Product Datasheet
ECK41-E Core Board



Chengdu Ebyte Electronic Technology Co.,Ltd.

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1. Product Overview

1.1.Product Introduction

The ECK41-E1 series core board from Ebyte is meticulously designed based on Rock chip's RK3506G series processor. It adopts a brand-new stamp hole + LGA interface, with commonly used function I/Os designed on the stamp holes. When only commonly used f unction I/Os are used, only the stamp hole pins need to be soldered.

The ECK41-E1 series core board is a fully domestically produced industrial-grade em bedded core board characterized by low power consumption, small size, high reliability, an d high cost-effectiveness. This core board is widely applicable to the Internet of Things (I oT), automation control, intelligent manufacturing, self-service terminals, and other e-comm erce and industrial equipment fields.

Rockchip's RK3506G is a high-performance tri-core Cortex A7 application processor d esigned for intelligent voice interaction, audio input/output processing, image output proces sing, and other digital multimedia applications. It integrates a 2D hardware engine and a d isplay output engine to minimize CPU load while meeting image display requirements. It f eatures a rich set of peripheral interfaces, such as SAI, PDM, SPDIF, audio DSM, audio ADC, USB2 OTG, RMII, and CAN, to meet diverse application development needs and r educe hardware development complexity and costs. The RK3506G2 also integrates 128MB of DDR3L memory, providing ample memory resources for complex software applications such as Linux, QT, and Python while significantly reducing product size.

The ECK41-E1 series core boards include two specific product models, both designed using domestically produced industrial-grade components. Their main difference lies in wh ether or not they include NAND flash memory; customers can choose the appropriate mod el based on their needs. See the product selection section for detailed product selection inf ormation.

The following is a physical image of the ECK41-E1 series core board (without comp onents on the bottom):

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Core board physical image

1.2.Features

1. Processor: Rockchip RK3506G2 series processor;
   - Triple-core ARM Cortex™-A7 processor with a maximum clock speed of 1. 2GHz;
   - ARM Cortex-M0 MCU;
2. Memory: The processor integrates 128MB of DDR3L memory;
3. Storage: Onboard 256MB SPI NAND FLASH optional;
4. Video output:
   - 1x Digital RGB parallel display interface;
   - 1x BT.656/BT.1120Display interface;
   - 1x 2-lane MIPI-DSIDisplay interface,1.5Gbps/lane;
   - The maximum output resolution is 1280x1280@60fps;
5. Audio:
   - 4x SAI connectors to GPIO, supporting I2S, PCM, and TDM;
   - 1x SPDIF TX and RX, supporting a maximum sampling rate of 192kHz;
   - Supports PDM, up to 8 microphones, and a maximum sampling rate of 192 kHz;
   - Supports 2x ASRC components;
   - 2x digital DAC outputs;
   - 1 x 24-bit ADC microphone input;
6. Memory interface: 1x SDIO interface, supporting eMMC4.51/SD3.0/MMC4.51/SDIO3. 0;

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7. Network controllers: 2 x 100Mbps Ethernet controllers, supporting RMII interface;

8. 2x USB2.0 OTG;

9. 3x SPI controllers;

10. 3x I2C controllers, supporting 100Kbit/s and 400Kbit/s modes;

11. 6x UART, maximum baud rate 4Mbps;

12. 12x PWM;

13. 2x CAN controllers, supporting CAN 2.0B protocol;

14. 1 x DSMC Master and 1 x DSMC Slave interface;

15. 1x FLEXBUS;

16. 4x single-ended SARADC, 10-bit resolution, maximum sampling rate of 1 MS/s;

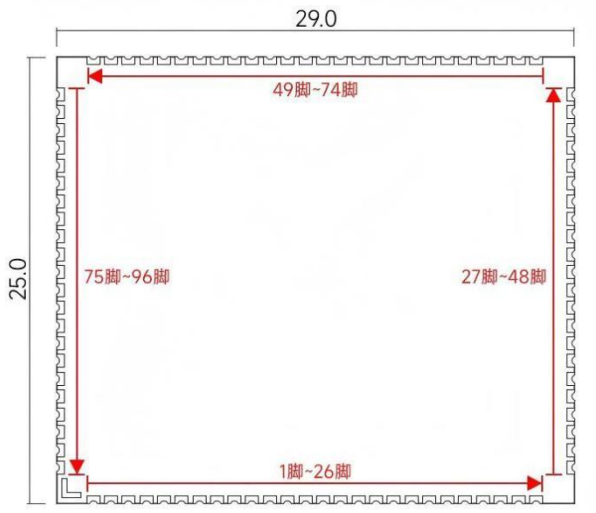
17. Supports up to 80 GPIOs and GPIO interrupts;

18. power supply:

- Single-channel DC +5V±10%@1A power input;
- One 3.3V@500mA power output;
- One 1.8V@100mA power output;

19. Interface type: 96-pin stamp hole + 44-pin LGA;

20. PCB dimensions: 29×25×1.0mm, as shown in the image below:



Dimensional diagram (unit: mm)

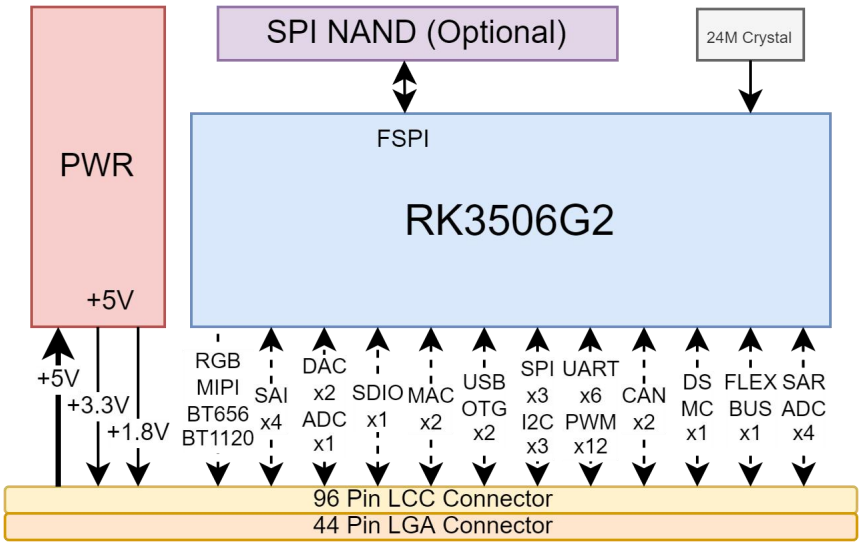
21. Operating temperature: -25℃ to 85℃;

22. PCB process: 6-layer board design, immersion gold plating, lead-free process;

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1.3.Core board functional block diagram



Core board functional block diagram

1.4.Typical applications

- Smart home;
- Smart toys;
- Smart cities;
- Tablet PC;
- IoT gateway;
- Advertising all-in-one machine;
- Industrial all-in-one PC;
- Industrial ControlMotherboard;
- Robots and drones.

1.5. Matching single-board computer

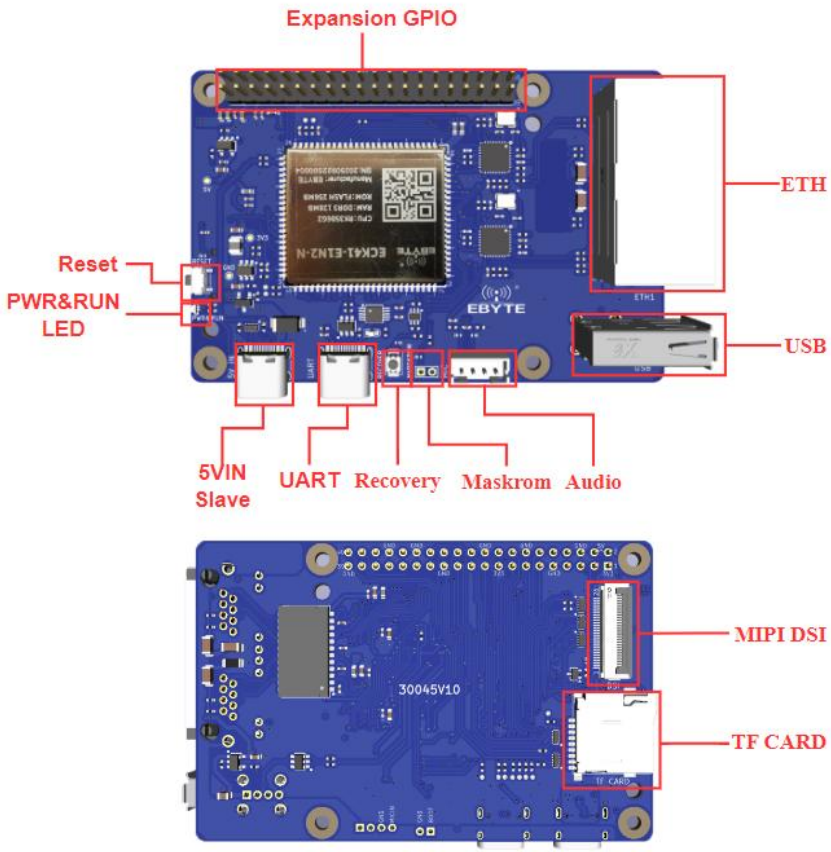
EBB has launched the ECB41-PGE single-board computer based on the ECK41-E series core board. The core board is a 140-pin stamp hole + LGA package, which can be soldered to the baseboard via SMT. The baseboard design makes full use of the core board's interfaces, bringing out interfaces including MIPI DSI display interface, USB 2.0, USB OTG, SDIO, debug interface, Ethernet interface, audio interface, and a rich set of expansion GPIO interfaces. This single-board computer features a higher design standard compared to standard development boards, and it can not only be used for core board functional veri

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fication, but also directly for mass production in industrial scenarios.

E-Bite provides stable reference designs and a comprehensive software development e nvironment, offering users hardware design documents, software development manuals, and open-source baseboard schematics, package files, and PCB design files. This effectively h elps users verify core board functionality, improve development efficiency, shorten develop ment cycles, optimize design quality, and accelerate product development and time-to-mark et. The single-board computer functional diagram is as follows:



Single-board computer functional description diagram

2. Product Selection

2.1.Model Configuration

The ECK41-E series core board selection and configuration table is as follows:

Core Board Product Selection and Configuration Table

Serial Number	Product Model	Processor Model	Memory	Storage	Operating temperature
1	ECK41-E1N2-N	RK3506G2	128MB DDR3L	256MB NAND	Wide temperature range -25℃ ~ 85℃

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				FLASH	
2	ECK41-E1-N	RK3506G2	128MB DDR3L	--	Wide temperature range -25℃ ~ 85℃

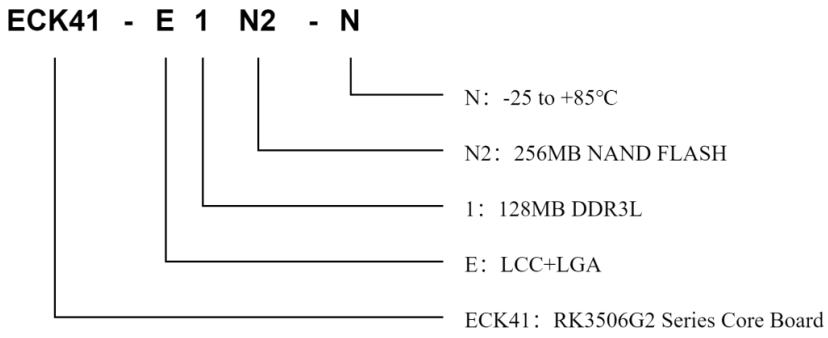
The ECB41-PGE series single-board computer selection and configuration table is as f ollows:

Single-board computer product selection and configuration table

Serial Number	Product Model	Core board model	Memory	storage	Operating temperature
1	ECB41-PGE1N2-N	ECK41-E1N2-N	128MB DDR3L	256MB NAND FLASH	Wide temperature range -25℃ ~ 85℃

2.2.Model code

The core board product model code explanation is shown in the following figure:

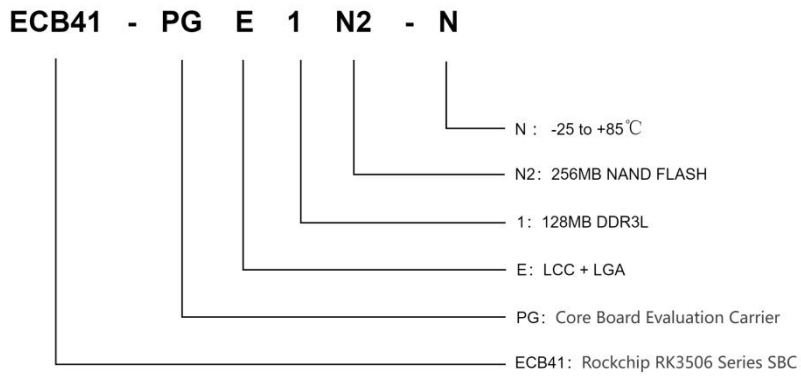


Core board model code explanation

The product model coding explanation for single-board computers is shown in the foll owing figure:

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Single-board computer model coding explanation

3. Functions and parameters

3.1.Core board product functions

The ECK41-E1 series core board mainly integrates a processor, DRAM memory, SPI NAND Flash storage, and power system, and exposes all I/O pins on the processor. Users can design a baseboard to utilize the I/O resources on the core board and configure the I/O to their required functional interfaces.

The table below lists the main functional parameters integrated into the ECK41-E1 series core board, as well as the functional parameters of reusable I/O resources. The description of each I/O function is the maximum performance that the core board can achieve with that I/O function without using other I/O functions (for example, after using the 24-bit color RGB interface function and the network interface function, the full UART function cannot be implemented).

Core Board Product Function Table

Function	Function Description
CPU	RK3506G2; Triple-core ARM Cortex-A7 CPU, up to 1.2GHz; ARM Cortex-M0 MCU;
MEM	Embedded 128MB DDR3L;
FLASH	On board 256MB SPI NAND Flash;
Video Output	1x RGB Parallel interfaces; 1 x BT.656/BT.1120 interface; 1x 2-lane MIPI DSI interface, 1.5Gbps/lane; Maximum resolution is 1280x1280@60fp;
Audio	5x SAI, support I2S, PCM, TDM, SAI0-3 connected to GPIO, SAI4 connected to internal Audio ADC;

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	Support SPDIF 1x TX and RX, sample rate up to 192KHz; Support PDM, up to 8 microphones, sample rate up to 192KHz; Support two ASRC components. Support 2-channel digital DAC; One channel 24 bit ADC microphone input;
MEM I/F	1x eMMC 4.51/SD 3.0/MMC 4.51/SDIO3.0 interface;
MAC	2x MAC, 10/100 Mbps port with RMII interface;
USB	2x USB 2.0 OTG;
SPI	3x SPI Controller;
I2C	3x I2C Master, standard mode 100 Kbit/s and fast mode 400 Kbit/s;
UART	6x UART, up to 4Mbps baud rate;
PWM	12x on-chip PWM;
CAN	2x CAN controllers, support CAN 2.0B protocol;
DSMC	1x DSMC master interface; 1x DSMC slave interface;
FLEXBUS	1x FLEXBUS;
SARADC	4x single-ended input, 10bits resolution, up to 1MS/s;
GPIO	80x GPIO, Supports Interrupt input;
Power input	DC +5V@1A;
Power output	DC +3.3V@500mA; DC +1.8V@100mA;
Temperature	Operating Temperature: -25°C to +85°C;
Dimensions	29 x 25 x 3.1mm;
Interface type	96-pin LCC + 44-pin LGA
PCB technology	6-layer board design;

3.2.Single-board computer product functions

Single-board computer product function table

Function	Function Description
Power Input	DC +5V±10% @ 2A, Type-C interface;
Display	1x 2-lane MIPI-DSI interface, up to 1280x1280@60fps;
USB HOST	1x USB 2.0 HOST, Type-A interface;
USB OTG	1x USB 2.0 OTG, Type-C interface (shared with power input), supports SLAVE mode;
Ethernet	2x 10/100M Ethernet ports with RJ45 interface;
TF Card Slot	1x TF card slot with insertion detection;
Audio	1x ACODEC_ADC_IN audio input, 4-pin PH2.0 interface;
Debug	1x debug serial port, Type-C interface;
GPIO	1x 2.54mm 2x20-pin standard RPI expansion interface, providing 3.3V and 5V power

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	output, totaling 28 GPIO pins, multiplexed with: 1x SPI 1x I2S 2x I2C 3x UART 2x CAN
Buttons	1x RESET button; 1x RECOVER button; 1x MASKROM button (1x2P-2.0mm header pinout);
led	1x dual-color (red/green) LED for power and status indication;

3.3.Environmental characteristics

Environmental Characteristics Table

Operating temperature	Wide temperature range	-25℃ ~ 85℃;
Storage temperature	-40℃ ~ 85℃;	
Operating humidity	5%–95% humidity, non-condensing;	
Storage humidity	60℃@95% humidity, non-condensing;	

3.4.Power consumption

Note: The following parameters were measured on the ECK41-E1N2-N core board under normal temperature conditions on a single-board computer. The power consumption measurements do not include the baseboard power consumption. Measurements were taken a TF card runs a Linux system. When running a stress test program under heavy power load, no display is shown. One USB flash drive and one network connection are connected. Power consumption can be affected by factors such as testing methods, usage functions, and ambient temperature; the following power consumption data is for reference only.

Power consumption meter

Power status	Test environment	Core board power consumption	Single-board computer power consumption
BOOT	U-boot state, unbooted kernel	388mW	654mW
PWRUP	No applications are running after system startup.	520mW	1128mW
PWRUP	Software reload testing	744mW	1343mW
SLEEP	Freeze mode sleep state	295mW	476mW
SLEEP	mem mode sleep state	226mW	397mW
PWRDN	Software shutdown	301mW	398mW

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4. Software resource

ECK41-ESeries core board Running on Linux6.1.99The development board comes bundled with the operating system of the kernel version, a cross-compilation toolchain required for embedded Linux system development, U-boot source code, source code of the Linux kernel and various driver modules, and various development and debugging tools suitable for Windows desktop environment and Linux desktop environment.

operating system:

Linux files built with Buildroot 2024.02system

System source code:

u-boot 2017.09

Kernel6.1.99

Buildroot 202402

Yocto

Development environment and tools:

USB burning tool: RKDevTool

SD card burning tool: SDDiskTool

4.1.System Resources

System Software Resource Table

category	name	describe	Source code
RKBIN	rkbin	Firmware provided by rock-chip	<SDK>/rkbin
BOOT	u-boot2017.09	bootloader	<SDK>/u-boot/
Kernel	Kernel 6.1.99	Linux kernel	<SDK>/kernel-6.1/
Device Driver	Audio	Built-in audio codec driver	sound/soc/codecs/rk3506_codec.c
	Thermal	Tsadc temperature sensing driver	drivers/thermal/rockchip_thermal.c
	fiq-debugger	Debugging serial port driver	drivers/soc/rockchip/fiq_debugger/rk_fiq_debugger.c
	FSPI	SPI driver	drivers/spi/spi-rockchip-flexbus-fspi.c
	MMC	MMC interface driver	drivers/mmc/host/dw_mmc-rockchip.c
	PWM	PWM driver	drivers/pwm/pwm-rockchip.c
	PM	Power management	drivers/soc/rockchip/rockchip_pm_config.c

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		driver	
	SARADC	SARADC driver	drivers/iio/adc/rockchip_saradc.c
	USB-PHY	USB PHY driver	drivers/phy/rockchip/phy-rockchip-inno-usb2.c
	GMAC	GMAC driver	drivers/net/ethernet/stmicro/stmmac/dwmac-rk.c
	Display	Display frame driver	drivers/gpu/drm/rockchip/rockchip_drm_drv.c
	VOP	Display output management driver	drivers/gpu/drm/rockchip/rockchip_vop_reg.c
	DSI	DSI drive	drivers/gpu/drm/rockchip/dw-mipi-dsi-rockchip.c
	I2C	I2C driver	drivers/i2c/busses/i2c-rk3x.c
	UART	Serial port driver	drivers/tty/serial/8250/8250_dw.c
	CAN	CAN driver	drivers/net/can/rockchip/rk3576_canfd.c
	DSMC	DSMC bus driver	drivers/memory/rockchip/dsmc-host.c
operating system	Buildroot	Buildroot 202402	<SDK>/buildroot
	Yocto	Yocto 5.0.3	<SDK>/yocto
Development tools	RKDevTool	USB burning tool	/tools/RKDevTool
	SDDiskTool	SD card burning tool	/tools/SDDiskTool

5. Structural dimensions

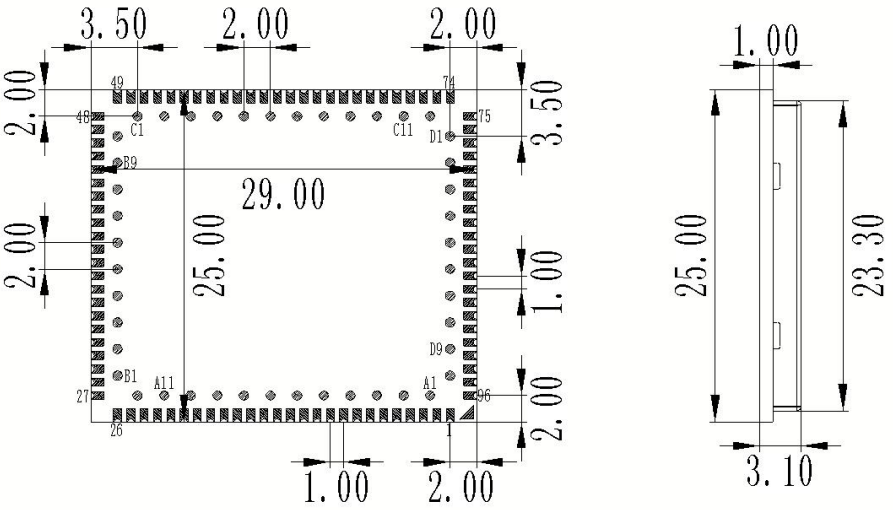
5.1.Core board structural dimensions

The ECK41-E series core board adopts an innovative design.96The board features a PIN stamp hole + 44-PIN LGA interface. Commonly used I/O functions are located on the stamp hole pins; if only some common functions are used, only the stamp hole pins need to be soldered. The bottom layer of the core board has no components or exposed traces, resulting in a simple baseboard design.

The ECK41-E series core board is 29.0mm long and 25.0mm wide. See the diagram below for structural dimensions. All dimensions are in millimeters (mm). Dimensional tolerance is ±0.1mm, and PCB thickness tolerance is 10%.

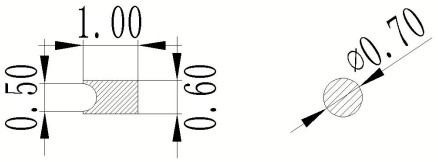
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Core board structural dimensions (bottom view on the left)

The dimensions of the stamp holes and LGA pads on the bottom surface of the ECK 41-E series core board are shown in the figure below. All dimensions are in millimeters (mm).



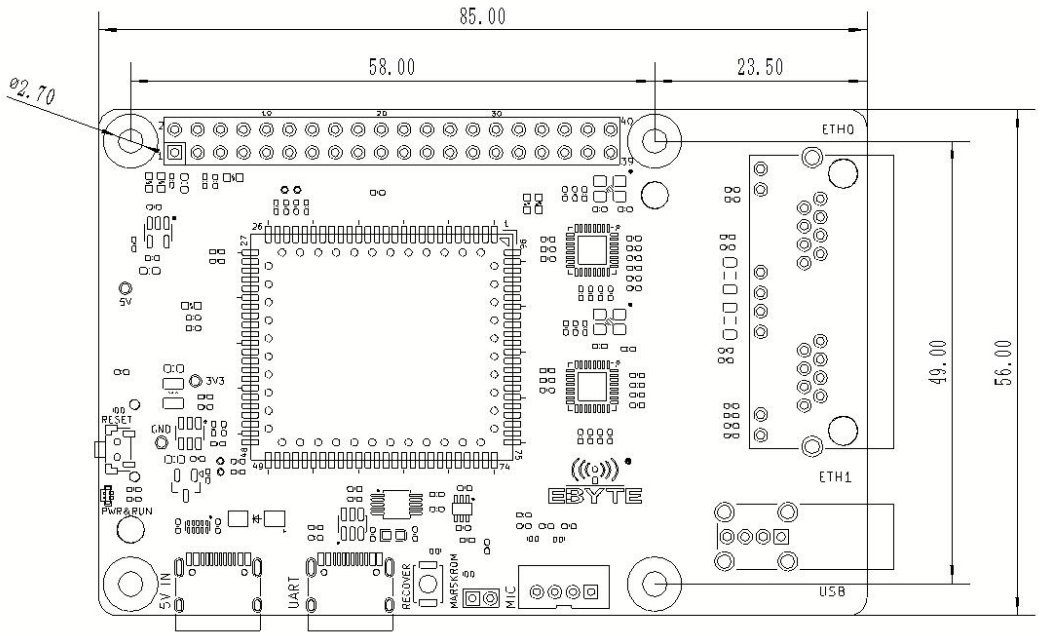
Core board pad size diagram

5.2.Single-board computer structure dimensions

The ECB41-PGE single-board computer is 85.0mm long and 56.0mm wide, compatibl e with Raspberry Pi board dimensions. See the diagram below for structural dimensions. A ll dimensions are in millimeters (mm). Dimensional tolerance is ±0.1mm, and PCB thickn ess tolerance is 10%.

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Single-board computer structural dimension diagram

6. core board welding instructions

Note: If you are soldering LGA interfaces, to ensure the quality of the module solder paste, the recommended stencil thickness for the LGA pad portion of the module is 0.15 ~0.18 mm.

6.1.Reflow soldering temperature

Reflow soldering temperature gauge

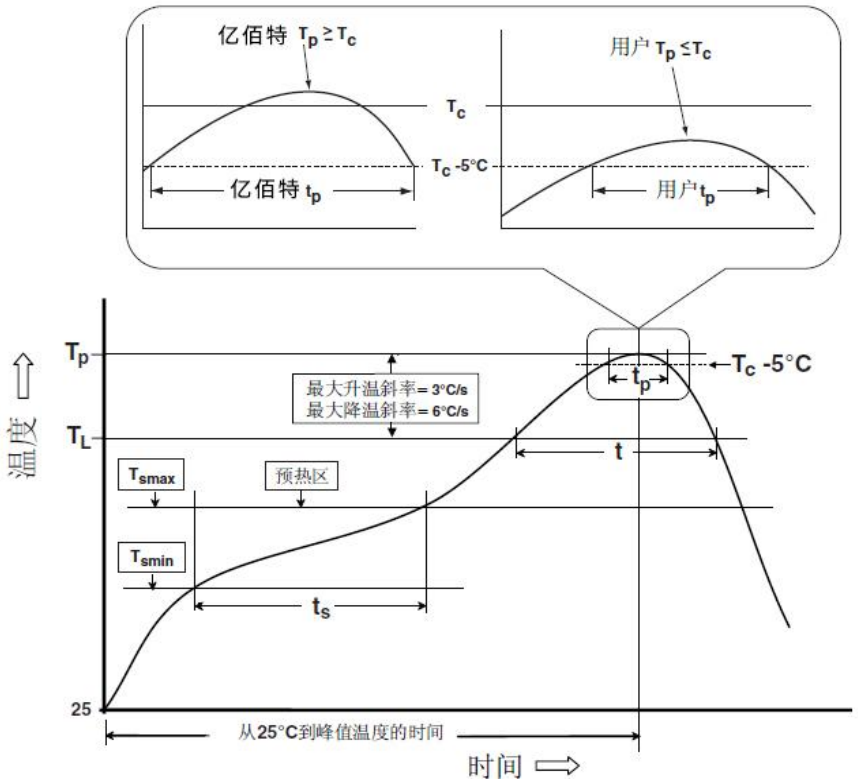
Reflow soldering profile characteristics		Lead-based assembly	Lead-free assembly
Preheating/Insulation	Minimum temperature (Tsmin)	100℃	150℃
	Maximum temperature (Tsmax)	150℃	200℃
	Time (Tsmin~Tsmin)	60-120 seconds	60-120 seconds
Temperature rise slope (TL~Tp)		3℃/second, maximum value	3℃/second, maximum value
Liquid phase temperature (TL)		183℃	217℃
Duration above TL		60~90 seconds	60~90 seconds
Package peak temperature Tp		Users must not exceed the temperature specified on the product's "Humidity Sensitivity" label.	Users must not exceed the temperature specified on the product's "Humidity Sensitivity" label.
The time (Tp) within 5° C of the specified grading temperature (Tc) is shown in the figure below.		20 seconds	30 seconds

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Cooling slope (Tp~TL)	6℃/second, maximum value	6℃/second, maximum value
Time from room temperature to peak temperature	6 minutes, the longest	8 minutes, the longest
* The peak temperature (Tp) tolerance of the temperature profile is defined as the user's upper limit.		

6.2.Reflow soldering curve



Reflow soldering curve

7. Revision Notes

Revision Notes

Version	Modifications	Modified time	prepared by	Proofreading	Approval
V1.0	First draft	25-10-31	WFX	WJ	WFX

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