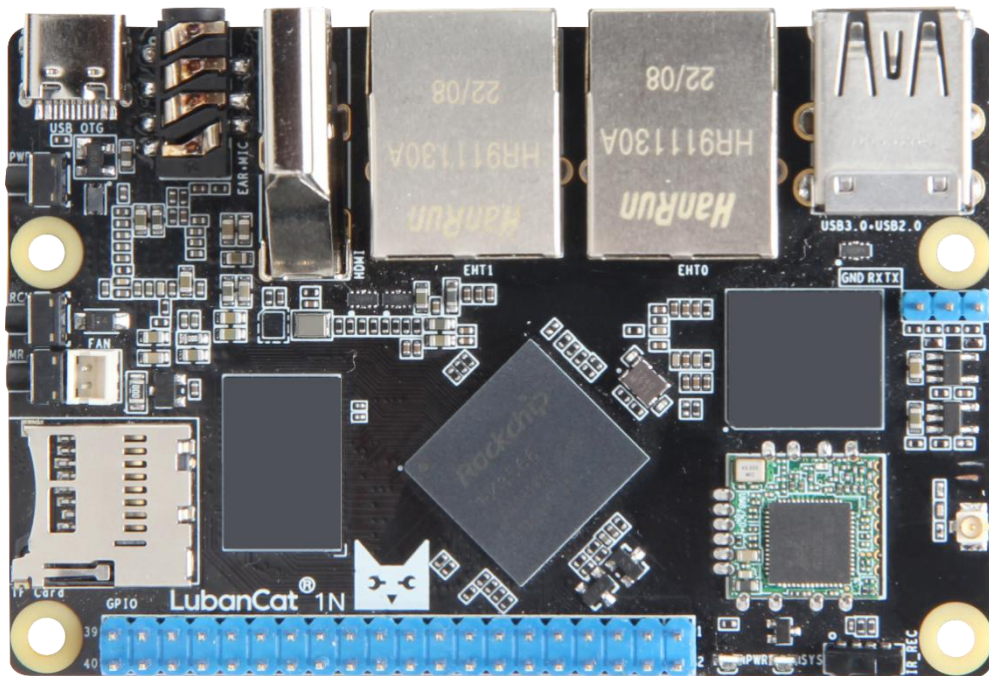


Luban Cat 1N

LubanCat 1N



Hardware specification

Rev. 1.3.1

2025/07/07

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3. For any undocumented, non-open-source, or modified content, please consult the documentation or contact sales for confirmation if you have any questions; otherwise, no guarantee shall be provided.

2. Scope of Technical Support

1. Provide explanations on the operation process and performance of the routines.
2. Limited discussion scope is provided for content modified by users, additionally developed, or beyond the source code of the sample routines.
3. Provide explanations for hardware resources.
4. Limited discussion scope is provided for the open-source schematic diagrams, and no guidance on hardware modifications will be offered.

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Users should follow the content of this document when using development boards and other products. Any losses caused by improper usage environment or inadequate product design will be borne by the user.

Manual version

Mannual version	date	Update Explanation
V 1.0	2023-10-31	• Initial version
V 1.1	2023-12-22	• Modify the specifications of the fan interface
V1.2	2023-12-29	• Revise the descriptions of the DSI and CSI sections
V1.2.1	2024-03-05	• Reference power consumption section at the end
V1.3	2024-05-09	• Add the "Overview of Version Differences of Lu Ban Cat 1N Development Board" chapter
V1.3.1	2025-07-07	• Added the operating system image and camera support • Corrected errors related to network ports, chip models, etc

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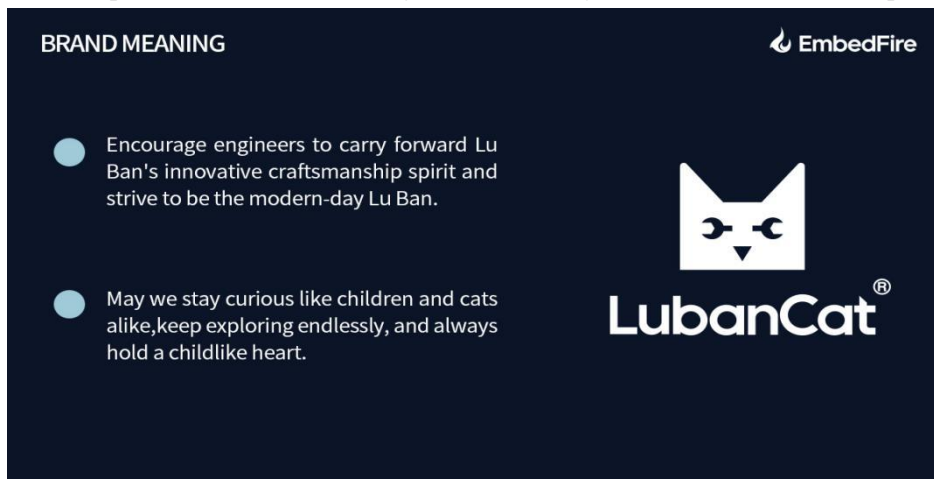
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Chapter 1 LubanCat Product Introduction

LubanCat is a Linux and Android card computer series brand launched by Embedfire. This series of card computers has a rich hardware product line, high compatibility with operating systems, numerous open-source teaching materials, and simple application development. With its superior performance and multiple product lines covering education, commercial applications, industrial control, and other fields, it has a wide range of application scenarios:

- Card computer: office, programming development, home entertainment, programming education, etc
- Linux servers: private cloud, soft router NAS, Personal web servers, etc
- Home intelligence center: TV box, smart home control, sensor data analysis, security monitoring, etc
- Industrialization: electronic billboards, vending machines, robots, drones, etc
- Embedded Development Board: Accelerating Embedded Project Validation and Development



The LubanCat series computers provide rich materials and versions from hardware to systems, textbooks, and applications, and strong versatility:

Hardware: controllers with different performance、 peripheral interfaces、 storage capacity、 and board size

System: Supports Ubuntu、 Debian、 OpenWrt、 Android、 OpenHarmony and other systems

Textbook: Provides multiple sets of textbooks, covering both pure application layer users and system development users, such as Python, Qt, Android application development, Linux system usage and kernel、 driver、 and image production

Application: Provide various application examples for the upper layer, such as using C/Python to control various hardware and developing applications based on ROS robot system

Complete open source materials, including but not limited to product manuals、 system source code、 schematic encapsulation libraries, various high-quality Linux development tutorials, etc. Even novice embedded players can complete development according to our tutorials, while experienced embedded veterans can accelerate the product's secondary development process.

Chapter 2 RK3566 Introduction

The entire LubanCat 1 series uses the Rockchip RK3566 chip as the main control chip.

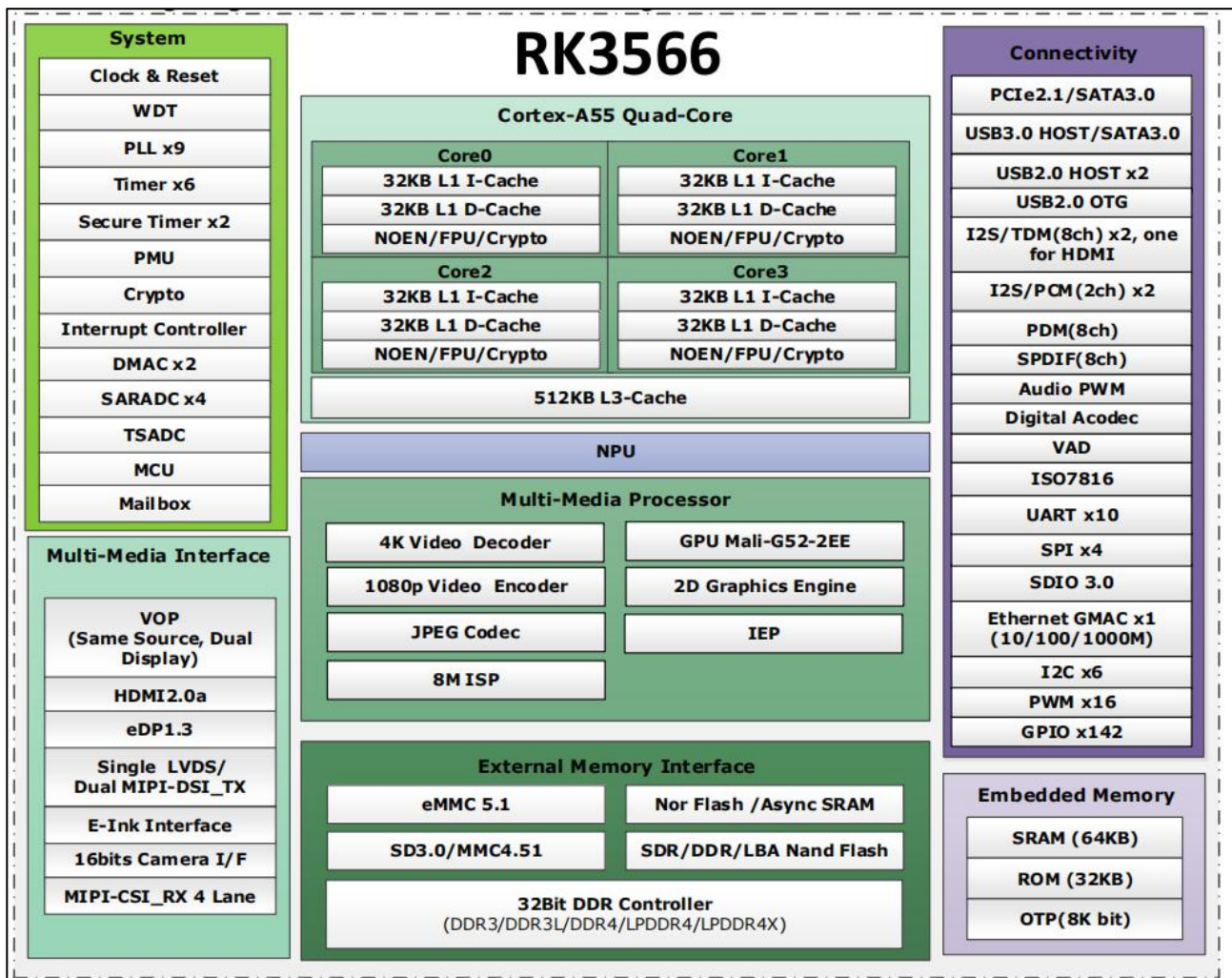
The Rockchip RK3566 is a general-purpose SoC based on the ARM architecture. It is equipped with a quad-core Cortex-A55 CPU, integrates a G52 GPU, and features a built-in independent NPU. The RK3566 is primarily designed for consumer products such as tablets, smart speakers with displays, Android laptops, and electronic translators, as well as industrial applications including face payment POS terminals, e-book readers, cloud terminals, video phones, and NAS storage devices.

The Rockchip RK3566 chip is a general-purpose SoC based on the ARM architecture. The CPU adopts a quad-core Cortex-A55 processor, integrates a G52 graphics processor, and has an independent NPU. The RK3566 is mainly customized for consumer products such as tablet computers, screen-equipped speakers, Android laptops, dictionary pens, etc., as well as industry products like facial payment POS machines, e-books, cloud terminals, video phones, and NAS storage.

The detailed parameters are as follows:

Detailed parameters	
CPU	• Quad-core Cortex-A55 architecture processor, with the maximum operating frequency of 1.8 GHz.
GPU	• ARM G52 2EE Graphics Processor
	• Supports OpenGL ES 1.1/2.0/3.2, OpenCL 2.0, Vulkan 1.1
	• Embedded high-performance 2D image acceleration module
NPU	• Rockchip self-developed NPU, with a maximum computing power of up to 1 TOPS.
	• Support one-click conversion of Caffe/TensorFlow/TFLite/ONNX/PyTorch/Keras/Darknet architecture models
display	• Single display, supports eDp/HDMI2.0/MIPI/LVDS/EBC
multi-media	• Supports 4K 60fps H.265/H.264/VP9 video decoding
	• Supports 1080P 60fps H.265/H.264 video encoding
	• Supports 8M ISP, which can be time-sharing multiplexed to meet the requirements of dual cameras.

The application diagram of RK3566 processor is as follows:



Chapter 3 Introduction to Version Differences of the LubanCat1N Development Board

This chapter mainly introduces the differences of the LubanCat 1N development board.

3.1 Version Changes

The specific changes of the LuBan Cat 1N development board at present are as follows:

Board version	Board silk screen printing	Description of Changes
LubanCat 1N	EBF41005 220220919	Initial version
	EBF410052V1 20221212	Correct the issue of RST pin level matching in the PHY chip

matters needing attention:

- (1) The board silkscreen is located on the back side.
- (2) Users in need may refer to the chapter 《Introduction to the LubanCat 1N Development Board》.

Chapter 4 Introduction to the LubanCat 1N Development Board

4.1 Appearance Drawing of LubanCat 1N Development Board

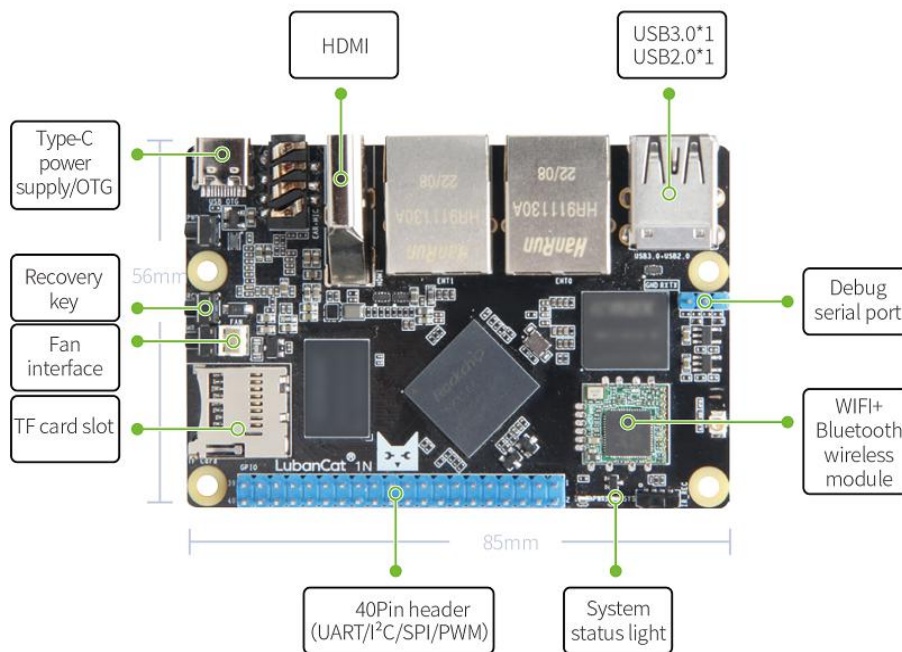


Figure 4.1-1 LubanCat 1N Front View1

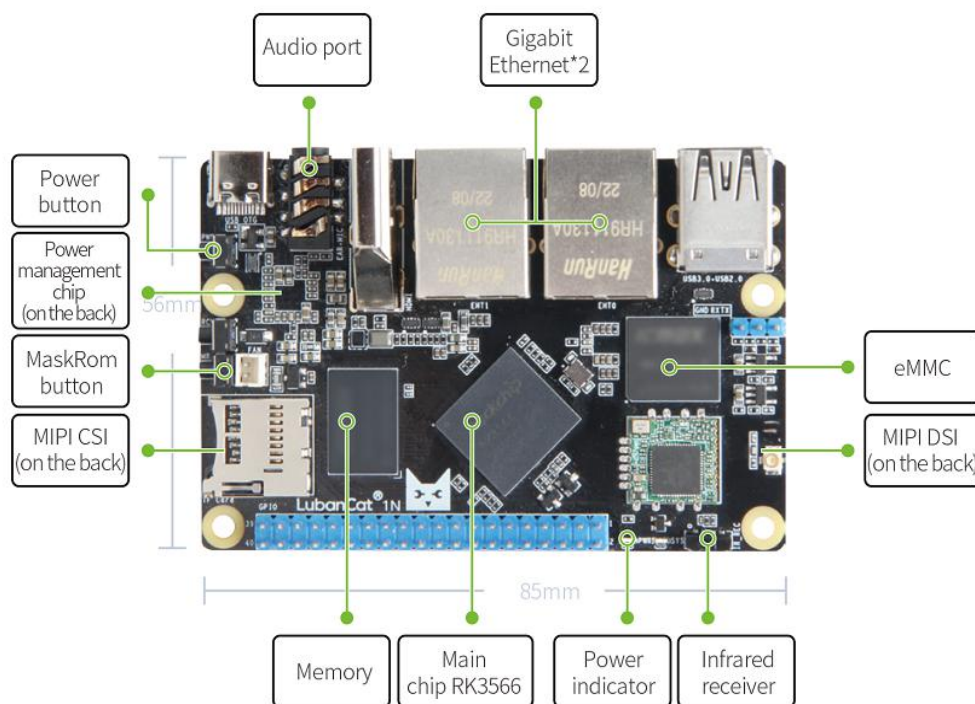


Figure 4.1-2 LubanCat 1N Front View2

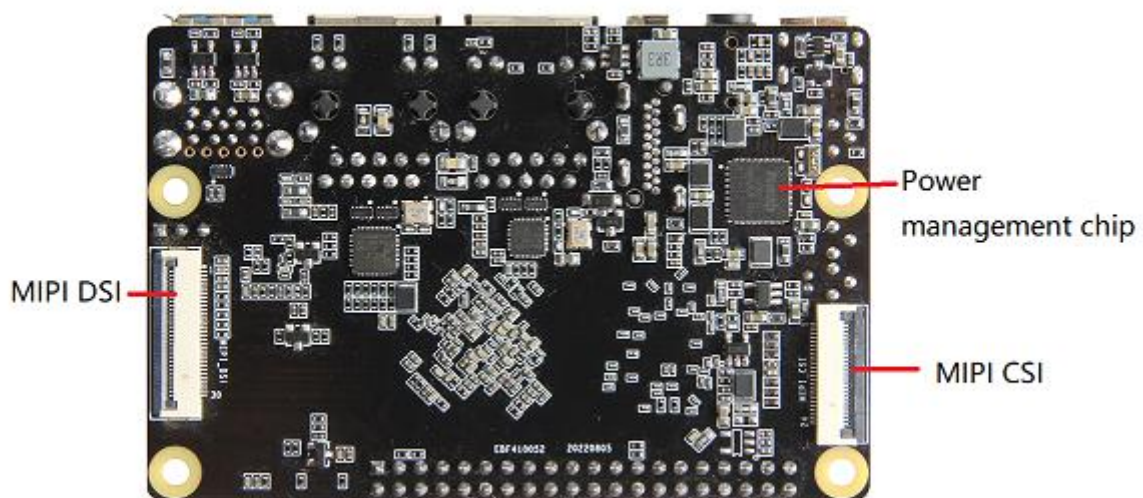


Figure 4.1-2 LubanCat 1N Back view

4.2 Size Drawing of LubanCat 1N Development Board

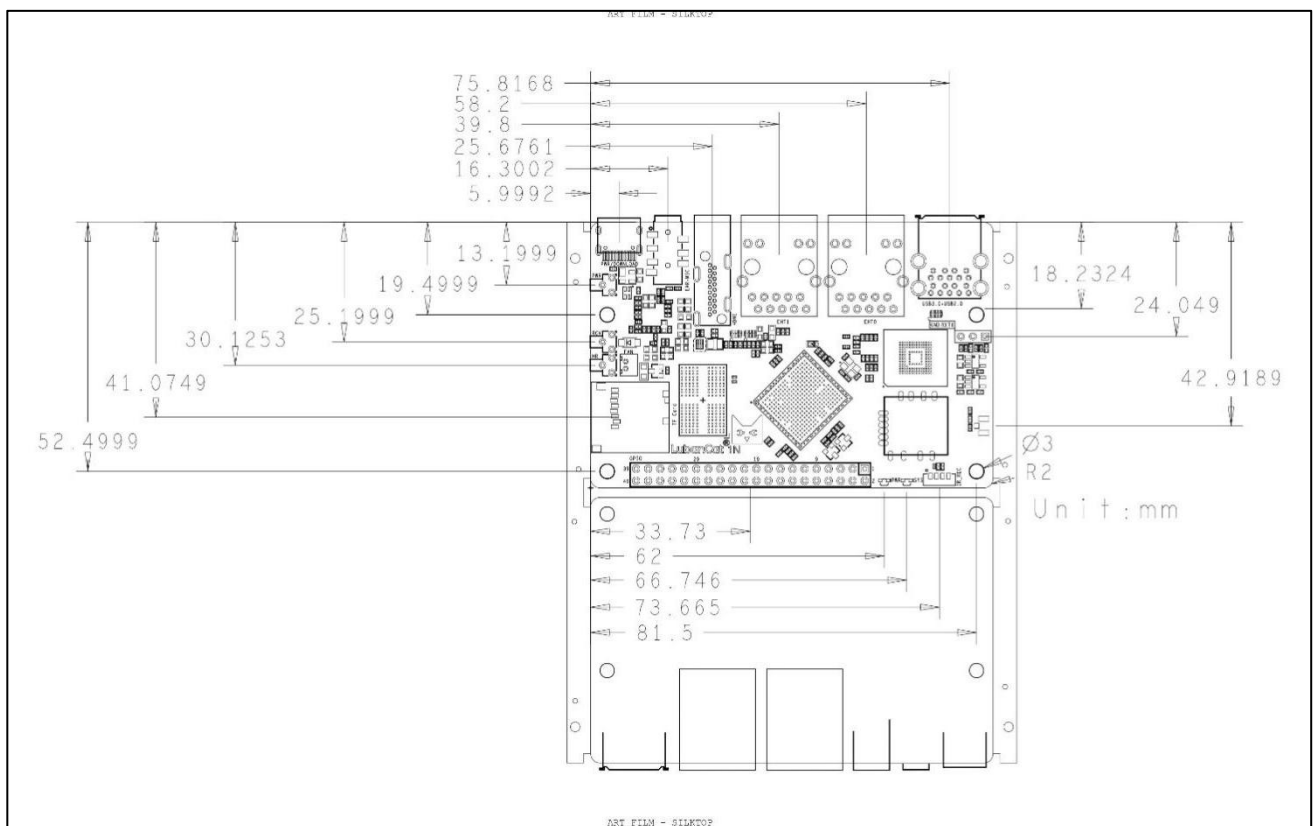


Figure 4.2-1 LubanCat 1N Mechanical dimension drawing

4.3 LubanCat 1N Hardware Specifications

LubanCat 1N hardware specifications	
SOC	Rockchip RK3566
PMU	Rockchip RK809-5
Memory	• The CXMT Changxin storage LPDDR4/LPDDR4X memory is adopted. The memory specifications include 1GB/2GB/4GB/8GB.
storage	• EMMC module: 8G/32GB/64GB/128GB • TF card: Supports TF card startup/expansion, up to 512GB
power supply	• Type-C 5V 3A
display	• Vertical standard HDMI interface, supporting up to 4K @ 60Hz • 1 x MIPI DSI 4-Lane interface, supporting up to 1080P @ 60Hz
Ethernet	• Gigabit * 2, supporting 10/100/1000 Mbps
USB	• 1 x USB3.0 HOST • 1 x USB2.0 HOST • 1 x USB2.0 OTG
Camera	• 1 x MIPI CSI 4-Lane Camera Interface
audio	• 1 x 3.5mm headphone jack, supporting audio input/output
FAN	• 2Pin 1.5mm specification 5V fan interface
40Pin	• Compatible with Raspberry Pi 40Pin interface, supporting PWM, GPIO, I2C, SPI, UART functions
infrared	• Onboard IRM-V838M3-C/TR1 infrared remote control receiver head, supporting infrared remote control
Wi-Fi + Bluetooth	• Using the TL8821CUB module, it supports Wi-Fi 5 + BT 4.2
Key	• 1 x PWR (power on/off) button, 1 x MR (MaskRom) button, 1 x REC (Recovery) button
operating system	• Support Ubuntu 20.04, Debian 10, Android 11, Android 13, Android 14, Android TV, OpenWrt, and OpenHarmonyOS based on open-source HarmonyOS, etc.
size	• 85 x 56 mm

4.4 Performance Parameters

4.4.1 System Frequency

name	specifications				describe
	minimum	typical	maxim	unit	
System CPU frequency Arm Cortex-A5	408	600、816、1104、1416、1608	1800	MHz	Modifiable, default automatic
System GPU frequency Arm Mali-G52	-	-	800	MHz	-
System DDR frequency	324	528、780	1056	MHz	Modifiable, default automatic
System NPU clock frequency	200	-	900	MHz	Modifiable, default 600 MHz

4.4.2 Power supply parameters

name	specifications				describe
	minimum	typical	maximum	unit	
Main power supply operating voltage	4.7	5.0	5.2	V	-
Main power supply working current	0.4	0.8	3.0	A	-
Startup power (bare metal Linux)	3.63	3.85	3.98	W	100 startup tests
Startup power (for Android11 with MIPI 800P screen)	6.11	6.24	6.37	W	100 startup tests

Note: ① Main power supply operating voltage: The allowable main power supply voltage for normal operation of LubanCat 1N.

② Main power supply working current: The main power supply current of the LubanCat 1N during normal operation, where the minimum working current refers to the standby current, the typical working current refers to the current when the CPU is fully loaded, and the maximum working current refers to the safe current allowed by the board. When working with external devices, please do not exceed the safe current.

③ Startup power (bare metal Linux): No peripherals, bare metal startup, test image is Debian10 lite image, test times 100 times.

④ Startup power (for Android11 with MIPI 800P screen): Only booting with the Wildfire 10.1-inch MIPI screen. The tested system is Androi 11, and the test was conducted 100 times.

4.4.3 Working environment

parameter description		specifications				describe
		minimum	typical	maximum	unit	
operation temperature	work environment	0	25	60	°C	-
	storage environment	-40	25	+125	°C	
humidity	work environment	10	-	90	%RH	-
	storage environment	5	-	95	%RH	

4.4.4 Development board interface speed

parameter	specifications				describe
	minimum	typical	maximum	unit	
Serial communication speed	-	9600	4M	bps	-
USB 3.0 interface speed	-	-	5	Gbps	-
USB 2.0 interface speed	-	-	480	Mbps	-

SPI clock frequency	-	-	50	MHz	-
I2C communication speed	-	100	400	Kbps	-

Note: For more interface speeds, please refer to the "Development Board Interface Resources" section.

4.5 Development Board Interface Resources

function	quantity	parameter
HDMI 2.0 output	1	Connected via standard HDMI socket, supporting: • 720p@30Hz、@60Hz、@120Hz • 1080p@30Hz、@60Hz、@120Hz • 1440p(2K)@30Hz、@60Hz • 2160p(4K)@30Hz、@60Hz The stable operating power consumption is approximately 0.25W, while the instantaneous power consumption during insertion or removal can reach up to 1.5W.
Ethernet	2	• The stable working power is output through the RJ45 interface. • Supports data transmission rates of 10/100/1000Mbps; • When connected to EHT0, the no-load power consumption is approximately 0.35W, and the speed measurement power consumption is approximately 0.7W. • When connected to EHT1, the no-load power consumption is approximately 0.3W, and the speed measurement power consumption is approximately 1.4W.
USB3.0 Host	1	• Introduced through Type-A USB interface; • 1 USB 3.1 Gen1, with the data rate of up to 5Gbps; • Supports up to 2000mA current output;
USB2.0 Host	1	• Introduced through Type-A USB interface; • Supports three modes: high-speed (480Mbps), full speed (12Mbps), and low-speed (1.5Mbps); • Supports up to 1000mA current output;
USB2.0 OTG	1	• Introduced through Type-C interface; • Even the firmware burning interface shares the same socket as the power interface.
MIPI DSI	1	• Supports 4-lane output, with the maximum resolution being 1080x1920 at 60fps. • Compatible with Embedfire 5.5, 7, and 10.1 inch MIPI screens;
MIPI CSI	1	• It is connected through the MIPI CSI interface, with an interface specification of a 24-pin FPC connector. • Supports 4-lane input. For specific compatible models, please refer to the camera section of the hardware usage instructions chapter.
WIFI&BT	1	• Equipped with Realtek TL8821CUB Wi-Fi module, supporting Wi-Fi 5 + BT 4.2;
Debug serial port	1	• One Debug serial port, default parameters 1500000-8-N-1;
UART	5	• Lead out through a 40 pin pin pin with a spacing of 2.54mm; • Available serial ports: UART3, UART4, UART5, UART7, UART9; • The highest baud rate can reach 4Mbps;

SPI	1	• Lead out through 40 pin with spacing of 2.54mm; • Each controller supports two chip select outputs; • Support serial master and serial slave modes; • The maximum clock frequency is 50MHz;
I2C	2	• Lead out through 40 pin with spacing of 2.54mm; • Supports 7-bit and 10 bit address modes; • The standard mode data transmission rate can reach 100 Kbps, and in fast mode it can reach up to 400 Kbps;
I2S	1	• The transmitting and receiving clocks can reach up to 50 MHz. • Support Time Division Multiplexing (TDM), Inter-IC Sound (I2C) and similar formats • Supports digital audio interface transmission (SPDIF, IEC60958-1 and AES-3 formats) • Support audio reference output clock
PWM	12	• Lead out through 40 pin with spacing of 2.54mm;
GPIO	28	• Lead out through a 40 pin with a spacing of 2.54mm; • In the 40 pin header, there are two 5V power pins, two 3V3 power pins, eight GND pins, The remaining 28 are GPIO pins, among which 9 of them do not have the pin re-mapping function.
TF card	1	• Supports TF card for system booting. The maximum capacity supported is 512GB. The speed is SDR104. The actual limit is determined by the card.
audio	1	• Comes out through a 3.5mm headphone jack, with a two-in-one headphone output and microphone input interface
FAN	1	• Onboard fan interface, supporting 5V fans with 2Pin 1.5mm specification interface

Note 1: The parameters/quantities in the table are the theoretical maximum values for hardware design or CPU, with most functional pins being multiplexed;

Note 2: The power consumption displayed on the above peripheral interfaces represents the increased power consumption value of the system when the peripheral is connected.

4.6 Development Board 40Pin Definition

4.6.1 40Pin Schematic diagram

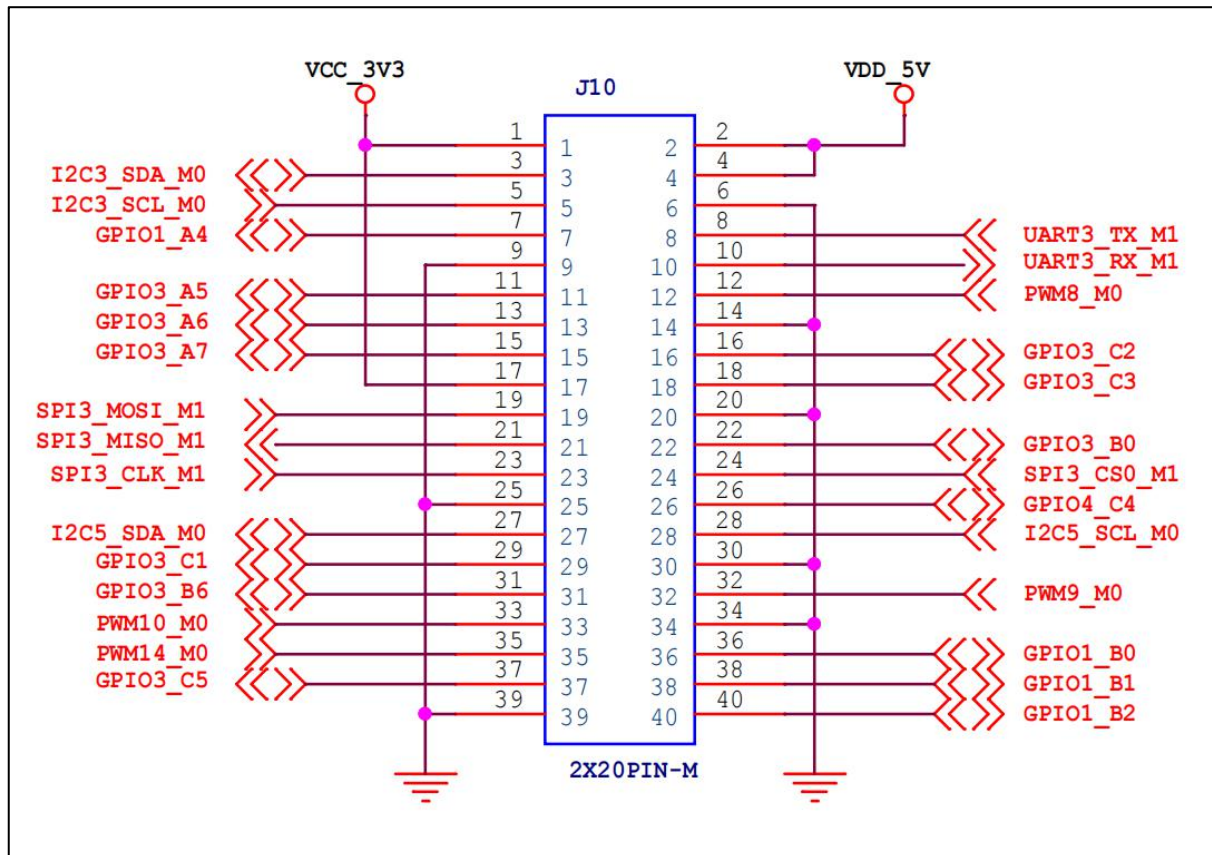


Figure 4.6-1 LubanCat 1N series pins Schematic diagram

4.6.2 40Pin Pin Function Diagram

LubanCat1 Series Pinout Diagram												
Function 4	Function 3	Function 2	Function 1	Number	GPIO	Physical Pin	GPIO	Number	Function 1	Function 2	Function 3	Function 4
					3.3V	1	2	5V				
		UART3_RX_M0	I2C3_SDA	32	GPIO1_A0	3	4	5V				
		UART3_TX_M0	I2C3_SCL	33	GPIO1_A1	5	6	GND				
				36	GPIO1_A4	7	8	GPIO3_B7	111	UART3_TX_M1	PWM12_M0	
					GND	9	10	GPIO3_C0	112	UART3_RX_M1	PWM13_M0	
				101	GPIO3_A5	11	12	GPIO3_B1	105	PWM8_M0	UART4_RX_M1	
				102	GPIO3_A6	13	14	GND				
				103	GPIO3_A7	15	16	GPIO3_C2	114		UART5_TX_M1	
					3.3V	17	18	GPIO3_C3	115		UART5_RX_M1	
I2S3_SCLK_M1		PWM15_IR_M1	MOSI	147	GPIO4_C3	19	20	GND				
I2S3_SDO_M1	UART9_TX_M1	PWM12_M1	MISO	149	GPIO4_C5	21	22	GPIO3_B0	104			
I2S3_MCLK_M1		PWM14_M1	SCLK	146	GPIO4_C2	23	24	GPIO4_C6	150	SPI3_CS0_M1	PWM13_M1	UART9_RX_M1
					GND	25	26	GPIO4_C4	148	CS1		I2S3_SDI_M1
			I2C5_SDA	108	GPIO3_B4	27	28	GPIO3_B3	107	I2C5_SCL_M0		I2S3_LRCK_M1
				113	GPIO3_C1	29	30	GND				
		I2C3_SDA_M1	PWM11_IR_M0	110	GPIO3_B6	31	32	GPIO3_B2	106	PWM9_M0	UART4_TX_M1	
		I2C3_SCL_M1	PWM10_M0	109	GPIO3_B5	33	34	GND				
		UART7_TX_M1	PWM14_M0	116	GPIO3_C4	35	36	GPIO1_B0	40			
	PWM15_IR_M0	UART7_RX_M1		117	GPIO3_C5	37	38	GPIO1_B1	41			
					GND	39	40	GPIO1_B2	42			

Figure 4.6-2 LubanCat 1N Function Pin Diagram

4.6.3 40Pin Function Description

Note:

Pin -- Physical pin number;

GPIO -- The universal I/O serial number of the Rockchip RK3566 chip, consisting of a controller (bank), ports, and index pins;

Num -- GPIO number, mainly used for program control.

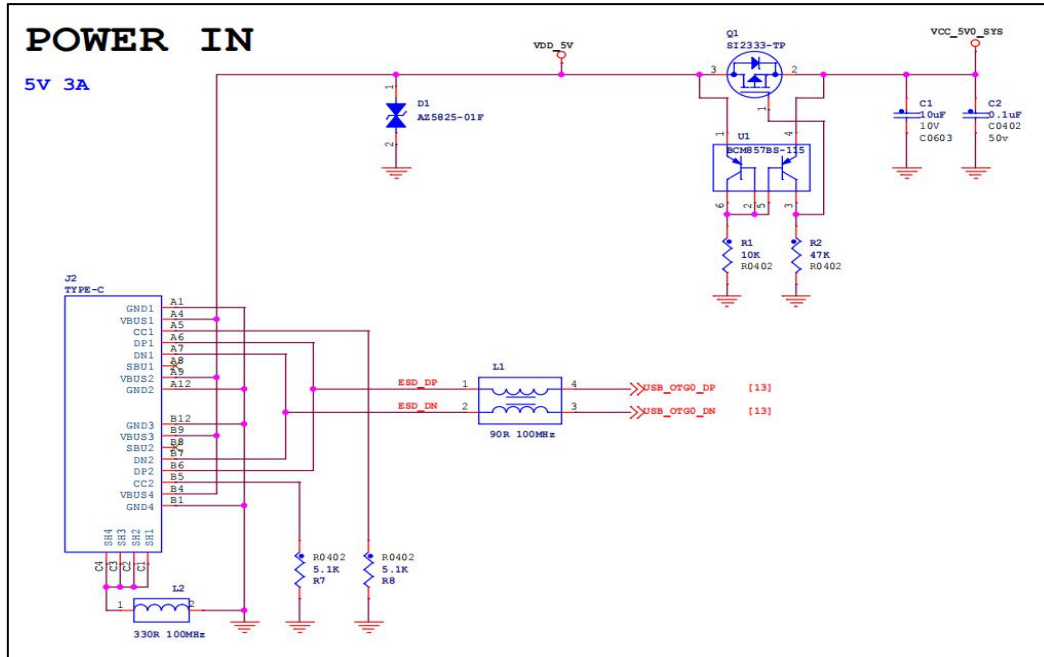
Table 4.6.3 LubanCat 1N 40Pin Interface Definition

Pin	GPIO	Num	Pin Description	PWM	UART	SPI	I2C/I2S
1	3V3	-	3.3V pin				
2	5V	-	5V pin				
3	GPIO1_A0	32	GPIO、I2C、UART		UART3_RX_M0		I2C3_SDA_M0
4	5V	-	5Vpin				
5	GPIO1_A1	33	GPIO、I2C、UART		UART3_TX_M0		I2C3_SCL_M0
6	GND	-	GND				
7	GPIO1_A4	36	GPIO				
8	GPIO3_B7	111	GPIO、PWM、UART	PWM12_M0	UART3_TX_M1		
9	GND	-	GND				
10	GPIO3_C0	112	GPIO、PWM、UART	PWM13_M0	UART3_RX_M1		
11	GPIO3_A5	101	GPIO				
12	GPIO3_B1	105	GPIO、PWM、UART	PWM8_M0	UART4_RX_M1		
13	GPIO3_A6	102	GPIO				
14	GND	-	GND				
15	GPIO3_A7	103	GPIO				
16	GPIO3_C2	114	GPIO、UART		UART5_TX_M1		
17	3V3	-	3.3V pin				
18	GPIO3_C3	115	GPIO、UART		UART5_RX_M1		
19	GPIO4_C3	147	GPIO、PWM、SPI、I2S	PWM15_IR_M1		SPI3_MOSI_M1	I2S3_SCLK_M1
20	GND	-	GND				
21	GPIO4_C5	149	GPIO、PWM、UART、SPI、I2S	PWM12_M1	UART9_TX_M1	SPI3_MISO_M1	I2S3_SDO_M1
22	GPIO3_B0	104	GPIO				
23	GPIO4_C2	146	GPIO、PWM、SPI、I2S	PWM14_M1		SPI3_CLK_M1	I2S3_MCLK_M1
24	GPIO4_C6	150	GPIO、PWM、UART、SPI、I2S	PWM13_M1	UART9_RX_M1	SPI3_CS0_M1	I2S3_SDI_M1
25	GND	-	GND				
26	GPIO4_C4	148	GPIO、SPI、I2S			CS1	I2S_LRCK_M1
27	GPIO3_B4	108	GPIO、I2C				I2C5_SDA_M0
28	GPIO3_B3	107	GPIO、I2C				I2C5_SCL_M0
29	GPIO3_C1	113	GPIO				
30	GND	-	GND				
31	GPIO3_B6	110	GPIO、PWM、I2C	PWM11_IR_M0			I2C3_SDA_M1
32	GPIO3_B2	106	GPIO、PWM、UART	PWM9_M0	UART4_TX_M1		
33	GPIO3_B5	109	GPIO、PWM、I2C	PWM10_M0			I2C3_SCL_M1
34	GND	-	GND				
35	GPIO3_C4	116	GPIO、PWM、UART	PWM14_M0	UART7_TX_M1		
36	GPIO1_B0	40	GPIO				
37	GPIO3_C5	117	GPIO、PWM、UART	PWM15_IR_M0	UART7_RX_M1		
38	GPIO1_B1	41	GPIO				
39	GND	-	GND				
40	GPIO1_B2	42	GPIO				

4.7 Hardware Instructions for Development Board

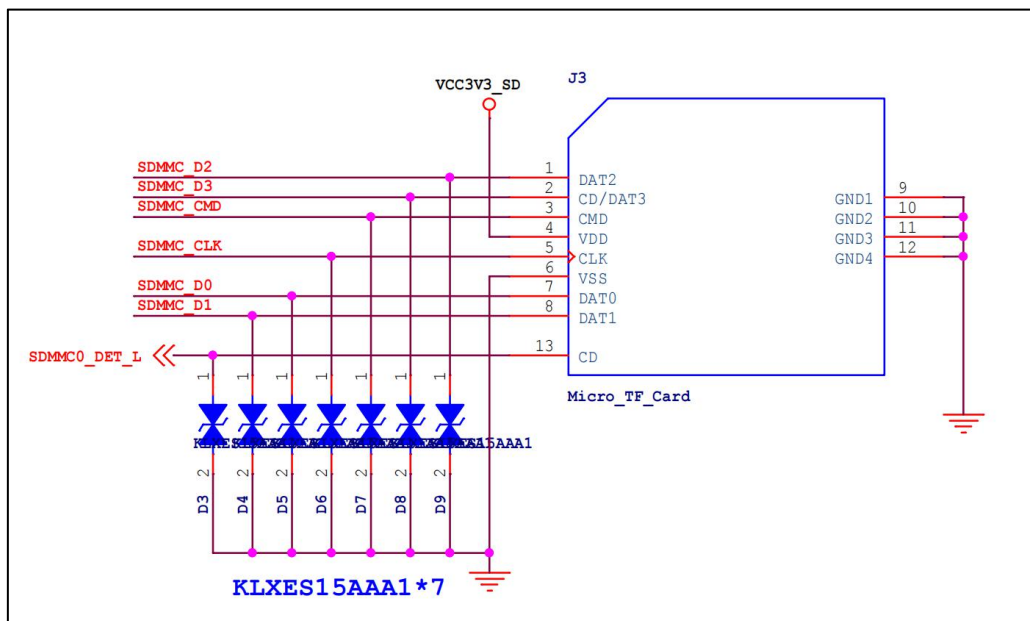
4.7.1 Power Supply

The LubanCat 1N is powered by a 5V 3A power adapter, and the power interface is a Type-C socket. The power system of the LubanCat 1N adopts the Rockchip RK809-5 chip, which in conjunction with peripheral DCDC and LDO circuits, provides stable power to DDR, Emmc, and related functional peripheral devices.



4.7.2 TF Card

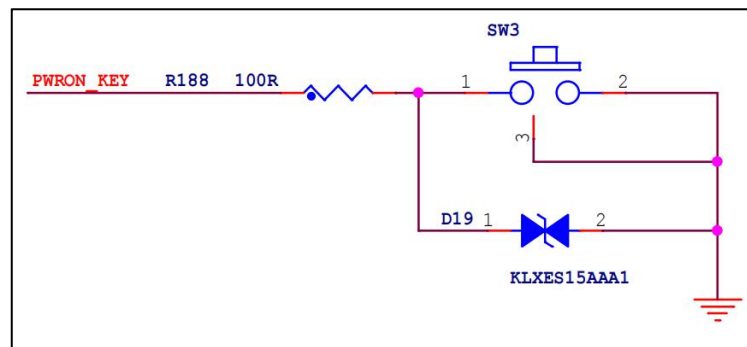
The TF card slot is located on the front of the motherboard. It is a self-retracting TF card holder, capable of supporting a maximum capacity of 512G. It can also be used for system booting and writing.



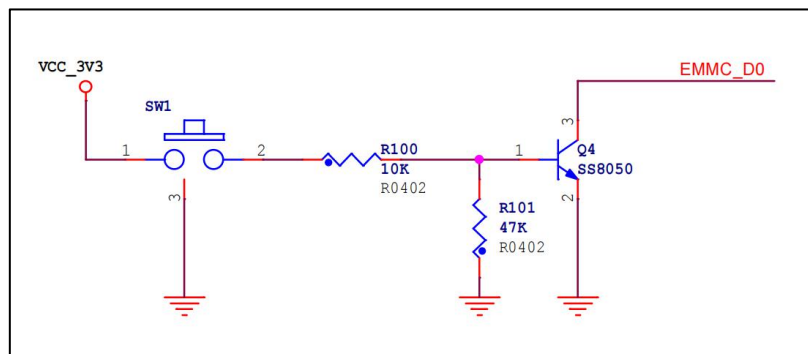
4.7.3 Buttons

There are three buttons on the LubanCat 1N, namely the PWR (power on/off) button, MR (MaskRom) button, and RCV (Recovery) button.

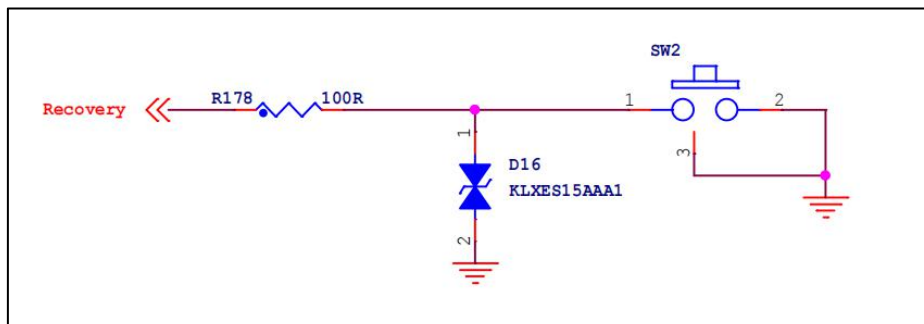
The PWR (Power On/Off) button, also known as the power button, has the main function of serving as the system's power on/off button and sleep button. When the running system is Linux, this button is mainly used as the system's power on/off button. When the running system is Android, this button is mainly used as the system's sleep button. The schematic diagram of the PWR (Power On/Off) button is shown in the following figure:



The MR (MaskRom) button is mainly used to facilitate the system to enter MaskRom mode for mirror burning/downloading EMMC. The usage method is to open the rockchip Micro Development Tool, press and hold the button while the power is off, then insert the data cable. When the computer rockchip Micro Development Tool interface prompts recognition of the MaskRom device, you can release the button and proceed to the next step of mirror burning. The schematic diagram of the MR button is shown in the following figure:



The RCV (Recovery) button is mainly designed to facilitate the system entering the Recovery mode for performing image burning/download on the EMMC. The usage method is the same as that of the MR (MaskRom) button. The schematic diagram of the RCV (Recovery) button is shown in the following figure:



4.7.4 Ethernet

The LubanCat 1N has two RJ45 interfaces, supporting data transmission rates of 10/100/1000 Mbps. The EHT0 network port and the EHT1 network port are respectively controlled by the onboard PHY chip RTL8211F and the Ethernet chip RTL8111H_CG.

EHT0 and EHT1 have two LED indicators. The one on the left is green and the one on the right is yellow. The LEDs on the left and right represent different meanings. The yellow light on the right indicates the network connection status. It is always on when the connection is successful, off when the connection is failed or not established. The green light on the left indicates the network data transmission status. It is always on when there is no data transmission, flashes when there is data transmission, and the flashing frequency is related to the real-time data transmission volume.

4.7.5 USB2.0/3.0

The RK3566 chip is equipped with 1 USB3.0 HOST controller, 3 USB2.0 HOST controllers and 1 USB2.0 OTG controller. One of the USB2.0 OTG connections is connected to the onboard Type-C interface, which shares the power interface, and can be used as a firmware burning/download interface; one USB3.0 HOST and one USB2.0 HOST are connected to the onboard USB 3.0 interface; the remaining two USB2.0 HOSTs are directly connected to the onboard USB2.0 interface, and the other one is connected to the onboard Wi-Fi module TL8821CUB.

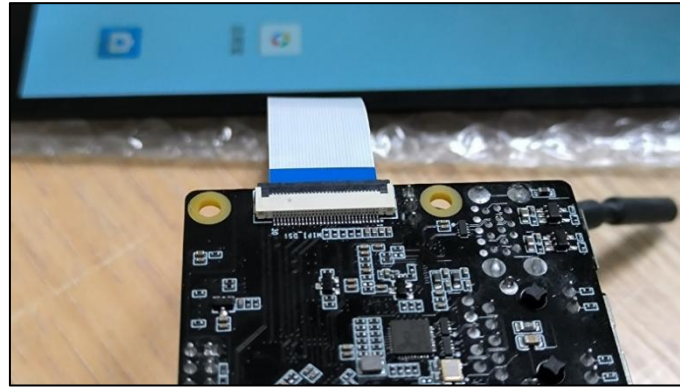
The onboard USB 3.0 interface is USB 3.1 Gen1, with a maximum data rate of up to 5 Gbps and backward compatibility with USB 2.0. The onboard USB 2.0 interface supports three modes: high-speed (480 Mbps), full-speed (12 Mbps), and low-speed (1.5 Mbps). The system will automatically select the appropriate mode based on the inserted device.

4.7.6 Video output/display

The video output interface of the LubanCat 1N mainly consists of a vertical standard HDMI interface and a MIPI DSI interface. The standard HDMI interface can be used to connect an external display, while the MIPI DSI interface can be used to connect the MIPI screen that is compatible with the Lu Ban Cat.

In terms of HDMI interface video output, the RK3566 chip supports HDMI 2.0 and is backward compatible with HDMI 1.4. It can support a maximum resolution of 4K@60Hz. It supports both video output and audio output. The standard HDMI interface equipped on Lu Ban Cat 1N can be directly connected to a display with a standard HDMI interface via a dual-head HDMI cable.

The MIPI DSI interface uses a 30-pin FPC connector and supports video output and touch. The connection with the MIPI screen is shown in the following diagram:

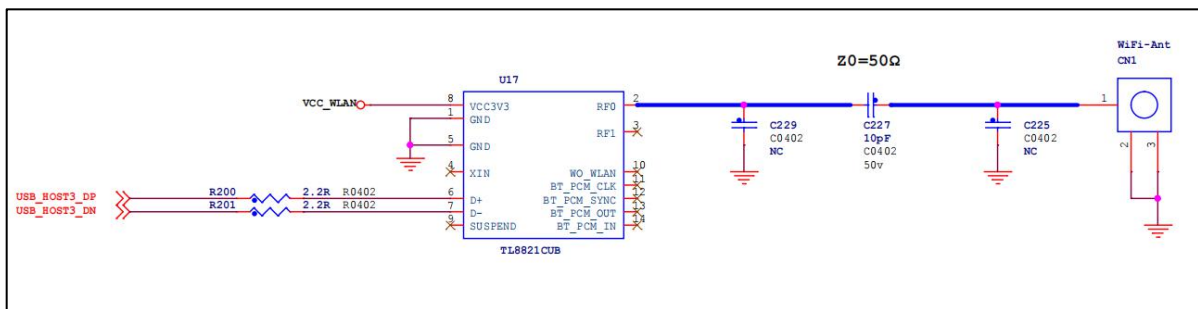


4.7.7 Audio Input/Output

The audio input/output interface is connected through the 3.5mm headphone jack, forming a 2-in-1 interface for headphones and microphone input. The audio input/output functions are realized by the power chip PMIC RK809-5.

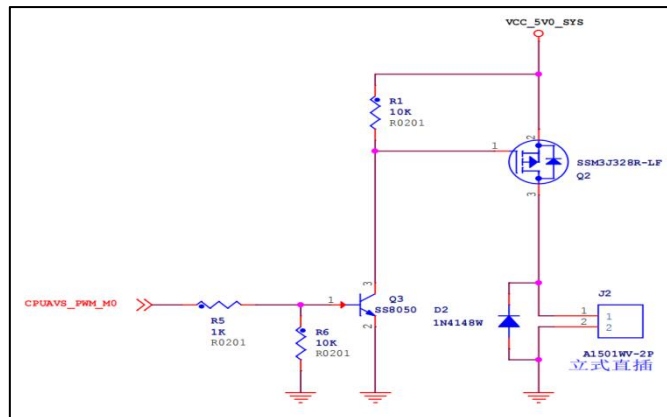
4.7.8 Wi-Fi / Bluetooth

The onboard Wi-Fi module is located on the front of the motherboard and uses Realtek TL8821CUB. Its interface is connected to the USB2.0 USB_HOST3 of RK3566. It supports 2.4GHz and 5.8GHz frequency bands, and supports 802.11 b/g/n/ac wireless standards, as well as Bluetooth BT2.1, BT3.0 and BT4.2. It adopts a single-frequency 1T1R mode, with stable transmission and the maximum transmission rate reaching up to 433Mbps.



4.7.9 FAN interface

The FAN interface reserved on the LubanCat 1N board card is located beside the TF card slot on the front of the board, and it is a 2-pin 1.5mm specification 5V fan power supply interface. It can control the conduction state of the SS8050 transistor through CPUAVS_PWM_M0, thereby controlling the conduction time of the MOS transistor and achieving the speed control of the fan. The schematic diagram of the FAN fan driver is shown as follows:

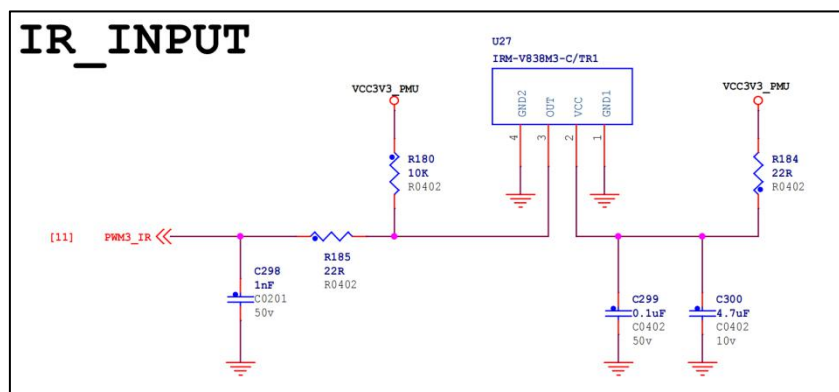


4.7.10 LED indicator

Next to the onboard Wi-Fi module, there are two LED indicators. The LED with "PWR" printed on it is the power indicator, and the LED with "SYS" printed on it is the system status indicator (heartbeat indicator). The power indicator remains red and constantly on after power-on, indicating that the power is operating stably. The system status indicator is a green LED. When the system is powered on normally, the status indicator enters the heartbeat mode, that is, it flashes twice in one cycle. At the same time, this indicator is a programmable control indicator, and users can also control this indicator themselves.

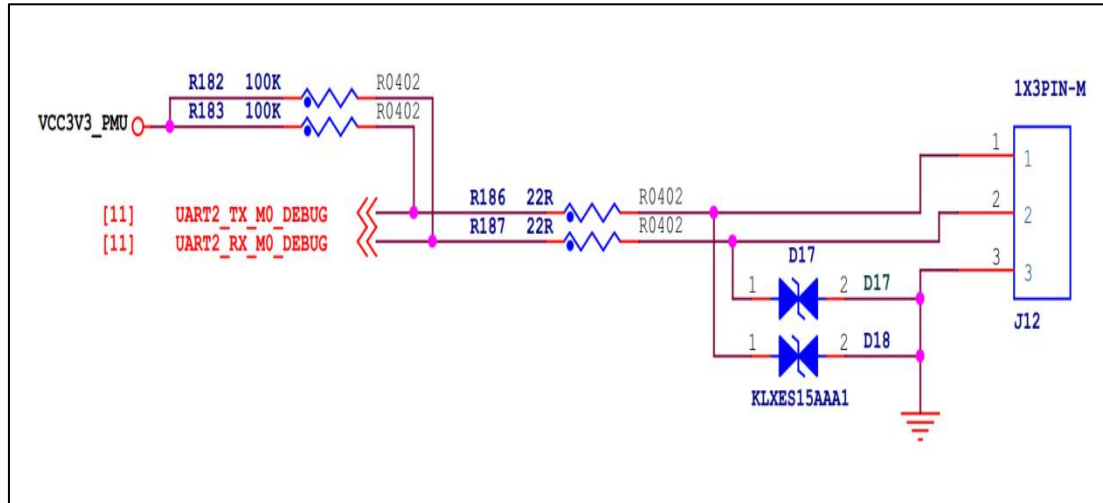
4.7.11 IR Infrared

The IR infrared receiver is located next to the Wi-Fi module and uses the IRM-V838M3-C/TR1 infrared remote control receiver. The IR infrared receiving signal is received by the PWM3_IR pin. As shown in the following figure:



4.7.12 Debug serial port

The on-board Debug debugging serial port is connected by a 2.54mm pitch 1 * 3-pin header. The three pins of the header are silk-screened as GND, RX, and TX. The TX and RX of UART2 of the RK3566 chip are respectively connected to the TXD and RXD header pins on the board through 22R resistors. Additionally, an ESD protection device KLXES15AAA1 is connected to the ground terminals of the TX and RX ports of the header, which helps protect sensitive electronic devices from the influence of electrostatic discharge (ESD) without distorting the data signal:



4.7.13 Camera

The onboard camera interface uses a 24-pin 0.5mm spacing FPC socket, and the silk-screened label on the board is MIPI CSI. This interface supports connection to MIPI cameras and UVC cameras. It supports connection to UVC cameras. Refer to models such as Wildfire OV5693/OV2720/OV9762. The compatible MIPI camera models include Wildfire mipi-imx415, Wildfire mipi-gc08a8, Wildfire mipi-gc2053, Wildfire mipi-gc4653, Wildfire mipi-ov8858, sc530ai, Raspberry Pi OV5647 camera (requires a adapter board). The connection between LubanCat 1N and the camera module is shown in the following figure:



Chapter 5 Reference power consumption

(1) Power consumption test of complete Linux systems

① Test Contents:

Startup/Standby Power Consumption Test: The test covers the process from system startup to entering the system's standby mode;

Sleep Power Consumption Test: The sleep mode used for the test is "freeze";

Full Load Power Consumption Test: A 10-minute quad-core full-load test is conducted using the s-tui and stress programs;

② Test Environment:

The test environment has a temperature of 25 °C, and the power supply is the original 5V 3A power supply. The external devices connected during the test are the Debug serial port, HDMI, and EHT0 network port. During the OpenWrt test, only the Debug serial port and EHT0 network port are connected. The power consumption of some external devices is described in the "Interface Resources of the Development Board" section.

Table 5-1 Power Consumption of Each Linux Image in LubanCat 1N

system	type		Instantaneous peak value	Stable value	Instantaneous power consumption	Stable power consumption	Stable/highest
Ubuntu20.04 20230826	lite	Start/standby test	979.8	426	4940	2165	51.9
		Sleep Test	-	160	-	831	-
		full loading	881.8	780	4448	3935	81.7
	xfce-full	Start/standby test	957.1	482.7	6166.5	2499.8	41.6(21)
		Sleep Test	-	234.2	-	1219.4	-
		full loading	1103.2	808.3	5639.6	4145.3	42.5/74.8
Ubuntu22.04 20230713	lite	Start/standby test	927.5	410	4669	2087	46.7
		Sleep Test	-	235	-	1200	-
		full loading	941.5	800	4736	4040	81.7
	xfce	Start/standby test	977.5	500	4920	2540	47.2
		Sleep Test	-	235	-	1210	-
		full loading	1068.3	800	5385	4040	81.7
Debian10 20230905	lite	Start/standby test	1004.1	440	5060.7	2240	50
		Sleep Test	-	160	-	832	-
		full loading	1171.5	825	5896	4160	83.3
	xfce	Start/standby test	1113.3	420	5607.9	2140	50.6
		Sleep Test	-	150	-	780	-
		full loading	1119.1	840	5639	4240	81.1

OpenWrt	ext4	Start/standby test	746.7	340	3758	1735	-

Note:

Instantaneous peak current: The maximum current value during the start-up/test process;

Stable current value: The current value after the start-up process is completed and enters the system / The current value during the test process;

Instantaneous power consumption: The maximum power consumption during the start-up/test process, real-time power consumption = real-time voltage × real-time current;

Stable power consumption: The power consumption after the start-up process is completed and enters the system / The power consumption value when the power consumption during the test process remains relatively stable;

Soc temperature: The highest temperature is taken during the full-load test, and the stable temperature is taken during the start-up/idle test

(2) Whole-machine power consumption tests of Android/HarmonyOS images
The testing environment temperature is 15-25 °C, and the power supply uses the original 5V 4A power supply. The peripherals connected during different mirror tests are shown in the table below.

① Test Contents:

Startup/Standby Power Consumption Test: The test measures the power consumption from the system startup to the system's standby process;

Sleep Power Consumption Test: This test is the PWR button sleep test;

Antutu Benchmark: The stress test is conducted using the Antutu benchmark, version v10.1.0;

② Test Environment:

The test environment temperature is 25°C, and the power supply uses the original 5V 3A power supply. The external devices connected during the test are HDMI and USB keyboard/mouse; during the MIPI screen mirroring test, only the MIPI screen is connected, and no other external devices are connected.

Table 5-2: f LubanCat 1N Android/HarmonyOS System Image Complete Machine Power Consumption Table

mirror image		Test content	Working current (mA)		Power consumption (mW)	
system	type		Instantaneous peak value	Stable value	Instantaneous power consumption	Stable power consumption
Android 11 20230916	hdmi	Start/standby test	1036	800	5220	4050
		Sleep Test	-	33	-	175
		Antutu Review	1190.7	900	5976	4550
	mipi800p (Embedfire 10.1 inches)	Start/standby test	1556.6	900	7754	4550
		Sleep Test	-	38	-	200
		Antutu Review	1500	1000	7484	5040
	mipi1080p (Embedfire 5.5 inches)	Start/standby test	1131.7	480	5699	2432
		Sleep Test	-	28	-	148
		Antutu Review	1362.1	1000	6817	5040

Android TV 20230916	-	Start/standby test	1033.2	440	5183	2240
		Sleep Test	-	37	-	196
Android 13 20230916	hdmi	Start/standby test	1055.9	400	5323	2036
		Sleep Test	-	31	-	165
		Antutu Review	1219.6	860	6116	4340
	mipi 1080p	Start/standby test	1223.8	550	6136	2785
		Sleep Test	-	34	-	180
		Antutu Review	1447.1	1000	7266	5040
OpenHarmonyOS	-	Start/standby test	1058.1	440	5297	2240

Note:

Instantaneous peak current: The maximum current value during the start-up/test process;

Stable current value: The current value after the start-up is completed and enters the system / The current value during the test process;

Instantaneous power consumption: The maximum power consumption during the start-up/test process, real-time power consumption = real-time voltage × real-time current;

Stable power consumption: The power consumption after the start-up is completed and enters the system / The power consumption that remains relatively stable during the test process;

During the AnTuTu stress test, the working current/power consumption curve is not a straight line, but consists of a large number of fluctuating broken lines mostly within the range of the stable value $\pm 25\%$ and a small part of instantaneous high/low peaks exceeding the stable value $\pm 25\%$.