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Hi-Link HLK-RM65 WiFI6 Wireless Router Module

Version: V1.0 Revision Date: August 11, 2023 Copyright © Shenzhen Hi-Link Electronic Co.,Ltd

Products

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.

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;

Module Specifications

Flowchart

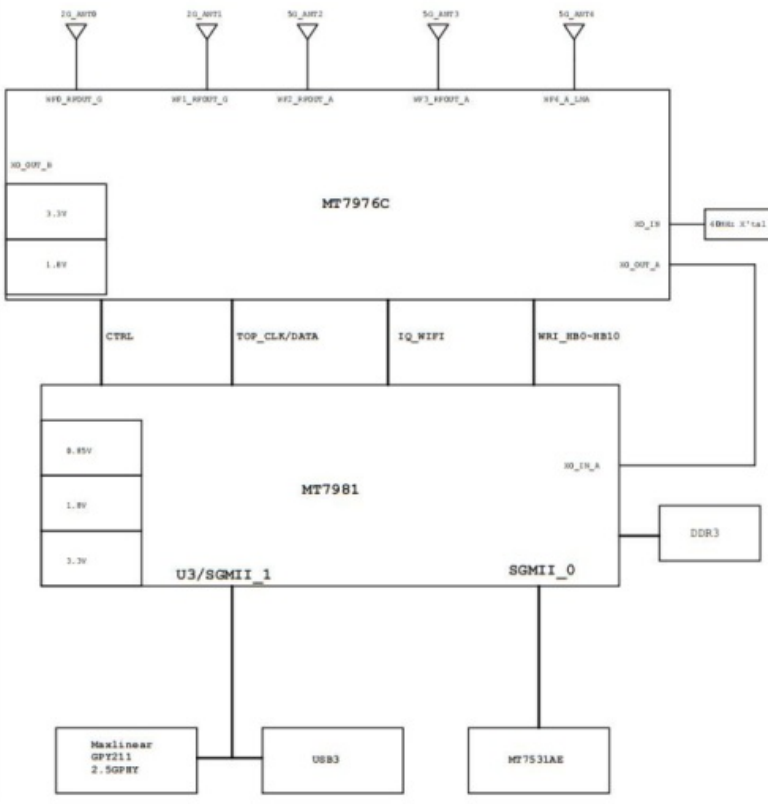

Figure 1.

Technical specification

Module (computer)	Model number	HLK-RM65							
	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)			
Wireless parameters	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

Product Pictures

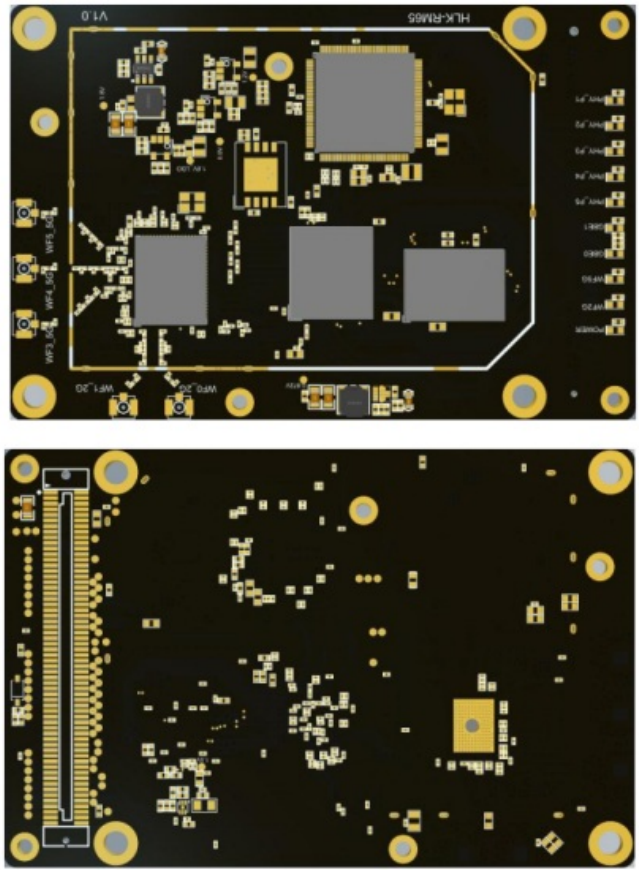

Figure 2. Module picture

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.

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.

/The interface compatible with PCIE of the 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

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

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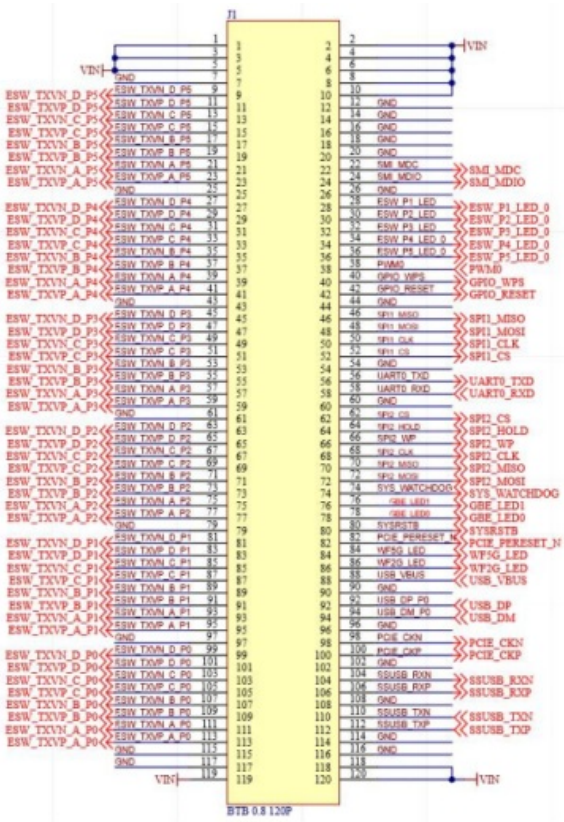


Figure 3. Module Interface Definition

Figure 3. Module Interface Definition

Description:

1. GPIO drive capacity 12mA.

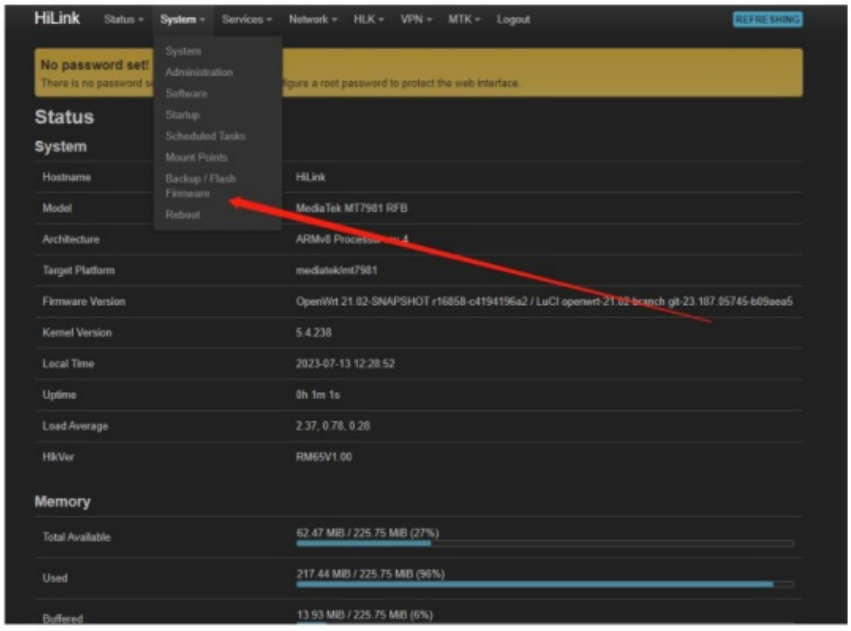
2. Certain functions need to be realized in conjunction with the appropriate software.

Description of the test substrate

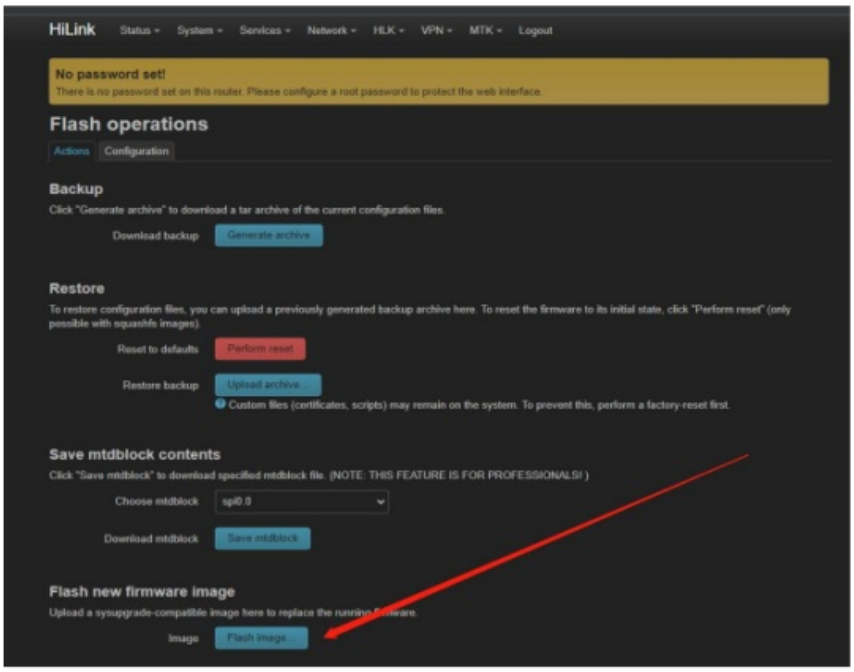
Figure 4. Illustration of the test base plate

Software upgrade instructions

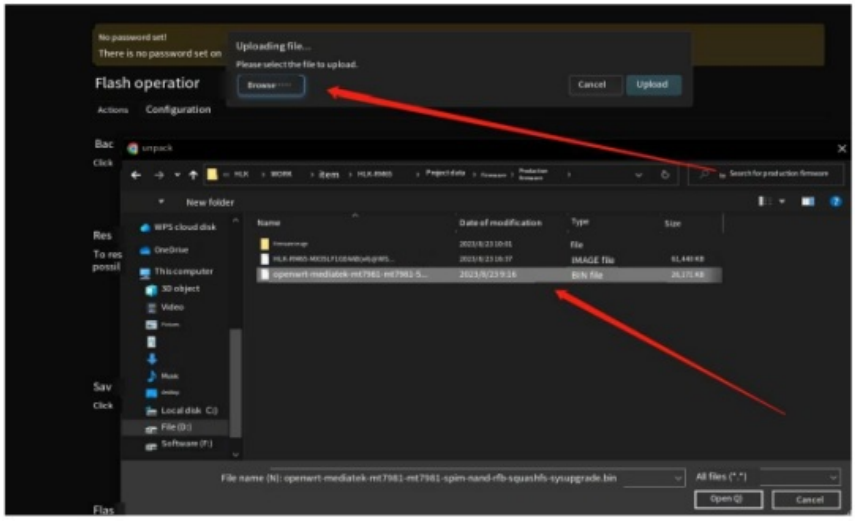
1. Module start LAN into the web page background 192.168.16.254;
2. Default user name is root and password is empty;
3. Click “System” and select “Backup and Upgrade”;



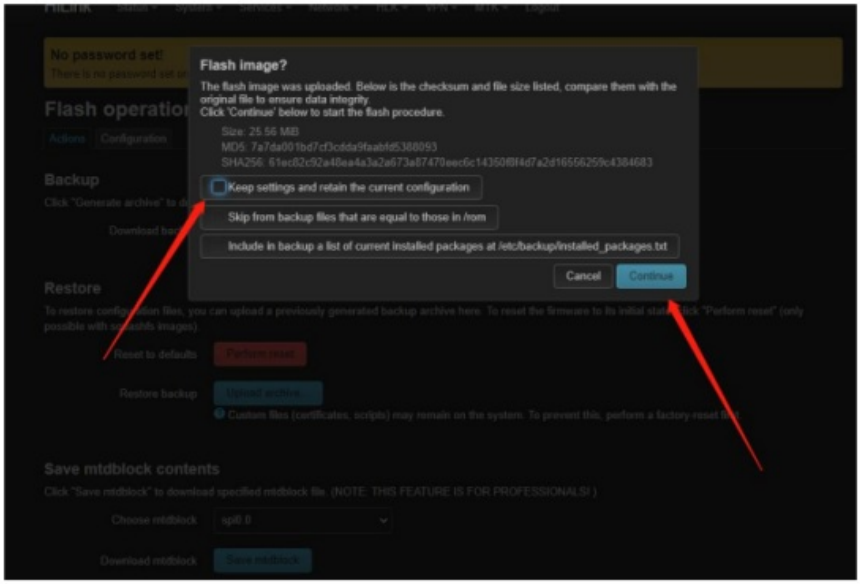
4. Select to brush the firmware;



5. Select the firmware that needs to be upgraded;



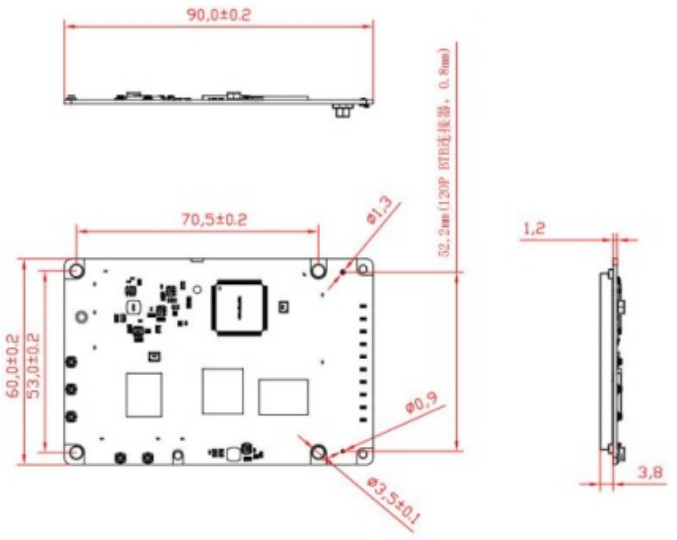
6. After uploading the firmware, cancel all the boxes, click upload, and wait for the module to reboot automatically after upgrading successfully.



Mechanical dimensions

Single Module Size

Single Module Size

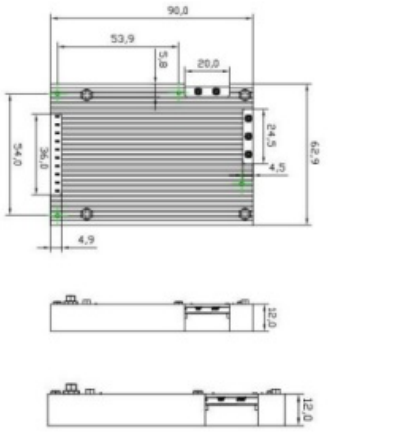


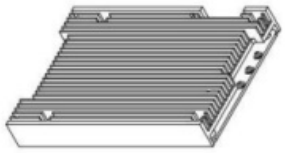
Unit: millimeters (mm)

Figure 5. Module Size

Radiator shield separated size (default use)

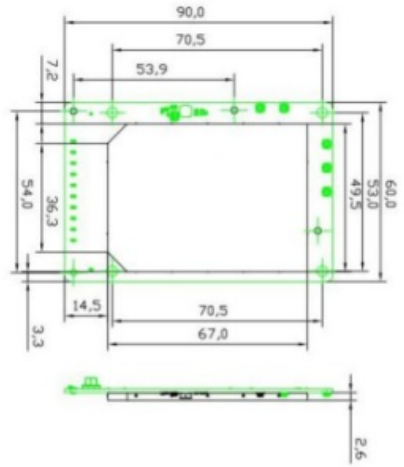
Radiator shield separated size (default use)

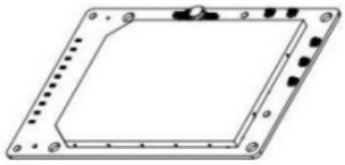




Unit: millimeters (mm)

Figure 6. Separated Radiator Dimensions





Unit: millimeters (mm)

Figure7. Separated Shield Dimensions

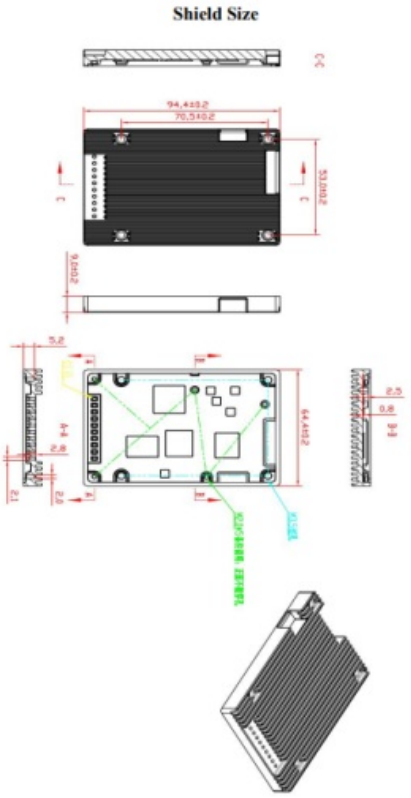


Figure 8. Shield Cover Dimensions Unit: millimeters (mm)

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

1. KDB 996369 D03 statements
2. List of applicable FCC rules:

   The module complies with FCC Part 15.247, FCC Part 15.407.

   FCC ID: 2AD56HLK-RM65 on User manual and on the external of the packaging.
3. Summarize the specific operational use conditions

   When installed in smart terminal products, the host manufacturer must negotiate with the module manufacturer on the final installation method in the system. The host manufacturer installing this module into their product must ensure that the final compost product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation. The host manufacturer has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product that

integrates this module. The end user manual shall include all required regulatory information warnings as show in this manual.

The module should be installed and operated with a minimum distance 20cm between the radiator & your body. and if RF exposure statement or module layout is changed, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID or new application. The FCC ID of the module cannot be used on the final product. In these circumstances, the host manufacturer will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization. When the host is a portable device, it is necessary to take a SAR test with your set mounted with this module. Class ll permissive change application is necessary using the SAR report. And an application for a Class ll permissive change from Mobile equipment to Portable equipment is also required.

Note) **Portable equipment:** Equipment for which the spaces between the human body and antenna are used within 20cm. Mobile equipment: Equipment used at a position in where the spaces between the human body and the antenna exceeded 20cm.

1. According to the following requirements of the power supply DCV, power up, about seconds to complete the initial.
2. iPhone / Android mobile phone WiFi function to open, search to the corresponding Wireless network adapter name (name can be changed according to customer production requirements), click the name of the WiFi and select the connection.

4. open application software (need to install the company's specific application software development application software interface can be customized according to the customer's product requirements).
5. **Limited module procedures**

   The module is not a limited module.
6. **Trace antenna designs**

   Not applicable
7. **RF exposure considerations**

   The module complies with FCC radiation exposure limits set forth for an uncontrolled environment. The module should be installed and operated with a minimum distance of 20 cm between the radiator & your body.
8. **Antennas**

This module has been approved to operate with the antenna types listed below, with the maximum permissible gain indicated. The module antenna requires professional installation, and the antenna type cannot be changed. The gain cannot exceed 4.69dBi.

Frequency band	Antenna Type	Antenna Max. Gain
2400-2500MHz	Dipole Antenna	3.76 dBi
5150-5850MHz	Dipole Antenna	4.69 dBi

9. **Label and compliance information**

   The host system using this module should have a label in a visible area indicating the following texts: “Contains FCC ID: 2AD56HLK-RM65

10. Information on test modes and additional testing requirements

    When testing host product, the host manufacturer should follow FCC KDB Publication 996369

    D04 Module Integration Guide for testing the host products. The host manufacturer may operate their product during the measurements. In setting up the configurations, if the pairing and call box options for testing does not work, then the host product manufacturer should coordinate with the module manufacturer for access to test mode software.

    The module has been certified for Potable applications. This transmitter must not be colocated or operate in conjunction with any other antenna or transmitter

11. **Additional testing, Part 15 Subpart B disclaimer**

    The module without unintentional-radiator digital circuity, so the module does not require an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B.

12. Note EMI Considerations host manufacturer is recommended to use D04 Module Integration Guide, recommending as “best practice” RF design, engineering testing and evaluation in case non-linear interactions generate additional non-compliant limits due to module placement to host components or properties

13. **How to make changes**

    This module is a stand-alone module. If the end product involves Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system. According to the KDB 996369 D02 Q&A Q12, that a host manufacturer only needs to do an evaluation (i.e., no C2PC required when no emission exceeds the limit of any individual device (including

unintentional radiators) as a composite. The host manufacturer must fix any failure.

For USA: The frequency stability of all transmission frequencies of U-NII-1, U-NII 2A, U-NII 2C and U-NII-3 meets the requirements of 47 CFR FCC Part 15.407 (g), and the manufacturer declares that their transmission is maintained at Band U-NII-1, U-NII 2A, U-NII 2C and U-NII-3.

Documents / Resources

	Hi-Link HLK-RM65 WiFI6 Wireless Router Module [pdf] User Guide HLK-RM65, 2AD56HLK-RM65, 2AD56HLKRM65, HLK-RM65 WiFI6 Wireless Router Module, HLK-RM65, WiFI6 Wireless Router Module, Wireless Router Module, Router Module, Module

References

- User Manual

Hi-Link

2AD56HLK-RM65, 2AD56HLKRM65, Hi-Link, HLK-RM65, HLK-RM65 WiFI6 Wireless Router Module, Module, Router Module, WiFI6 Wireless Router Module, Wireless Router Module

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