmer 3.28.0.exe	English	40.63 MB	12/12/2018
PSoC Programmer 3.27.3 ISO	English	596.66 MB	07/09/2018
PSoC Programmer 3.27.3	English	37.88 MB	07/09/2018
PSoC Programmer 3.27.1	English	37.89 MB	02/25/2018
PSoC Programmer 3.27.1 ISO (Create CD)	English	596.67 MB	02/25/2018
PSoC Programmer 3.26	English	44.62 MB	06/02/2017
PSoC Programmer 3.26 ISO (Create CD)	English	590.54 MB	06/02/2017
PSoC Programmer 3.25 ISO (Create CD)	English	580.3 MB	09/13/2016

CY8C20xx6A/S
CY8C21x23
CY8C21x34/B
CY8C22xxx/CY8C21x45
CY8C23x33
CY8C24x23A
CY8C24x94
CY8C27x43
CY8C28xxx
CY8C29x66
SmartSense™

RELATED PARTS

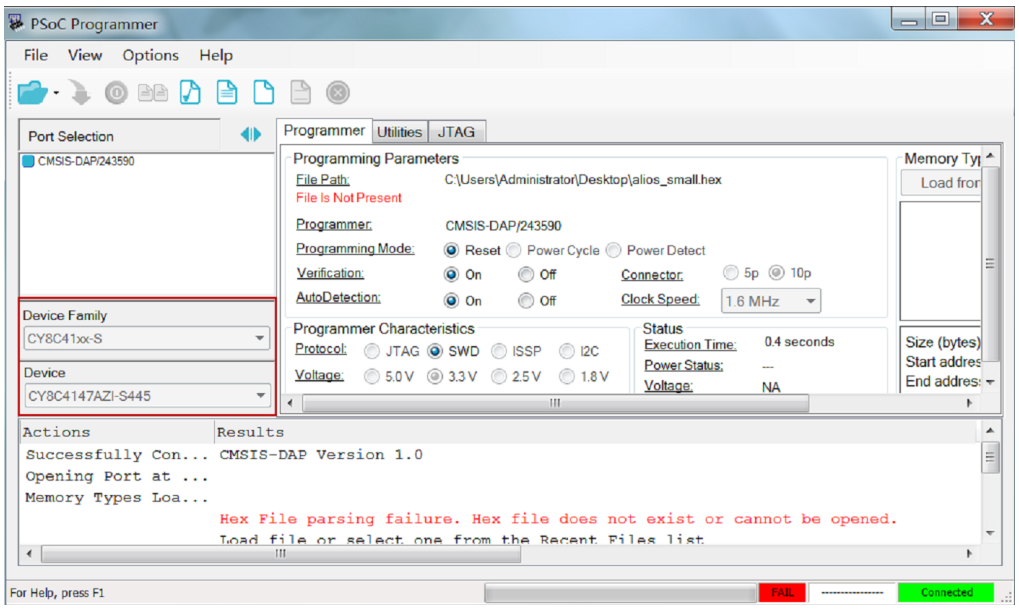
CY8C20234-12LKXI
CY8C20234-12LKXIT
CY8C20334-12LQXI
CY8C20334-12LQXIT
CY8C20434-12LQXI

Step 2:Install PSOC Programmer

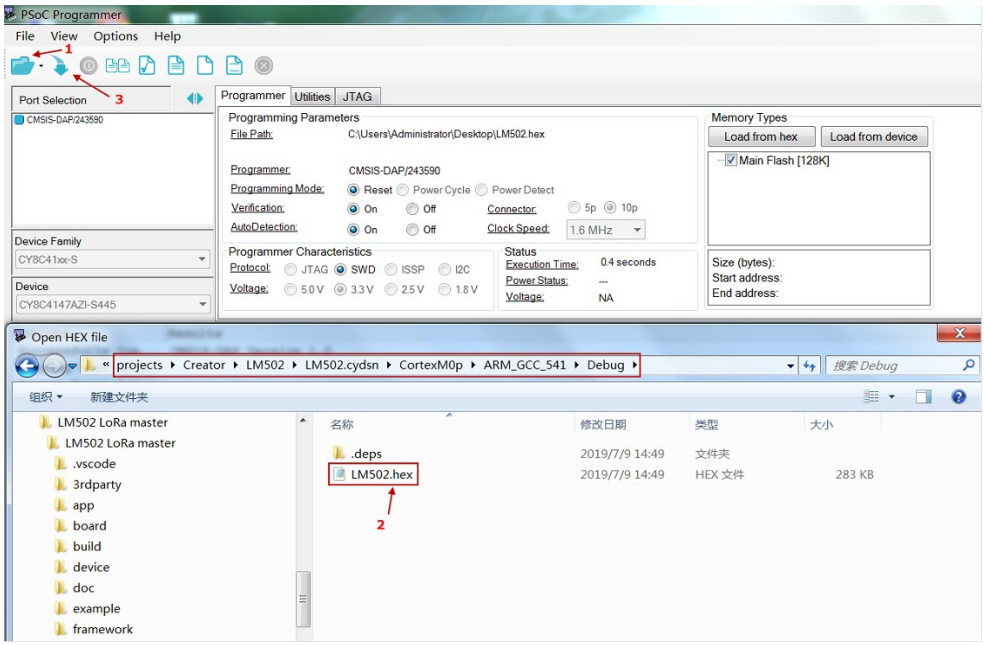


Step 3:Check Module Connection

If LM502 is detected, the PSOC programmer will show the device CY8C4147AZI-SI445

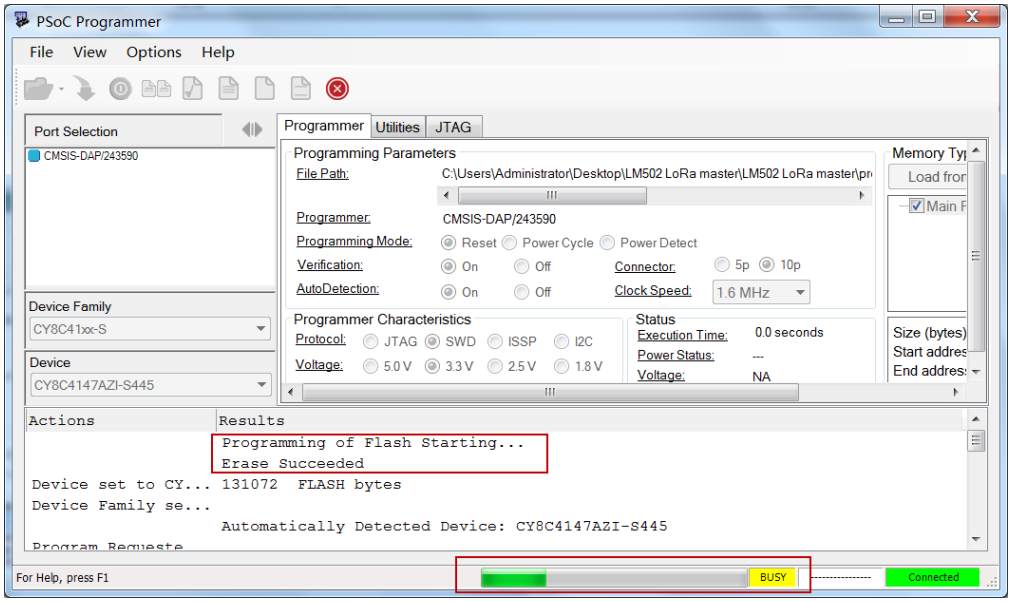


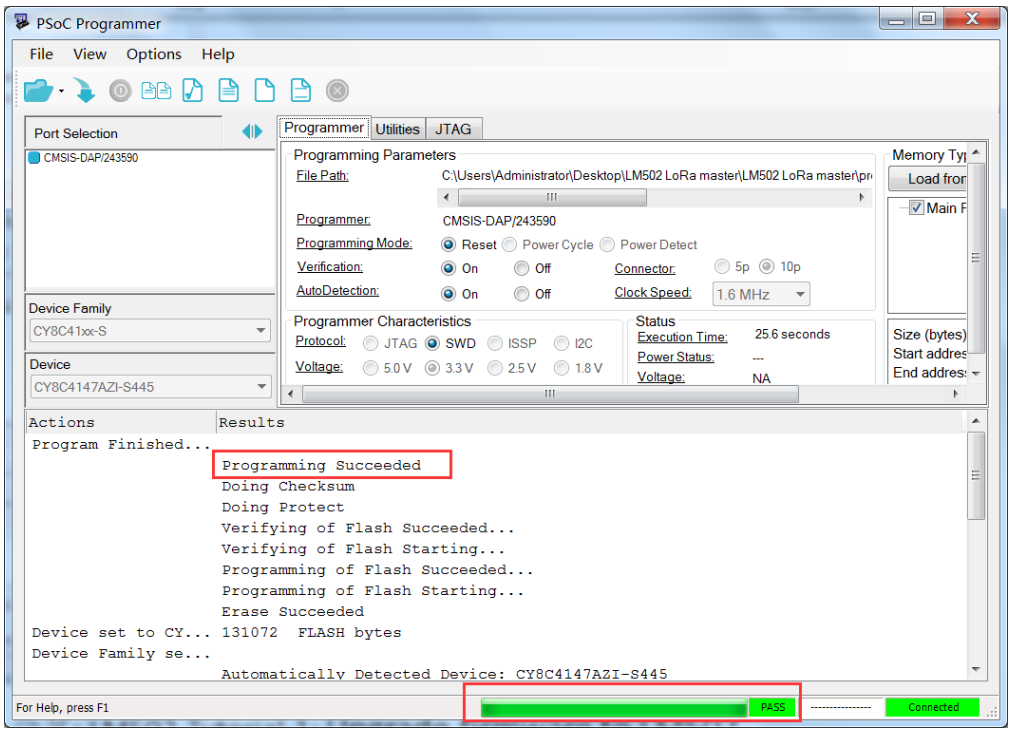
Step 4:Select file to update



Step 5:Output for a success upgrade

◦





Video: LM502-Tutorial-4: Upgrade firmware to LM502

Link: https://youtu.be/3dWfX3nTAc4

6. Compile Firmware

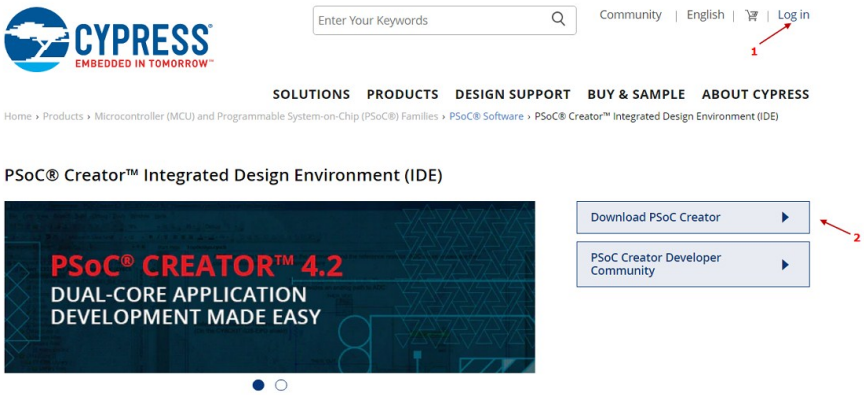
The LM502 is an open source module; user can develop the firmware for customized applications.

This chapter describes how to set up the develop environment and compile the firmware for LM502.

Step 1:Download PSOC Creator

The PSOC Creator is the program tool to compile the firmware for LM502.

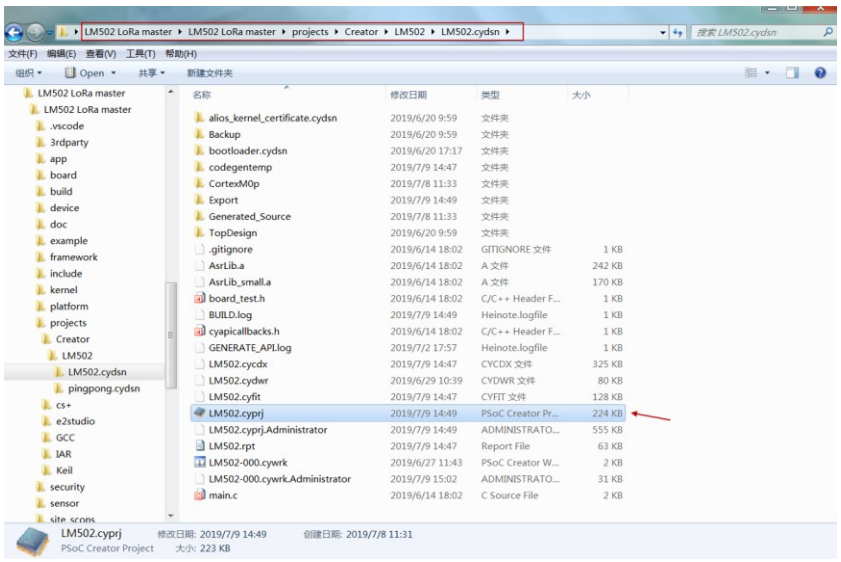
The download link is: PSOC Creator . Before download PSOC Creator, please download and install PSOC programmer 3.27.1 first. So there will be no compatible issue for upload firmware to LM502.



Step 2:Download LM502 source code from git

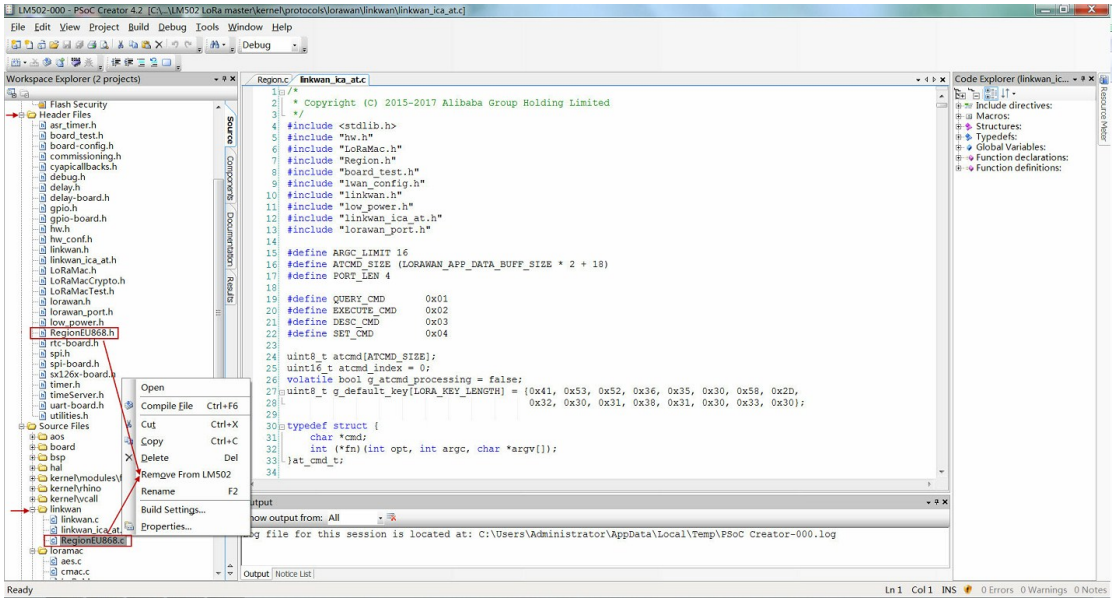
Downlink link: https://github.com/dragino/LM502/tree/master/Software

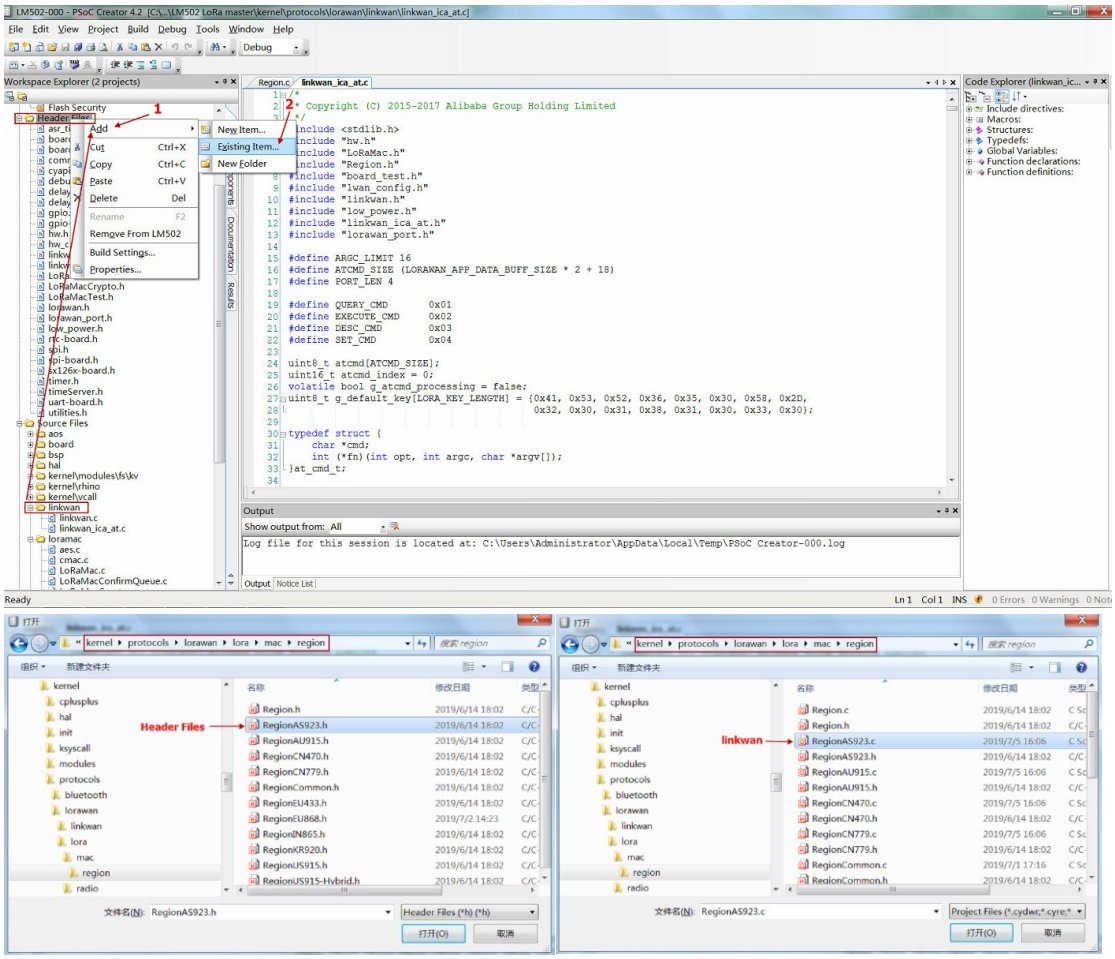
The project file is under : projects/Creator/LM502/LM502.cyprj. Open this file to open the LM502 project.



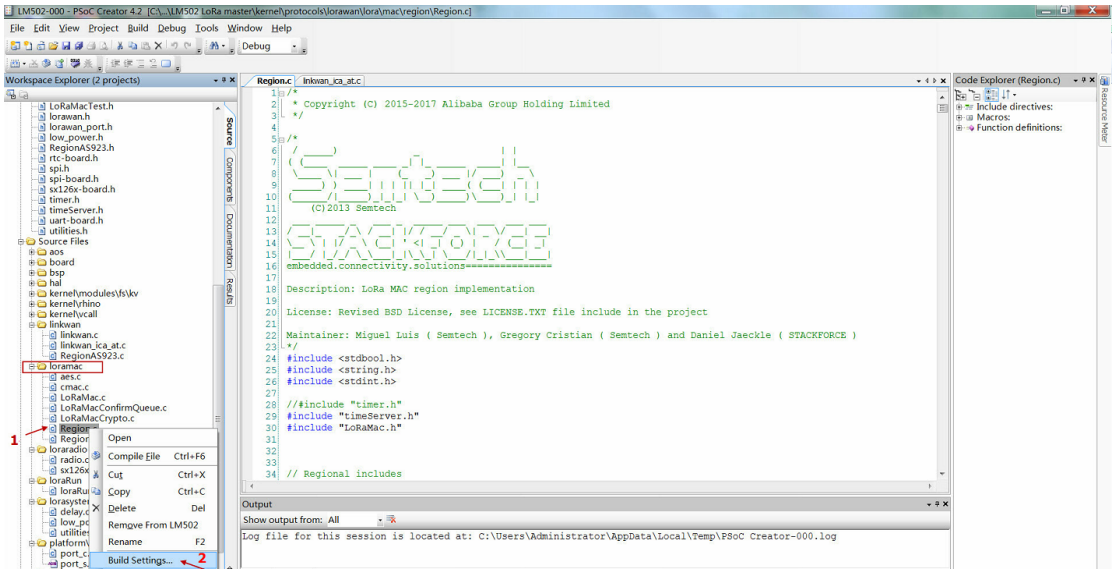
Step 3:Try to change a frequency band

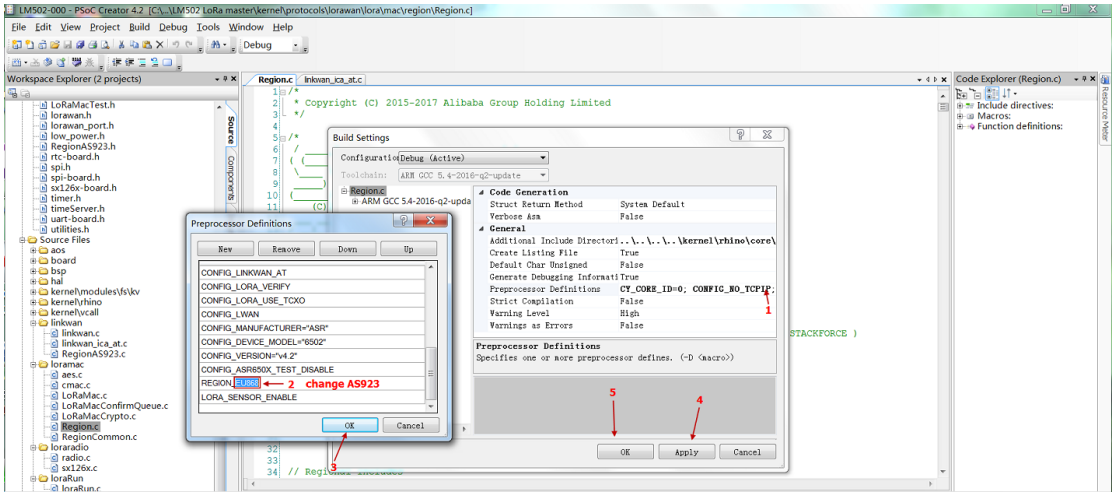
The header files and LinkWAN directory has the frequency band definition. If user want to add more frequency file, user can right click the folder and select add to add different frequency bands.



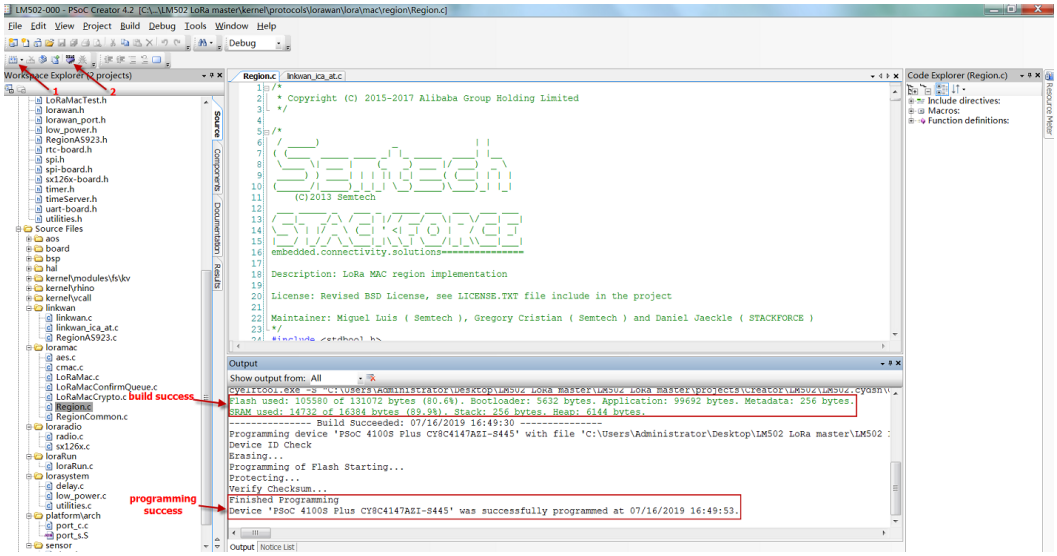


For frequency change, user also need to change the macro in the build settings.





Step 4:Build Image and upload to board



Video: LM502-Tutorial-5: Compile firmware for LM502

Link: https://youtu.be/N4y_AKAMNZw

7. Advance Examples

The advance examples require user to upload firmware to the module or even modify the source code and compile to use.

7.1 Point to Point transmit LM502

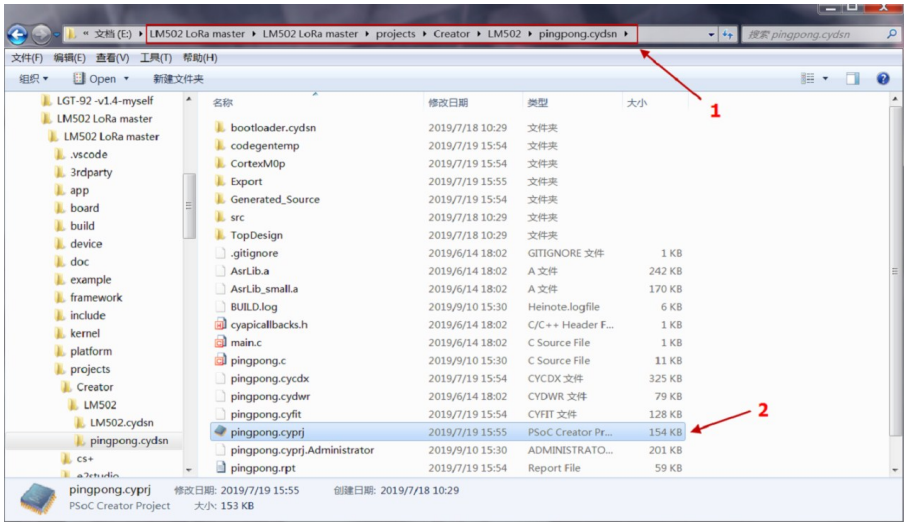
This example shows how to use LM502 to do point to point transmit. It is not LoRaWAN basic, the protocol is the simplest transmit example base on LoRa.

There is an example firmware for point to point test from here: PingPong_868_SF7. This example radio parameter is hard code to 868 Mhz and SF7. The source code can be found at PingPong source code to change to different frequency or Data Rate.

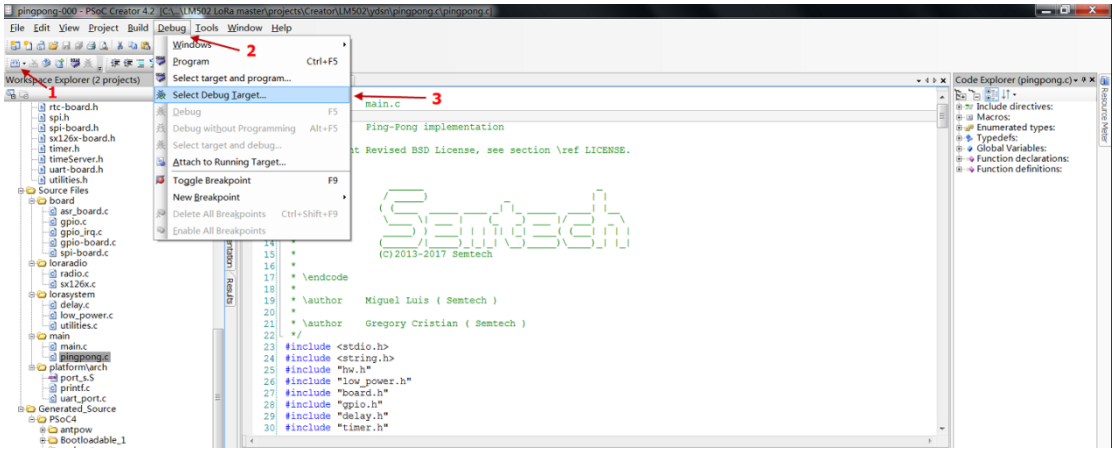
Step1: Hardware set up for this example. Two of LM502

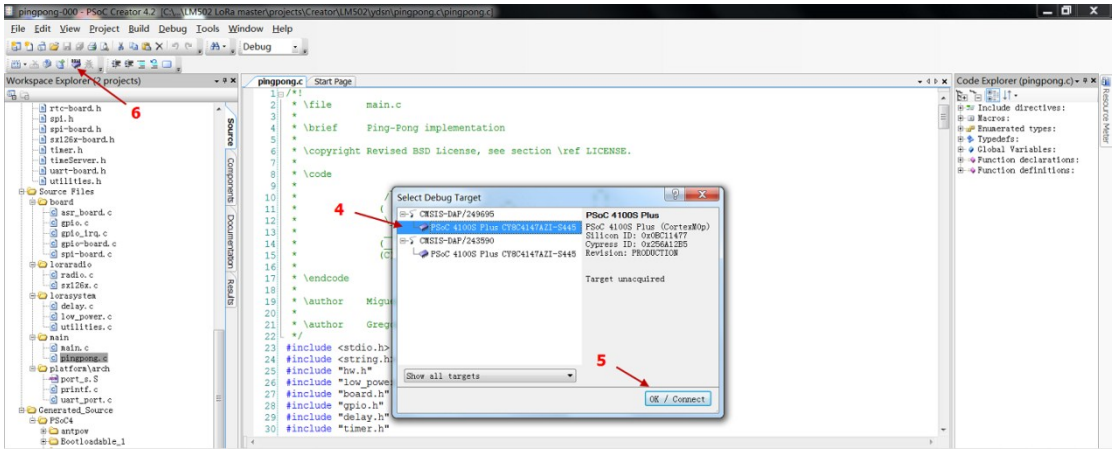
Step2: Found project file.

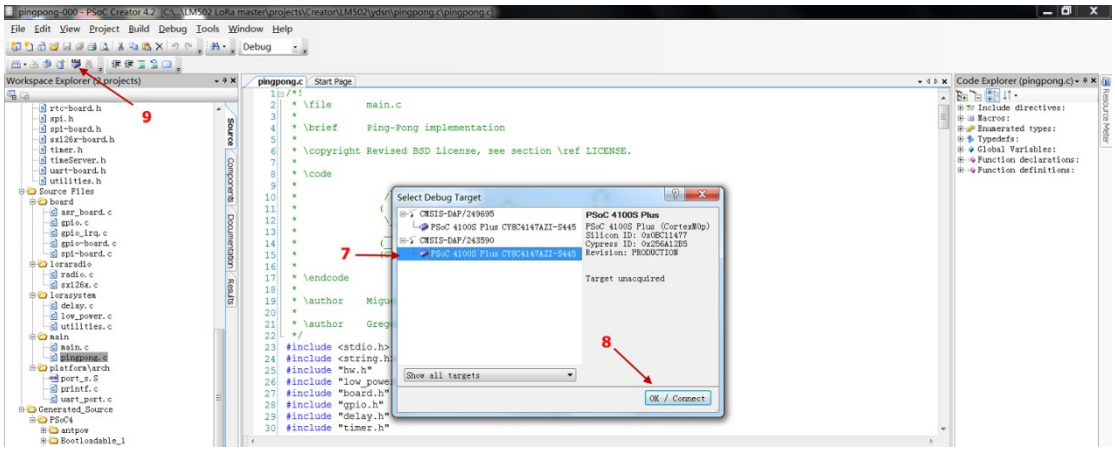
Under projects/Creator/LM502/pingpong.cydsn.



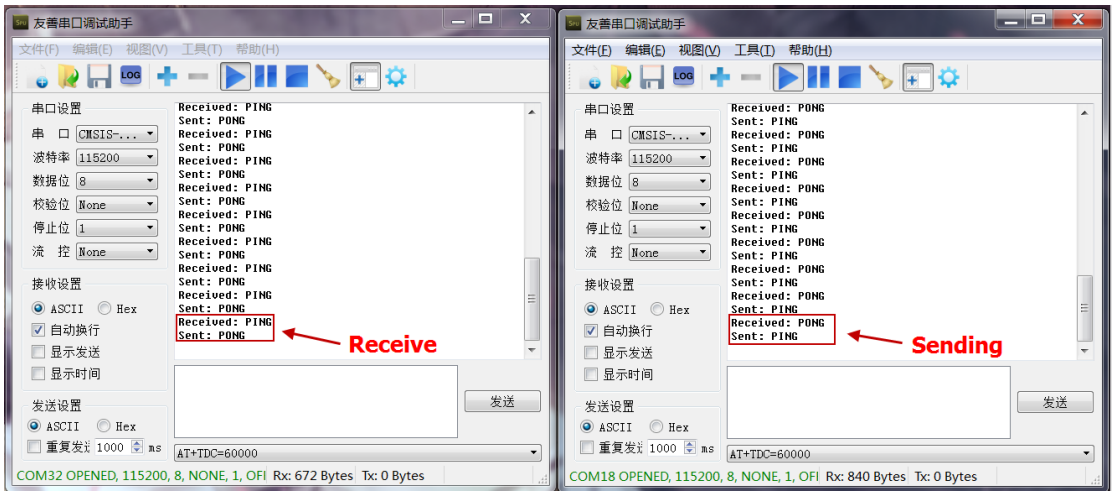
Step3: Compile and upload to LM502s.







Output from two LM502s' serial monitor.



Video: LM502-Tutorial-6: Point to Point transmission between LM502s

Link: https://youtu.be/ZWcHWt_2dJ0

7.2 OTAA Join LoRaWAN network without external MCU control

This example shows how to use LM502 as a standalone LoRaWAN module. In this working mode, there is no extra laptop or mcu required. The LM502 will auto join to the LoRaWAN network after power on and uplink data periodically.

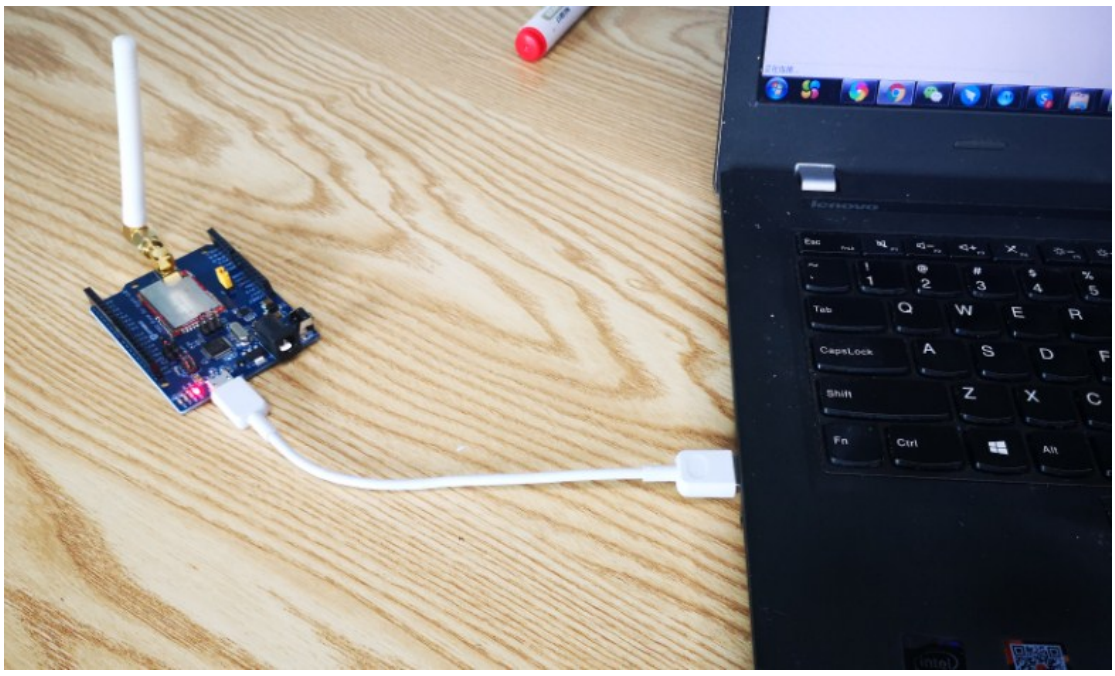
Developer can develop LM502's I/O pins to connect different sensors base on this example to get the smallest hardware design the lowest cost.

System structure is as below figure.

LM502 as standalong module in a LoRaWAN Network

Test set up:

- ✓ LoRaWAN Network. (How to Prepare LoRaWAN Network?)
- ✓ LM502-Demo-Board with sensor node image (Download image here). Photo is as below



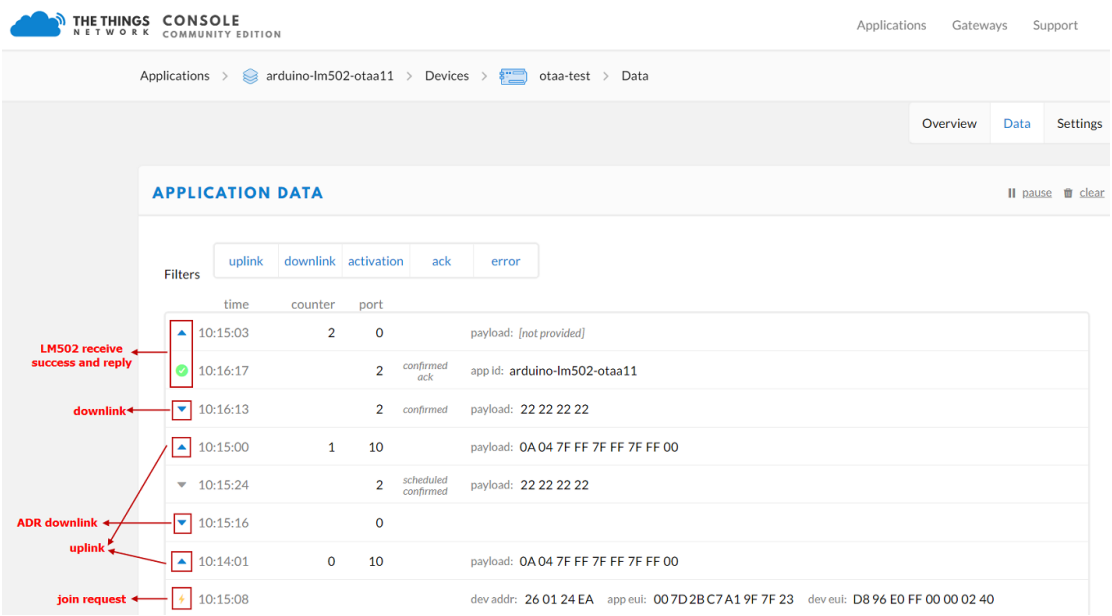
Step1: Upgrade the LM502 firmware to the sensor node firmware.

After upgrade to the firmware, please run AT+CRESTORE to reset device to factory default, this only need to do at first boot.

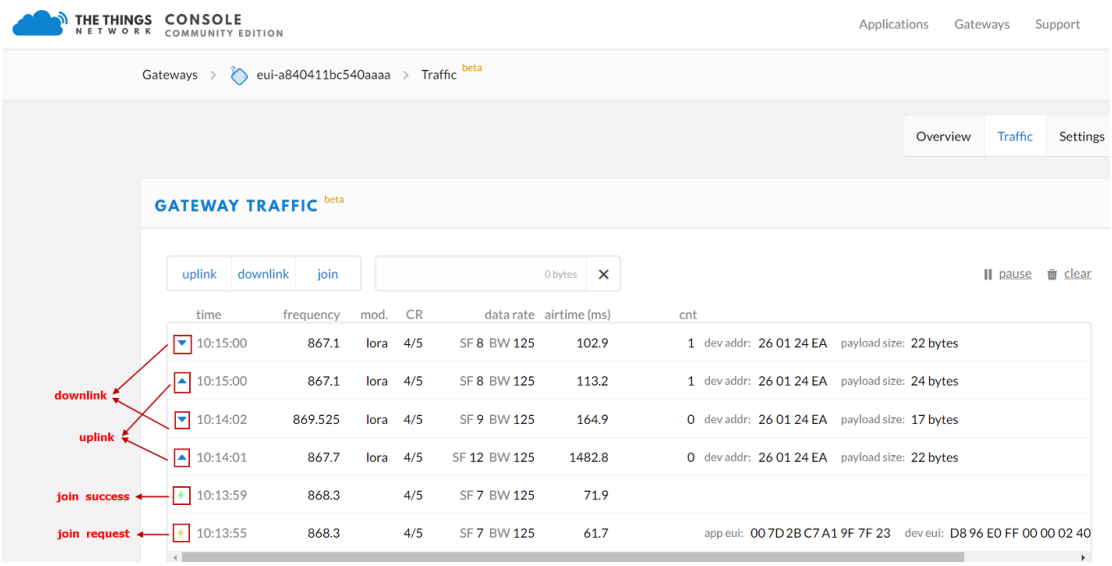
Step2: check the OTAA join data flow in serial monitor.

```
[1]======Dragino LM502 LoRaWAN Sensor Node=======
[270]Frequency Band: EU868 v1.0
[272]OTAA
[273]DevEui= D896E0FF00000240
[276]AppEui= 007D2BC7A19F7F23
[278]AppKey= 077EE45C6E4564D96D76AE55AFD3AA89
[283]class type A
[284]freq mode intra

[288]***** UpLinkCounter= 0 *****
[299]TX on freq 868300000 Hz at DR 5          --> join request
[308]Start to Join, nb_trials:48
[372]txDone
[5443]rxDone
+CJOIN:OK
[5452]Joined                                  --> join success

[5468]***** UpLinkCounter= 0 *****
[5472]TX on freq 867700000 Hz at DR 0
[6967]txDone
[8198]rxTimeOut
[9133]rxDone                                  --> ADR downlink

OK+SENT:01
[9141]receive data: rssi = -54, snr = 10, datarate = 3

OK+RECV:00,00,00

[65469]***** UpLinkCounter= 1 *****           --> uplink
[65473]TX on freq 867100000 Hz at DR 4
[65598]txDone
[66701]rxDone                                 --> receive data success

OK+SENT:01
[66710]receive data: rssi = -64, snr = 15, datarate = 4
rx: port = 2, len = 4
0x22 0x22 0x22 0x22

OK+RECV:01,02,04,22222222                     --> data
```

Step2: check the TTN--> device page data



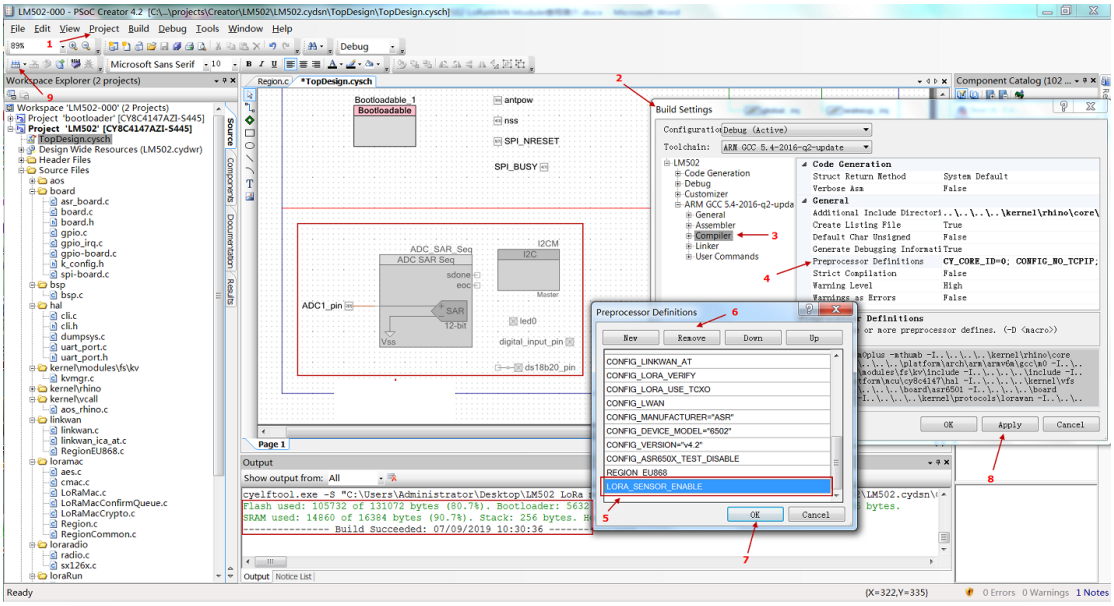
Step3: check the TTN--> Gateway traffic.



Extend:

When compile the source code for a stand along module, user need to add a MACRO in the source code to build the sensor node firmware.

Add new macro LORA_SENSOR_ENABLE at project --> Build Settings --> Complier --> Preprocessor definition



Video: LM502-Tutorial-7: OTAA Join LoRaWAN network without external MCU control

Link: https://youtu.be/mQdLBvV_yQ0

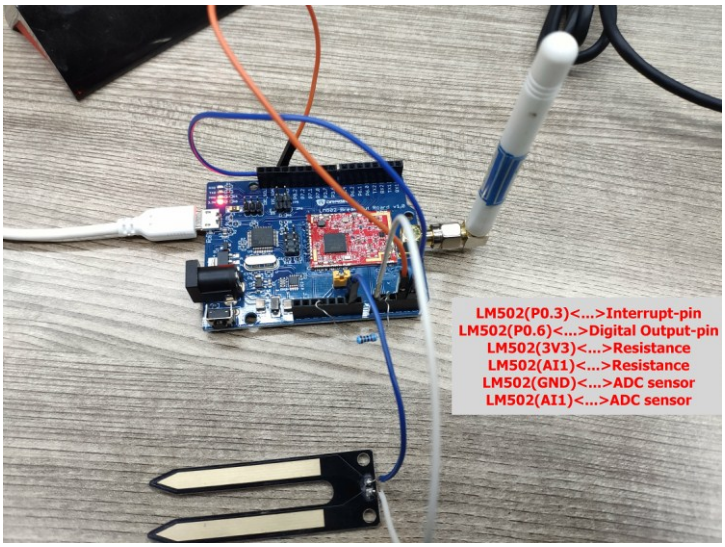
7.3 Read Digital input & ADC & Interrupt via LoRaWAN Network

This example shows how to add some external sensors to LM502. The sensors used in this example:

- ✓ Digital Input
- ✓ ADC
- ✓ Interrupt

Hardware Connection is as below:

Note: there is a resistor (10K) between AI1 and 3v3, so the ADC will measure the 3v3 voltage.

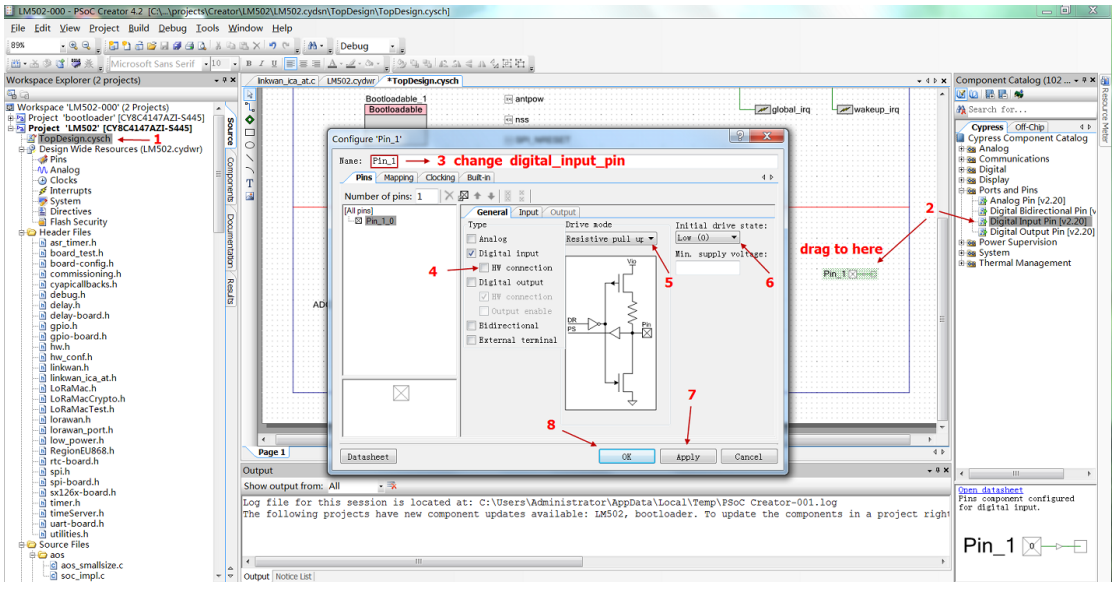


7.3.1 Add digital input pin

Step1: Add a digital input in the source code.

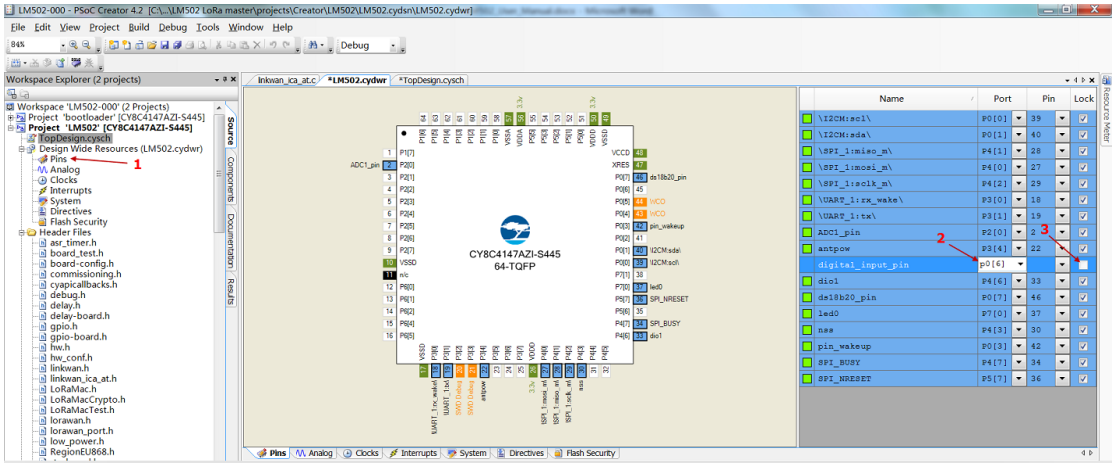
In Topdesign.cydn --> Ports and Pins --> Digit Input pins.

The pin name must be digital_input_pin to match the code in other place (bsp.c ,lorarun.c)



Step2: Map the digital Input pin to MCU.

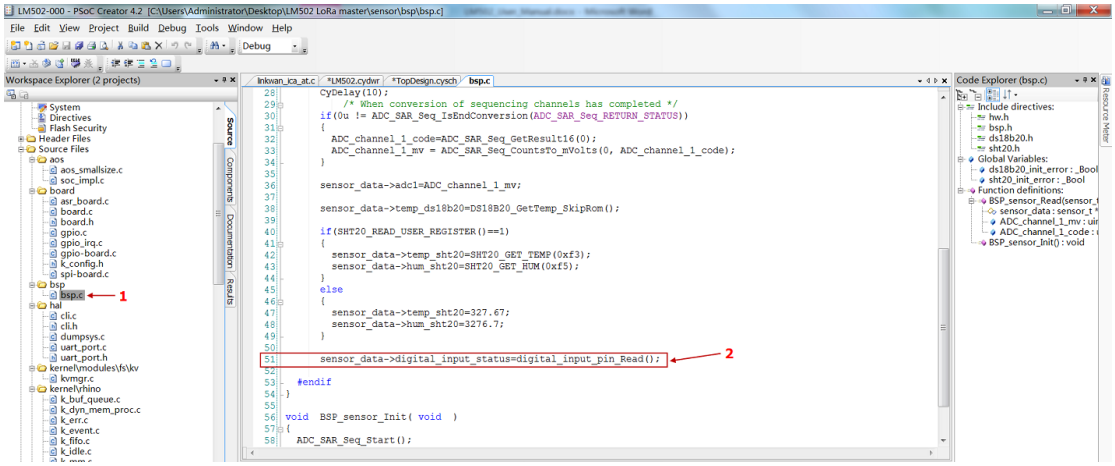
In Design Wide Resources, Map digital input pin to p0.6



Step3: Modify source code to support this pin

* Check /sensor/bsp/bsp.c --> BSP_sensor_Read functions

* Check example/lorawan/loraRun/loraRun.c

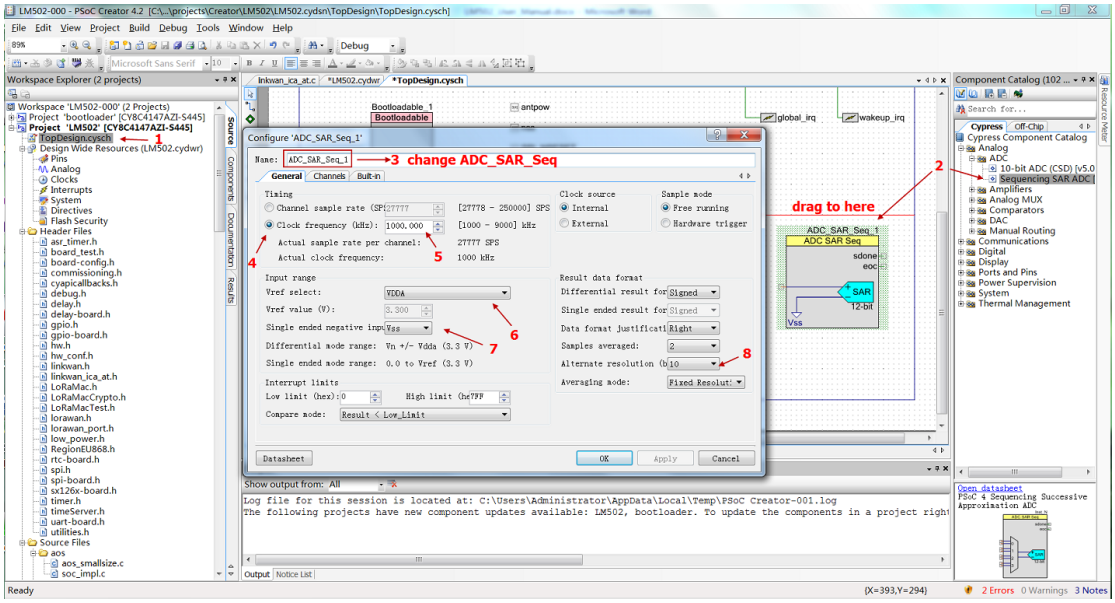


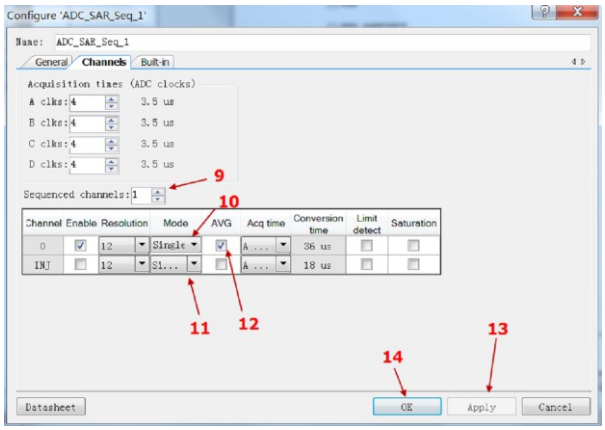
7.3.2 Add ADC

Step1: Add an ADC in the source code.

In Topdesign.cydn --> Analog --> Sequencing ADC

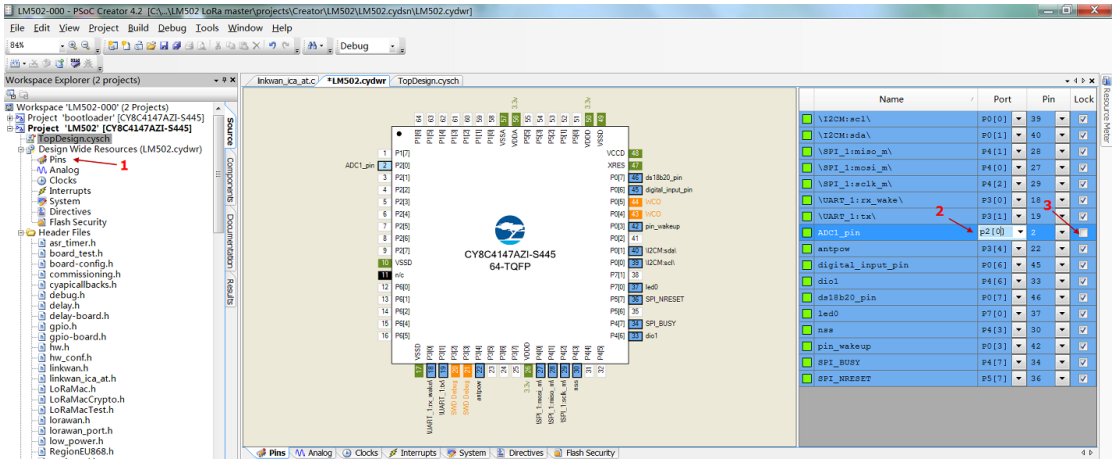
Add the ADC, The pin name must be ADC_SAR_Seq to match the code in other place (bsp.c ,lorarun.c)





Step2: Map the ADC pin to MCU.

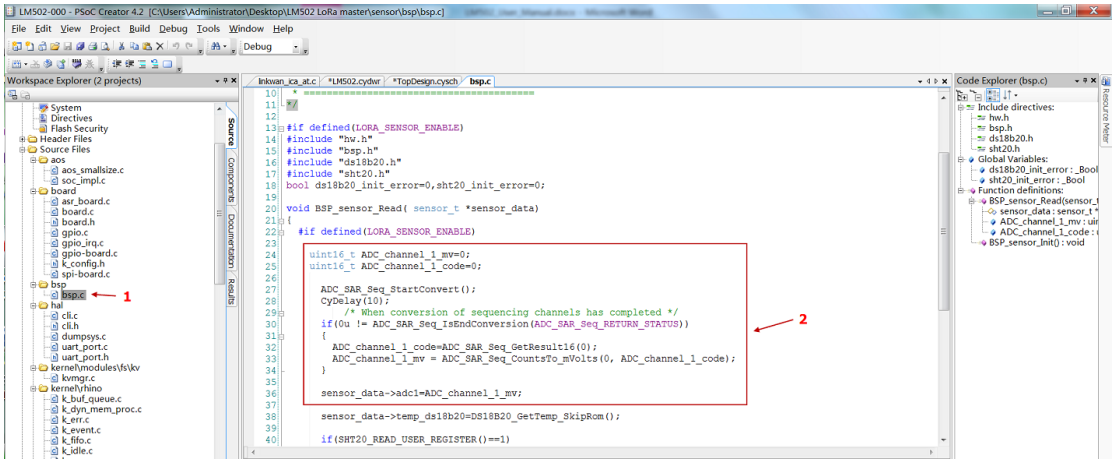
In Design Wide Resources, Map digital input pin to p2.0



Step3: Modify source code to support this pin

Check /sensor/bsp/bsp.c --> BSP_sensor_Read function.

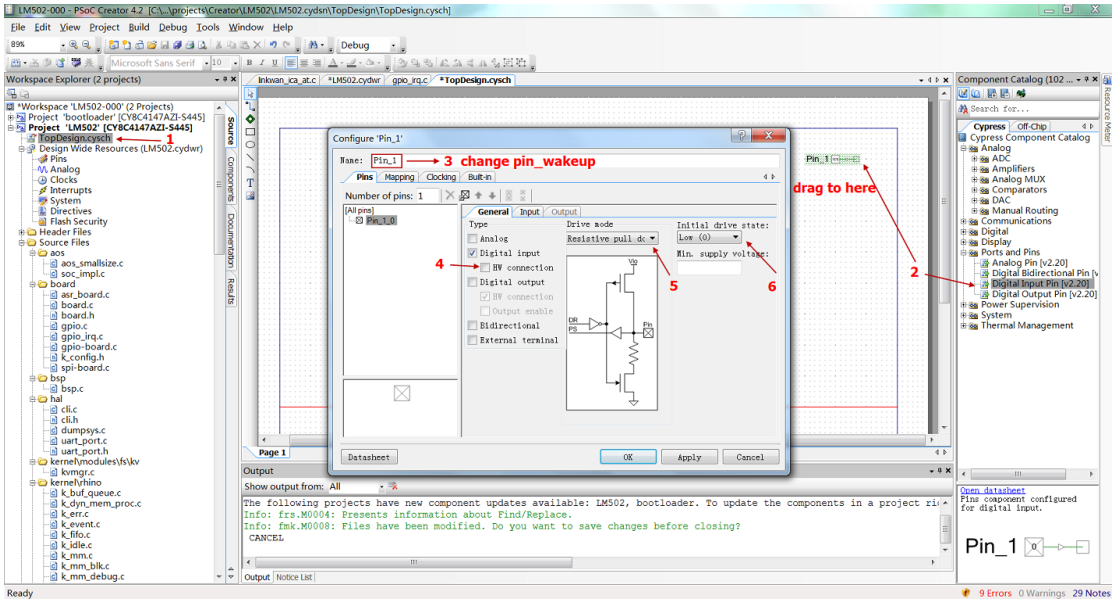
example/lorawan/loraRun/loraRun.c



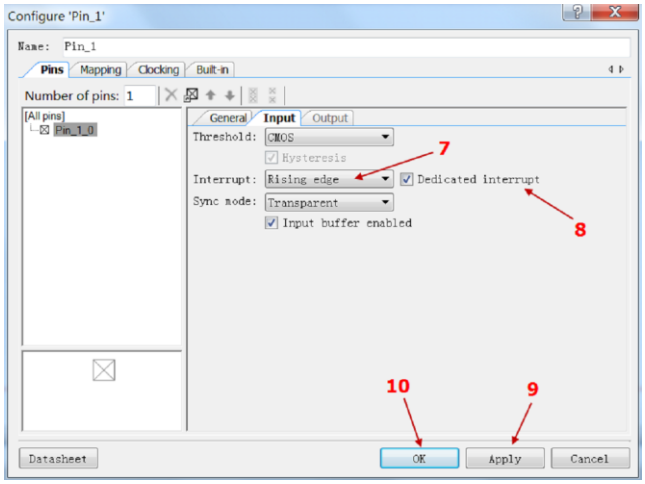
7.3.3 Add Interrupt pin

Step1: Add an Interrupt(wakeup_pin) in the source code.

In Topdesign.cydn --> Ports and Pin --> Digital Input

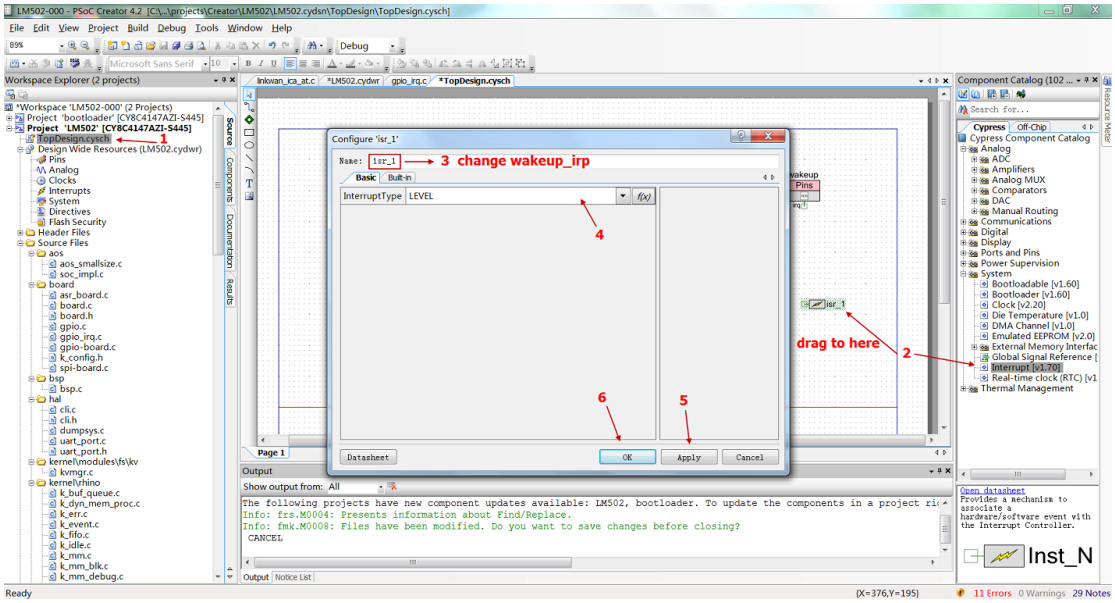


Change to use rising edge.

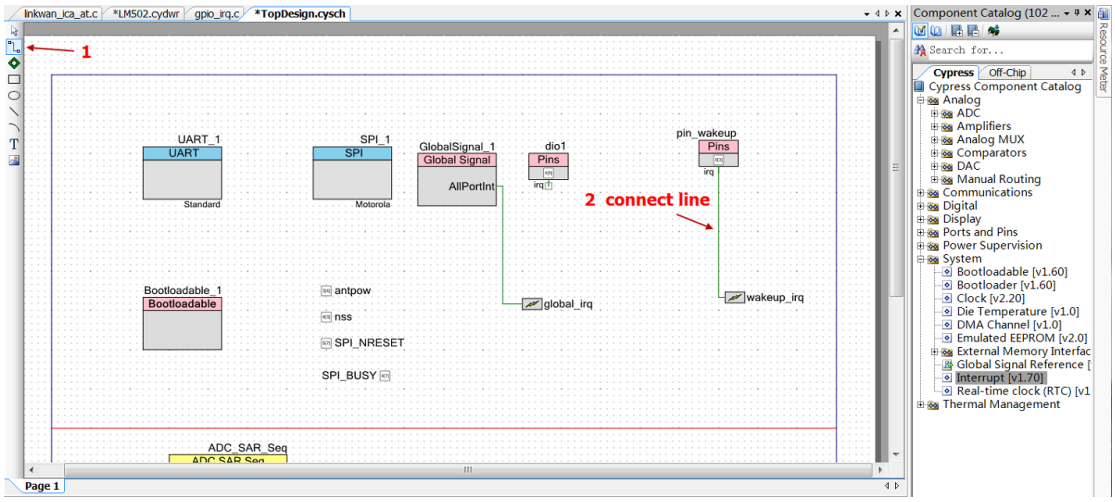


Step2: Add an wakeup_irp pin

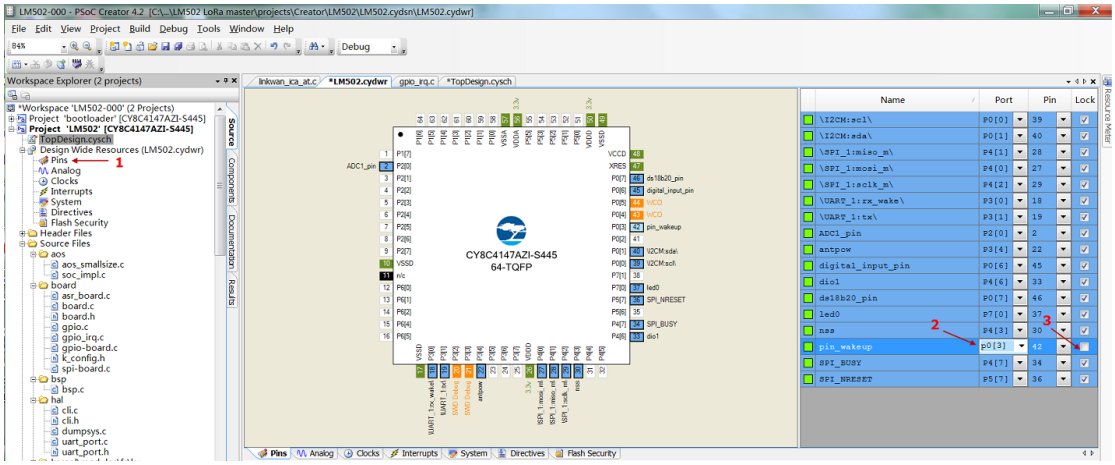
In Topdesign.cydn --> System--> Interrupt. The pin name must be wakeup_irp to match the code in other place (bsp.c,gpio_irq.c,lorarun.c)



Step3: Connect wakeup_irp to wakeup_pin



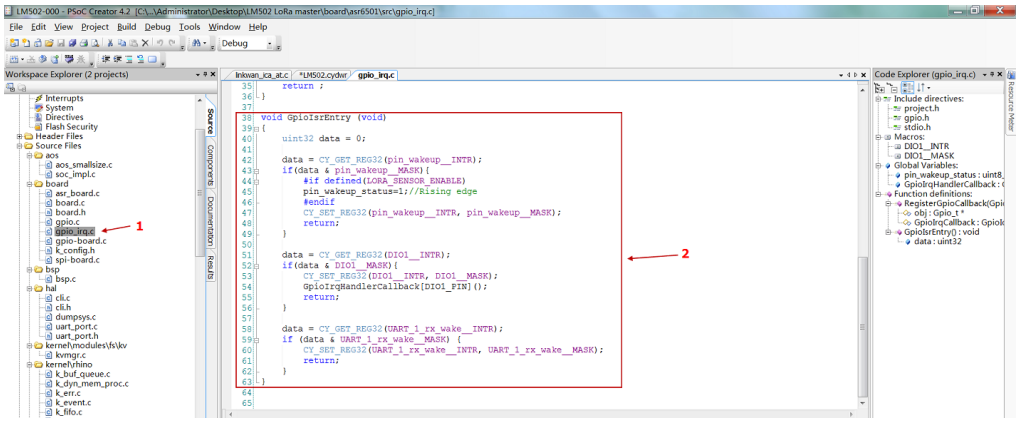
Step4: Map the interrupt pin to mcu.



Step5: Modify source code to support interrupt

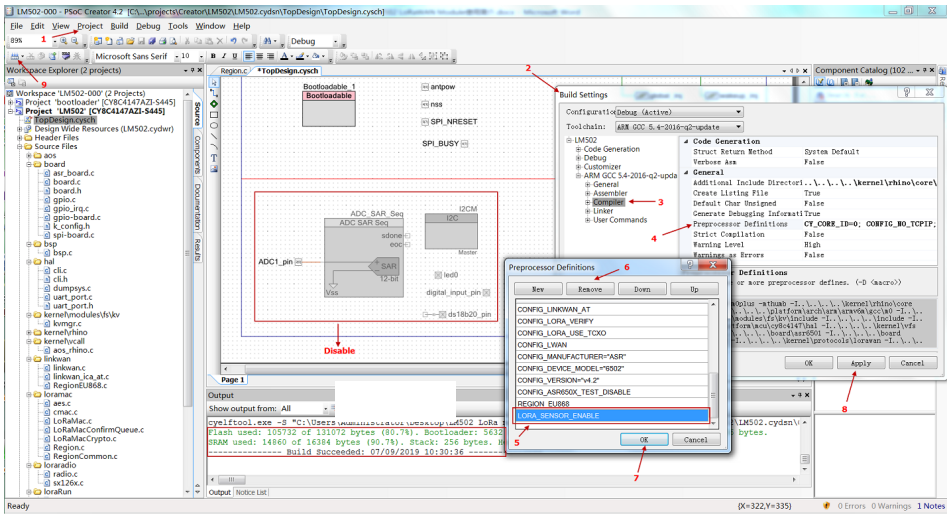
Check /board/asr6501/src/gpio_irq.c --> GpioIsrEntry function.

example/lorawan/loraRun/loraRun.c

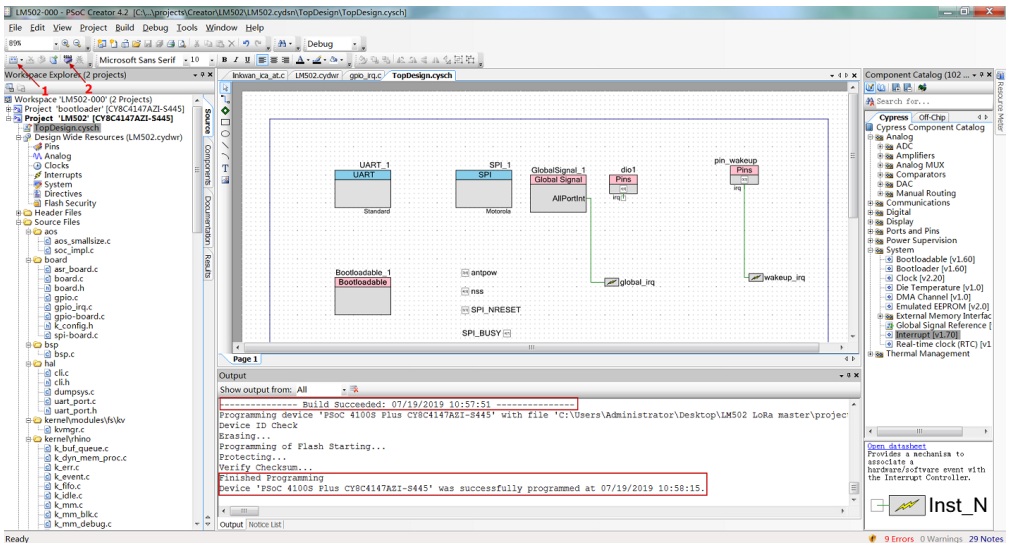


Step6: Make sure LoRa_SENSOR_ENABLE is set

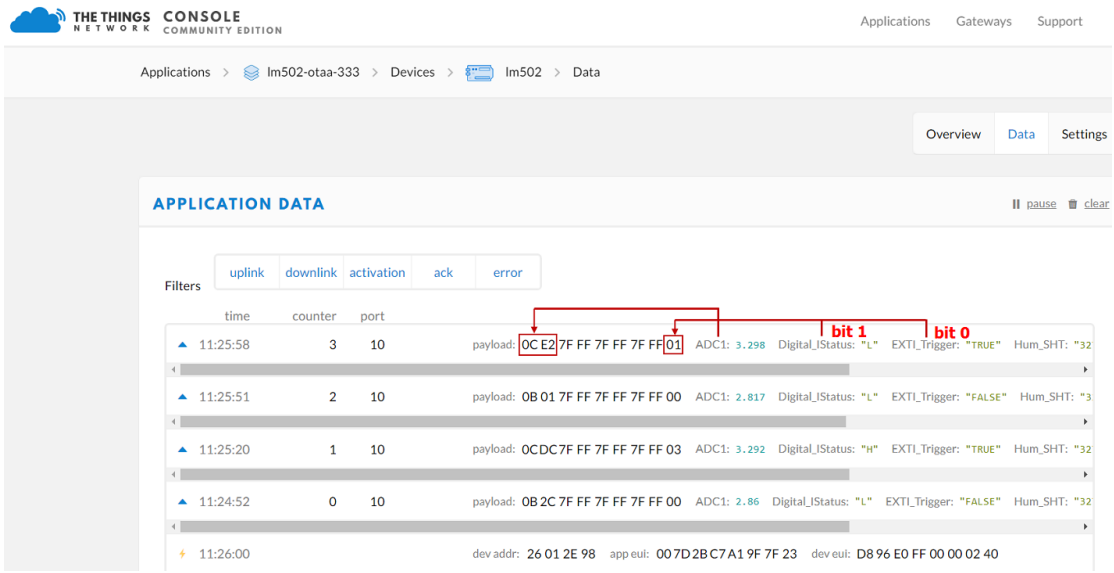
Add new macro LORA_SENSOR_ENABLE at project --> Build Settings --> Complier --> Preprocessor definition.



Step7: Compile and upload



Step8: Check result



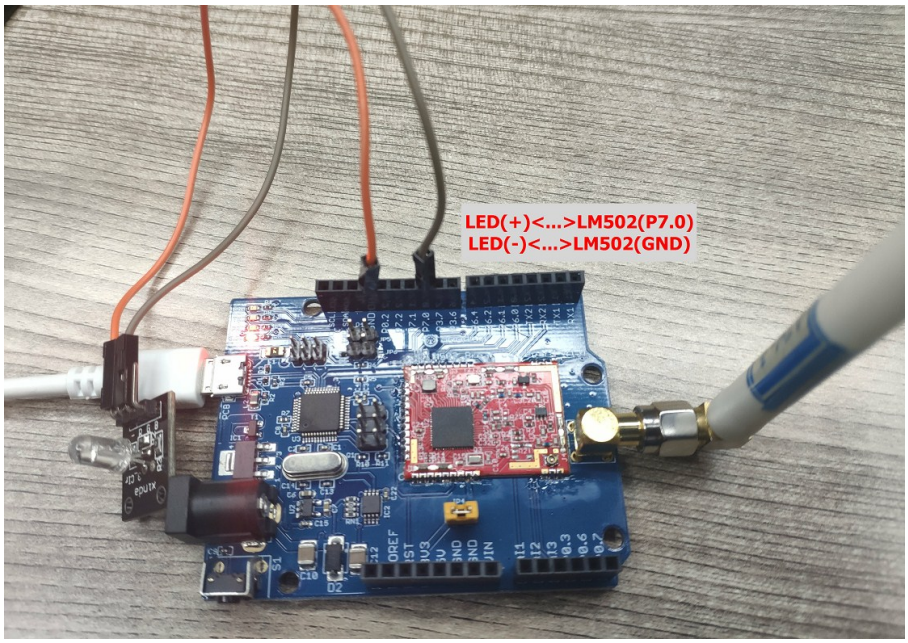
Video: LM502-Tutorial-8: Add Digital Input, Interrupt & ADC

Link: https://youtu.be/E_JUBIW3OwA

7.4 Digital Output via LoRaWAN Network

This example shows how to use set LM502 pin as a digital output and control a LED.

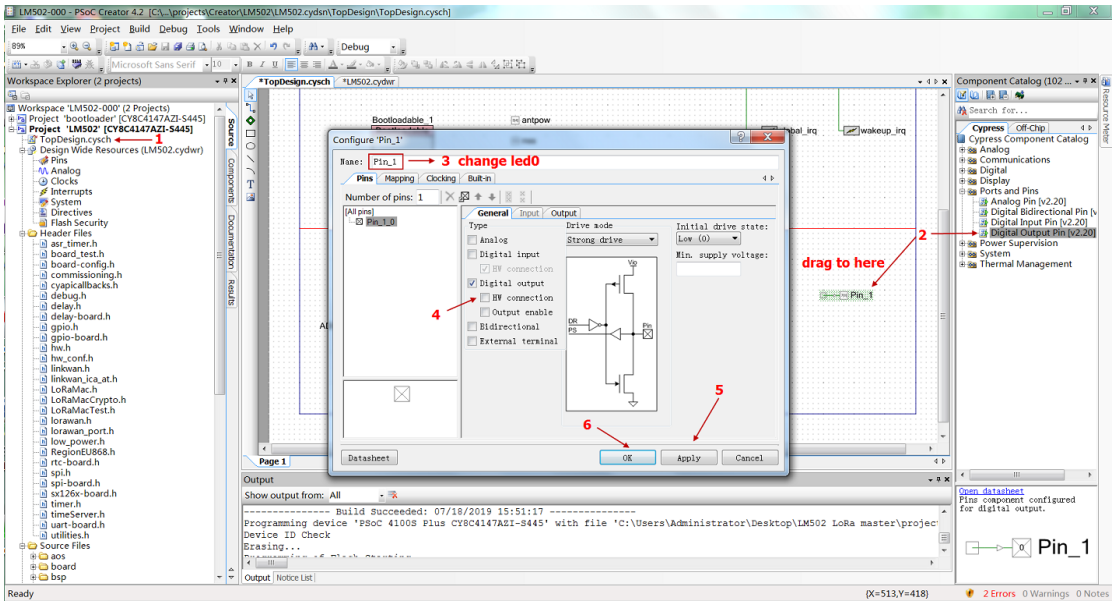
Hardware Connection is as below, connect a LED module to the P7.0 and GND of LM502



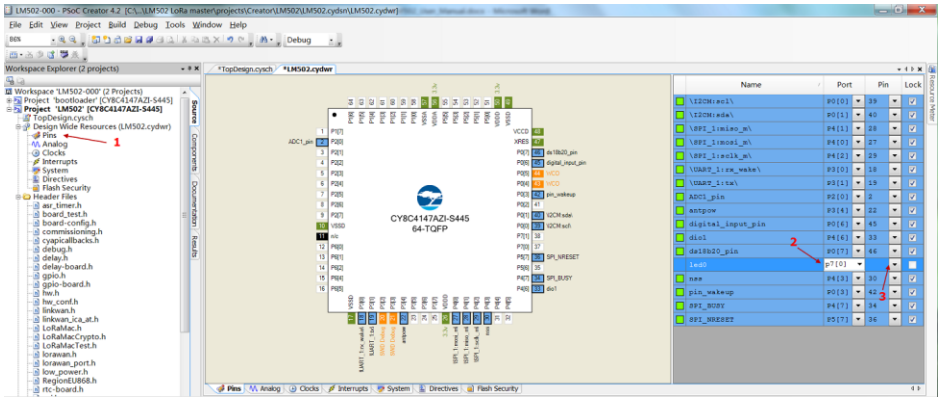
Step1: Add a digital output in the source code.

In Topdesign.cydn --> Ports and Pins --> Digital output pins

The name must be led0 to match settings in lorarun.c

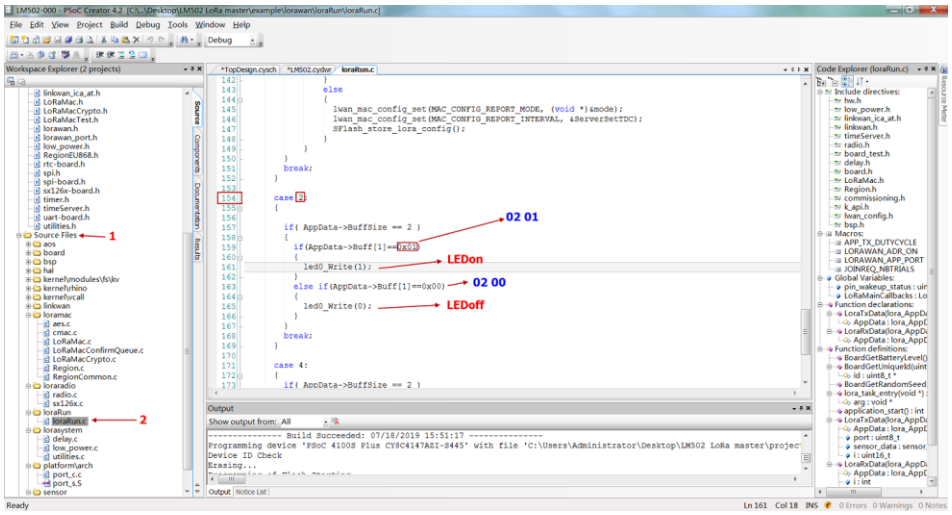


Step2: Map digital output pin to actual pin of LM502 P7.0.



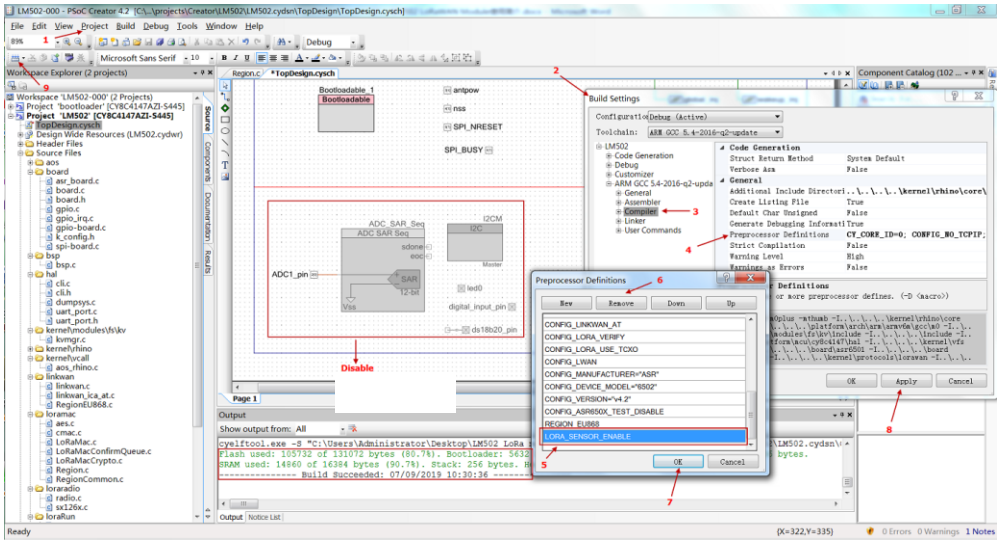
Step3: Change downlink code to control LED

Code are in example/lorawan/loraRun/loraRun.c

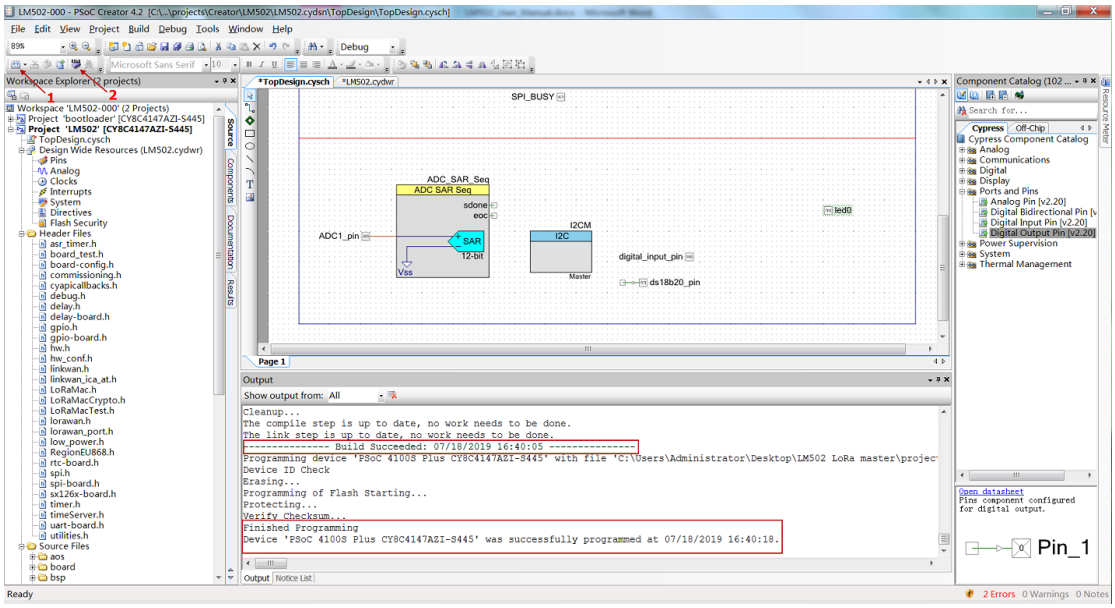


Step4: Make sure LoRa_SENSOR_ENABLE is set

Add new macro LORA_SENSOR_ENABLE at project --> Build Settings --> Complier --> Preprocessor definition.

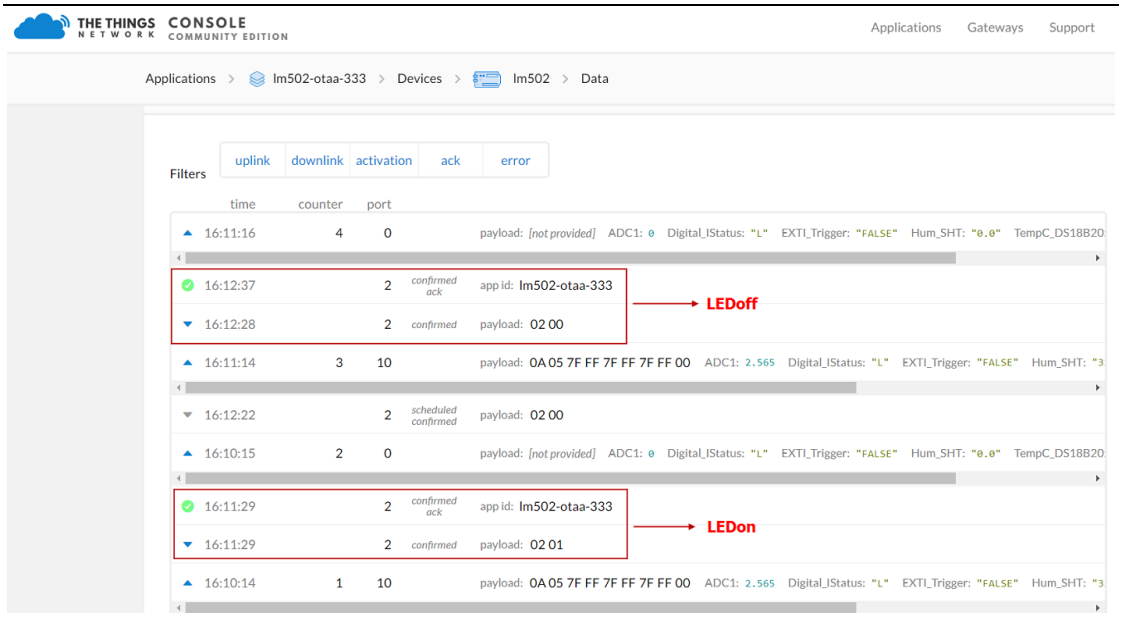


Step5: Compile and upload



Step5: Check Result

In TTN device page use downlink to control LED



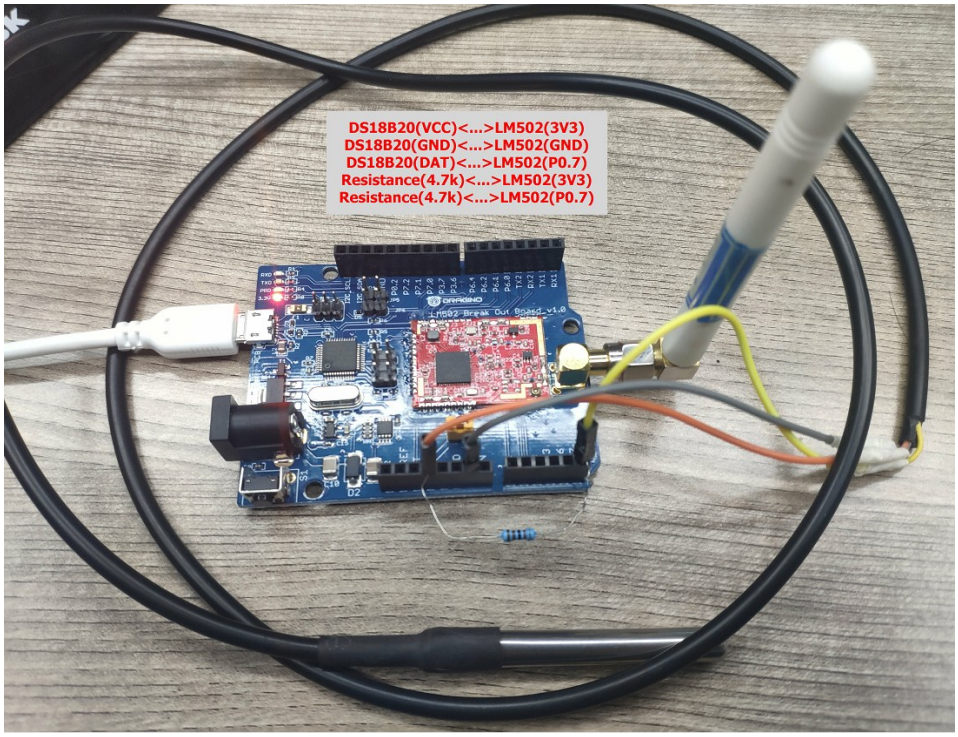
Video: LM502-Tutorial-9: Add Digital output to control LED

Link: https://youtu.be/cwnj1bS_aMI

7.5 Add DS18B20 Temperature Sensor

This example shows how to use LM502 to connect a DS18B20 temperature sensor

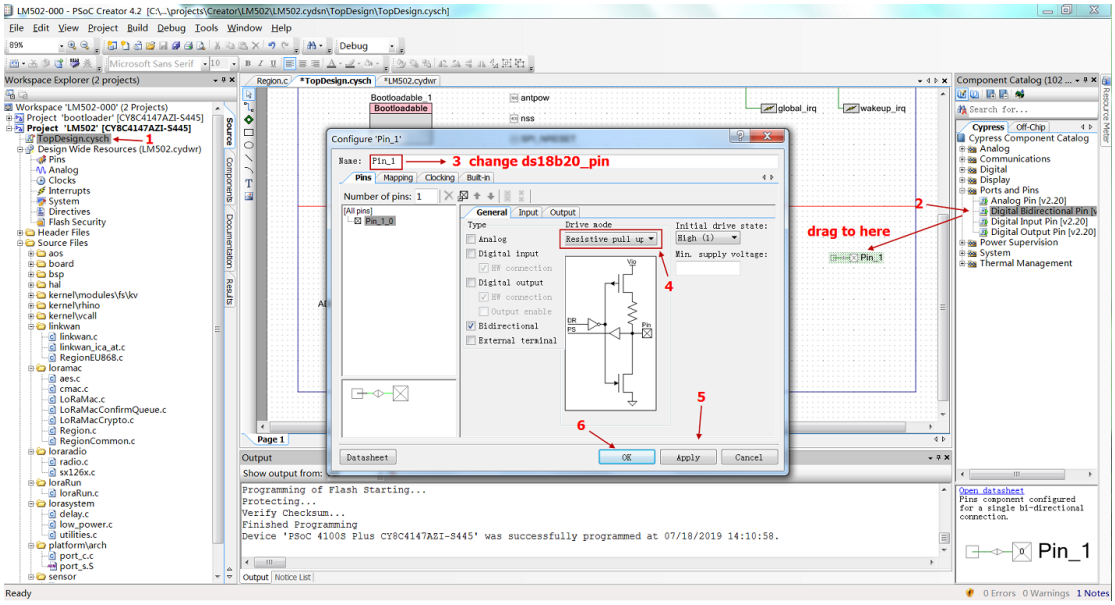
Hardware Connection is as below, note that there is 4.7k pull up resistor between DS18B20 DAT (P0.7) and 3.3v.



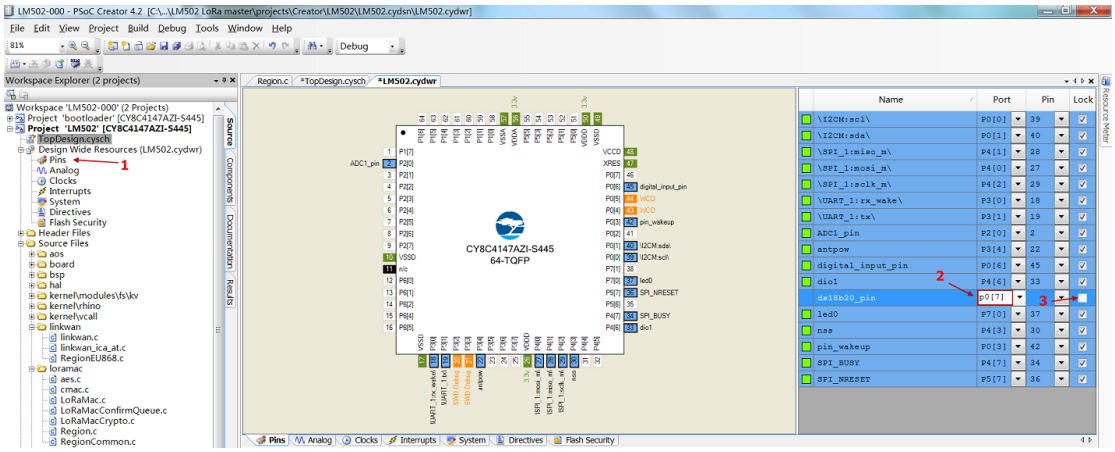
Step1: Add a digital di-direction pin.

In Topdesign.cydn --> Ports and Pins --> Didirectional pin

The name must set to ds18b20_pin to match the ds18b20.c file and bsp.c file

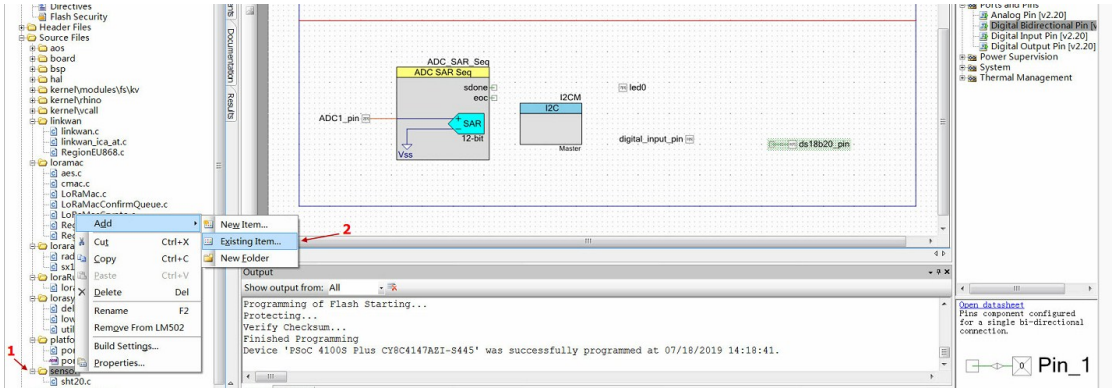


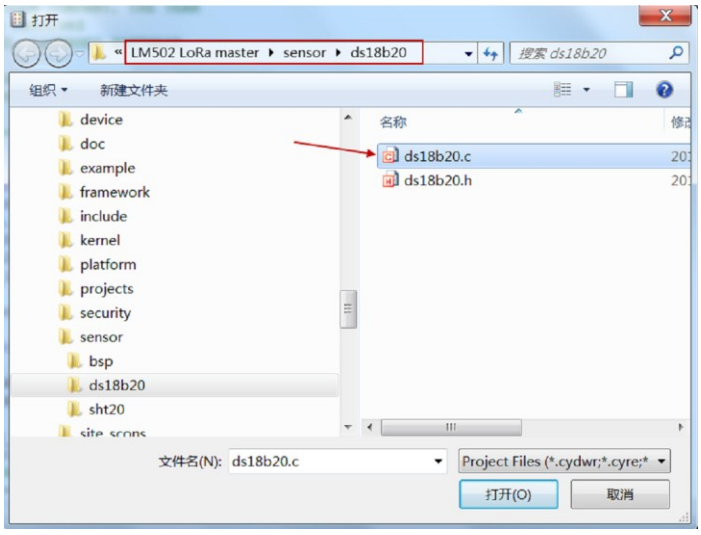
Step2: Map this pin to LM502 actual pin



Step3: Add DS18B20 code

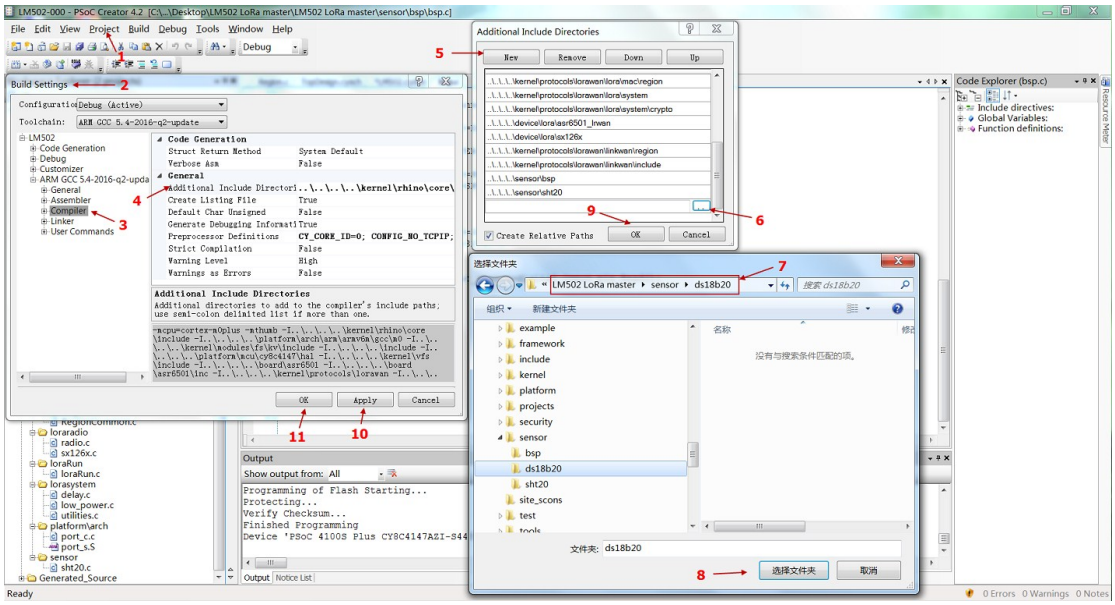
Add Existing Item /sensor/ds18b20





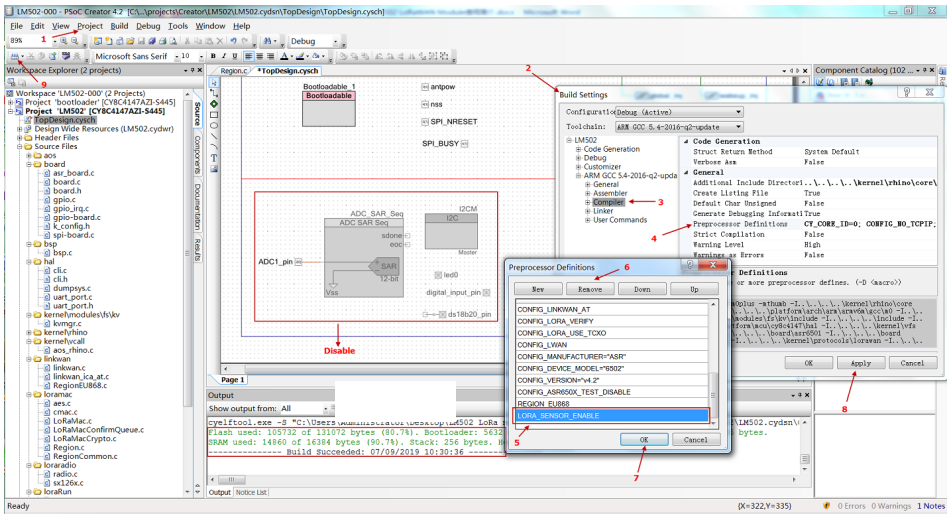
Step4: Include DS18B20 library

Project ->Build Settings -> Compiler -> Additional Include directories -> Include DS18B20 directory.

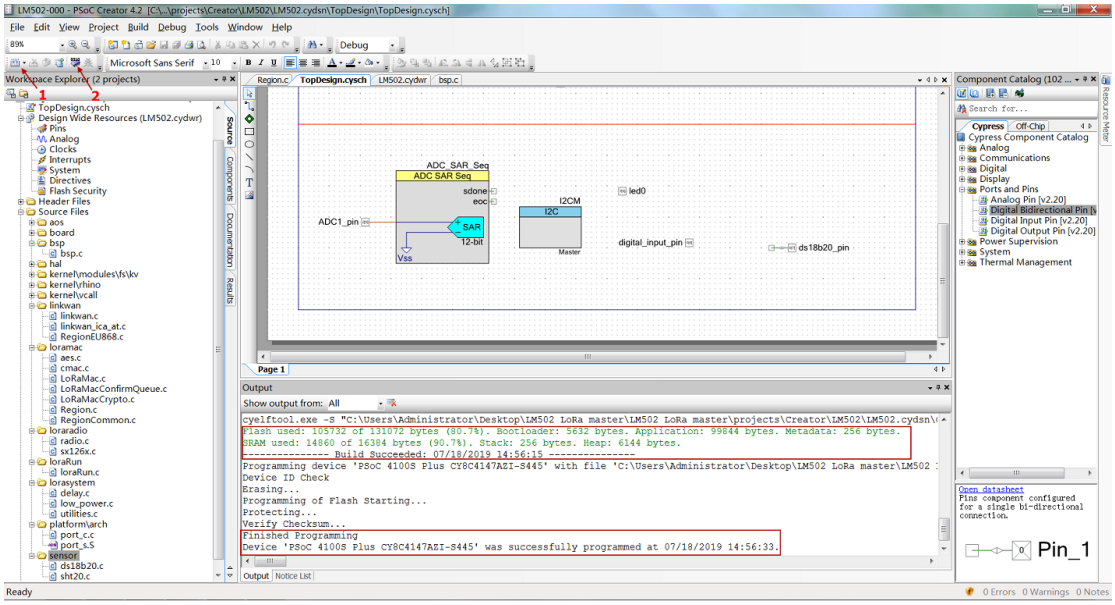


Step5: Make sure LoRa_SENSOR_ENABLE is set

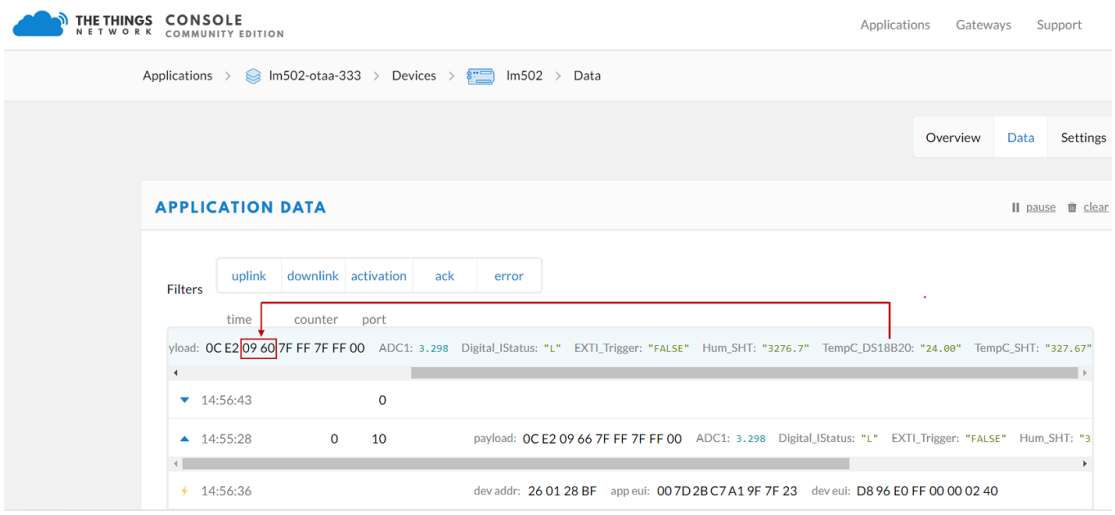
Add new macro LORA_SENSOR_ENABLE at project --> Build Settings --> Complier --> Preprocessor definition.



Step5: Compile and upload



Step5: Check result in TTN



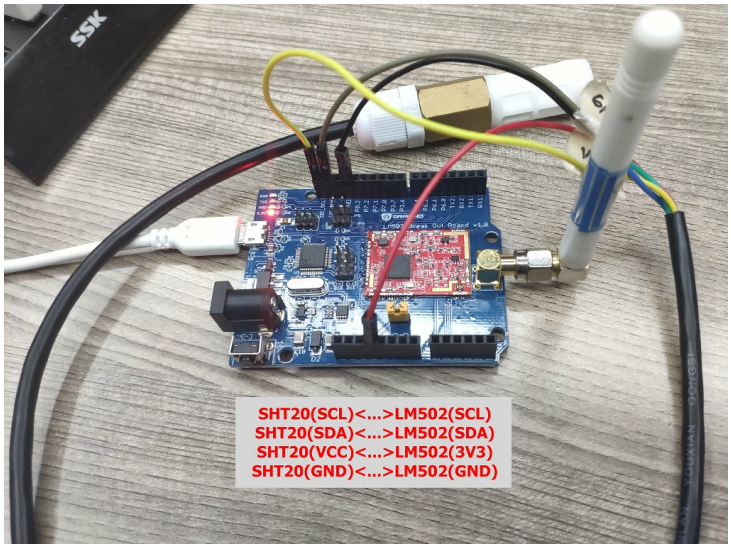
Video: LM502-Tutorial-10: Add DS18B20 temperature sensor

Link: https://youtu.be/GCUb5G1sBmc

7.6 Add SHT20 I2C device

This example shows how to use LM502 to connect a SHT20 temperature & humidity sensor

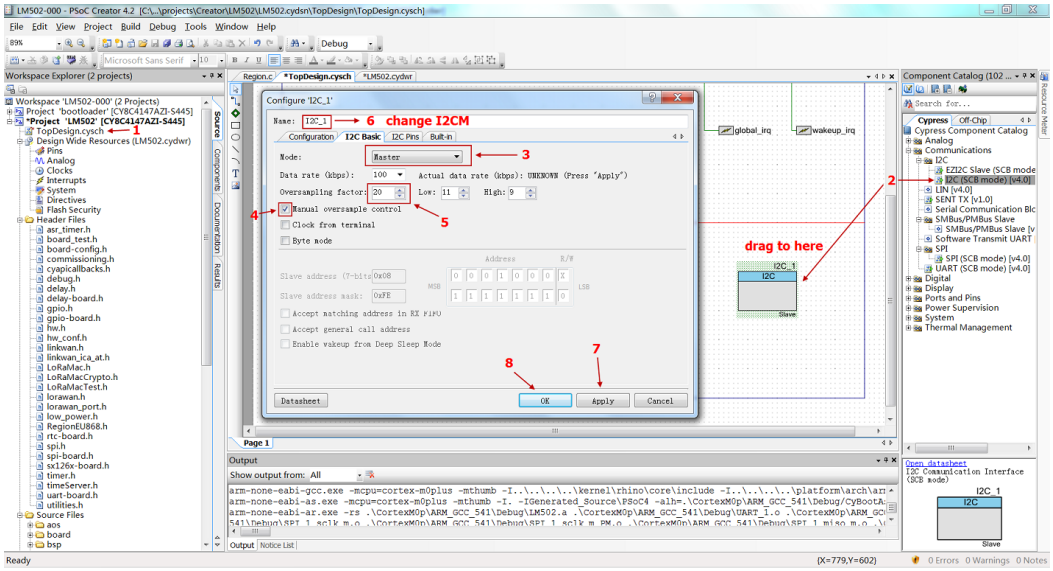
Hardware Connection is as below:



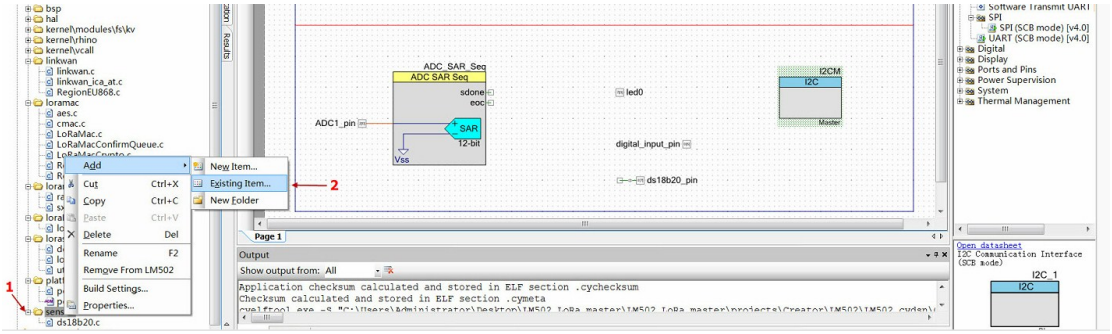
Step1: Add I2C pin.

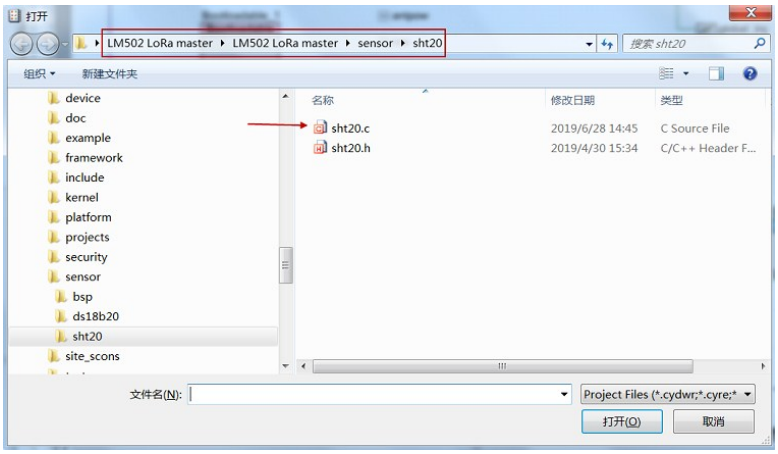
In Topdesign.cydn --> Communications --> I2C

The name must set to I2CM to match the sht20.c file and bsp.c file

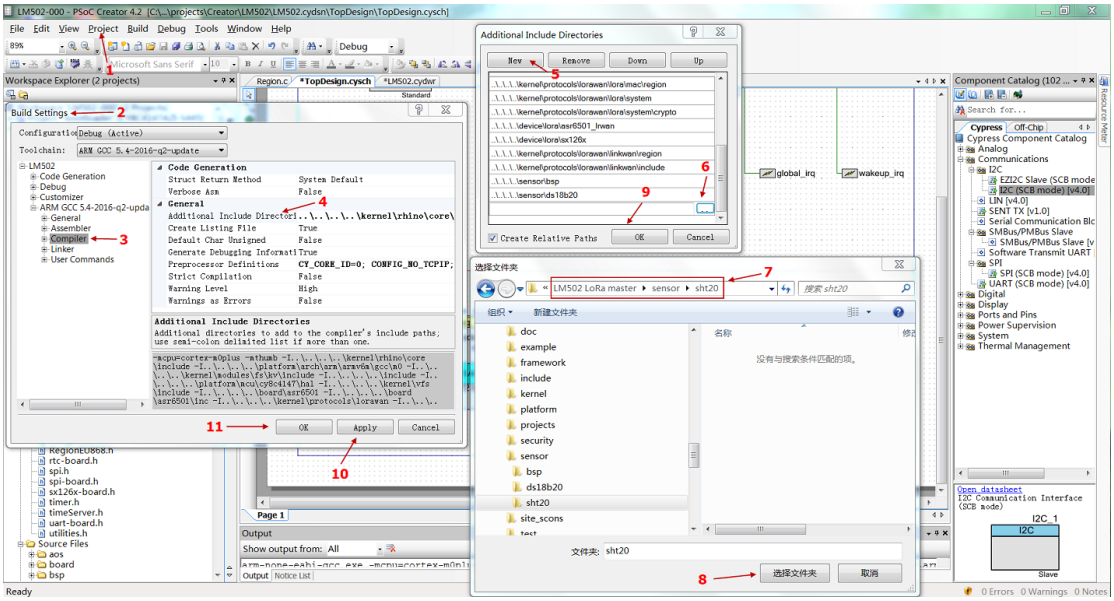


Step2: Add I2C code.

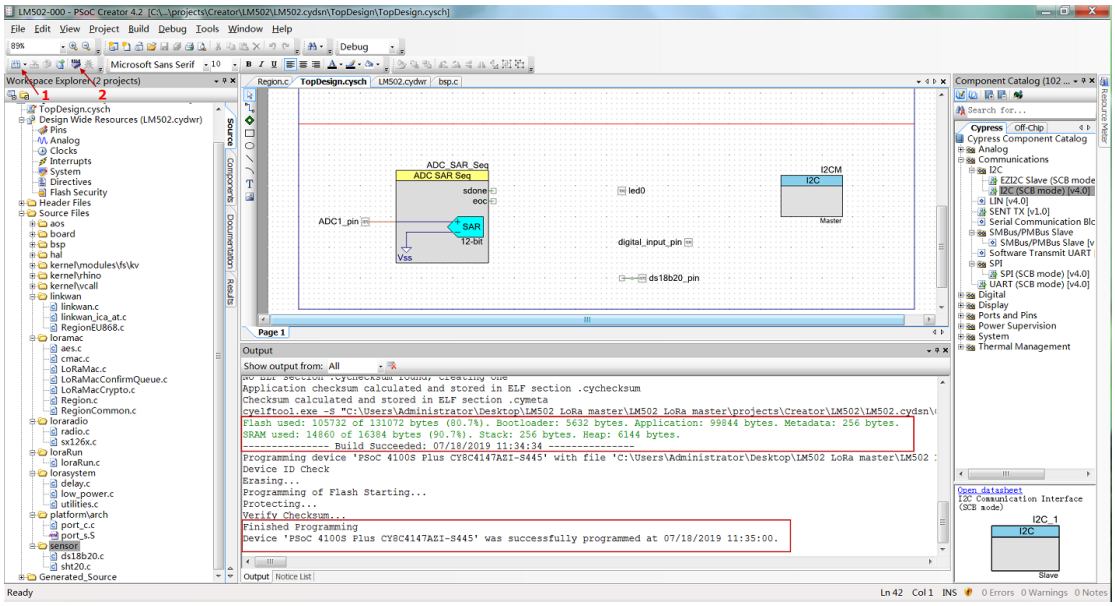


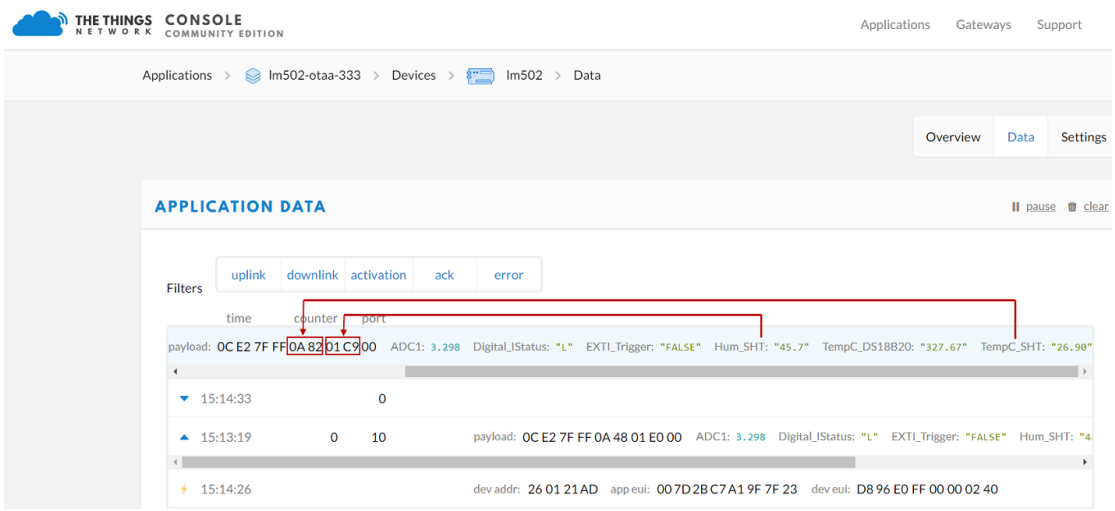


Step3: Add I2C directory



Step4: Compile and upload





Video: LM502-Tutorial-11: Add SHT20 I2C sensor

Link: https://youtu.be/BjPEjuO8sPk

8. FAQ

8.1 What is the frequency range of LM502?

Different LM502 version supports different frequency range, below is the table for the working frequency and recommend bands for each model :

Mark	Working Frequency	Best Tune Frequency	Recommend Bands
LM502-4	Band2(LF): 410 ~525 Mhz	470Mhz	CN470/EU433
LM502-8	Band1(HF):862~1020 Mhz	868Mhz	EU868/IN865
LM502-9	Band1(HF):862 ~1020 Mhz	915Mhz	AS923/AU915/ KR920/US915

8.2 How to change the LoRa Frequency Bands/Region?

User can follow the introduction for how to upgrade image. When download the images, choose the required image file for download.

9. Order Info

Order Link: http://www.dragino.com/buy.html

Part Number: **LM502-XXXXX**

XXXXX: The default frequency band

- ✓ **AS923**: LoRaWAN AS923 band
- ✓ **AU915**: LoRaWAN AU915 band
- ✓ **EU433**: LoRaWAN EU433 band
- ✓ **EU868**: LoRaWAN EU868 band
- ✓ **KR920**: LoRaWAN KR920 band
- ✓ **US915**: LoRaWAN US915 band
- ✓ **IN865**: LoRaWAN IN865 band
- ✓ **CN470**: LoRaWAN CN470 band

Part Number: **LM502-Demo-Board-XXXXX**

XXXXX: The default frequency band

- ✓ **AS923**: LoRaWAN AS923 band
- ✓ **AU915**: LoRaWAN AU915 band
- ✓ **EU433**: LoRaWAN EU433 band
- ✓ **EU868**: LoRaWAN EU868 band
- ✓ **KR920**: LoRaWAN KR920 band
- ✓ **US915**: LoRaWAN US915 band
- ✓ **IN865**: LoRaWAN IN865 band
- ✓ **CN470**: LoRaWAN CN470 band

10. Packing Info

Model	Content	Dimension/Weight
LM502	*LM502 module x 1	Device Size: 2 x 2.75 x 5 cm Device Weight: 137g
LM502-Demo-Board	*LM502-Break-Out board with LM502 soldered x 1 *LoRa Sticker Antenna x 1	

11. Support

- Support is provided Monday to Friday, from 09:00 to 18:00 GMT+8. Due to different timezones we cannot offer live support. However, your questions will be answered as soon as possible in the before-mentioned schedule.
- Provide as much information as possible regarding your enquiry (product models, accurately describe your problem and steps to replicate it etc) and send a mail to

support@dragino.com

12. Reference

- Product Page , DataSheet, Video Instructions
- Image Download
- AT Command Manual
- CY8C4147AXI-S445 MCU Page
- LM502-Demo-Board Hardware Source
- LM502 DXF file