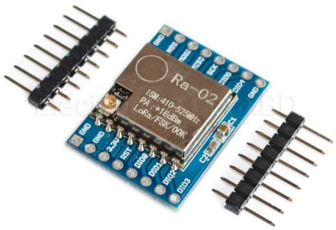

Hyeco Smart Tech ML601 Embedded Low Power Consumption Lora Module User Manual

ML601
Embedded low power consumption LoRa module manual
0V1

Date	Author	Version	Note
June 21st ,2021	Yebing Wang	V0.1	First edition, modules' definition of hardware and request c function.

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Introduction

The ASR6601 is a LoRa soc chip.

The interior is implemented by core of Cortex M4 with the software core of Semtech's LoRa transceiver SX1262. The module can achieve 868(for EU)/915Mhz frequency band communication. The module implements the LoRa device with CLASS A,B,C protocol, DTU and various private protocols. Class A, B,C protocol is nonstandard Lorawan protocol and is only suitable for our gateway. The MCU inside the module is powerful, with a 48Mhz master frequency and 16kbytes Sram,128k flash, making a big leap in performance from the previous ASR6505. In order to reduce the cost of hardware, the Open MCU scheme can be used directly inside by user without expand MCU.
The module's maximum receiving sensitivity is up to – 140dBm, maximum transmit power up to 14dBm@868MHz(for EU) Band / 94dBuV/m@3m@915MHz Band.

Main feature

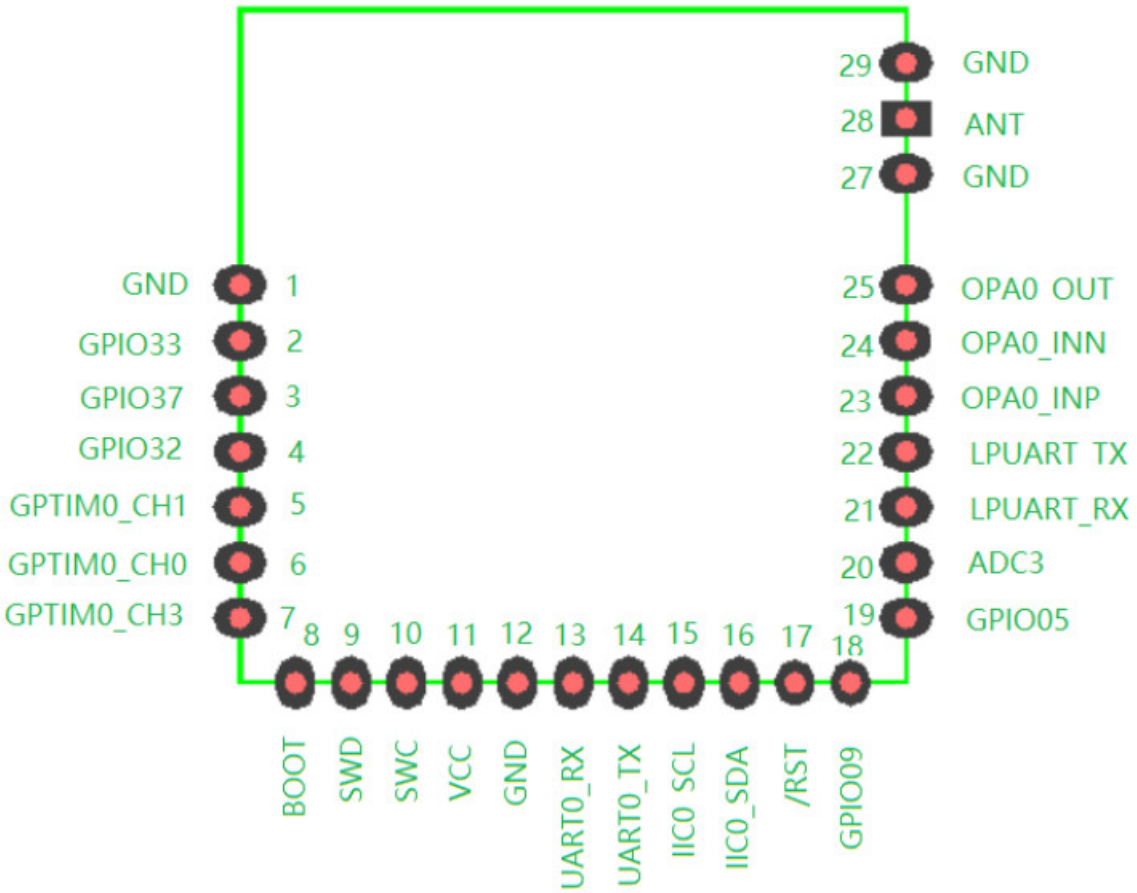
- Maximum reception sensitivity is up to -148dBbm
- Maximum launch power is 14dBm@868MHz(for EU) Band / 94dBuV/m@3m@915MHz Band.
- Maximum transmission speed: 62.5kbps
- Minimum dormant current: 2uA
- Maximum master frequency: 48Mhz
- 16kbytes Sram, 128k Flash

Basic parameters of the module

Classify	Parameter	Value
Wireless	Launch power	
		I 4dBm@868MHz(for EU) Band
		94dBuV/m@3m@915MHz Band.
	Receive sensitivity	-124dbm@SF7(5470bps)
		-127dbm@SF8(3125bps)
		– I 29.5dbm@SF9(1760bps)
Hardware	Data interface	UART /SPI/IIC/PWM/I0&etc.
	Power range	3-3.6V
	Current	120mA
	dormant current	2uA
	Temperature	-20-85
	Size	I 8.2x18x2.5mm
Software	Networking protocol	CLASS A, B, C, DTU & private protocol
	Encryption type	AES128
	User configuration	AT instruction

Hardware introduction

Outline of module



Notes for Hardware design:

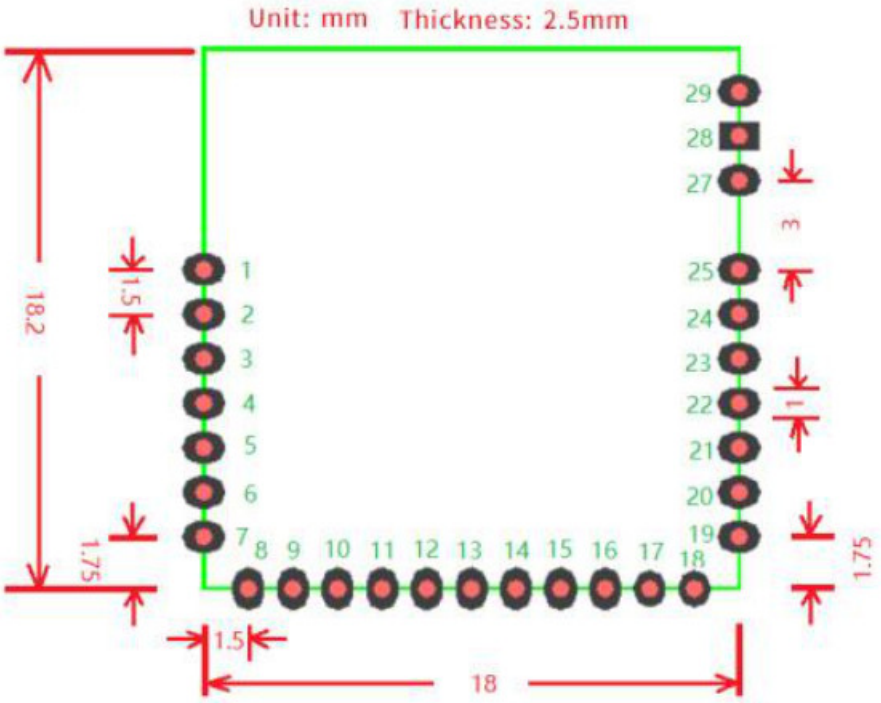
1. Try to supply the module using separate power supplies with low noise LDO such as SGM2033.
2. The supply current of the module must be >120mA, not including the rest system current.

The definition of pin

Pin number	Name	Type	Description
I	GND	Power	System GND
2	GPI033	()	This 10 function is high output at module wake up and 10 low during hibernation. For 9V battery power supply cases. for low power consumption. Power is supplied by LIX) when the module is dormant and by DCDC when the module wakes up. External LED. usually high. put low when lighting.
3	GPI037	1	I. For the external MCU to wake up the LoRa module. (Usually high level. when the module ne eds to wake up. the MCU output I ms pulse (low l evel effective) to the module. All mode pull-down l ow levels above 2S recovery port rate default): 2. For the external MCU tells Lora is ready to rec eive AT instructions:
4	GPI032	0	I. To wake up external MCU. 2. Use to tell the MCU. Lora module has been aw akened to accept AT instructions: Lower wireless data. finish sanding. and hibernation
5	GPTIMO_CH I SP10_ CS GPI001	I0	PWM output SPI chip selection 10
6	GPTIMO_CHO SP1O _CLK GP1000	I0	PWM output SPI clock I0
7	GPTIMO_CH3 SPIO_ RX GPI003	I0	PWM output SPI input I0
8	BOOT GPTIMO_CH2 SPIO_TX GP1002	I0	Choose BOOT(internal pull-down). PWM output SP1 output I0
9	SWD GP1006	I0	Simulator debugging SWD t pull-up) I0

10	SWC GP1007	0	Simulator debugging SWC (pull-down) 10
II	VCC	0	Power input 3.3V. Maximum peak current150mA.
12	GND	Power	System GND
13	UAFtTO_RX GP1016	I0	Serial port 0 receive 10-download-print
14	UARTO_TX GP1017	I0	Serila port 0 send 10-download-print
15	11CO_SCL GP1014	I0	IICO clk 10
16	11CO_SDA GY1015	I0	IICO DATA 10
17	/RST	0	System reset. low effectiveness
18	GP1009 GPTIMI CHI	0	I0 PWM output
19	GP105 ADC2	I0/A	I0 ADC CH2
20	ADC3 GPI004	A/I0	ADC CH3 10
21	LPUART_RX GPI060	I0	Low Power UART RX 10-AT interactive
22	LPUART_TX GP1047	I0	Low Power UART TX 10
23	OPAO_INP GP1045	MO	Operational amplifier 0. positive enter point I0
24	OPAO_INN GP1044	.A/I0	Operational amplifier 0. negative enter point I0
25	OPAO_OUT GP1010	MO	Operational amplifier 0. output point 10
27	GND	Power	System GND
28	ANT	RF	Antenna wire
29	GND	Power	System grounding line

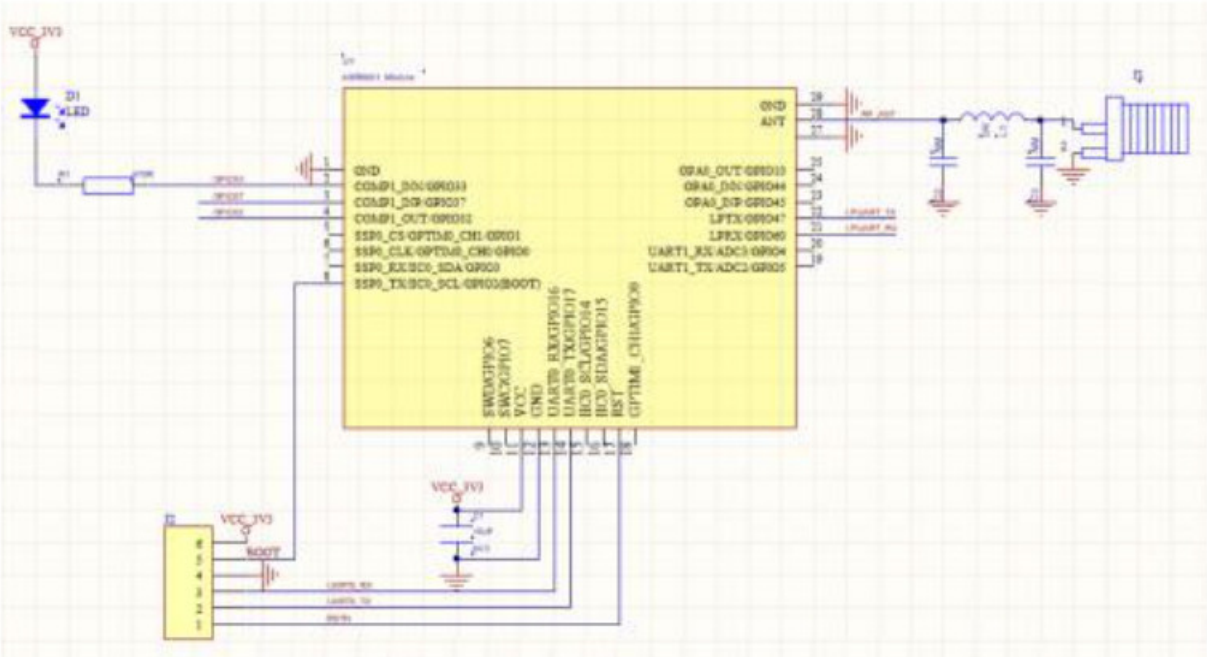
Hardware size



Electrical character

Parameter	Condition	Minimum	Normal	Maximum	Unit
Working voltage		3	3.3	3.6	V
Working current	Continuous send		120		mA
dormant current	RTC work		2		uA

Reference design



Parameter of function.

1. Support wireless transmission
2. Changeable serial port rate and test bit
3. Support for transmission data encryption and decryption
4. Support for frequency and rate-setting
5. Support the selective preservation of setting parameters. The MCU control the module does not need to be saved, and it is used separately as a transmission module
6. Support the use of external MCU control modules and independent modules
7. The serial port rate, Lora rate, Lora frequency, and secret key within the same transmission combination need to be consistent, and the inconsistency will lead to anomalies
8. LED lamp (GPIO33) flash at 2S frequency
9. Pull GPIO32 down when sending data, sent and dormant
10. Export “AT + START\r\n”, until it receives this command Directive configuration and data transfer
11. The recovery default serial port rate is 38400, no verification function

Regional division of FLASH

Internal Flash has a total of 128kbytes, page in size of 4k.

Region	Range of region	Byte	Note
DTU routine are	0x0800_0000-0x0801_EFFF	124K	DTU routine is
INFO	0x0801_F000-0x0801_FFFF	4K	Store some user information

Usage of module

Module use can be controlled by an external MCU and as independent modules using two, with an arbitrary combination of port rate and rate, the packet length transmission supports a maximum of 1K (1023Byte) byte data.

1. External MCU control

   The default GPIO32 of the power is high, the GPIO32 is pulled down during the data transmission process, and the GPIO32 is high, which can be determined here whether the broken module is dead, the timeout should be greater than 5.26S (sending 1 K bytes at SF9,2400 baud rate).
2. When the transmission data is greater than 1K, the 1K data is sent first to continue to send the remaining data when the GPIO32 is restored to high, so that the circular transmission is sent.

AT instruction

(Note: Sending the command needs to return the line and return the AT command to return the line)
7.1 **Enter into AT instruction mode**

Serial port	Format	Note
Send	+++	The start and end byte of a frame must be with an ending wit h three consecutive '+'+"\r\n", send a character 'a' between1 0ms to 1s
Send	a	The 'a' must end with the frame start byte + "\ r \ n" and if the + + 'character is not received in module 1S, the' + + +'is issu ed as a data transmission
Return	AT+ENAT=OK	Enter into command mode

7.2, **Set the serial port rate**

Note: After this step, the serial port returns OK or ERR, MCU according to the previous port rate, and check bit to synchronously initialize the corresponding port rate and check bit after receiving the successful setup command.

Serial port	Format	Note
Send	AT+BAUD=9600,0	2400 4800 9600 14400 19200 38400(default) 7600 115200 o ptional 0-No check bit default 1-Check odd 2-Check even
Return	AT+BAUD=OK	Correct return
	AT+BAUD=ERR	Wrong return
Send	AT+BAUD=?	Inquiry
Return	AT+BAUD=9600,0	

7.3, **Set the Lora frequency interval**

Serial port	Format	Note
Send	AT+FREQ=4400	470Mhz span 4300~5100 868Mhz(for EU) span 8600~9200 Default 4400
Return	AT+FREQ=OK	Correct return
	AT+FREQ=ERR	Wrong return
Send	AT+FREQ=?	Inquiry
Return	AT+FREQ=4400	

7.4 **Set the Lora rate**

Serial port	Format	Note
Send	AT+RATE=7	7(5470bps) /8(3125bps) /9(1760bps)optional Default 7
Return	AT+RATE=OK	Correct return
	AT+RATE=ERR	Wrong return
Send	AT+RATE=?	Inquiry
Return	AT+RATE=7	

7.5, **Set the working mode**

Serial port	Format	Note
Send	AT+WORKMODE=1	After sending the data in dormant mode
Return	AT+WORKMODE=2	Post the data delay dormancy mode
	AT+WORKMODE=3	No dormant mode (default)
Send	AT+WORKMODE=OK	Correct return
Return	AT+WORKMODE=ERR	Wrong return
Send	AT+WORKMODE=?	Inquiry
Return	AT+WORKMODE=1	

7.6, **Set the Lora packet length**

Serial port	**Format**	**Note**
Send	AT+LORALENTH=240	Set the Lora data per packet 32~240
Return	AT+LORALENTH=OK	Correct return
	AT+LORALENTH=ERR	Wrong return
Send	AT+WORKMODE=?	Inquiry
Return	AT+WORKMODE=240	

7.7, **Set up the key**
Fixed 16 bytes and 16 decimal numbers (16 characters) with the encryption key to resolve the data correctly.Query is not supported.

Serial port	Format	Note
Send	AT+DATAKEY=Qqert,91234567890	Support for numbers, English, and English characters. Default All 0
Return	AT+DATAKEY=OK	Correct return
	AT+DATAKEY=ERR	Wrong return
Send	AT+DATAKEY=?	Inquiry
Return	AT+DATAKEY=ERR	

7.8, **Save the parameters set above**
Note: Perform this command to save the previously set AT instruction parameters.

Serial port	**Format**	**Note**
Send	AT+SAVE	Save the above set AT instruction parameters
Return	AT+SAVE=OK	

7.9, **clear the above set parameters- -the restart takes effect**
Note: restore default except the above setting AT instruction parameters.

Serial port	Format	Note
Send	AT+RESTORE	Clear the above set AT instruction parameter s to restore the default values
Return	AT+RESTORE=OK	

7.10, **Exit the AT instruction mode**
Note: This step indicates that the setting is complete and the module receives the instruction into transmission mode. The setting was not complete midway, and the previous setting was also successful.

Serial port	Format	Note
Send	AT+EXAT	Exit the at instruction mode
Return	AT+EXAT=OK	

Note: The parameters configured through the AT instruction will not be automatically saved, the configured parameters after power again will restore the default, which need to be saved through AT + SAVE.

Restores the default serial port rate 38400 and no checked

GPIO37 pin holding low level above 2S can restore the default serial port rate and return to AT + BAUD=38400,0 + return line.
Please take attention that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
The module is limited to OEM installation ONLY The OEM integrator is responsible for ensuring that the end-user has no manual instruction to remove or install-module.
When the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains FCC ID: 2AZ6I-ML601" and the information should be also contained in the devices' user manual.

Documents / Resources

	Hyeco Smart Tech ML601 Embedded Low Power Consumption Lora Module [pdf] User Manual ML601, 2AZ6I-ML601, 2AZ6IML601, ML601 Embedded Low Power Consumption Lora Module, Embedded Low Power Consumption Lora Module, Consumption Lora Module, Lora Module