Shenzhen Hi-Link Electronic Co.,Ltd

HLK-RM65 Specification

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1. Products

1.1. Outline

HLK-RM65 is a high performance embedded WIFI6 AX3000 module from Hi-Link Electronics, a highly integrated system-on-a-chip wireless network router module using **MT7981B+MT7976C+MT7531A solution, with a theoretical maximum wireless rate of 574Mbps+2402Mbps.**Used for high wireless performance, home entertainment and home automation, etc.

The SoC used is manufactured using an advanced silicon process and integrates a dual-core ARM®Cortex-A53MPCoreTM operating at up to 1.3GHz and more DRAM bandwidth. A variety of peripherals are also included, including SGMII and USB3.0 (host) ports. Two 2.5Gbps HSGMII Ethernet interfaces are also implemented. The MT7981B, combined with the RF chip, provides a dual-band concurrent chipset solution for the WIFI6E AX3000 wireless router platform.

1.2. Product Characteristics

- Dual-band (2.4GHz and 5GHz) MIMO 802.11 a/b/g/n/ac/ax RF with bandwidth 20/40/80/160MHz
- Flash/DDR3 Expandable support DDR3/DDR4-2133 2GB/4GB;
- Bandwidth range: 2.4-2.4835 GHz 5.180-5.885 GHz;
- Integrated 2.4GHz/5GHz PA, LNA;
- Wireless connection: I-pex Generation 1 cradle;
- Interface WAN.LAN1.LAN2.LAN3.LAN4.LAN5.USB3.0.
- WAN access method PPPoE, Dynamic IP, Static IP, 3G/4G/5G;
- Static address assignment, virtual servers, port forwarding DMZ hosts;
- Module supply voltage: DC3.3V5A;

2. Module Specifications

2.1. Flowchart

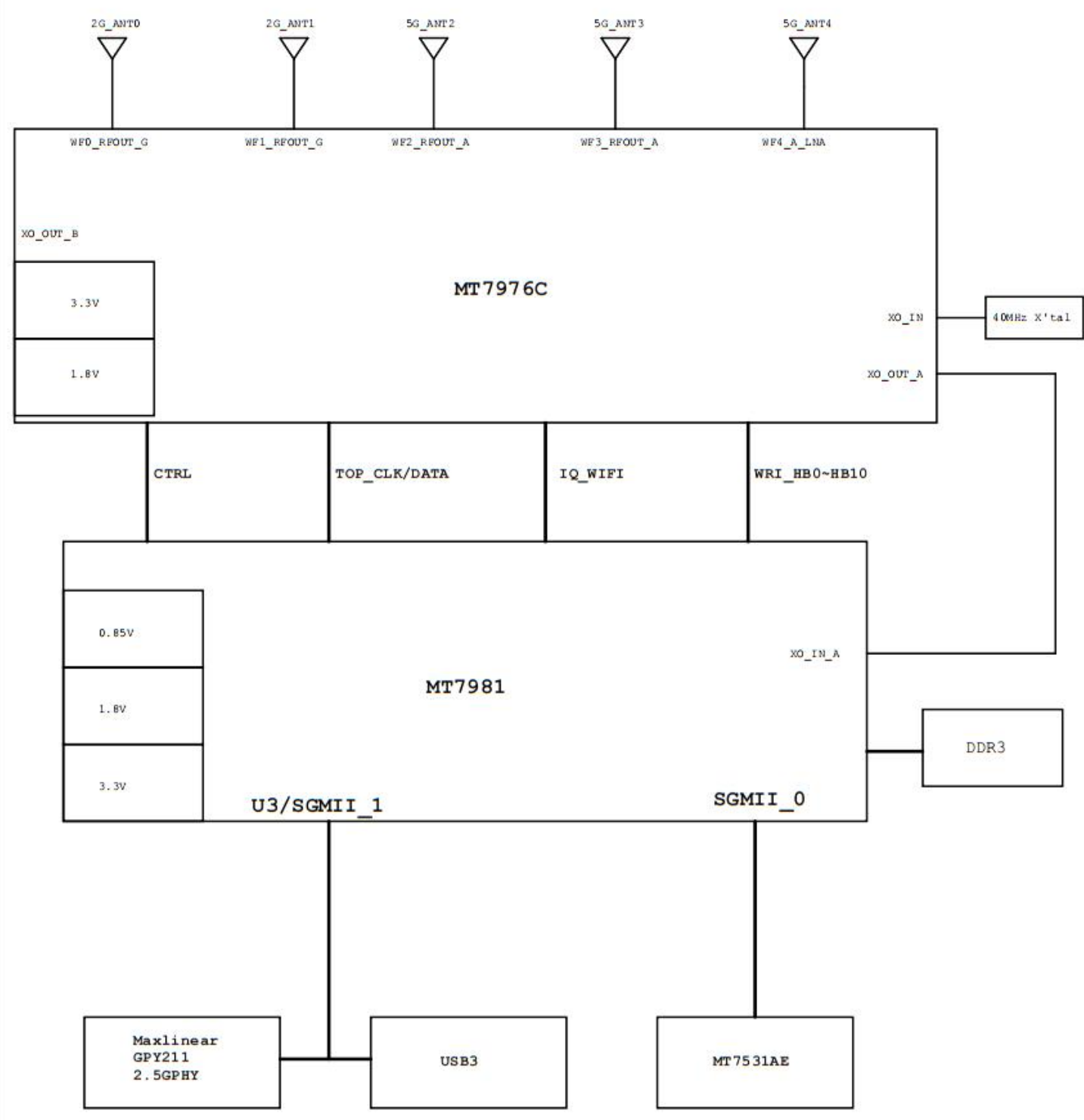


Figure 1.

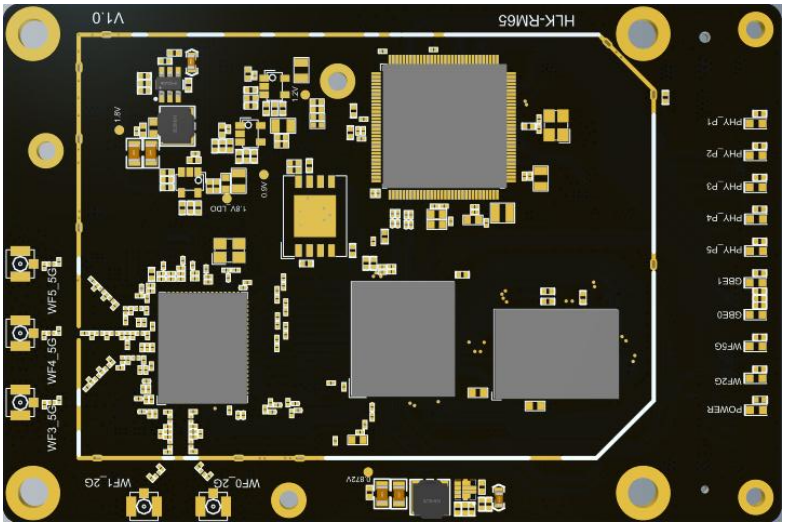
2.2. Technical specification

Module (computer)	Model number	HLK-RM65							
Wireless parameters	Wireless standard	MIMO IEEE 802.11 a/b/g/n/ac/ax							
	Frequency range	2.4-2.4835 GHz				5.180-5.885 GHz			
	Firing power	802.11b: +23±1.5dBm (11M)				802.11a: +20±1.5dBm (54M)			
		802.11g: +20±2dBm (54M)				802.11n(20M): +18±2dBm (MCS7)			
		802.11n(20M): +19±2dBm (MCS7)				802.11n(40M): +18±1.5dBm (MCS7)			
		802.11n(40M): +19±1.5dBm (MCS7)				801.11ac(20M):+17.5±2dBm (MCS9)			
		801.11ac(20M): +17±2dBm (MCS9)				801.11ac(40M): +17.5±1.5dBm (MCS9)			
		801.11ac: (40M)+17±1.5dBm (MCS9)				801.11ac(80M):+17.5±1.5dBm (MCS9)			
		802.11ax(20M): +17±1.5dBm (MCS11)				802.11ax(20M): +17±1.5dBm (MCS11)			
		802.11ax(40M): +16.5±1.5dBm (MCS11)				802.11ax(40M): +17±1.5dBm (MCS11)			
						802.11ax(80M): +17±1.5dBm (MCS11)			
						802.11ax(160M): +15.5±1.5dBm (MCS11)			
	Receiver sensitivity	Unit: dBm	ch1	ch6	ch13	Unit: dBm	ch50	ch114	ch163
		2G BW20: (MCS0)	-93.5	-93.5	-93.5	5G BW20: (MCS0)	-92.5	-92.5	-92.5
		2G BW20: (MCS7)	-74.5	-74	-74	5G BW20: (MCS7)	-73.5	-73.5	-73.5
		2G BW20: (MCS9)	-68.5	-68	-68	5G BW20: (MCS9)	-68	-68	-68
		2G BW20: (MCS11)	-63	-63	-63.5	5G BW20: (MCS11)	-62	-62	-62
		2G BW40: (MCS0)	-90.5	-90.5	-90.5	5G BW160: (MCS0)	-83	-83	-83
		2G BW40: (MCS7)	-71.5	-71.5	-71.5	5G BW160: (MCS7)	-64.5	-64.5	-64.5
		2G BW40: (MCS9)	-65.5	-65.5	-65.5	5G BW160: (MCS9)	-58.5	-59	-59
		2G BW40: (MCS11)	-60	-60	-60	5G BW160: (MCS11)	-53	-53.5	-53.5
	Antenna form	External: I-PEX Generation Antenna Mount *5							
Hardware parameters	Storage capacity	DDR3: 256M(2Gbit); Nand Flash: 128M(1Gbit)							
	Hardware interface	UART,IIC,GPIO, SPI,USB,PWM							

	Network port	Gigabit Ethernet ports*6: WAN*1, LAN*5	
	USB	Partial foot reuse	USB3.0*
	PCIe		PCIe*1
	SGMII		2.5G SGMII*1
	Operating voltage	3.3V	
	Operating Current	Under continuous transmission => average: 2.8A@3.3V (3.3V power supply capacity of 5A or more is recommended) Normal mode => average: 1.27A@3.3	
	IO drive capability	VMax: 12ma	
	Temp	Working Temperature: -20℃~80℃	
	Package Size	60*90mm	
	Storage environment	Temperature: 5~40℃, Relative Humidity: 10%~90%R.H.	
Software parameter	Wireless Network Type	STA/AP/APClient	
	Firmware Upgrade	Web page upgrade, command port upgrade	
	Network protocol	IPv4, TCP/UDP	
	Software environment	Openwrt	
	User configuration	Web Configuration	

Table 1: Technical specifications

2.3. Product Pictures



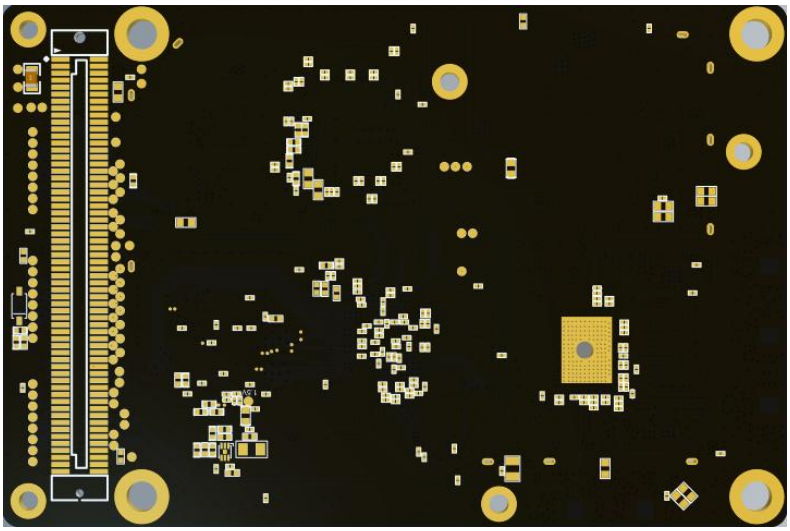


Figure 2. Module picture

3. Application Areas

- Smart Home;
- Instrumentation;
- Wi-Fi remote monitoring/control;
- Toy field;
- Color LED control;
- Routing Gateway;
- Smart Agriculture;
- Home Routing;
- Intelligent integrated management of fire and security;
- Smart card terminals, wireless POS, handheld devices, etc.

4. Module Pinout

Chip leg	Pin Description	HLK-RM65 Module Interface Pin Definition				Pin Description	Chip leg
		NO.	Pin Name	NO.	Pin Name		
	Power pin: +3.3V	1	VCC	2	VCC	Power pin: +3.3V	
	Power pin: +3.3V	3	VCC	4	VCC	Power pin: +3.3V	
	Power pin: +3.3V	5	VCC	6	VCC	Power pin: +3.3V	
	GND	7	GND	8	VCC	Power pin: +3.3V	
For MT7531AE Pin 30	Network port P5/LAN	9	ESW_TXVP_D_P5	10	VCC	Power pin: +3.3V	
For MT7531AE Pin 31	Network port P5/LAN	11	ESW_TXVN_D_P5	12	GND	GND	
For MT7531AE Pin 28	Network port P5/LAN	13	ESW_TXVP_C_P5	14	GND	GND	
For MT7531AE Pin 29	Network port P5/LAN	15	ESW_TXVN_C_P5	16	GND	GND	
For MT7531AE Pin 25	Network port P5/LAN	17	ESW_TXVP_B_P5	18	GND	GND	
For MT7531AE Pin 26	Network port P5/LAN	19	ESW_TXVN_B_P5	20	GND	GND	
For MT7531AE Pin 22	Network port P5/LAN	21	ESW_TXVP_A_P5	22	SMI_MDC	MDC	For MT7981B Pin L17
For MT7531AE Pin 23	Network port P5/LAN	23	ESW_TXVN_A_P5	24	SMI_MDIO	MDIO	For MT7981B Pin K17
	GND	25	GND	26	GND	GND	
For MT7531AE Pin 9	Network port P4/LAN	27	ESW_TXVP_D_P4	28	ESW_P1_LED	P1 Status LED	For MT7531AE Pin 81

For MT7531AE Pin 10	Network port P4/LAN	29	ESW_TXVN_D_P4	30	ESW_P2_LED	P2 Status LED	For MT7531AE Pin 79
For MT7531AE Pin 7	Network port P4/LAN	31	ESW_TXVP_C_P4	32	ESW_P3_LED	P3 Status LED	For MT7531AE Pin 75
For MT7531AE Pin 8	Network port P4/LAN	33	ESW_TXVN_C_P4	34	ESW_P4_LED	P4 Status LED	For MT7531AE Pin 74
For MT7531AE Pin 4	Network port P4/LAN	35	ESW_TXVP_B_P4	36	ESW_P5_LED	P5 Status LED	For MT7531AE Pin 70
For MT7531AE Pin 5	Network port P4/LAN	37	ESW_TXVN_B_P4	38	PWM0	PWM **Startup-related***	For MT7981B Pin D20
For MT7531AE Pin 2	Network port P4/LAN	39	ESW_TXVP_A_P4	40	GPIO_WPS	WPS Features	For MT7981B Pin E17
For MT7531AE Pin 3	Network port P4/LAN	41	ESW_TXVN_A_P4	42	GPIO_RESET	Pull down 1s reset Pull down 8s to restore factory	For MT7981B Pin E18
	GND	43	GND	44	GND	GND	
For MT7531AE Pin 126	Network port P3/LAN	45	ESW_TXVP_D_P3	46	SPI1_MISO	SPI1	For MT7981B Pin A18
For MT7531AE Pin 127	Network port P3/LAN	47	ESW_TXVN_D_P3	48	SPI1_MOSI	SPI1	For MT7981B Pin B18
For MT7531AE Pin 123	Network port P3/LAN	49	ESW_TXVP_C_P3	50	SPI1_CLK	SPI1	For MT7981B Pin A19
For MT7531AE Pin 124	Network port P3/LAN	51	ESW_TXVN_C_P3	52	SPI1_CS	SPI1	For MT7981B Pin C17

For MT7531AE Pin 120	Network port P3/LAN	53	ESW_TXVP_B_P3	54	GND	GND	
For MT7531AE Pin 121	Network port P3/LAN	55	ESW_TXVN_B_P3	56	UART0_TXD	Debug port, baud rate 115200	For MT7981B Pin G17
For MT7531AE Pin 117	Network port P3/LAN	57	ESW_TXVP_A_P3	58	UART0_RXD	Debug port, baud rate 115200	For MT7981B Pin G16
For MT7531AE Pin 118	Network port P3/LAN	59	ESW_TXVN_A_P3	60	GND	GND	
	GND	61	GND	62	SPI2_CS	SPI2	For MT7981B Pin V2
For MT7531AE Pin 112	Network port P2/LAN	63	ESW_TXVP_D_P2	64	SPI2_HOLD	SPI2	For MT7981B Pin U2
For MT7531AE Pin 113	Network port P2/LAN	65	ESW_TXVN_D_P2	66	SPI2_WP	SPI2	For MT7981B Pin U1
For MT7531AE Pin 109	Network port P2/LAN	67	ESW_TXVP_C_P2	68	SPI2_CLK	SPI2 **Startup-related***	For MT7981B Pin T2
For MT7531AE Pin 110	Network port P2/LAN	69	ESW_TXVN_C_P2	70	SPI2_MISO	SPI2	For MT7981B Pin T1
For MT7531AE Pin 106	Network port P2/LAN	71	ESW_TXVP_B_P2	72	SPI2_MOSI	SPI2	For MT7981B Pin T3
For MT7531AE Pin 107	Network port P2/LAN	73	ESW_TXVN_B_P2	74	SYS_WATCHDOG		For MT7981B Pin R1
For MT7531AE Pin 103	Network port P2/LAN	75	ESW_TXVP_A_P2	76	GBE_LED1		For MT7981B Pin R2

For MT7531AE Pin 104	Network port P2/LAN	77	ESW_TXVN_A_P2	78	GBE_LED0		For MT7981B Pin M4
	GND	79	GND	80	SYSRSTB		For MT7981B Pin N2
For MT7531AE Pin 100	Network port P1/LAN	81	ESW_TXVP_D_P1	82	PCIE_PERESET_N	PCIE reset	For MT7981B Pin N3
For MT7531AE Pin 101	Network port P1/LAN	83	ESW_TXVN_D_P1	84	WF5G_LED	5G WiFi LED	For MT7981B Pin M2
For MT7531AE Pin 97	Network port P1/LAN	85	ESW_TXVP_C_P1	86	WF2G_LED	2.4G WiFi LED	For MT7981B Pin M1
For MT7531AE Pin 98	Network port P1/LAN	87	ESW_TXVN_C_P1	88	USB_VBUS	USB_VBUS **Startup-related***	For MT7981B Pin L3
For MT7531AE Pin 93	Network port P1/LAN	89	ESW_TXVP_B_P1	90	GND	GND	
For MT7531AE Pin 94	Network port P1/LAN	91	ESW_TXVN_B_P1	92	USB_DP	USB D+	For MT7981B Pin K2
For MT7531AE Pin 91	Network port P1/LAN	93	ESW_TXVP_A_P1	94	USB_DM	USB D-	For MT7981B Pin K3
For MT7531AE Pin 92	Network port P1/LAN	95	ESW_TXVN_A_P1	96	GND	GND	
	GND	97	GND	98	PCIE_CKN/NC*	PCIE CLK pin CK -/NC*	For MT7981B Pin H3
For MT7981B Pin M20	Network port P0/WAN	99	ESW_TXVP_D_P0	100	PCIE_CKP/NC*	PCIE CLK pin CK +/NC*	For MT7981B Pin H2

For MT7981B Pin M19	Network port P0/WAN	101	ESW_TXVN_D_P0	102	GND	GND	
For MT7981B Pin N19	Network port P0/WAN	103	ESW_TXVP_C_P0	104	SSUSB_RXN	USB3.0	For MT7981B Pin G2
For MT7981B Pin N20	Network port P0/WAN	105	ESW_TXVN_C_P0	106	SSUSB_RXP	USB3.0	For MT7981B Pin G1
For MT7981B Pin R19	Network port P0/WAN	107	ESW_TXVP_B_P0	108	GND	GND	
For MT7981B Pin P19	Network port P0/WAN	109	ESW_TXVN_B_P0	110	SSUSB_TXN	USB3.0	For MT7981B Pin F1
For MT7981B Pin T20	Network port P0/WAN	111	ESW_TXVP_A_P0	112	SSUSB_TXP	USB3.0	For MT7981B Pin F2
For MT7981B Pin T19	Network port P0/WAN	113	ESW_TXVN_A_P0	114	GND	GND	
	GND	115	GND	116	GND	GND	
	GND	117	GND	118	VCC	Power pin: +3.3V	
	Power pin: +3.3V	119	VCC	120	VCC	Power pin: +3.3V	

Startup-related*: Startup-related pins cannot be pulled up and down during module startup.

/NC*:The interface compatible with PCIE of MT7981A scheme is reserved, the MT7981B interface has no function.

Table 2. Pin Descriptions

Foot Reuse Description

（See the MT7981B datasheet for detailed multiplexing information.）

Foot order	Function 1	Function 2	Function 3
104	SSUSB_RXN	SGMII1 data pin RX -	PCIE_LN0_RXN
106	SSUSB_RXP	SGMII1 data pin RX +	PCIE_LN0_RXP
110	SSUSB_TXN	SGMII1 data pin TX -	PCIE_LN0_TXN
112	SSUSB_TXP	SGMII1 data pin TX +	PCIE_LN0_TXP
68	SPI2_CLK	UART1_RXD	
72	SPI2_MOSI	UART1_TXD	
50	SPI1_CLK	UART2_RXD	
48	SPI1_MOSI	UART2_TXD	

Foot order	Pin Names/Functions	Pin Description	Reuse
USB3.0			
104	SSUSB_RXN	USB_RXN data pin RX -	**reuse**
106	SSUSB_RXP	USB_RXP data pin RX +	**reuse**
110	SSUSB_TXN	USB_TXN data pin TX -	**reuse**
112	SSUSB_TXP	USB_TXP data pin TX +	**reuse**
92	USB_DP	USB data pin Data +	
94	USB_DM	USB data pin Data -	
SGMII			
104	SGMII_LN1_RXN	SGMII1 data pin RX -	**reuse**
106	SGMII_LN1_RXP	SGMII1 data pin RX +	**reuse**
110	SGMII_LN1_TXN	SGMII1 data pin TX -	**reuse**
112	SGMII_LN1_TXP	SGMII1 data pin TX +	**reuse**

Table 3. Introduction of multifunctional reuse

5. Electrical parameters

Parameters	Minimal	Typical Case	Maximum	Unit
Module supply voltage	3.1	3.3	3.5	V
Chip supply voltage	3.1	3.3	3.5	V
I/O Voltage	3.1	3.3	3..5	V
Average module power consumption		4.0		W
Module Current Peak		2.8		A
Supply Current Requirements		≥5		A
Power supply ripple requirements		≤50		mV
ESD Contact Discharge	-	±2	-	KV
ESD non-contact discharge	-	±2	-	KV

Table 4. Electrical parameters

6. Pin Definitions

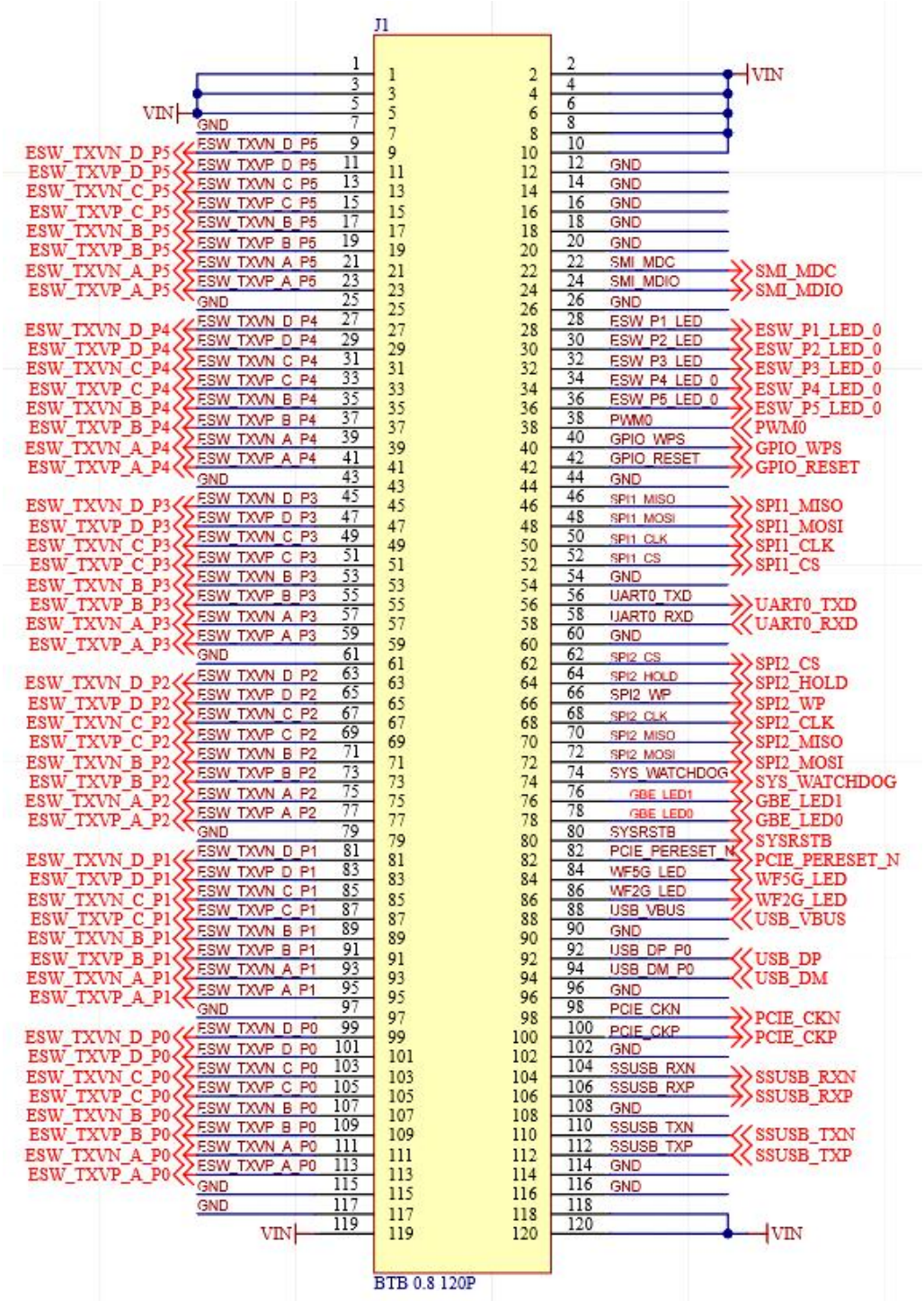


Figure 3. Module Interface Definition

Description:

1，GPIO drive capacity 12mA.

2，Certain functions need to be realized in conjunction with the appropriate software.

7. Description of the test substrate

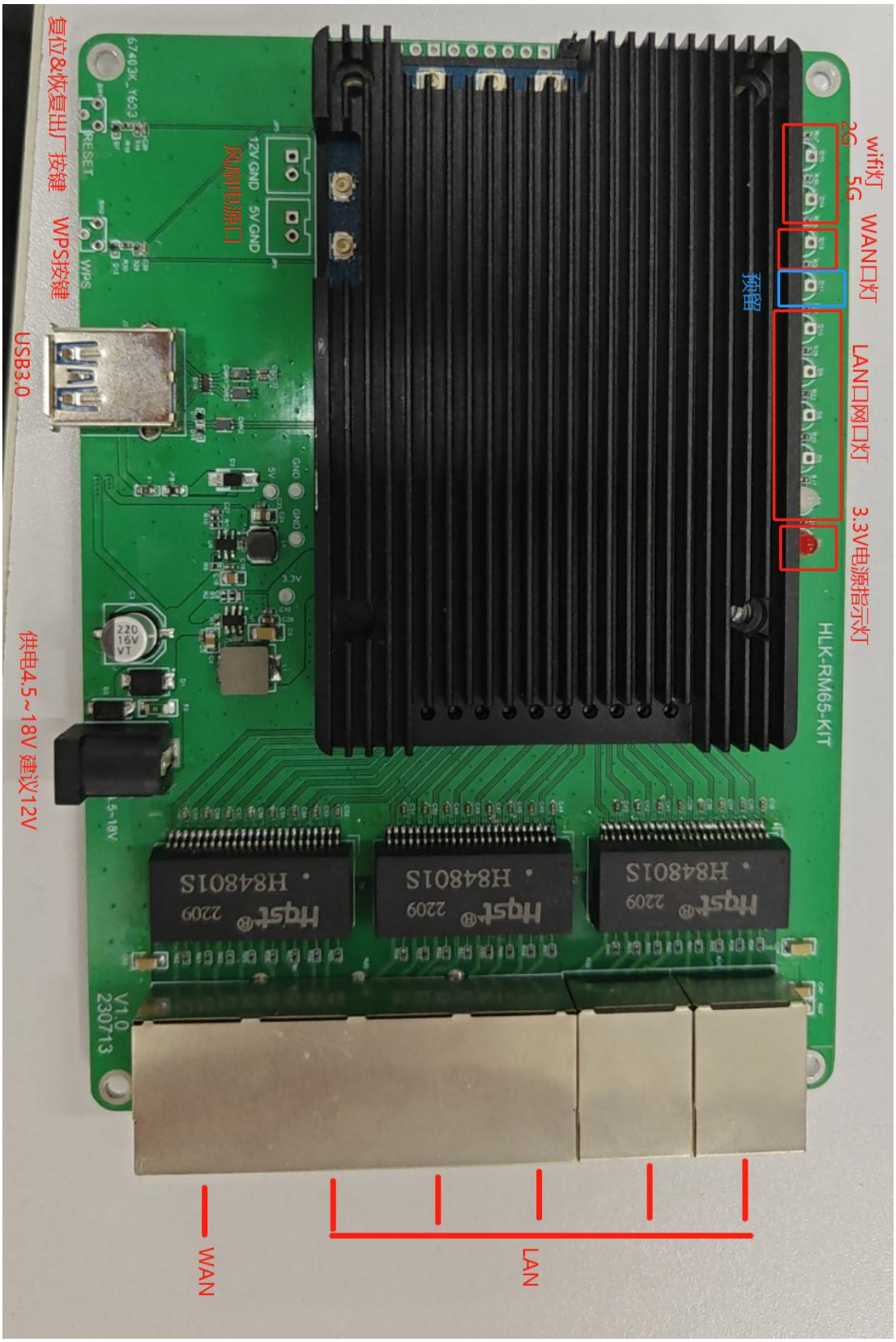


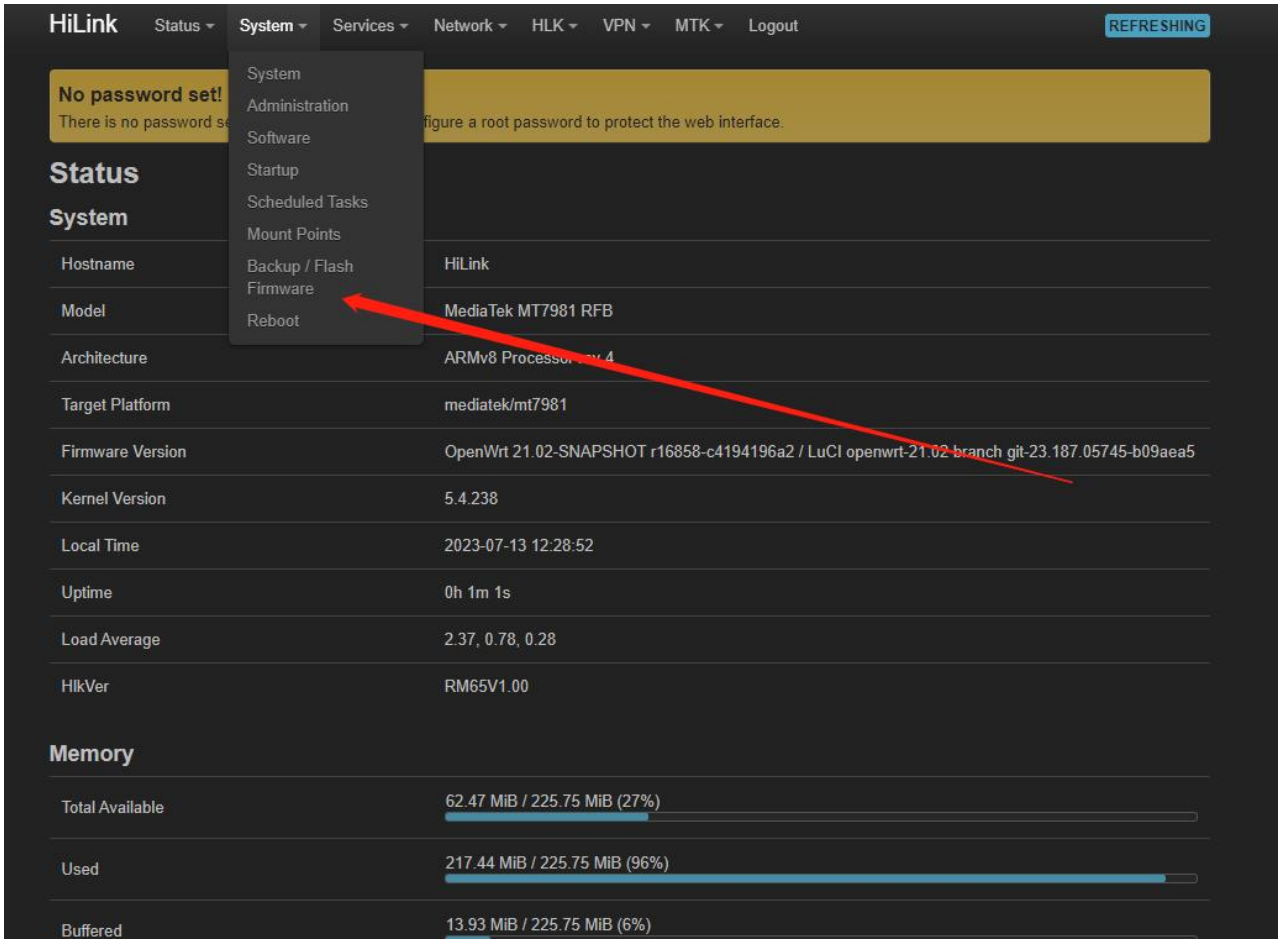
Figure 4. Illustration of the test base plate

8. Software upgrade instructions

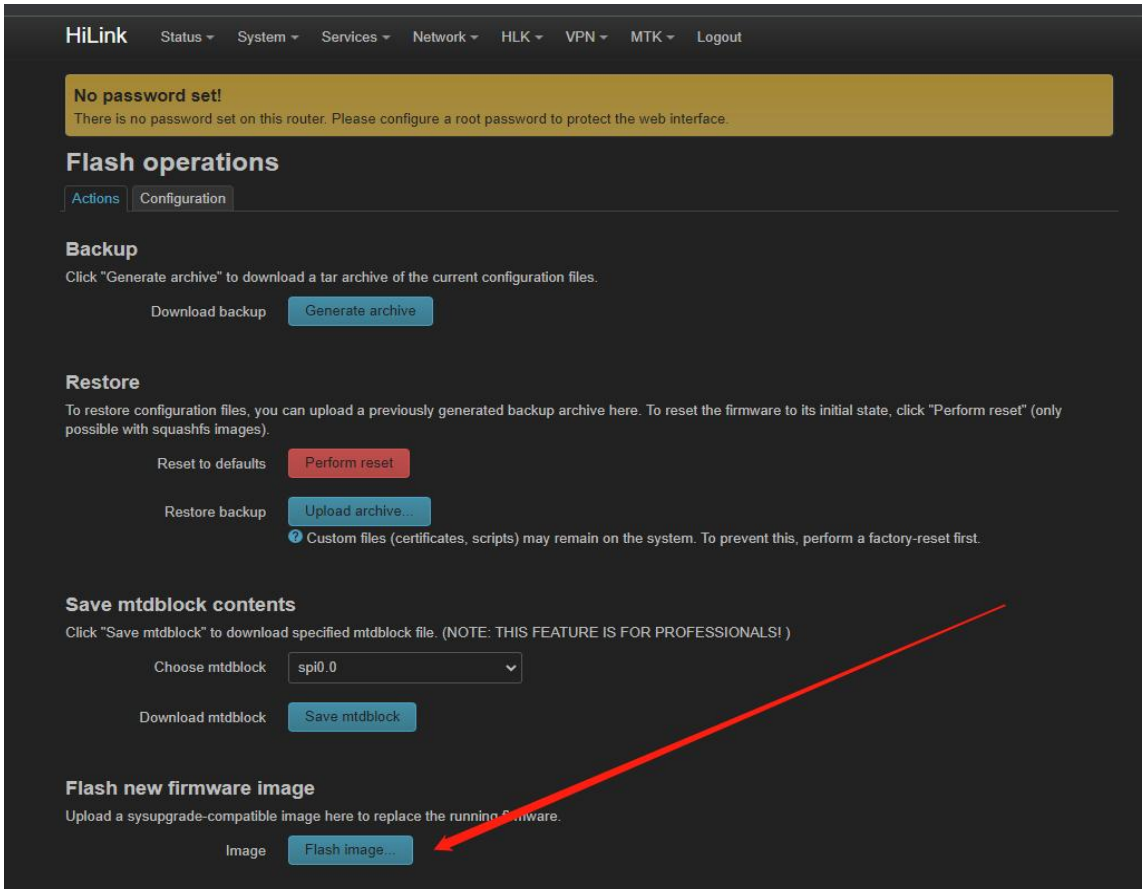
1、Module start LAN into the web page background 192.168.16.254;

2、Default user name is root and password is empty;

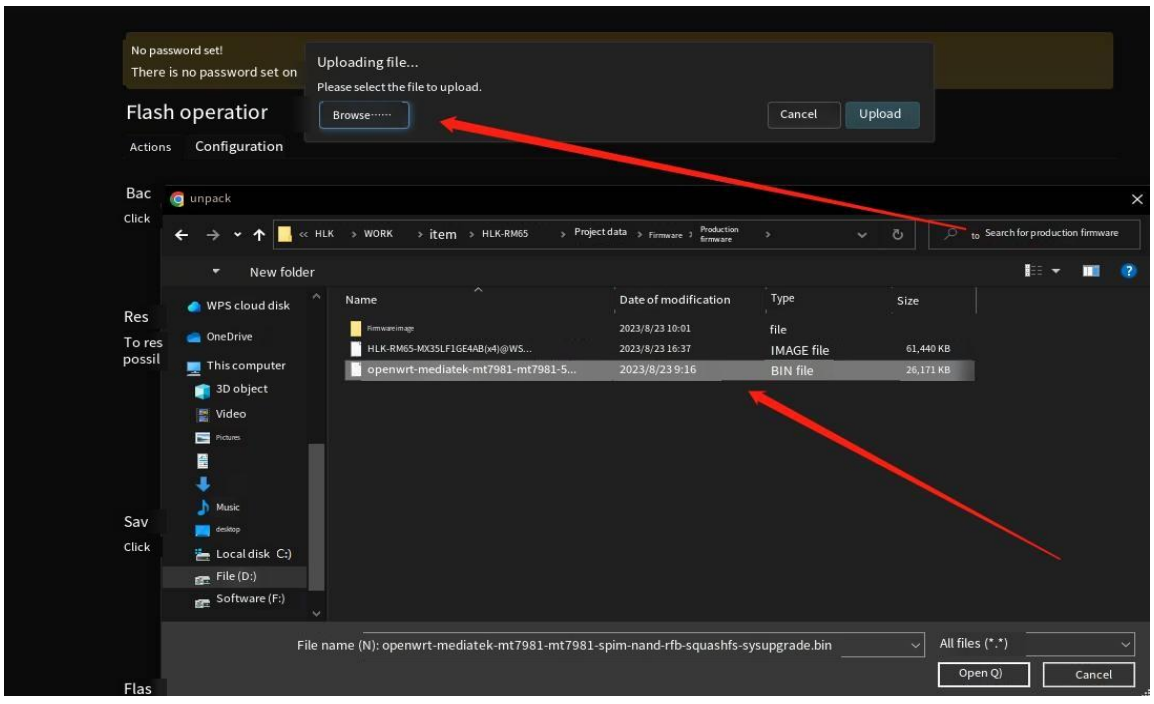
3、Click "System" and select "Backup and Upgrade";



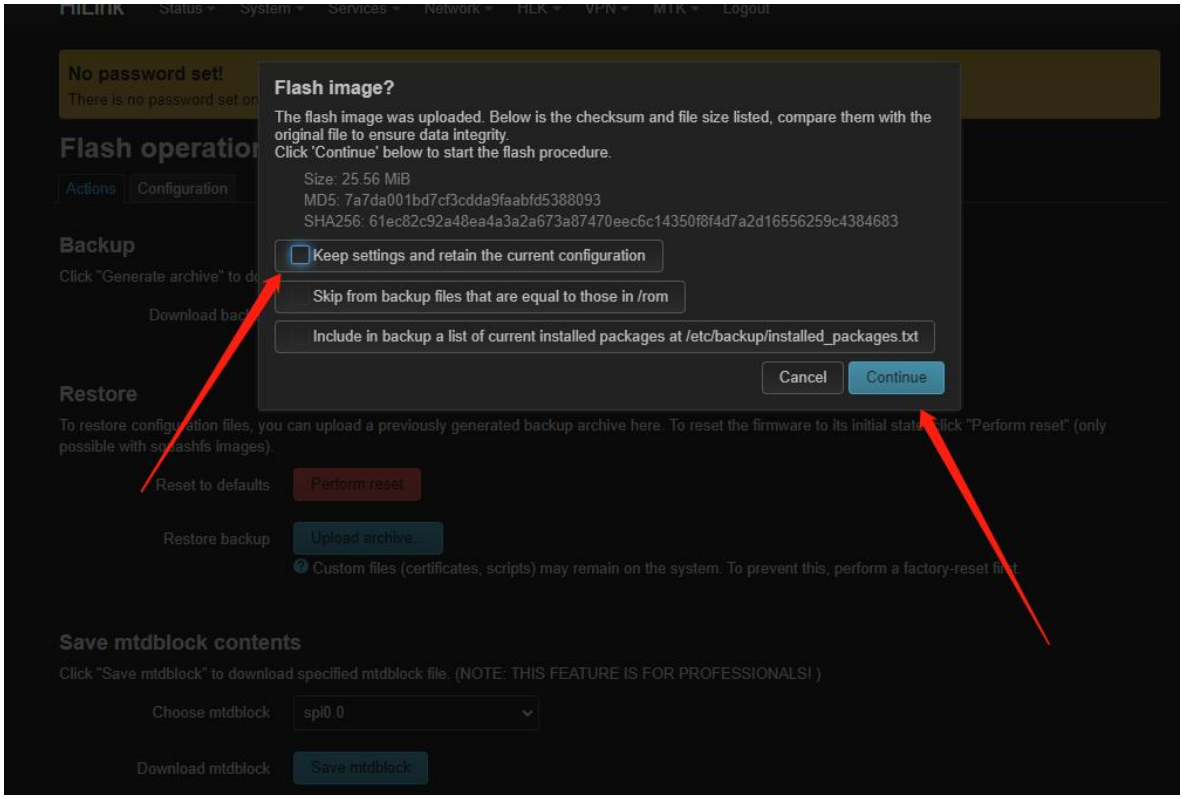
4、Select to brush the firmware;



5、Select the firmware that needs to be upgraded;

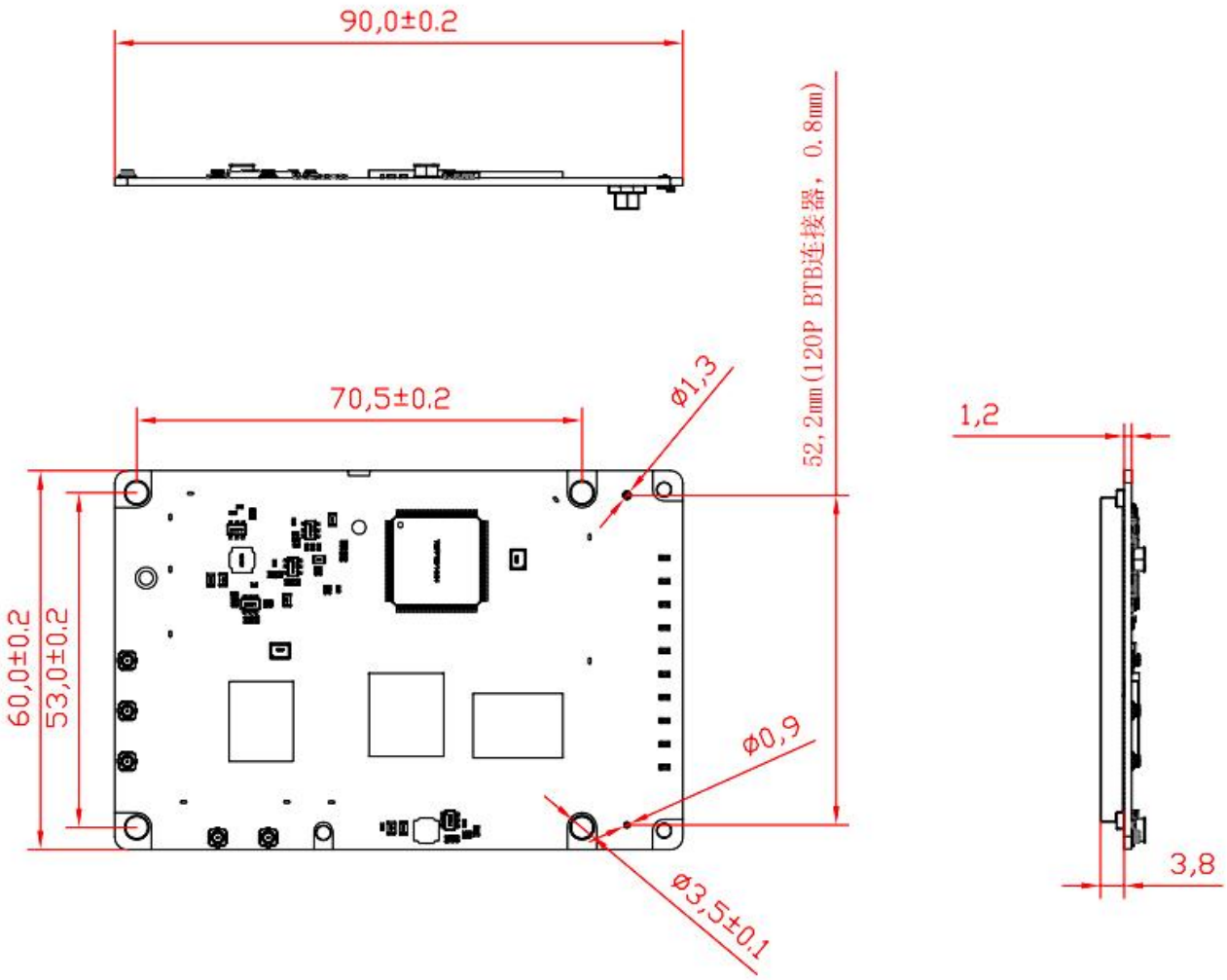


6、After uploading the firmware, cancel all the boxes, click upload, and wait for the module to reboot automatically after upgrading successfully.



9. Mechanical dimensions

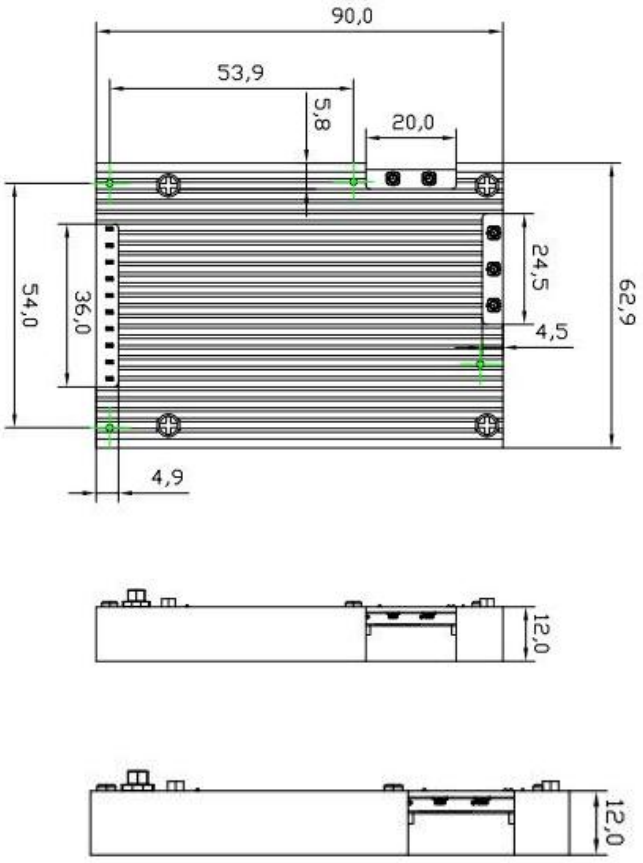
Single Module Size

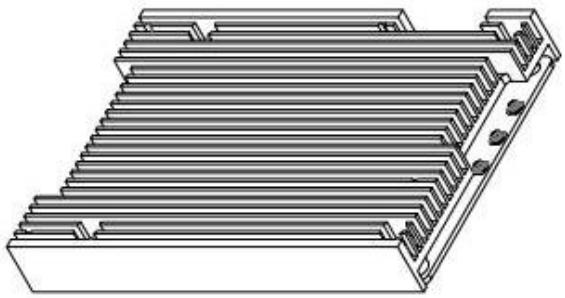


Unit: millimeters (mm)

Figure 5. Module Size

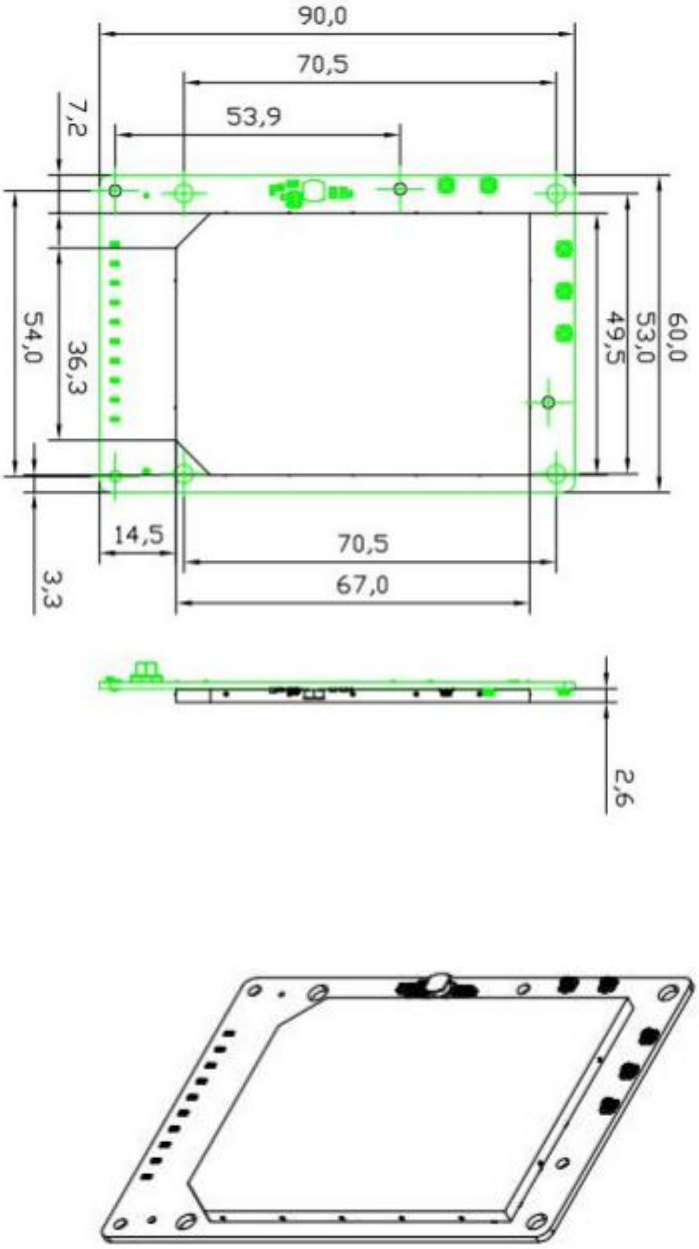
Radiator shield separated size (default use)





Unit: millimeters (mm)

Figure 6. Separated Radiator Dimensions



Unit: millimeters (mm)

Figure7. Separated Shield Dimensions

Shield Size

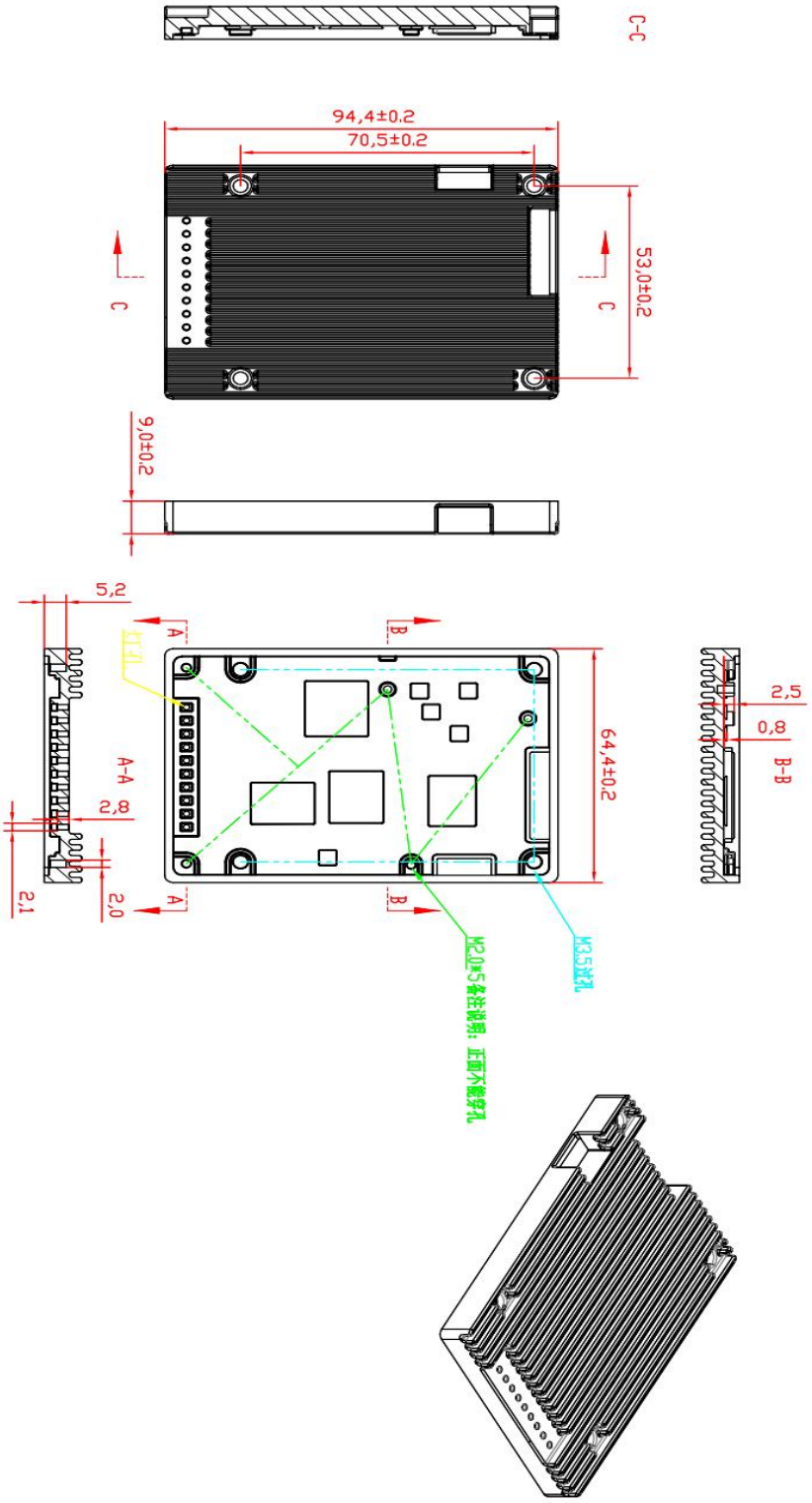
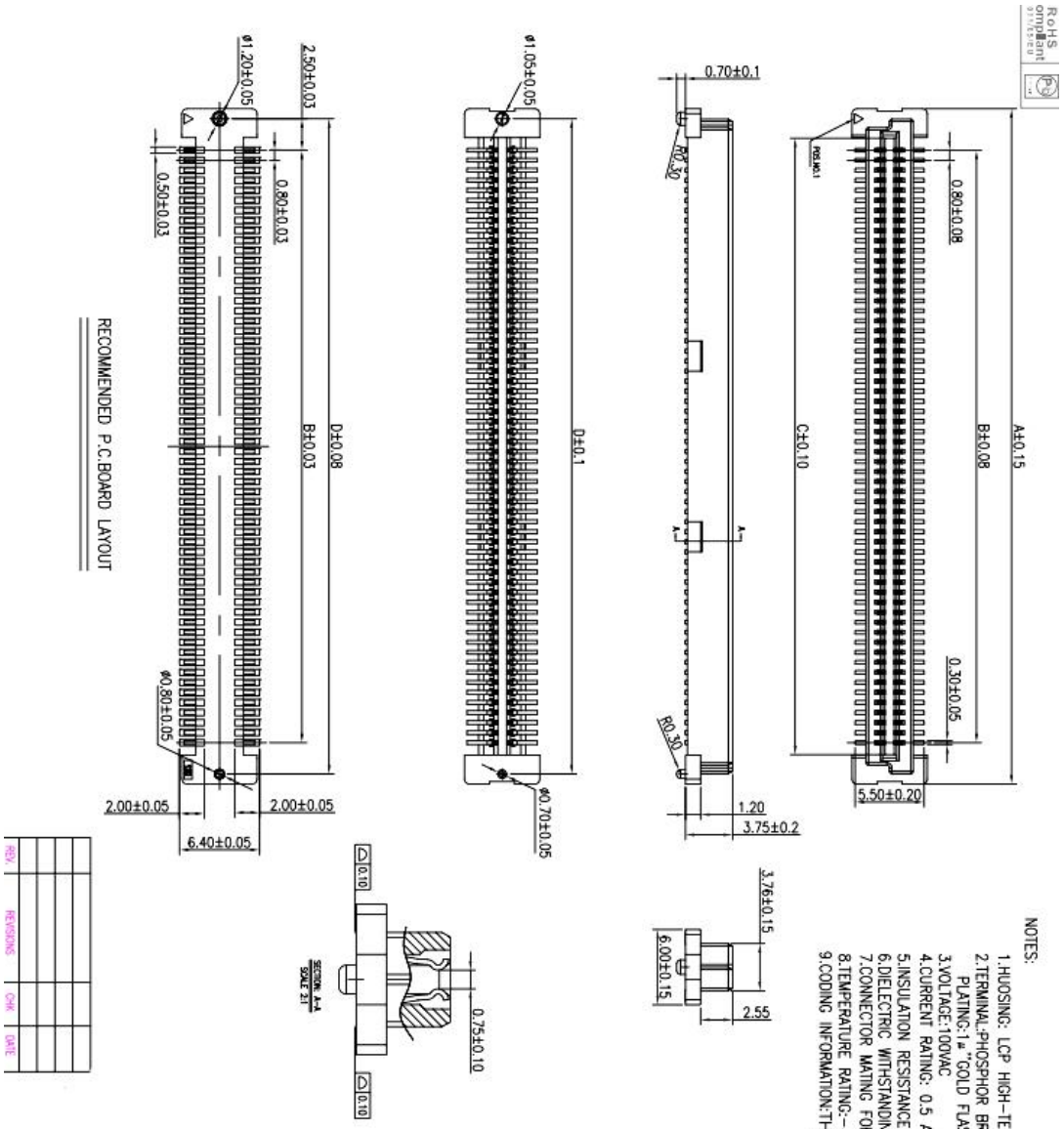


Figure 8. Shield Cover Dimensions

Unit: millimeters (mm)

BTB Connector (120P 0.8mm Female) Dimensions



NO.of contacts	Dimensions			
	A.	B.	C.	D.
40	21.80	15.20	17.10	20.20
60	29.80	23.20	25.10	28.20
80	37.80	31.20	33.10	36.20
100	45.80	39.20	41.10	44.20
120	53.80	47.20	49.10	52.20
140	61.80	55.20	57.10	60.20
160	69.80	63.20	65.10	68.20
180	77.80	71.20	73.10	76.20
200	85.80	79.20	81.10	84.20

Figure 9. BTB Connector Specification

Unit: millimeters (mm)

Appendix A Document Revision Log

Version Number	Scope of revision	Date
V1.0	Initial version.	August 23, 2023
V1.1	Added specification of shielding heat dissipation dimensions.	September 21, 2023
V1.2	Modified the foot position description.	January 17, 2024