E78-400M22S1C

ASR6601 400/470MHz LPWAN Low Power LoRa Wireless SoC



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Chengdu Ebyte Electronic Technology Co.,Ltd.

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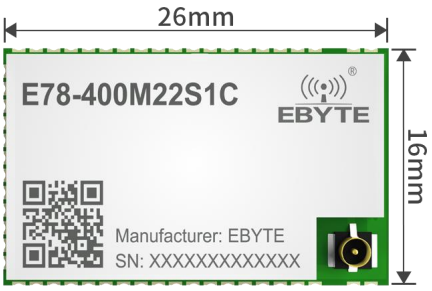
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1 Introduction

1.1 Brief Introduction



E78 series are RF transceiver module of various frequency bands designed and manufactured by Chengdu Ebyte, with long communication distance and extremely low power mode current consumption. It is a small-sized SMD type (pin pitch 1. lmm).

E78-400M22S1C is developed by ASR6601, the first domestically made LPWAN wireless communication SoC chip that supports LoRa. ASR6601 integrates a general-purpose micro Limit parametercontroller and radio frequency unit on a single chip, including radio frequency transceivers, modems, and a 48 MHz clocked 32-bit MCU with Arm Cortex M4 architecture. The Flash capacity is 256kB, and the SRAM capacity is 64kB. Low power consumption, support up to 62.5Kbps airspeed under LoRa modulation, support up to 300Kbps airspeed under (G)FSK modulation, support LoRaWAN, LinkWAN multiple protocol standards, applicable for a variety of IoT application scenarios, is currently the best choice for LPWAN applications..

E78-400M22S1C is a hardware platform, cannot be used independently. Users need to conduct secondary development. (We can customize standard LoRaWan, Ali linkWan nodes).

1.2 Features

- The first domestic universal LPWAN wireless SoC module based on ASR6601;
- Support LoRaWAN, LinkWAN multiple protocol standards;
- Ultra-high sensitivity of -148 dBm and a maximum transmit power of 22 dBm;
- Support 42 configurable GPIOs：3xI2C，1xICS，4xUART，1xLPUART，1xSWD，3xSPI，1xQSPI 和 2xWDG;
- 62.5Kbps air data rate under LoRa modulation, and 300Kbps under (G)FSK modulation;
- Support the global license-free ISM 433MHz band, support 470MHz meter reading frequency band;
- Support deep sleep, the power consumption of the whole machine is about 2uA in this mode;
- The measured communication distance can reach 5.5km;
- Built-in embedded LCD driver;
- Support AES, DES, RSA, ECC, SHA, SM2/3/4 hardware encryption;
- Industrial grade standard design, support -40 ~ 85 °C for working over a long time;
- IPEX and stamp hole optional, good for secondary development and integration.

1.3 Application

- Street lamp control, environmental monitoring, etc;
- Smart parking lot sensor;
- Smart home and industrial sensors, etc.
- Smart Agriculture Sensor;
- Wireless alarm security system;

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- Building automation solutions;
- Wireless industrial-grade remote control;
- Health care products;
- Advanced Meter Reading Architecture(AMI).

2 Specification and parameter

2.1 Specification

Model No.	Frequency	Transmit power	Reference distance(stamp hole/IPEX)	Package	Antenna
E78-400M22S1C	410-490MHz	21dBm	5.5Km(Lora 1kbps)	SMD	Stamp/IPEX

Model No.	IC	Size	Net Weight	Operation Temperature	Operation Humidity	Storage Temperature
E78-400M22S1C	ASR6601	26* 16*2.8 mm	1.9g	-40 ~ 85℃	10% ~ 90%	-40 ~ 125℃

2.2 Limit parameter

Main parameter	Performance		Remark
	Min	Max	
Power supply（V）	-0.3	3.9	≥3.9 V ensures output power
Digital input level voltage（V）	-0.3	3.9	≥3.9 V ensures output power
Rf input power（dBm）	-	+10	Chances of burn is slim when modules are used in short distance
Temperature（℃）	Storage：-55~+125	Operating：-40~+85	Industrial grade
Humidity（%）	Storage：5~95	Operating：10~95	Without condensation

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2.3 Operating parameter

Main parameter	Performance			Remark
	Min	Type	Max	
Power supply（V）	1.7	3.3	3.7	
Communication level（V）	1.7	3.3	3.7	
TX Current (mA)	105	108	110	LoRa Pout=+22dBm
RC current (mA)	8.5	8.7	11	LoRa 125KHz DCDC Mode, MCU Operation, Build-in TCXO
Sleep current(uA)	0.8	1	1	MCU reserved
Sleep current(uA)	1.6	1.8	1.8	RF/MCU/RTC reserved
TX power (dBm)	20.6	20.8	21	Set up Pout=+22dBm
Recommended frequency (MHz)	410	433/470/490	490	Module working frequency 410~490MHz
Receiving sensitivity (dBm)	-	-148	-	
TCXO crystal (MHz)	-	32	-	Built-in crystal oscillator and uses PWR_TCXO for power supply
TCXO crystal voltage（V）	1.8	1.8	3.3	Recommended output voltage of PWR_TCXO pin
Antenna	IPEX/Stamp hole			50 ohm impedance

2.4 Parameter description

- When designing the power supply circuit for the module, it is recommended to reserve more than 30% of the remaining amount, and the whole machine is conducive to long-term stable operation;
- The current required for the inst ant of launch is large but often because the launch time is extremely short, the total energy consumed may be smaller;
- When customers uses an external antenna, the impedance matching degree between the antenna and the module at different frequency points will affect the magnitude of the transmission current to varying degrees;
- The current consumed by the RF chip in the pure receiving state is called the receiving current. Some RF chips with communication protocols or developers have loaded some self-developed protocols on the whole machine, which may cause the receiving current of the test to be too large;
- The current in the purely receiving state is often mA level, and the "receiving current" of the μA level needs to be processed by the developer through software;
- The shutdown current is often much smaller than the current consumed by the power supply part of the whole machine at no load, without being overly demanding;
- Since the material itself has a certain error, a single LRC component has an error of +0.1%. However, since a plurality of LRC components are used in the entire RF loop, there is a case where error accumulation occurs,

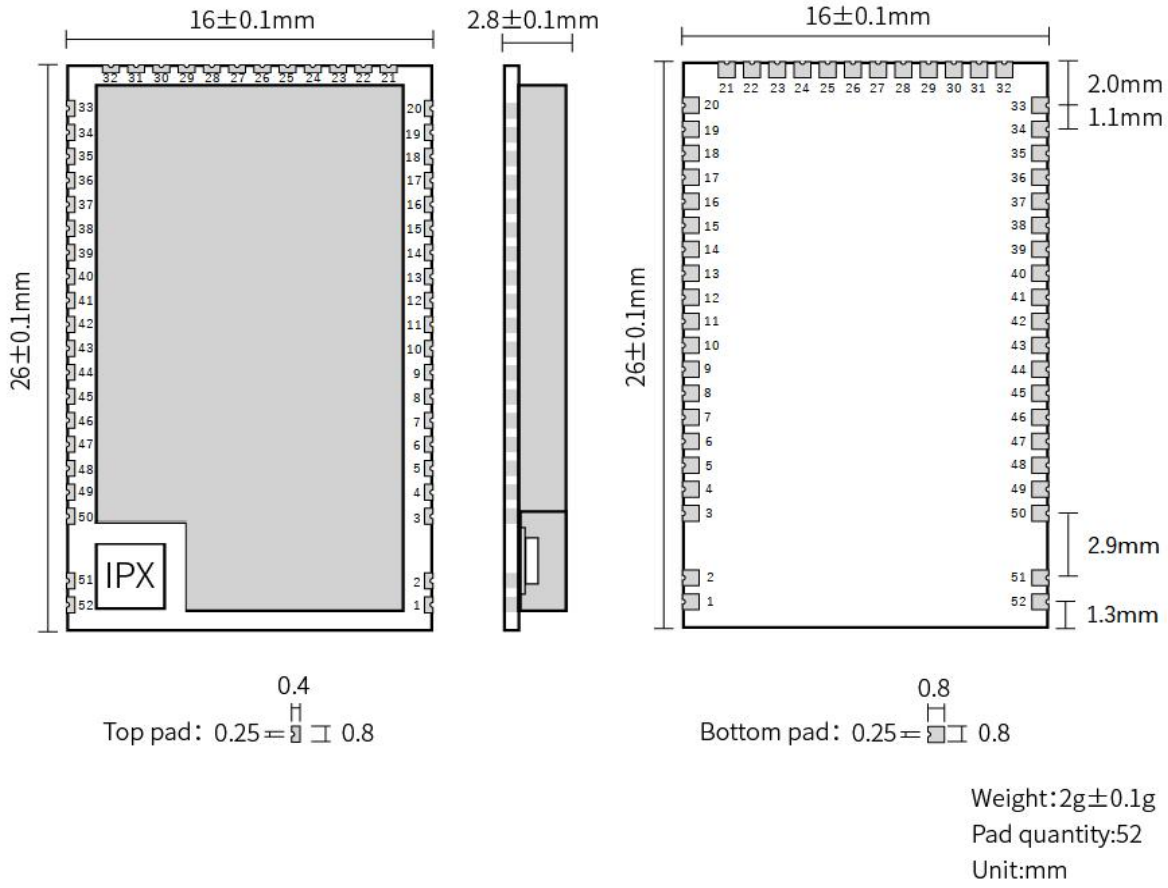
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resulting in a difference in emission current and reception current of different modules;

- Reducing the transmit power can reduce power consumption to some extent, but reducing the transmit power emissions for a number of reasons reduces the efficiency of the internal PA.

3 Size and pin definition



Pin No.	Item	Direction	Description
1	GND	-	Ground wire, connected to the power reference ground
2	GND	-	Ground wire, connected to the power reference ground
3	GND	-	Ground wire, connected to the power reference ground
4	NC	-	Reserved
5	GPIO01	Input/Output	MCU GPIO
6	GPIO00	Input/Output	MCU GPIO
7	GPIO03	Input/Output	MCU GPIO
8	GPIO02	Input/Output	MCU GPIO
9	GPIO06	Input/Output	MCU GPIO
10	GPIO07	Input/Output	MCU GPIO

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11	NRST	Input	External reset pin
12	GPIO14	Input/Output	MCU GPIO
13	GPIO15	Input/Output	MCU GPIO
14	GPIO23	Input/Output	MCU GPIO
15	GPIO25	Input/Output	MCU GPIO
16	GPIO24	Input/Output	MCU GPIO
17	GPIO27	Input/Output	MCU GPIO
18	GPIO26	Input/Output	MCU GPIO
19	GPIO29	Input/Output	MCU GPIO
20	GND	-	Ground wire, connected to the power reference ground
21	GPIO28	Input/Output	MCU GPIO
22	GPIO30	Input/Output	MCU GPIO
23	GPIO31	Input/Output	MCU GPIO
24	GPIO62	Input/Output	MCU GPIO
25	UART0_RX	Input	MCU GPIO
26	UART0_TX	Output	MCU GPIO
27	GPIO60	Input/Output	MCU GPIO
28	GPIO58	Input/Output	MCU GPIO
29	GPIO13	Input/Output	MCU GPIO
30	GPIO12	Input/Output	MCU GPIO
31	VCC	-	Power supply, range 2.5V ~ 3.7V (recommended to add external ceramic filter capacitor)
32	GND	-	Ground wire, connected to the power reference ground
33	GND	-	Ground wire, connected to the power reference ground
34	GPIO11	Input/Output	MCU GPIO
35	GPIO08	Input/Output	MCU GPIO
36	GPIO05	Input/Output	MCU GPIO
37	GPIO04	Input/Output	MCU GPIO
38	GPIO09	Input/Output	MCU GPIO
39	GPIO45	Input/Output	MCU GPIO
40	GPIO44	Input/Output	MCU GPIO
41	GPIO42	Input/Output	MCU GPIO
42	GPIO41	Input/Output	MCU GPIO
43	GPIO40	Input/Output	MCU GPIO
44	GPIO37	Input/Output	MCU GPIO
45	GPIO33	Input/Output	MCU GPIO
46	GPIO32	Input/Output	MCU GPIO
47	GPIO36	Input/Output	MCU GPIO
48	GPIO35	Input/Output	MCU GPIO
49	GPIO34	Input/Output	MCU GPIO
50	GND	-	Ground wire, connected to the power reference ground

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51	ANT	Output	Antenna interface, stamp hole (50 ohm characteristic impedance)
52	GND	-	Ground wire, connected to the power reference ground
★ For the pin definition,software driver and communication protocol of the module, please refer to ASR official 《ASR6601 Datasheet》 ★			

4 E78-400M22S1C development

- In the process of software development, please be sure to follow ASR6601 official user manual and related software development materials in detail, details see ASR official;
- The E78-400M22S1C module has a built-in 32MHz TCXO. The crystal power supply uses the PWR_TCXO pin of the ASR6601 chip. The recommended voltage is 1.8V;
- The module has a built-in external 32.768KHz crystal oscillator, and the load capacitance of the crystal oscillator is programmable inside the ASR6601 chip;
- Module firmware download can use SWD and UART two ways, the pins are respectively:

Download port	**Pin description**
SWD	GPIO06 (SWDATA), GPIO07 (SWCLK), NRST respectively are the 9th, 10th, and 11th pins
Serial	UART0_RX and UART0_TX respectively are the 25th and 26th pins
Note: Use the official SDK, before starting to download, please connect GPIO02 to high level, then restart the module to enter the serial download mode.	

- The module integrates a radio frequency switch, which supports two modes of single control and dual control, see the table below for details：

Operating mode	**GPIO10**	**GPIO59**	**Remark**
Transmit mode	1	1	Single control mode
Receive mode	1	0	Single control mode
Others: GPIO59 (LORA_RF_SWITCH) is the DIO2 pin with built-in RF. After the official SDK is modified to TCXO mode, it can be directly downloaded to the module for running test.			

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5 FAQ

5.1 Communication range is too short

- The communication distance will be affected when obstacle exists;
- Data lose rate will be affected by temperature, humidity and co-channel interference;
- The ground will absorb and reflect wireless radio wave, so the performance will be poor when testing near ground;
- Sea water has great ability in absorbing wireless radio wave, so performance will be poor when testing near the sea;
- The signal will be affected when the antenna is near metal object or put in a metal case;
- Power register was set incorrectly, air data rate is set as too high (the higher the air data rate, the shorter the distance);
- The power supply low voltage under room temperature is lower than 2.5V, the lower the voltage, the lower the transmitting power;
- Due to antenna quality or poor matching between antenna and module.

5.2 Module is easy to damage

- Please check the power supply, ensure it is between the recommended values, voltage exceed the maximum than will cause permanent damage to the module.
- Please check the stability of power supply, the voltage cannot fluctuate too much.
- Please make sure antistatic measure are taken when installing and using, high frequency devices have electrostatic susceptibility.
- Please ensure the humidity is within limited range, some parts are sensitive to humidity.
- Please avoid using modules under too high or too low temperature.

6 Production guidance

6.1 Reflow soldering temperature

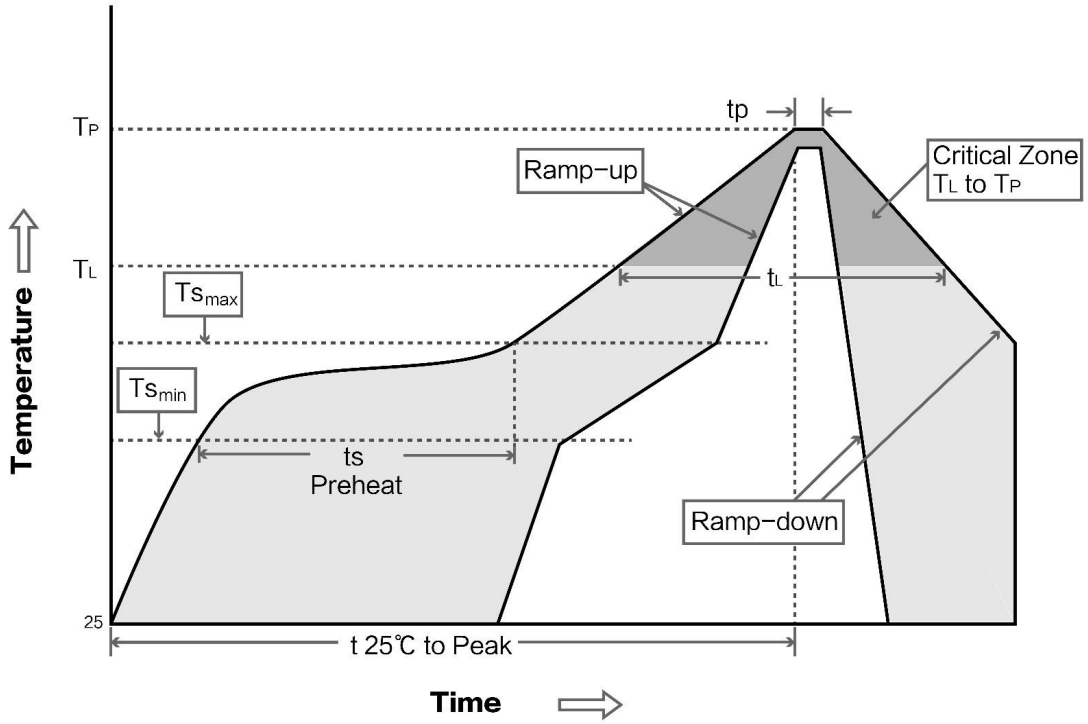
Profile Feature	Curve characteristics	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Solder paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min （Tsmin）	Min preheating temp.	100℃	150℃
Preheat temperature max (Tsmax)	Mx preheating temp.	150℃	200℃
Preheat Time (Tsmin to Tsmax)(ts)	Preheating time	60-120 sec	60-120 sec
Average ramp-up rate(Tsmax to Tp)	Average ramp-up rate	3℃/second max	3℃/second max
Liquidous Temperature (TL)	Liquid phase temp.	183℃	217℃

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Time（TL）Maintained Above（TL）	Time below liquid phase line	60-90 sec	30-90 sec
Peak temperature（Tp）	Peak temp.	220-235℃	230-250℃
Aveage ramp-down rate（Tp to Tsmax）	Aveage ramp-down rate	6℃/second max	6℃/second max
Time 25℃ to peak temperature	Time to peak temperature for 25℃	6 minutes max	8 minutes max

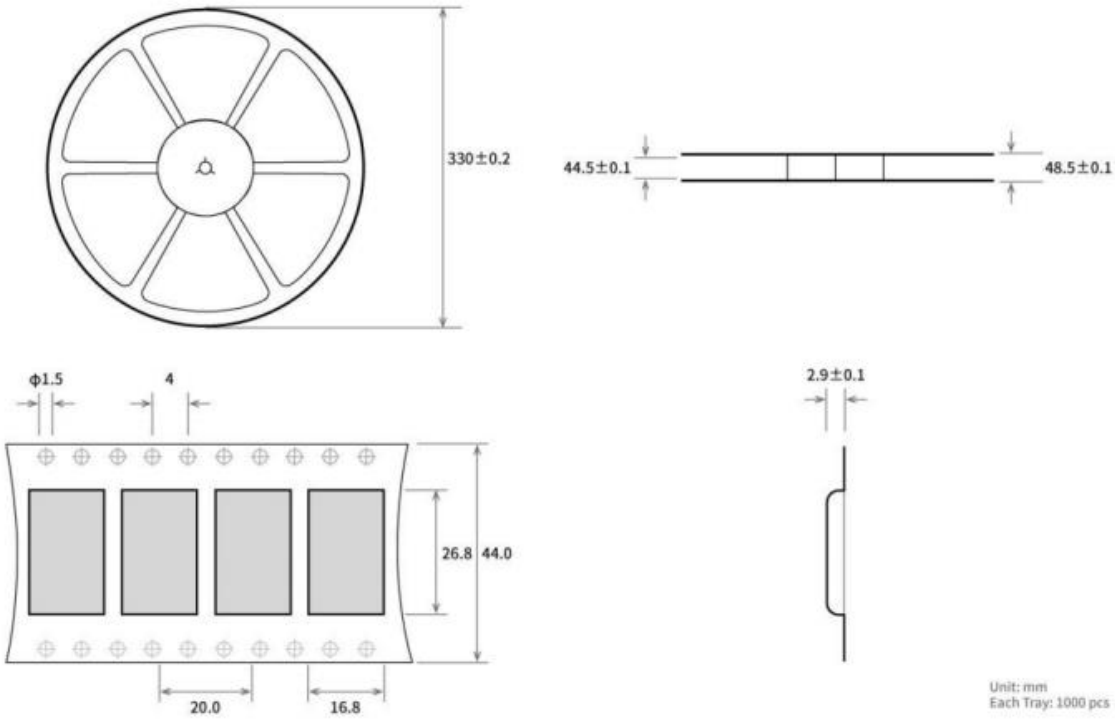
6.2 Reflow soldering curve



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7 Bulk packaging



Revision history

Version	Date	Description	Issued by
1.0	2020/12/01	Initial version	Linsoin

About us

Sales Hotline: 4000-330-990 Company Tel: 028-61399028

Technical support: support@cdebyte.com

Official website: https://www.cdebyte.com/

Company address: B333-D347, Innovation Center, No. 4 Xixin Avenue, High-tech West District, Chengdu, Sichuan Province

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