

LCS2028 规格书/datasheet

WIFI 802.11n

+ Bluetooth DM 5.1

文档信息/Document Information

标题/Title	LCS2028 规格书/datasheet WIFI 802.11n + Bluetooth DM 5.1	
类型/Document type	规格书/datasheet	
编号/Document number	LS-21060007	
版本和日期/Revision and date	V2.04	6-July -2023
权限/Disclosure restriction	外部公开/External public	

历史版本/Revision History

版本/Revision	描述/Description	审核/Approved	日期/Date
V1.01	初始版本/Initial Release	George He	20210615
V1.02	增加BLE特性/Add BLE feature	George He	20210621
V1.03	增加英文版/Add English version	Wendy	20210701
V1.04	增加包装工艺和参考电路/ Add Packaging Specification and Reference Circuit	Wendy	20211207
V1.05	优化部分描述/Optimization section description	Mason	20220326
V1.06	更新PCB参考封装/Update Recommend PCB Footprint	Wendy	20220418
V2.01	删除正常待机模式功耗/Delete power consumption in normal standby mode	Wendy	20220617
V2.02	更正订购信息/update order information	Wendy	20221025
V2.03	更新引脚定义/Update pin definition	Wendy	20230425
V2.04	更新特性描述/Update feature description	Wendy	20230706

SKYLAB 保留本文档及本文档所包含的信息的所有权利。SKYLAB 拥有本文档所述的产品、名称、标识和设计的全部知识产权。严禁没有征得 SKYLAB 的许可的情况下复制、使用、修改或向第三方披露本文档的全部或部分内容。

SKYLAB 对本文档所包含的信息的使用不承担任何责任。没有明示或暗示的保证，包括但不限于关于信息的准确性、正确性、可靠性和适用性。SKYLAB 可以随时修订这个文档。可以访问 www.skylab.com.cn 获得最新的文件。

Copyright © 2022, 深圳市天工测控技术有限公司。

SKYLAB® 是深圳市天工测控技术有限公司在中国的注册商标。

SKYLAB reserves all rights to this document and the information contained herein. Products, names, logos and designs described herein may in whole or in part be subject to intellectual property rights. Reproduction, use, modification or disclosure to third parties of this document or any part thereof without the express permission of SKYLAB is strictly prohibited.

The information contained herein is provided "as is" and SKYLAB assumes no liability for the use of the information. No warranty, either express or implied, is given, including but not limited, with respect to the accuracy, correctness, reliability and fitness for a particular purpose of the information. This document may be revised by SKYLAB at any time. For most recent documents, visit www.skylab.com.cn.

Copyright © 2022, Skylab M&C Technology Co., Ltd.

SKYLAB® is a registered trademark of Skylab M&C Technology Co., Ltd in China

目录/Contents

1.概述/General Description	4
2.应用/Applications	5
3.特性/Features	5
4.框图/Application Block Diagram	6
5.模块引脚描述/Module Pinout Description	7
模块引脚分配/Module Pinout	7
引脚说明/Pin Description	8
6.接口/Interfaces	9
6.1 GPIO	9
6.2 下载 firmware/Download the firmware	9
6.3 UART	9
6.4 PWM	9
7.PCB 规格尺寸/PCB Footprint and Dimensions	10
8.电气特性/Electrical Characteristics	11
a)绝对最大额定值/Absolute Maximum Ratings	11
b)推荐使用范围/Recommended Uses	11
c)测量条件/Masurement Conditions	11
9. 性能参数/Performance Specification	12
10. 制造工艺/Manufacturing Process Recommendations	14
11. 包装工艺/Packaging Specification	15
12. 订购信息/Ordering Information	15
13. 参考电路/Reference Circuit	16
14.联系方式/Contact Information	16

1.概述/General Description

LCS2028 是一款蓝牙双模5.1 和Wi-Fi 802.11n的模块。模块集成了完整的Wi-Fi 和蓝牙应用需要的硬件和软件资源，可以支持AP 和STA 双角色连接，并同时支持经典蓝牙和低功耗蓝牙连接。运行速度最高可到120 MHz 的32-bit MCU 以及内置的256 KB RAM，可以使得芯片支持云连接。

The LCS2028 is a Bluetooth dual-mode 5.1 and Wi-Fi 802.11n module. The module integrates hardware and software resources needed to complete Wi-Fi and Bluetooth applications, supports AP and STA dual role connections, and supports both classic and low-power Bluetooth connections.

LCS2028 拥有丰富的外设，如PWM、I2C、UART、SPI、SDIO 以及IRDA。可以直接通过UART 下载和烧录程序。多达六路的32 位高速PWM 输出使用芯片非常适合高品质的LED 控制。每2 个PWM 可配置为相位可控的差分模式，以支持电机和灯带驱动。

LCS2028 has a wealth of peripherals, such as PWM, I2C, UART, SPI, SDIO and IRDA. You can download and burn the program directly through UART. Up to six channels of 32-bit high-speed PWM output use the chip ideal for high quality LED control. Each 2 PWM can be configured for phase-controlled differential mode to support motor and lamp strip drives.

LCS2028 内部集成了基于优先级的Wi-Fi 和蓝牙共存控制模块，实现实时的优先级和收发调度。LCS2028 可以提供当前收发器的收发状态指示，从而支持外部的PA 和LNA 扩展。

LCS2028 internally integrates priority-based Wi-Fi and Bluetooth coexisting control module to realize real-time priority and dispatch.LCS2028 supports external PA and LNA extensions by providing an indication of the transceiver status of the current transceiver.

LCS2028 内嵌EFUSE 并支持FLASH 内的OTP 读写，可以用于提供唯一序列号、代码加密并保护调试接口安全。内部集成了真随机数发生器和安全模块，保证通信的安全和快速的身份验证和网络连接。LCS2028 has built-in EFUSE and supports OTP reading and writing within Flash, which can be used to provide unique serial numbers, code encryption, and secure debugging interfaces. Internal integration of true random number generator and security module, ensure the security of communication and fast authentication and network connection.

LCS2028 支持低功耗睡眠模式，MCU 可以进入睡眠状态，达到微安级的睡眠电流。LCS2028 支持的深度睡眠模式，可以在几个微安的电流下，运行32 位时钟，并可以被此时钟唤醒或者被任何GPIO 唤醒。

The LCS2028 supports low-power sleep mode, and the MCU can enter the sleep state and reach the microamp level of sleep current. The LCS2028 supports deep sleep mode, which can run 32 bit clock at several microampals of current and can be awakened by this clock or by any GPIO.

LCS2028是一款外形小巧，支持协议802.11 b / g / n 的单流板载低功耗应用处理器的WIFI模块。它是一个低成本串行WIFI模块，支持UART-WIFI-以太网数据传输。

LCS2028 is a compact WIFI module that supports 802.11b/g/n single-stream, low-power application processor. It is a low cost serial WIFI module that supports UART-WIFI-ethernet data transmission.



图 1: LCS2028 正视图/Top view

2.应用/Applications

- ◆ 物联网/ IOT (internet of things)
- ◆ 网络消费设备/ Network Consumer Device
- ◆ 计量/ Metering
- ◆ 楼宇自动化/ Building Automation
- ◆ 家庭自动化/ Home Automation
- ◆ 智能家居网关/ Smart Home Gateway
- ◆ 智能照明/ Smart Lighting
- ◆ 智能插头和灯/ Smart Plugs and Lights
- ◆ 婴儿监视器/ Baby Monitors
- ◆ 网状网络/ Mesh Network
- ◆ 传感器网络/ Sensor Network
- ◆ 工业控制/ Industry Control

3.特性/Features

- ◆ 符合 IEEE 802.11b/g/n WLAN / 802.11 b/g/n
- ◆ 集成经典蓝牙和低功耗BLE系统/ Integrated classic Bluetooth and low power BLE system
- ◆ 蓝牙和Wi-Fi 共享天线和收发电路/ Bluetooth and Wi-Fi share antennas and transceiver circuits
- ◆ 内部基于优先级的调度逻辑保证蓝牙和Wi-Fi 双连接的稳定并能够有效地共享空中资源/ Internal

priority-based scheduling logic ensures the stability of Bluetooth and Wi-Fi dual connections and the efficient sharing of air resources

- ◆ 802.11 n (2.4 GHz) , 高达150Mbps / 802.11n (2.4 GHz) up to 150Mbps
- ◆ 支持STA、AP/ Support STA and AP
- ◆ AT Set, 云服务器, 应用程序/ AT Set, cloud server, application

- ◆ 网络协议: IPv4, TCP / UDP / HTTP / FTP/ Network protocol: IPv4, TCP/UDP/HTTP/FTP
- ◆ 256 KB 内部RAM/ 256 KB internal RAM
- ◆ 2MB 内部Flash/ 2 MB internal Flash
- ◆ 256 Byte ~ 2K Byte OTP
- ◆ Wi-Fi保护访问 (WPA) / WPA2/ WPA2企业版/无线网络连接受保护的设置 (WPS) /
Wi-Fi Protected Access (WPA)/WPA2/ WPA2 Enterprise/Wireless Network Connection Accepted Settings (WPS)
- ◆ 六路高速10 位多通道ADC/ Six - way high - speed 10 - bit multi - channel ADC
- ◆ 符合ROHS 环保要求/ ROHS
- ◆ 符合FCC,CE/ FCC,CE

4.框图/Application Block Diagram

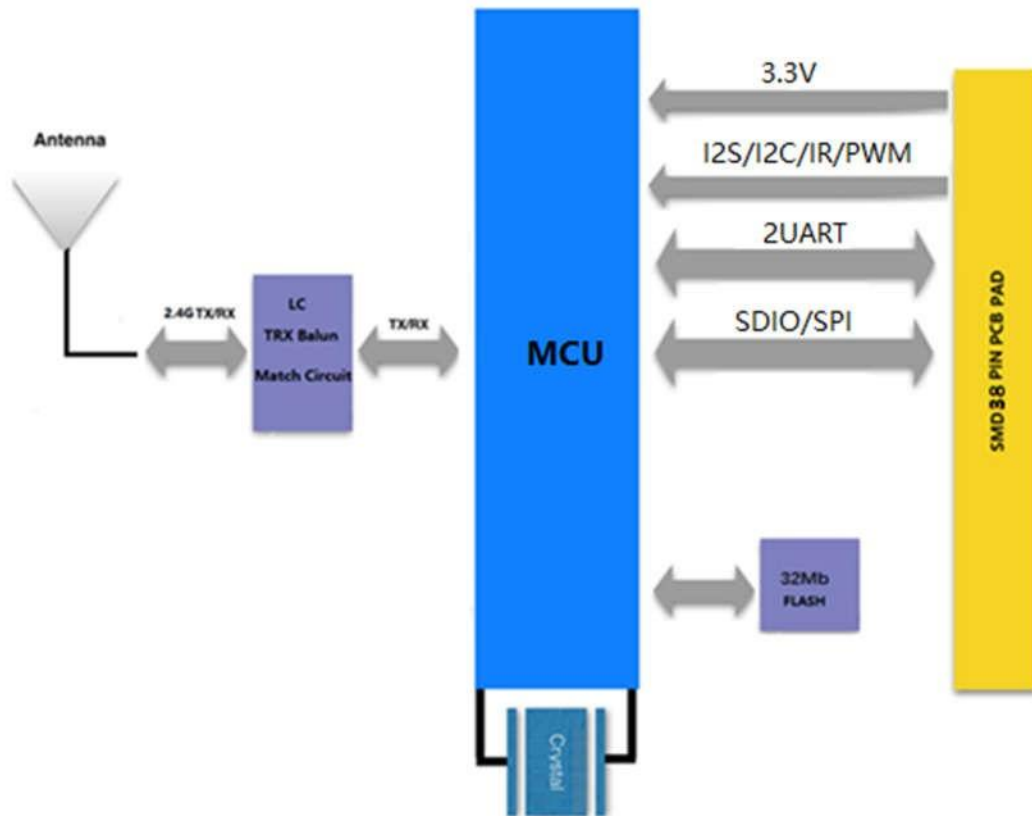


图2: LCS2028 方框图/Block Diagram

5. 模块引脚描述/Module Pinout Description

模块引脚分配/Module Pinout

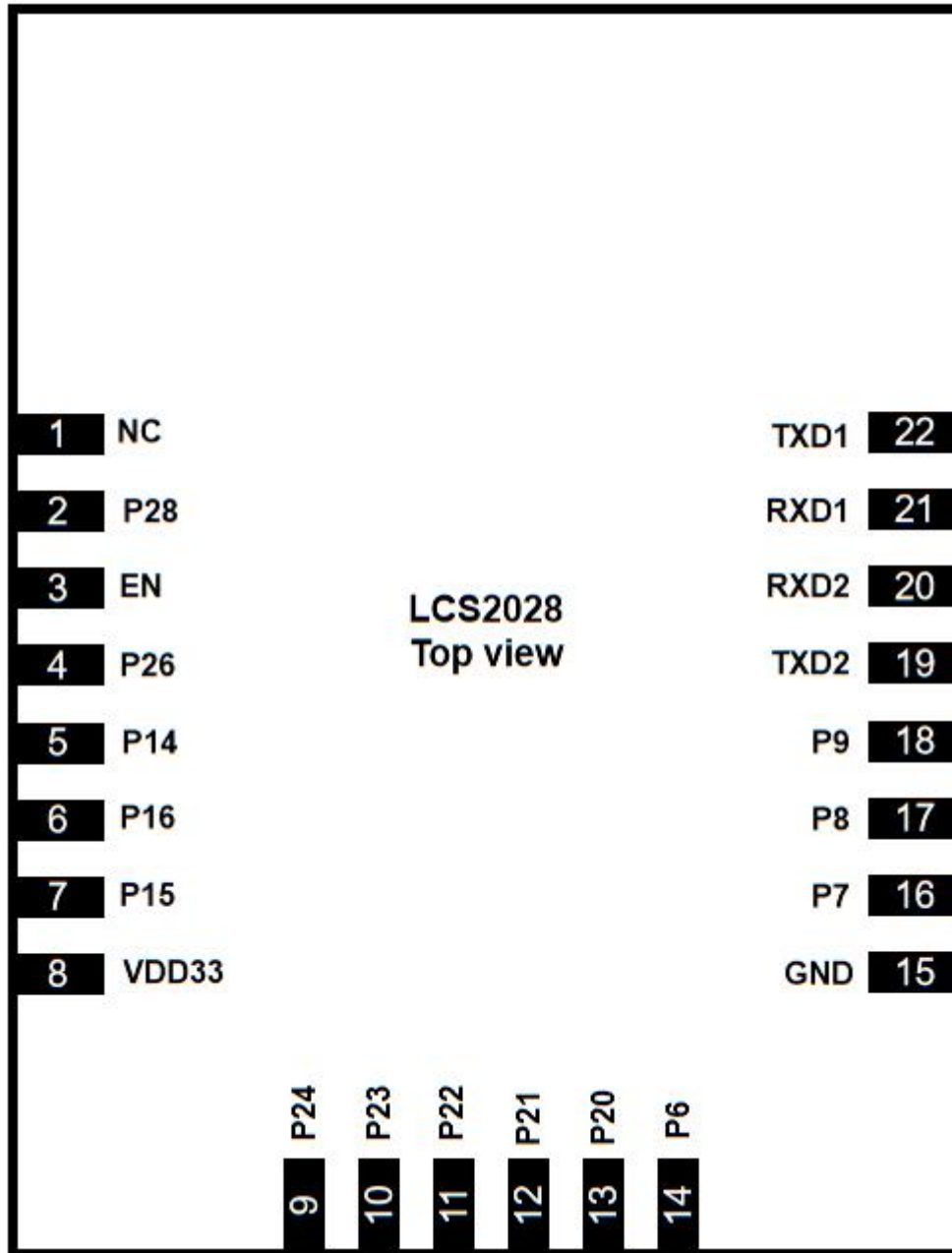


图 3: LCS2028 Pin封装/packaging

引脚说明/Pin Description

NO	Name	Function
1	NC	NC
2	P28	P28/ADC4/RXEN_通用IO口或ADC4或射频接收时置高
3	EN	CEN_芯片使能, 高有效
4	P26	P26/ADC1/IRDA/PWM5_通用IO口或ADC1或红外接收或PWM5
5	P14	P14/SD_CLK/SCK/ANT0_通用IO口或SD的CLK或SPI的SCK或BLE天线控制ANT0
6	P16	P16/SD_CMD/MOSI/ANT2_通用IO口或SD的CMD或SPI的MOSI或BLE天线控制 ANT2
7	P15	P15/CSN/ANT1_通用IO口或SPI的CSN或BLE天线控制ANT1
8	VDD33	VDD_3V3_CHIP
9	P24	P24/ADC2/LPO_CLK/PWM4_通用 IO 口或 ADC2 或低功耗时钟32.768K 输出或 PWM4
10	P23	P23_TDO_F_SO_通用 IO 口或 ADC3 或 JTAG 的 TDO 或Flash 用 SPI 下载时的数据输出
11	P22	P22_TDI_F_SI_通用 IO 口或 ADC5 或晶体频率输出或 JTAG 的 TDI 或射频发射时置高或 Flash用 SPI 下载时的数据输入
12	P21	P21_TMS_F_CSN_通用 IO 口或 ADC6 或 I2C1 的 SDA 或 JTAG 的 TMS 或 Flash 用 SPI 下载时的片选
13	P20	P20_TCK_F_SCK_通用 IO 口或 I2C1 的 SCL 或 JTAG 的TCK 或 Flash 用 SPI 下载时的时钟
14	P6	P6_PWM0_通用IO口或晶体时钟的1, 2, 4, 8分频输出或PWM0
15	GND	GND
16	P7	P7_PWM1_通用IO口或WIFI与BT共存的WIFI_ACTIVE控制或PWM1
17	P8	P8_PWM2_通用IO口或WIFI与BT共存的BT_ACTIVE控制或PWM2
18	P9	P9_PWM3_通用IO口或WIFI与BT共存的BT_PRIORITY控制或PWM3
19	TXD2	P0_UART2_TXD_通用IO口或串口UART2的TXD或 I2C2的SCL
20	RXD2	P1_UART2_RXD_通用IO口或串口UART2的RXD 或I2C2的SDA
21	RXD1	P10_UART1_RXD_通用IO口或FLASH用UART下载的RXD或串口UART1的RXD
22	TXD1	P11_UART1_TXD_通用 IO 口或 FLASH 用 UART 下载的TXD 或串口 UART1 的 TXD

6.接口/Interfaces

6.1 GPIO

LCS2028 有 18 个GPIO 引脚，可以通过编写适当的寄存器来分配给各种功能。（最大驱动能力 6mA）

这些引脚可与I2C、I2S、UART、PWM、IR远程遥控等功能复用。

The LCS2028 has 18 GPIO pins which can be assigned to various functions by programming the appropriate registers.(Maximum drive capacity 6mA)

These pins can be multiplexed with other functions such as I2C, I2S, UART, PWM, IR remote control etc.

6.2 下载 firmware/Download the firmware

表6-1: Download pin share scheme

LCS2028 Pin Number	Pin Name	Function Name
22	TXD1	UART(default)
21	RXD1	UART(default)

6.3 UART

表6-2:UART pin share scheme

LCS2028 Pin Number	Pin Name	GPIO	Function Name
21	RXD1	P10	UART1_RXD(AT)
22	TXD1	P11	UART1_TXD(AT)
20	RXD2	P1	UART2_RXD(LOG)
19	TXD2	P0	UART2_TXD(LOG)

6.4 PWM

表6-3: PWM pin share scheme

LCS2028 Pin Number	Pin Name	GPIO	Function Name
14	P6	P6	PWM0
16	P7	P7	PWM1
17	P8	P8	PWM2
18	P9	P9	PWM3

7.PCB 规格尺寸/PCB Footprint and Dimensions

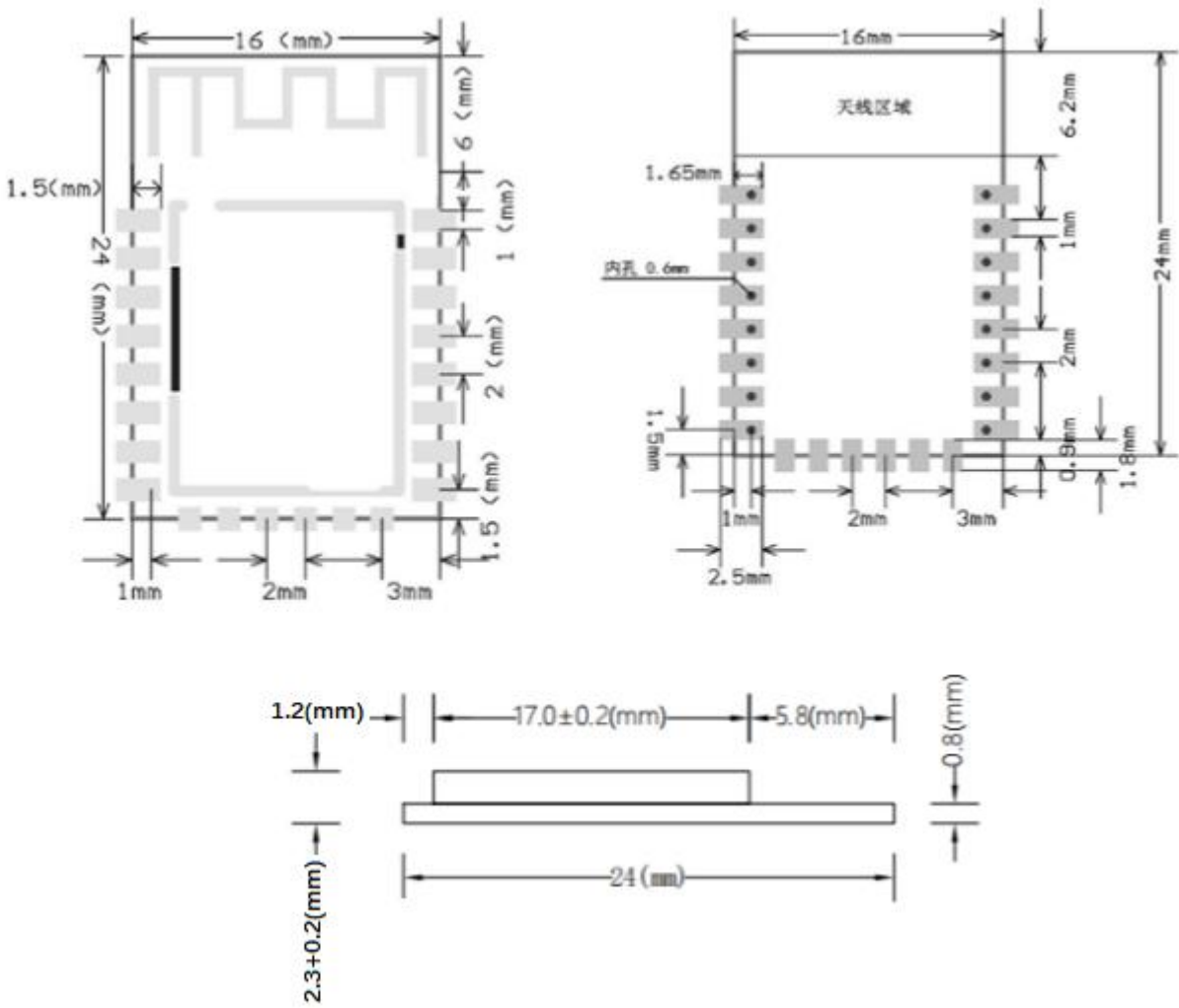


图4: LCS2028 参考 PCB 封装/Recommend PCB Footprint

8.电气特性/Electrical Characteristics

a)绝对最大额定值/Absolute Maximum Ratings

表8-1: 绝对最大额定值/Absolute Maximum Ratings

Parameter	Condition	Min.	Type	Max.	Unit
存储温度范围/ Storage temperature range		-40		125	°C
ESD 保护/ESD protection	VESD	/		2000	V
电源电压/Supply voltage	VDD33	0		3.6	V
I/O脚上电电压/ Voltage On Any I/O Pin		-0.3		3.63	V

b)推荐使用范围/Recommended Uses

表8-2: 操作条件/Operating conditions

Parameter	Symbol	Min.	Type	Max.	Unit
扩展温度范围/ Extended temperature range	TA	-20		70	°C
电源/Power Supply	VDD33	3.0	3.3	3.6	V
输入低电平/ Input Low Voltage	VIL	-0.3		0.8	V
输入高电平/ Input High Voltage	VIH	2		3.6	V

c)测量条件/Measurement Conditions

表8-3: 不同状态下的功耗/Power consumption in different states

系统状态/System State	Description	Current (Typ.)@3.3V
发射电流/Emission current	18dBm, 802.11b 11Mbps	106mA
发射电流/Emission current	13dBm, 802.11g 54Mbps	102mA
接收电流/Receive current	-10dBm输入、802.11b 11Mbps	50mA
接收电流/Receive current	-10dBm输入、802.11g 54Mbps	60mA

深度睡眠/Deep sleep	主MCU 系统断电，只有GPIO 状态保持并且AON 部分保持工作。GPIO 边沿改变或者AON 计数器中断可以唤醒系统到工作状态。AON 的保持寄存器保持内容。 The main MCU system is powered down, only GPIO status remains and the AON part remains active. GPIO edge change or AON counter interruption can wake the system to working state. The hold register of AON holds the contents.	5uA
关机模式/Shutdown	当CEN=0 系统进入关机模式。当CEN=1 持续几个毫秒后，系统上电启动进入工作模式。 When CEN=0 the system enters shutdown mode. When CEN=1 lasts for a few milliseconds, the system is powered up to enter the operating mode.	1uA
低电压待机模式/ Low voltage Standby	MCU 和所有数字外设的时钟都被停止，此时仅有GPIO 中断和AON 计数器中断可以唤醒系统恢复到正常电压继续运行。 The clock of the MCU and all digital peripherals is stopped, and only GPIO interruption and AON counter interruption can wake the system to resume operation at normal voltage.	10uA

9. 性能参数/Performance Specification

表9-1: 硬件特性参数/Hardware Features

硬件特性/Hardware Features	
模块/Model	LCS2028
天线类型/Antenna type	PCB Antenna or IPEX Connector
电压/Voltage	3.3V+/-10%
尺寸(L×W×H)/ Dimensions(L×W×H)	24.0mm*16.0mm*2.3mm
其他/Others	
环境/environment	Operating Temperature: -20°C~70°C Storage Temperature: -40°C~125°C Operating Humidity: 10%~90% non-condensing Storage Humidity: 5%~90% non-condensing

表9-2: WIFI特性参数/WIFI Features

2.4GHz WIFI 特性/2.4GHz WIFI Features	
无线标准/Wireless standards	IEEE 802.11 b/g/n/

频率范围/Frequency range	2.412-2.484GHz
传输速率/Data rates	IEEE 802.11 b Standard Mode: 1,2,5.5,11Mbps
	IEEE 802.11g Standard Mode: 6,9,12,18,24,36,48,54Mbps
	IEEE 802.11n Standard Mode: 150Mbps @ HT40(MCS7)
2.4G 接收灵敏度/ 2.4G Receive sensitivity	HT20 MCS7 : -71dBm@10% PER(MCS7)
	OFDM 54M: -73dBm@10% PER
	CCK, 11M: -88dBm@ 8% PER
无线安全/Wireless security	Supports WEP64/128, WPA, WPA2, TKIP, WAPI, and AES hardware encryption
发射功率±2dBm/ Wireless transmit power with ±2dBm tolerance	IEEE 802.11n: 12dBm@HT20 MCS7 IEEE 802.11g: 13dBm IEEE 802.11b: 18dBm
工作模式/ Work mode	Soft AP/ Station

表9-3: BLE特性参数/BLE Features

参数/Parameter	条件/Condition	最小 /Minimum	典型/Typical	最大/Maximum	单位/Unit
工作频率/ Working frequency		2402		2480	MHz
空中速率/ Data Rate			1		Mbps
发射功率 /Wireless transmit power		-20	5	20	dBm
灵敏度/ Sensitivity				-97	dBm
最大射频信号输 入/Maximum RF signal input		-10			dBm

10. 制造工艺/Manufacturing Process Recommendations

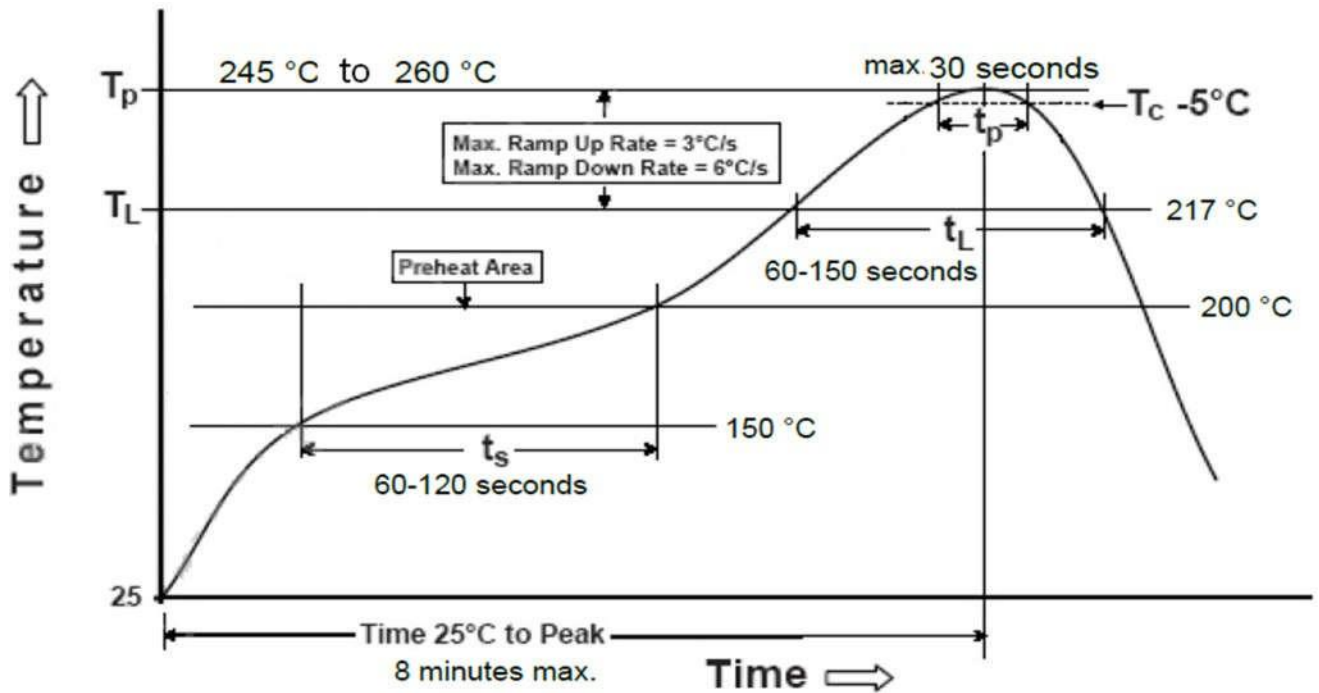
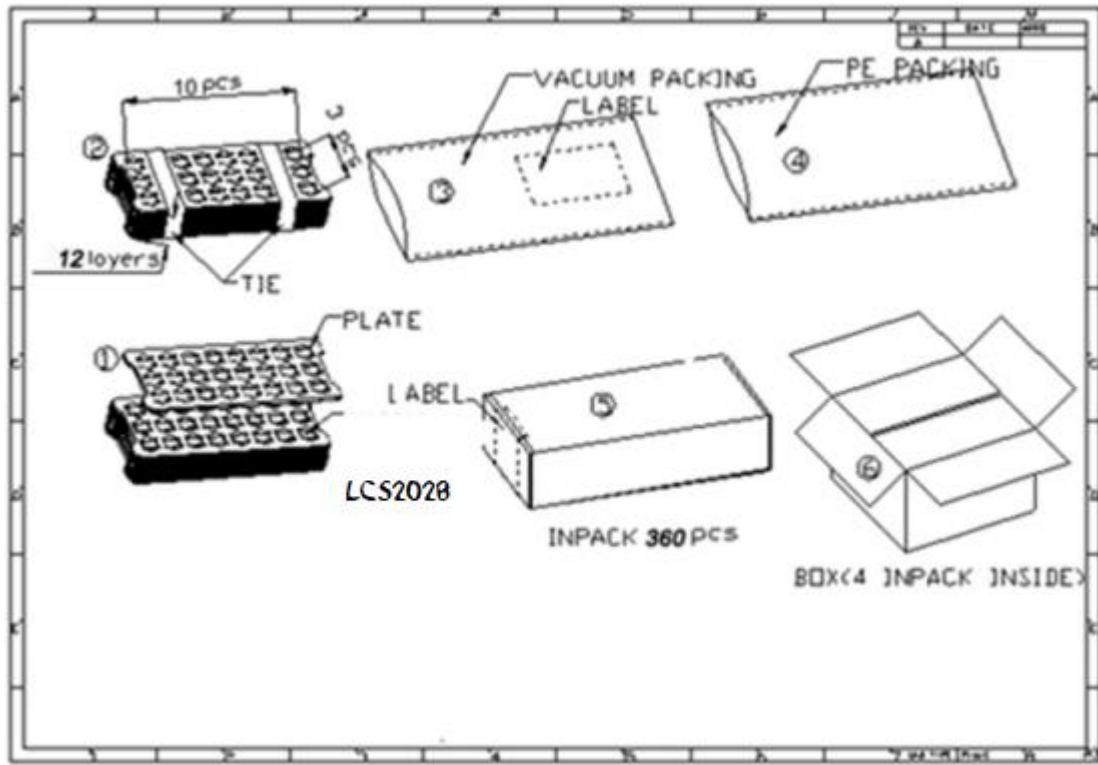


图 5: LCS2028 Typical Lead-free Soldering Profile

注意: 工厂最终选择的焊接温度取决于其他外部因素，如焊锡膏的选择、基板的尺寸、厚度和性能等。超过推荐的焊接型材中的最高焊接温度可能永久损坏模块。

Note: The final welding temperature selected by the plant depends on other external factors, such as solder paste selection, substrate size, thickness and performance. Exceeding the recommended maximum welding temperature in the welded profile may permanently damage the module.

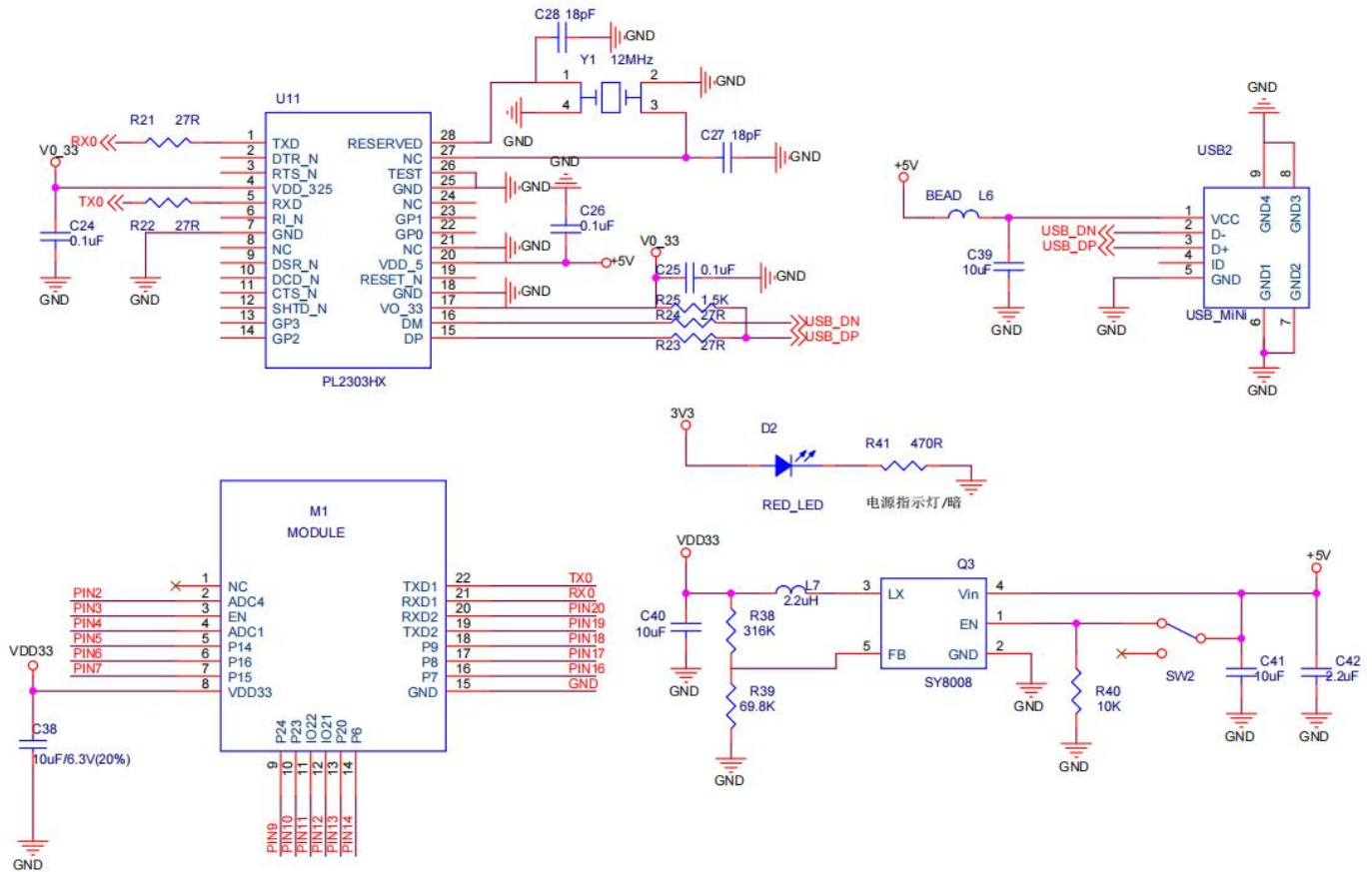
11. 包装工艺/Packaging Specification



12. 订购信息/Ordering Information

Module No.	Antenna Connector Type	Flash Size
LCS2028_P	板载天线/PCB Antenna	2M Bytes
LCS2028_E	IPEX天线/IPEX Connector	2M Bytes

13. 参考电路/Reference Circuit



LCS2028参考电路

14. 联系方式/Contact Information

Skylab M&C Technology Co., Ltd.

深圳市天工测控技术有限公司

Address: 6Floor, No.9 Building, Lijincheng Scientific & Technical park, Gongye East Road, Longhua District, Shenzhen, Guangdong, China

地址: 中国广东省深圳市龙华区龙华街道工业东路利金城科技工业园9栋6楼

销售热线: 86-755 8340 8210 (Sales Support)

技术支持: 86-755 8340 8510 (Technical Support)

传真/ Fax: 86-755-8340 8560

邮箱/ E-Mail: sales1@skylab.com.cn

网页/ Website: www.skylab.com.cn

www.skylabmodule.com