



LM502 22dBm SX1262 LoRaWAN module User Manual

Document Version: 1.0

Version	Description	Date
1.0	Release	2019-Sep-10



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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</p>

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)	Ουτρυτ	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	



www.dragino.com

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:

LM502 22dBm LoRaWAN End Node User Manual





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: <u>http://www.dragino.com/downloads/index.php?dir=LM502/drivers/&file=CMSIS_DAP.inf</u>

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 <u>TTN LoRaWAN Network</u>. Below is the network structure, we use <u>LG308</u> as LoRaWAN gateway here.

LM502 in a LoRaWAN Network



The LG308 is already set to connect to <u>TTN network</u>. 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:







Add APP EUI in the application

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

NSOLE	Applications	Gateways	Suppor
Applications > <a>> dragino_test_application1			
Application ID dragino_test_application1 Description a test application for Dragino Created 2 years ago Handler ttn-handler-eu (current handler)		documentar	ion
APPLICATION EUIS		o manage e	uis
(·) ::::::::::::::::::::::::::::::::::::			

Add APP KEY and DEV EUI

NSOLE MENITY EDITION	Applications	Gateways	Supp
Applications > 🤤 dragino_test_application1 > Devices			
REGISTER DEVICE		bulk import devi	2005
Device ID This is the unique identifier for the device in this app. The device ID will be immutable.			
80		0	
Device EUI The device EUI is the unique identifier for this device on the network. You can change the EUI later.			
× A8 40 41 00 01 81 85 48		🥑 8 bytes	
App Key The App Key will be used to secure the communication between you device and the network.			
∞ 57 4E 37 E6 8A EC FC CD B3 B9 3D 87 A9 3B 4B 2C		🥑 16 bytes	
App EUI			
3F 77 AD E3 6B CA AB 65		0	

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.



LM502 with external MCU in a LoRaWAN Network

Test set up:

- ✓ LoRaWAN Network. (<u>How to Prepare LoRaWAN Network</u>?)
- ✓ LM502-Demo-Board with AT Command works in PC (<u>How to use AT Command</u>?). 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:

LM502:~# AT+CJOIN=1,1,10,8

OK LIND 02: "#
[19573]***** UpLinkCounter= 0 *****
[19584][X on freq 868300000 Hz at DR 5
[19593]Start to Join, nb_trials:48
[19657]txDone
[24727]rxDone
*CJOIN:0K
rub200111010 LM502:~# join success [24737]Joined [24741]<u>***** UpLinkCounter= 0 *****</u> [24745]TX on freq 867100000 Hz at DR 0 [25912]txDone [27143]rxTimeOut [27945]rxTimeOut OK+SENT:01 AT+DTRX=0,0,10,0123456789 uplink OK+SEN D:05 LM502:~# [51745]***** UpLinkCounter= 1 ***** [51749]TX on freq 868100000 Hz at DR 0 [53079]txDone [54311]<u>rxTimeOut</u> [55245]rxDone → receive data success OK+SENT:01 [55254]receive data: rssi = -26, snr = 11, datarate = 3 rx: port = 2, len = 4 0x11 0x11 0x11 0x11 0K+RECV:01,02,04,<mark>11111111 → data</mark>



Screen Shot in TTN- Device Page:

	K CONS	SOLE	N					Application	s Gatew	ays Su	pport
	Application	s > 🥪 ar	duino-Im50	2-otaa11	> Device	; > ;;;;	otaa-test > Data				
									Overview	Data	Settings
	APPLI	CATION	DATA							II paus	<u>e</u> 🗑 <u>clear</u>
	Filters	uplink	downlink	activation	ack	error					
LM502 receive		time .6:31:12	counter	port	confirmed ack	app id: ardu	ino-Im502-otaa11				
success and reply	1	6:30:03	2	0		payload: [no	t provided]				
downlink 🗲	— 1	.6:31:09		2	confirmed	payload: 11	11 11 11				
uplink 🗲		6:30:00	1	10	scheduled	payload: 01	23 45 67 89				
		.6:29:33	0	10	confirmed retry	payload: 00					
join request 🗸	- + 1	.6:30:35				dev addr: 2	5 01 20 72 app eui: 00 7D 2B C7 A1 9F 7F 23 dev eui:	D8 96 E0 FF	00 00 02 4	D	

Screen Shot in TTN-Gateway-Traffic Page:

	COMMUNITY EDITIO	ON					Applications	Gateways Sup	oport
	Gateways > 🏷 eu	ii-a840411bc54	ł0aaaa → Tra	iffic ^{beta}					
							Overv	iew Traffic	Settings
	GATEWAY TR	AFFIC beta							
	uplink down	link join			0 bytes 🗙			🛛 pause 🖞	i <u>clear</u>
	time 16:30:03	frequency 868.5	mod. CR lora 4/5	data rate SF 12 BW 125	airtime (ms) 1155.1	cnt 2 dev addr: 26 01 20 72 pa	yload size: 12 byte	s	
downlink ∢	16:30:01	869.525	lora 4/5	SF 9 BW 125	164.9	0 dev addr: 26 01 20 72 pa	yload size: 17 byte	s	
uplink	16:30:00	868.1	lora 4/5	SF 12 BW 125	1318.9	1 dev addr: 26 01 20 72 pa	yload size: 18 byte	s	
	16:29:33	867.1	lora 4/5	SF 12 BW 125	1155.1	0 dev addr: 26 01 20 72 pa	yload size: 14 byte	'S	
join success	✓ 16:29:31	868.3	4/5	SF 7 BW 125	71.9				
join request	← 🛃 16:29:27	868.3	4/5	SF 7 BW 125	61.7	app eui: 00 7D 2B C7 A1 9F	7F 23 dev eui:	D8 96 E0 FF 00 00	02 40

Video Demo:

LM502-Tutorial-1---Use AT Command to join LoRaWAN via OTAA Link: <u>https://youtu.be/xqUK-j4lGcE</u>



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. (<u>How to Prepare LoRaWAN Network</u>?)
- ✓ LM502-Demo-Board with AT Command works in PC (<u>How to use AT Command?</u>). 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 // xxxxxxx 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= 8 ***** [94224]***** UpLinkCounter= 8 ***** [95255]KuDone [95757]KuDone [95779]r*TimeOut [977740]receive data: [97740]receive data: rssi = -27, snr = 11, datarate = 3 rx: port = 1, len = 4 8x11 8x11 8x11 8x11 OK+RECU:01,01,04,01111111 \longrightarrow data

Dataflow in TTN device page:

	CONS	SOLE	N				Applicatio	ons Gatew	vays Su	pport
	Application	s > 🥪 a	rduino-Im50	2-abp11	> Device	s > 🚝 lm502-abp > Data				
								Overview	Data	Settings
	APPLI	CATION	DATA						II paus	<u>e</u> 🗃 <u>clear</u>
	Filters	uplink	downlink	activatio	on ack	error				
		time	counter	port						
LM502 receive	1	.6:37:47	1	0		payload: [not provided]				
success and reply	0 1	.6:38:55		1	confirmed ack	app ld: arduino-Im502-abp11				
downlink 🗲	• 1	.6:38:52		1	confirmed	payload: 11 11 11 11				
uplink 🗲	1	.6:37:44	0	10	retry	payload: 01 23 45 67 89				Settings
	▼ 1	.6:38:39		1	scheduled confirmed	payload: 11 11 11 11				

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

THE THINGS CONSOLE		Applications Gateways Support
Gateways > 🏷 eui-a840411bc	640aaaa → Traffic ^{beta}	
		Overview Traffic Settings
GATEWAY TRAFFIC beta		
uplink downlink join	Obytes X	pause 📋 clear
time frequency	mod. CR data rate airtime (ms)	cnt
16:37:47 868.1	lora 4/5 SF 12 BW 125 1155.1	1 dev addr: 26 01 19 11 payload size: 12 bytes
downlink 16:37:45 869.525	lora 4/5 SF 9 BW 125 164.9	0 dev addr: 26 01 19 11 payload size: 17 bytes
Uplink 16:37:44 868.1	lora 4/5 SF 12 BW 125 1318.9	0 dev addr: 26 01 19 11 payload size: 18 bytes

Video Instruction: LM502-Tutorial-2: Use AT Command & ABP to join LoRaWAN Link: <u>https://youtu.be/-Pk2SMQLVM0</u>



4.3 Arduino & OTAA to Join LoRaWAN network

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

LM502 with external MCU in a LoRaWAN Network



Test set up:

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



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:

<pre>Channel Control and Diversion (Control A</pre>	
2010 immune Cost 18100 Resume Costone 2817 Resume Costone 30 Resume Costone 31 Resume Costone 32 Resume Costone 33 Resume Costone 34 Resume Costone 35 Resume Costone 36 Resume	- 0 X
and the maximum interment (when "File" scalar-distribution (a); 3); and the maximum interment (when "File" scalar-distribution (a); 3); bit and the maximum interment (when "File" scalar-distribution (a); 3); constructions (a); ,,,,,,,	
2 Soft Wrang Human yakan 4 cons 5 cons series we wrang human yakan 5 cons series we wrang human yakan 5 cons series we wrang human yakan 5 cons 6 char dtra[16] or AT+DTRK-0, 0, "; 7 char flag=0; 9 0 void setup() { 1 // (hitalize both serial ports; 9 Seriel N both seriel (JS200)	· .
<pre>3</pre>	
Scons WHX Your arr '1, 1, 10, 8\r\n"; 6 char dtx[16]= " AT-DTEK=0, 0, "; 7 char flag=0; 9 9 9 9 9 9 9 9 9 9 9 9 9	
6 char dtrx[16]=" AT-DTEX=0,0,"; 7 char flags=0; 8 //char flag1=0; 9 9 10 void setupO { 11 // initialize both serial ports:	
7 char flags=0; 8//char flag1=0; 9 0void setup() { 1 // initialize both serial ports:	
<pre>8//char flag1=0; 9 Vorid setup() { 1 // initialize both serial ports; 9 Seal=11 bett (JISPO0);</pre>	
9 Ovoid setup() { 1 // initialize both serial ports: 2 Scalel best (15000);	
0void setup() { 1 // initialize both serial ports: 2	
1 // initialize both serial ports:	
2 Seciel Line (115200) .	
2 Seriali. Degin (115200);	
3 Serial.begin(115200);	
4 while (!Serial1) {	
NAL.	
viduda dana Thank yau	^

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



Check device dataflow on TTN:

	CONS	OLE NITY EDITIO	N						Applicati	ons Gate	ways Su	pport
	Applications	s > 🤤 al	rduino-Im50	2-otaa11	> Device	es 👌 📰) of	taa-test > Data				
										Overview	Data	Settings
	APPLIC	CATION	DATA								II paus	e 🛍 <u>clear</u>
	Filters	uplink	downlink	activation	n ack	error						
		time	counter	port		nadaadi (u	(الماشي				
LM502 receive success and reply		9:48:40	3	2	confirmed ack	app id: ard	duind	o-Im502-otaa11				
downlink	• • •	9:48:39		2	confirmed	payload: 1	11 1:	1 11 11				
	0	9:47:31	2	10		payload: 0	01 23	3 45 67 89				
	- 0	9:48:25		2	scheduled confirmed	payload: 1	11 1:	1 11 11				
uplink +	0	9:47:01	1	10		payload: 0	01 23	3 45 67 89				
	0	9:46:51	0	10		payload: 0	00					
join request	0 🗲 🛶	9:47:54				dev addr:	26 0	112A F0 app eui: 007D2BC7A19F7F23 dev eu	D8 96 E0	FF 00 00 02	40	

Check gateway – traffic on TTN:

	CONSOLE COMMUNITY E	DITION					Applications Gateways Support
Gat	eways > 🏷	eui-a840411bc	540aaaa	> Tra	affic ^{beta}		
							Overview Traffic Settings
G	GATEWAY	TRAFFIC beta	1				
	uplink d	lownlink join				0 bytes X	pause 🝵 clear
	time	frequency	mod.	CR	data rate	airtime (ms)	cnt
downlink 🔶	- • 09:47:31	868.5	lora	4/5	SF 7 BW 125	51.5	0 dev adur: 26 012AF0 payload size: 12 bytes 0 dev addr: 26 012AF0 payload size: 17 bytes
uplink	09:47:31	868.5	lora	4/5	SF 7 BW 125	51.5	2 dev addr: 26 01 2A FO payload size: 18 bytes
	09:47:01	868.3	lora	4/5	SF 7 BW 125	51.5	1 dev addr: 26 01 2A F0 payload size: 18 bytes
	09:46:51	867.3	lora	4/5	SF 7 BW 125	46.3	0 dev addr: 26 01 2A F0 payload size: 14 bytes
join success 🗲	• 09:46:50	868.5		4/5	SF 7 BW 125	71.9	
join request 🗲	- 🗲 09:46:46	868.5		4/5	SF 7 BW 125	61.7	app eui: 00 7D 2B C7 A1 9F 7F 23 dev eui: D8 96 E0 FF 00 00 02 40
	4						•

Video: LM502-Tutorial-3: Arduino & OTAA to Join LoRaWAN network Link: <u>https://youtu.be/OIVXXyiuTH0</u>



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: <u>PSoC Programmer Download link</u>. IMPORTANT: Please use version (3.27.1), higher version will have compatible issue.

elated 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
DSoC 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
C 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

Step 2:Install PSOC Programmer





Step 3:Check Module Connection

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

PSoC Programmer		- 0 X
File View Options Help		
🖆 · 🗼 💿 BB 🚺 🗎 🗅		
Port Selection	Programmer Utilities JTAG	
CMSIS-DAP/243590	Programming Parameters	Memory Ty
	File Path C.\Users\Administrator\Desktop\alios_small.hex File Is Not Present Comparison	Load fror
	Programmer. CMSIS-DAP/243590	
	Programming Mode: Reset Power Cycle Power Detect 	
	Verification: On Off Connector: 5p @ 10p	=
Device Family		
CY8C41xx-S 👻	Programmer Characteristics Status Execution Time: 0.4 seconds	Size (bytes)
	Protocol. JTAG SWD ISSP 12C Power Status:	Start addres
Device	Voltage: 5.0 V @ 3.3 V 0 2.5 V 0 1.8 V Voltage: NA	End addres: 👻
CY8C4147AZI-S445	✓ III	•
Actions Result	S	•
Successfully Con CMSIS-	-DAP Version 1.0	=
Opening Port at		
Memory Types Loa		
Hex Fi	ile parsing failure. Hex file does not exist or cannot be opened	
Toad	file or select one from the Recent Files list	v
	III	4
For Help, press F1	FAIL	Connected

Step 4:Select file to update

PSoC Programmer					
File View Options Help					
💣 🖓 🙆 🖉 🙆 🚺					
Port Selection 3	Programmer Utilities JTAG				
CMSIS-DAP/243590	Programming Parameters <u>File Path:</u> C:\Users\Administrator\Desktop\LM	502 hex	Memory Typ Load from	es hex Load from device	
	Programmer. CMSIS-DAP/243590 Programming Mode: • Reset • Power Cycle •	ver Detect		lash [128K]	
Device Family		Copeed. I.b MHZ			
CY8C41xx-S	Programmer Characteristics	xecution Time: 0.4 seconds	Size (bytes):		
Device	Voltage: 5.0 V @ 3.3 V @ 2.5 V @ 1.8 V	Power Status:	Start address	S.	
CY8C4147AZI-S445		/oltage: NA	End address	•	
Open HEX file	10.8				×
G v k rojects V Crea	ator ▶ LM502 ▶ LM502.cydsn ▶ CortexM0p ▶ ARM	_GCC_541 Debug		▼ ◆ 搜索 Debug	Q
组织 ▼ 新建文件夹				i≣ • [0
👢 LM502 LoRa master	^ 名称 [^]	修改日期	类型	大小	
LM502 LoRa master	leps	2019/7/9 14:49	文件夹		
.vscode	LM502.hex	2019/7/9 14:49	HEX 文件	283 KB	
ann	1				
board	2				
build					
L device					
L doc					
	100				
📙 example	=				



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: <u>PSOC Creator</u>. 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.

	Enter Your Keywords	Q Commun	nity English 译 Log in
SOL Home > Products > Microcontroller (MCU) and Programmable Sy	UTIONS PRODUCTS I stem-on-Chip (PSoC®) Families > PS	DESIGN SUPPORT BUY & SA ioC® Software > PSoC® Creator™ Integra	MPLE ABOUT CYPRESS ted Design Environment (IDE)
PSoC® Creator™ Integrated Design I	Environment (IDE)		
	JAJ	Download	PSoC Creator
PSoC [®] CREATOR™	4.2	PSoC Crea Communi	tor Developer ty
DUAL-CORE APPLICATION DEVELOPMENT MADE EA	SY SY		

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.

F) 编辑(E) 查看(V) 工具(T) 希!	助(H)						
R • 📋 Open • 共享 •	新建文件夹				ē	•	(
LM502 LoRa master	名称	修改日期	类型	大小			
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.vscode	Backup	2019/6/20 9:59	文件夹				
1 3rdparty	bootloader.cvdsn	2019/6/20 17:17	文件夹				
👃 app	L codegentemp	2019/7/9 14:47	文件夹				
L board	L CortexM0p	2019/7/8 11:33	文件夹				
👃 build	Export	2019/7/9 14:49	文件夹				
L device	. Generated Source	2019/7/8 11:33	文件夹				
L doc	L TopDesign	2019/6/20 9:59	文件夹				
k example	, aitianore	2019/6/14 18:02	GITIGNORE 文件	1 KB			
L framework	AsrLib.a	2019/6/14 18:02	A 文件	242 KB			
1. include	AsrLib_small.a	2019/6/14 18:02	A文件	170 KB			
kernel	Doard_test.h	2019/6/14 18:02	C/C++ Header F	1 KB			
platform	BUILD.log	2019/7/9 14:49	Heinote.logfile	1 KB			
projects	i cyapicallbacks.h	2019/6/14 18:02	C/C++ Header F	1 KB			
Creator "	GENERATE_APLlog	2019/7/2 17:57	Heinote.logfile	1 KB			
LM502	LM502.cycdx	2019/7/9 14:47	CYCDX 文件	325 KB			
LM502.cydsn	LM502.cydwr	2019/6/29 10:39	CYDWR 文件	80 KB			
📙 pingpong.cydsn 🦳	LM502.cyfit	2019/7/9 14:47	CYFIT 文件	128 KB			
CS+	a LM502.cyprj	2019/7/9 14:49	PSoC Creator Pr	224 KB ◀			
L e2studio	LM502.cyprj.Administrator	2019/7/9 14:49	ADMINISTRATO	555 KB			
GCC	LM502.rpt	2019/7/9 14:47	Report File	63 KB			
L IAR	III LM502-000.cywrk	2019/6/27 11:43	PSoC Creator W	2 KB			
E Keil	LM502-000.cywrk.Administrator	2019/7/9 15:02	ADMINISTRATO	31 KB			
security	i main.c	2019/6/14 18:02	C Source File	2 KB			
sensor							

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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





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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: <u>PingPong 868 SF7</u>. This example radio parameter is hard code to 868 Mhz and SF7. The source code can be found at <u>PingPong</u> <u>source code</u> 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.

F) 编辑(E) 查看(V) 工具(T) 帮]助(H)			~			
・ 🗒 Open ・ 新建文件	决					-	
🗼 LGT-92 -v1.4-myself 👘 🖌	名称	修改日期	类型	大小	` +		
📕 LM502 LoRa master	bootloader.cvdsn	2019/7/18 10:29	文件来		-		
LM502 LoRa master		2019/7/19 15:54	文件夹				
L .vscode	L CortexM0p	2019/7/19 15:54	文件夹				
📙 3rdparty	Export	2019/7/19 15:55	文件夹				
👃 арр	Generated_Source	2019/7/19 15:54	文件夹				
L board =	▶ src	2019/7/18 10:29	文件夹				
L build	L TopDesign	2019/7/18 10:29	文件夹				
L device	gitignore	2019/6/14 18:02	GITIGNORE 文件	1 KB			
L doc	AsrLib.a	2019/6/14 18:02	A文件	242 KB			
L example	AsrLib_small.a	2019/6/14 18:02	A文件	170 KB			
L framework	BUILD.log	2019/9/10 15:30	Heinote.logfile	6 KB			
L include	g cyapicallbacks.h	2019/6/14 18:02	C/C++ Header F	1 KB			
kernel	🗐 main.c	2019/6/14 18:02	C Source File	1 KB			
	ingpong.c	2019/9/10 15:30	C Source File	11 KB			
i projects	pingpong.cycdx	2019/7/19 15:54	CYCDX 文件	325 KB			
	pingpong.cydwr	2019/6/14 18:02	CYDWR 文件	79 KB			
IM502 orden	pingpong.cyfit	2019/7/19 15:54	CYFIT 文件	128 KB	2		
	pingpong.cyprj	2019/7/19 15:55	PSoC Creator Pr	154 KB			
L cs+	pingpong.cyprj.Administrator	2019/9/10 15:30	ADMINISTRATO	201 KB			
altudio	pingpong.rpt	2019/7/19 15:54	Report File	59 KB			

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Step3: Compile and upload to LM502s.

pingpong-000 - PSoC Creator 4.2	[C:\\LM502 LoRa master\projects\Creator\	M502\ydsn\pingpong.c\pingpong.c		
<u>File Edit View Project Build</u>	Debug Tools Window Help			
🔁 🖞 👌 🐸 🖬 🖉 🖨 🐧 🐇 🖏 🖎	Windows			
□-△参馆 攀头,连续雪的	Program Ctrl+F5			
Workspace Explorer (2 projects)	Select target and program		- 4 b x	Code Explorer (pingpong.c) - * * 👔
¶ a `1	★ Select Debug Target	← 3		be b
rtc-board.h	浅 Debug F5	main.c •		e
- spi-board.h	表 Debug without Programming Alt+F5	Ping-Pong implementation		e an macros. e an Enumerated types: ≩
sx126x-board.h	* Select target and debug			🔹 🕈 Typedefs:
timeServer.h	Attach to Bunning Target	t Revised BSD License, see Section (ref LICENSE.		Global variables. Function declarations:
uart-board.h	Toggle Proskesist 50	-		E
Source Files	roggie breakpoint P9			
🖶 🤭 board	New Breakpoint			
- asr_board.c	Delete All Breakpoints Ctrl+Shift+F9			
gpio.c	Enable All Breakpoints			
gpio_inq.c				
spi-board.c	ğ 15 *	(C) 2013-2017 Semtech		
🕀 🗀 Ioraradio	9 16 *			
- c] radio.c	20 17 * \endcoo	e		
C lorasystem	§ 18 *			
delay.c	a 19 * \author	Miguel Luis (Semtech)		
low_power.c	20 *			
utilities.c	21 * \author	Gregory Cristian (Semtech)		
🕆 🗀 main	22 - */			
- C main.c	23 #include <	stato.n>		
in Co platform\arch	24 #include	string.n>		
port s.S	25 #include			
o printf.c	26 #include	low power.n.		
iuart_port.c	= 27 finclude	Doard . n.		
Generated_Source	20 #include	way here a second se		
B PSOC4	30 #include	timer. h ^a		
B Controadable 1	SU TINCIUM	CARNUE FIE		
			,	







Output from two LM502s' serial monitor.

☑ 友善串口调试助手		×	🔽 友善串口调试助手
文件(F) 编辑(E) 视图(V) 工具(T) 帮助(H)			文件(E) 编辑(E) 视图(V) 工具(I) 帮助(H)
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串□设置 Received: PING 漆特傘 115200 Received: PING 漆特傘 115200 Received: PING 紫螺位 8 Received: PING 紫螺位 8 Received: PING 紫螺位 8 Received: PING 紫螺位 8 Received: PING 水硷位 8000 Received: PING 修止位 1 Received: PING 素 控 8000 Received: PING 麦 按 8000 Received: PING 素 控 8000 Received: PING Sent: PONG R	发送		串□设置 Received: PDMG 多ent: PIMG Sent: PIMG 波特率 115200 数据位 Received: PDMG 数据位 Received: PDMG 数据位 Received: PDMG 数据位 Received: PDMG Sent: PIMG Sent: PIMG Sent: PIMG Sent: PIMG
■ 重复发光 1000 ◆ ms AT+TDC=60000		•	■ 重复发说 1000 🕀 ms 🗛 T+TDC=600000 🗸 🗸
COM32 OPENED, 115200, 8, NONE, 1, OFI Rx: 672 Bytes Tx: 0 Bytes			COM18 OPENED, 115200, 8, NONE, 1, OFI Rx: 840 Bytes Tx: 0 Bytes

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. (<u>How to Prepare LoRaWAN Network</u>?)
- ✓ LM502-Demo-Board with sensor node image (<u>Download image here</u>). 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.



Step2: check the TTN--> device page data

	S CONS	SOLE	N					Applicatio	ns Gatewa	ays Su	pport
,	Application	ns > 🥪 ar	duino-Im50	2-otaa11	> Device	s > 🐖	otaa-test > Data				
									Overview	Data	Settings
	APPLI	CATION	DATA							II paus	e 🛍 <u>clear</u>
	Filters	uplink	downlink	activation	n ack	error					
		time	counter	port							
LM502 receive	▲ 1	10:15:03	2	0		payload: [no	ot provided]				
success and reply	0 1	10:16:17		2	confirmed ack	app id: ardu	uino-Im502-otaa11				
downlink←	1	10:16:13		2	confirmed	payload: 22	2 22 22 22				
		10:15:00	1	10		payload: 04	4 04 7F FF 7F FF 7F FF 00				
/	• 1	10:15:24		2	scheduled confirmed	payload: 22	2 22 22 22				
ADR downlink	- 1	10:15:16		0							
uplink 🐛	_ 1	10:14:01	0	10		payload: 04	4 04 7F FF 7F FF 7F FF 00				
join request 🗲	- + 1	10:15:08				dev addr: 2	26 01 24 EA app eui: 00 7D 2B C7 A1 9F 7F 23	dev eui: D8 96 E0 F	F 00 00 02 40)	



Step3: check the TTN--> Gateway traffic.

	S CONSOLE	ON					Applications	Gateways S	upport
	Gateways > 🏷 ei	ui-a840411bc54	40aaaa > Tra	iffic beta					
							Overvi	iew Traffic	Settings
	GATEWAY TR	AFFIC beta							
	uplink down	nlink join			0 bytes X			II pause	🗑 <u>clear</u>
	time	frequency 867.1	mod. CR lora 4/5	data rate SF 8 BW 125	airtime (ms) 102.9	cnt 1 dev addr: 26 01 24 EA pay	yload size: 22 byte	s	
downlink 🛫	10:15:00	867.1	lora 4/5	SF 8 BW 125	113.2	1 dev addr: 26 01 24 EA pay	/load size: 24 byte	s	
uplink	10:14:02	869.525	lora 4/5	SF 9 BW 125	164.9	0 dev addr: 26 01 24 EA pay	/load size: 17 byte	S	
	10:14:01	867.7	lora 4/5	SF 12 BW 125	1482.8	0 dev addr: 26 01 24 EA pay	/load size: 22 byte	s	
join success 🗲	10:13:59	868.3	4/5	SF 7 BW 125	71.9				
join request ┥		868.3	4/5	SF 7 BW 125	61.7	app eui: 00 7D 2B C7 A1 9F	7F 23 dev eui:	08 96 E0 FF 00 0	00 02 40

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 Al1 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)



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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.

Configure 'Pin_1'		? X
Name: Pin_1		
Pins Mapping Clocking	Buit-in	4.1
Number of pins: 1 \times		
[All pins]	General Input Output	
	Threshold: CMOS	
	✓ Hysteresis	
	Interrupt: Rising edge 🛛 🔽 Dedicated interrupt	
	Sync mode: Transparent	
	✓ Input buffer enabled	8
		-
,		
	10 0	
	10 9	
Datasheet	OK Apply	Cancel



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

LM502-000 - PSoC Creator 4.2 [C:\\projects\Creato	\LM502(LM502.cydsn\TopDesign\TopDesign.vsch)	_ 0 <mark>_ X</mark>
Eile Edit View Project Build Debug Tools W	indow Help	
1898 - Q.Q. 121 1 A 12 1 2 4 Q X 10	☆× * 7 ℃ 紛・ Debug ・	
Microsoft Sans Serif - 10		
Workspace Explores (2 projects)	lineway to at c / 1992 codw / one to c / Tenbesen.cost	Component Catalog (102 👻 🕈 🗿
Workspace 'LM502-000' (2 Projects)		Search for
🖶 💁 Project 'bootloader' [CY8C4147AZI-S445] 👘 👩	•	8
Project 'LM502' [CY8C4147AZI-S445]		Cypress Off-Chip 4 b
Proposignicysch Proposignicysch Segurces (I M502 cydwr)	0	Bise Analog
# Pins Q		🖲 📾 ADC
-M Analog	nin wakein E	Amplifiers
- O Clocks = 9	T UART SPL GlobalSignal 1 dio1 Prins	Analog MUX Em Comparators
System of	Global Signal Pins	H Sa DAC
Directives	AllOcation in T	🖲 🌆 Manual Routing
Flash Security	PulPolane Page	B Gommunications
B Course Files	369/00/0 L	a a Digital
in the approximate the second		Ba Ports and Pins
aos_smallsize.c 9		Power Supervision
soc_impl.c		🗄 🦦 System
B arr board c		Bootloadable [V1.60] Bootloader [v1.60]
o board.c	Bootloadable antpow	- Clock [v2.20]
board.h	Eventse and the second	Die Temperature [v1.0]
gpio.c		DMA Channel [v1.0] Emulated EEPROM (v2.0)
gpio_irq.c	SPI_NRESET	Bas External Memory Interfac
b k_config.h		- 3 Global Signal Reference [
g spi-board.c	SPI_BUSY 🖂 👻	 Interrupt [v1.70]
B 🖸 bsp		Real-time clock (RTC) [v1
B 😋 hal	Page 1 4 P	2 Martiner management
cli.c	Output - • • ×	
dumpsys c	Show output from: All	
uart_port.c	Build Succeeded: 07/19/2019 10:57:51	
uart_port.h	Programming device 'PSoC 4100S Plus CY8C4147AZI-S445' with file 'C:\Users\Administrator\Desktop\LM502 LoBa master\projec	
B control kernel (modules) (s) (kv	Device ID Check	
e 🗠 kernel\rhino	Erasing	* F
k_buf_queue.c	Programming of Flash Starting	Open datasheet
A k_dyn_mem_proc.c	Protecting	associate a
- 0 k event.c	Verlay Checksum	hardware/software event with the Internet Controller.
- k_fifo.c	Device 'PSoc 41005 Flus CY8C4147AZI-S445' was successfully programmed at 07/19/2019 10:58:15.	
- a k_idle.c	· · · · · · · · · · · · · · · · · · ·	🗆 🗹 Inat NI
C k mm blk c	< m >>	Inst_IN
k mm_debug.c + 🗘	Output Notice List	
Ready		9 Errors 0 Warnings 29 Notes

Step8: Check result

CONS	OLE	N							Ap	plications	Gateway	rs Suj	oport
Applications	i > 🤤 In	n502-otaa-3	33 > Dev	ices >	🔚 Im502	2 > Data							
										0	verview	Data	Settings
APPLIC	CATION	DATA										II pause	e 📋 <u>clear</u>
Filters	uplink	downlink	activation	ack	error								
▲ 11	time 1:25:58	counter 3	port 10		payload: OC	E27F FF 7F FF 7F	FF01	ADC1: 3.298	bit 1 Digital_IStatus: "L'	EXTI_Trig	p it O ger: "TRUE"	Hum_SH	IT: "32
▲ 11 ∢	1:25:51	2	10		payload: OB	01 7F FF 7F FF 7F	FF 00	ADC1: 2.817	Digital_IStatus: "L'	EXTI_Trig	ger: "FALSE	' Hum_S	iHT: "3
▲ 11 ∢	1:25:20	1	10		payload: OC	DC7F FF 7F FF 7F	FF 03	ADC1: 3.292	Digital_IStatus: "H'	EXTI_Trig	ger: "TRUE"	Hum_SH	HT: "32 ▶
▲ 11 +	1:24:52	0	10		payload: OB	2C 7F FF 7F FF 7F	FF 00	ADC1: 2.86	Digital_IStatus: "L"	EXTI_Trigg	er: "FALSE"	Hum_SH	IT: "32 [™]
÷ 11	1:26:00				dev addr: 20	5 01 2E 98 app eui:	: 007D	2BC7A19F7	7F 23 dev eui: D8	96 E0 FF 0	0 00 02 40		

Video: LM502-Tutorial-8: Add Digital Input, Interrupt & ADC Link: <u>https://youtu.be/E_JUBIW30wA</u>



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







Interview <td

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

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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

Applications > @ In502-otaa-333 > Devices > E In502 > Data Filters uplink downlink activation ack error time counter port 1 6:11:16 4 0 payload: [not provided] ADC1: 0 0 16:12:37 2 confirmed applid: In502-otaa-333 • 16:12:28 2 0 payload: 02:00 • 16:11:14 3 10 payload: 02:00 • 16:12:22 2 scheduled payload: 02:00 • 16:12:22 2 confirmed payload: 02:00 • 16:12:22 2 confirmed payload: 02:00 • 16:12:22 2 confirmed payload: 02:00 • 16:12:22 2 confirmed payload: 02:00 16:11:129 2 confirmed • 16:11:29 2 confirmed app id: In502-otaa-333	TWORK COM	NSOLE	ON			Applications Gateways	Suppo
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Video: LM502-Tutorial-9: Add Digital output to control LED Link: <u>https://youtu.be/cwnj1b5_aMI</u>



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





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

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Step5: Check result in TTN

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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

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Video: LM502-Tutorial-11: Add SHT20 I2C sensor Link: <u>https://youtu.be/BjPEjuO8sPk</u>



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	Recommend Bands
		Frequency	
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 <u>how to upgrade image</u>. 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