



UG0602

RTL8730ELH User Guide—Evaluation Board

This document describes the evaluation board based on RTL8730ELH.

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USING THIS DOCUMENT

Though every effort has been made to ensure that this document is current and accurate, more information may have become available subsequent to the production of this guide.

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1 Overview

1.1 Introduction

The evaluation board (EVB) based on RTL8730ELH is designed to provide users with flexible function demonstration and usage evaluation. It builds the minimum system including power supply and clock, and provides various circuits such as Wi-Fi, Bluetooth, Audio, MIPI, ADC, SD Card, GPIO, etc. Users can configure the functions freely by using the Software Development Kit (SDK) and related tools provided by REALTEK.

1.2 Features

The EVB based on RTL8730ELH includes the following features:

- Embedded 64M bits PSRAM/1G bits DDR2/2G bits DDR3L
- Embedded 64M bits NOR Flash/1G bits NAND FLASH /2G bits NAND FLASH
- Supports for ARM's SWD and SEGGER J-Link protocol options
- 5V DC power supply through USB-C socket
- Buttons for chip reset and UART download
- PCB and external antennas options for Wi-Fi and Bluetooth
- SD Card, MIPI, USB, Cap-touch interfaces and related on-board circuits
- Audio circuits of AMIC, DMIC and power amplifier for speaker or earphone
- User LED and user key circuits

2 Quick Start

2.1 Power

The EVB based on RTL8730ELH can be powered by connecting a USB cable between PC and board in USB-C socket.

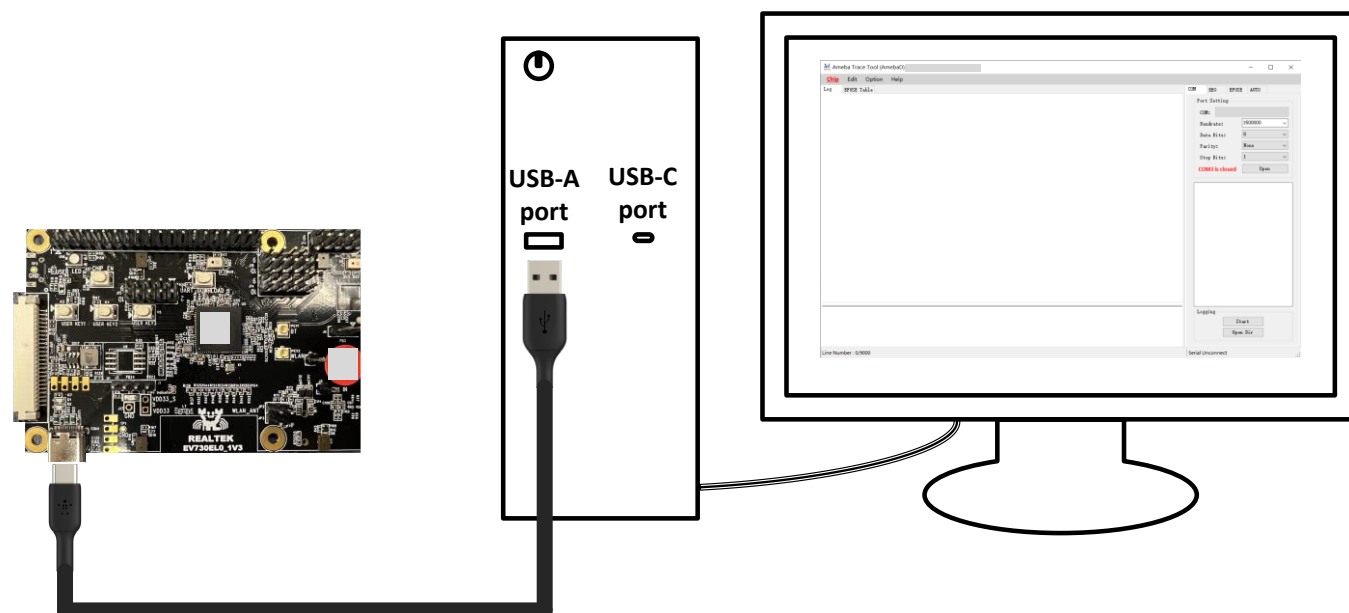


Figure 2-1 8730ELH EVB power supply schematic

2.2 FLASH Download

Before the EVB leaving the factory, REALTEK has already downloaded default basic bin files into FLASH inside the chip. Users are allowed to download their own bin files into the FLASH through either LOGUART port or USB port of RTL8730ELH.

NOTE

Before downloading bin files into RTL8730ELH, please refer to the application note (AN0600) for detailed instructions.

2.3 Log

LOGUART is an important way for users to interact with the chip. Users can judge the working status of the code and perform online operations through the log transferred by the serial port.

The default transmission formats and transfer speed of LOGUART are: 8bits data, no parity bit, 1stop bit and 1.5Mbps respectively.

NOTE

- The EVB has integrated a USB to UART IC on board so that the LOGUART function can be available only through a regular USB-A/USB-C to USB-C cable.
- Users can freely use any serial tool to communicate between PC and RTL8730ELH. If Trace Tool provided by REALTEK is chosen, please refer to the application note (AN0600) for detailed instructions.

2.4 Functions

The EVB based on RTL8730ELH provides many functions for users to use freely. When users want to use a specific function, please follow the following steps:

- Confirm the available pin for the function through the PINMUX document.
- Find the location of the pin according to Figure 3-1 and Table 3-1.
- Connect EVB and external circuits through DuPont lines or use circuits on board such as SD Card, Audio, etc.

3 PCB Layout

3.1 Component Distribution

The EVB is a four-layer PCB board, with a size of 85mm*56mm, and a positioning hole diameter of 2.7mm. The interfaces and dimensions of the EVB based on RTL8730ELH are all compatible with the Raspberry Pi 4.

3.1.1 Top Layer

The top layer of the EVB is illustrated in Figure 3-1.

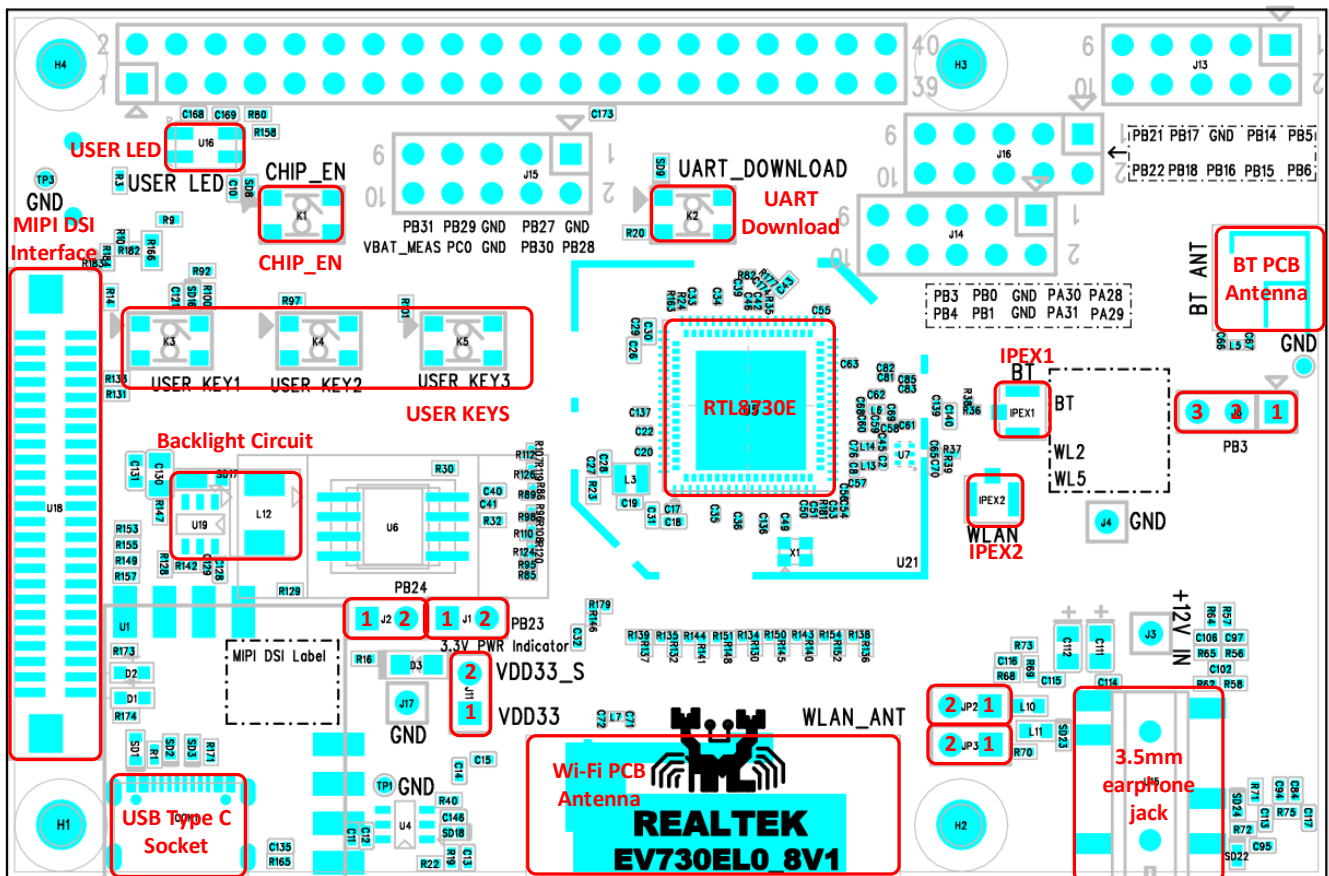


Figure 3-1 8730ELH EVB – top layer

3.1.2 Bottom Layer

The bottom layer of the EVB is illustrated in Figure 3-2.



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3.2.4 Audio Amplifier

ESMT's high-efficiency stereo Class-D audio amplifier (AD52058) is used as the driver of external speakers or earphone. It can deliver 15W/CH output power into 4Ω loudspeaker within 10% THD+N at max 12V supply voltage without external heat sink.

CAUTION

On the EVB, AD52058 is powered by 5V by default. If user wants to use external 12V power supply to drive higher power speakers, please confirm that R50 resistor has been removed and R55 0 ohm resistor has been soldered before power on or the PC or USB adaptor connected to the USB-C socket will be damaged. After that, user can connect J3.1 and J4.1 to the positive and negative terminals of a power supply respectively.

3.2.5 RF Circuits

PCB antenna is designed as copper wire or copper foil on PCB to reduce its volume. PCB antennas on the EVB include one Bluetooth antenna and one WLAN antenna, and the isolation between them is less than -20dB.

3.3 Connector

Multiple connectors are provided on the EVB for the expansion of different functions of the chip. The positions of different connectors on the EVB are shown in the Figure 3-1 and Figure 3-2.

NOTE

Only connectors with numbers and the names described next to them can be configured in the Figure 3-1 错误!未找到引用源。 . Other connectors with no specific purpose are used for internal test or other reserved functions. Please do not configure them arbitrarily to avoid affecting the normal operation of the chip.

3.3.1 Pin Headers

The pin multiplexing and description of each jumper is listed in Table 3-1. All designators and pins shown in the following table can be located in Figure 3-1.

Table 3-1 8730ELH EVB - pin headers

Designator	Pin number	Symbol	Description
J10	1	VDD33	3.3V voltage supplied by 5V-to-3.3V DC-DC converter.
	2	VDD5	5V voltage supplied by USB interface.
	3	PB10	Used as GPIO or other functions connected to PB10 of RTL8730ELH directly.
	4	VDD5	5V voltage supplied by USB interface.
	5	PB11	Used as GPIO or other functions connected to PB11 of RTL8730ELH directly.
	6	GND	Ground.
	7	PA_2	Used as GPIO or other functions connected to PA2 of RTL8730ELH through R144 0 ohm resistor.
	8	PB20	Used as GPIO or other functions connected to PB20 of RTL8730ELH directly.
	9	GND	Ground
	10	PB19	Used as GPIO or other functions connected to PB19 of RTL8730ELH directly.
	11	PA_3	Used as GPIO or other functions connected to PA3 of RTL8730ELH through R151 0 ohm resistor.
	12	PA_4	Used as GPIO or other functions connected to PA4 of RTL8730ELH through R134 0 ohm resistor.
	13	PA_5	Used as GPIO or other functions connected to PA5 of RTL8730ELH through R138 0 ohm resistor.
	14	GND	Ground.
	15	PA10	Used as GPIO or other functions connected to PA10 of RTL8730ELH directly.
	16	PA_0	Used as GPIO or other functions connected to PA0 of RTL8730ELH through R135 0 ohm resistor.
	17	VDD33	3.3V voltage supplied by 5V-to-3.3V DC-DC converter.
	18	PA_1	Used as GPIO or other functions connected to PA1of RTL8730ELH through R139 0 ohm resistor.

	19	PA13	Used as GPIO or other functions connected to PA13 of RTL8730ELH directly.
	20	GND	Ground.
	21	PA14	Used as GPIO or other functions connected to PA14 of RTL8730ELH directly.
	22	PA_6	Used as GPIO or other functions connected to PA6 of RTL8730ELH through R143 0 ohm resistor.
	23	PA15	Used as GPIO or other functions connected to PA15 of RTL8730ELH directly.
	24	PA16	Used as GPIO or other functions connected to PA16 of RTL8730ELH directly.
	25	GND	Ground
	26	PA9	Used as GPIO or other functions connected to PA9 of RTL8730ELH directly.
	27	PB_25	Used as GPIO or other functions connected to PB25 of RTL8730ELH through R76 0 ohm resistor.
	28	PB_26	Used as GPIO or other functions connected to PB26 of RTL8730ELH through R77 0 ohm resistor.
	29	PA_7	Used as GPIO or other functions connected to PA7 of RTL8730ELH through R150 0 ohm resistor.
	30	GND	Ground.
	31	PA_8	Used as GPIO or other functions connected to PA8 of RTL8730ELH through R154 0 ohm resistor.
	32	PA11	Used as GPIO or other functions connected to PA11 of RTL8730ELH directly.
	33	PA12	Used as GPIO or other functions connected to PA12 of RTL8730ELH directly.
	34	GND	Ground
	35	PB7	Used as GPIO or other functions connected to PB7 of RTL8730ELH directly.
	36	PB8	Used as GPIO or other functions connected to PB8 of RTL8730ELH directly.
	37	PB9	Used as GPIO or other functions connected to PB9 of RTL8730ELH directly.
	38	PB12	Used as GPIO or other functions connected to PB12 of RTL8730ELH directly.
	39	GND	Ground.
	40	PB13	Used as GPIO or other functions connected to PB13 of RTL8730ELH directly.
J13	1	PA20	Used as GPIO or other functions connected to PA20 of RTL8730ELH directly.
	2	PA21	Used as GPIO or other functions connected to PA21 of RTL8730ELH directly.
	3	PA22	Used as GPIO or other functions connected to PA22 of RTL8730ELH directly.
	4	PA23	Used as GPIO or other functions connected to PA23 of RTL8730ELH directly.
	5	PA24	Used as GPIO or other functions connected to PA24 of RTL8730ELH directly.
	6	PA25	Used as GPIO or other functions connected to PA25 of RTL8730ELH directly.
	7	GND	Ground.
	8	GND	Ground.
	9	PA26	Used as GPIO or other functions connected to PA26 of RTL8730ELH directly.
	10	PA27	Used as GPIO or other functions connected to PA27 of RTL8730ELH directly.
J16	1	PB5	Used as GPIO or other functions connected to PB5 of RTL8730ELH directly.
	2	PB6	Used as GPIO or other functions connected to PB6 of RTL8730ELH directly.
	3	PB14	Used as GPIO or other functions connected to PB14 of RTL8730ELH directly.
	4	PB15	Used as GPIO or other functions connected to PB15 of RTL8730ELH directly.
	5	GND	Ground.
	6	PB16	Used as GPIO or other functions connected to PB16 of RTL8730ELH directly.
	7	PB17	Used as GPIO or other functions connected to PB17 of RTL8730ELH directly.
	8	PB18	Used as GPIO or other functions connected to PB18 of RTL8730ELH directly.
	9	PB21	Used as GPIO or other functions connected to PB21 of RTL8730ELH directly.
	10	PB22	Used as GPIO or other functions connected to PB22 of RTL8730ELH directly.
J14	1	PA28	Used as GPIO or other functions connected to PB28 of RTL8730ELH directly.
	2	PA29	Used as GPIO or other functions connected to PB29 of RTL8730ELH directly.
	3	PA30	Used as GPIO or other functions connected to PA30 of RTL8730ELH directly.
	4	PA31	Used as GPIO or other functions connected to PA31 of RTL8730ELH directly.
	5	GND	Ground.
	6	GND	Ground.
	7	PB0	Used as GPIO or other functions connected to PB0 of RTL8730ELH directly.
	8	PB1	Used as GPIO or other functions connected to PB1 of RTL8730ELH directly.
	9	PB3	Used as GPIO or other functions connected to PB3 of RTL8730ELH directly.
	10	PB4	Used as GPIO or other functions connected to PB4 of RTL8730ELH directly.
J15	1	GND	Ground.
	2	PB_28	Used as GPIO or other functions connected to PB28 of RTL8730ELH through R119 0 ohm

			resistor (default NC).
	3	PB_27	Used as GPIO or other functions connected to PB27 of RTL8730ELH directly through R107 0 ohm resistor (default NC).
	4	PB_30	Used as GPIO or other functions connected to PB30 of RTL8730ELH directly through R96 0 ohm resistor (default NC).
	5	GND	Ground.
	6	GND	Ground.
	7	PB_29	Used as GPIO or other functions connected to PB29 of RTL8730ELH through R86 0 ohm resistor (default NC).
	8	PC_0	Used as GPIO or other functions connected to PC0 of RTL8730ELH through R120 0 ohm resistor (default NC).
	9	PB_31	Used as GPIO or other functions connected to PB31 of RTL8730ELH through R108 0 ohm resistor.
	10	VBAT_MEAS	VBAT_MEAS voltage measurements input pin.(Input voltage range 0-5V)
J6	1	AOUT_LP	Audio output LP signal to drive speaker. AOUT_LP can be driven by connecting J6.1 and J6.2.
	2	PB3	Used as GPIO or other functions connected to PB3 of RTL8730ELH directly.
	3	AOUT_LPE	Audio output LP signal to drive earphone. AOUT_LP can be driven by connecting J6.3 and J6.2.
J4	1	GND	Ground.
J3	1	VDD12	Positive terminal of 12V voltage supply connected to AD52058 which can be supplied by external power supply instrument.
J2	1	FT_LOG_RX	UART RX signal of FTDI FT232.
	2	PB24	Default LOGUART TX function of RTL8730ELH.
J1	1	FT_LOG_TX	UART TX signal of FTDI FT232.
	2	PB23	Default LOGUART RX function of RTL8730ELH.
JP2	1	AOUT_RP	Audio output RP signal for external instrument test.
	2	GND	Ground.
JP3	1	AOUT_LPE	Audio output LPE signal for external instrument test.
	2	GND	Ground.

NOTE

Not all GPIOs are connected to the pin headers. If the following GPIOs(PB27, PB28, PB29, PB30, PC0) need to be used on the pin headers, please refer to Table xx to determine the hardware changes that need to be made on the EVB board. In addition, please refer to Figure 3-1 and Figure 3-2 for the specific location of the components that need to be adjusted on the board.

Table 3-2 Circuit modification instructions of GPIOs

Pin name	Resistors need to be soldered	Resistors need to be removed	Note
PB27	R107(0 ohm)	R79(27 ohms)	After R79/R84/R88/R90/R91 is removed, the SDIO circuits on board cannot be used.
PB28	R119(0 ohm)	R84(27 ohms)	
PB29	R86(0 ohm)	R88(27 ohms)	
PB30	R96(0 ohm)	R90(27 ohms)	
PC0	R120(0 ohm)	R91(27 ohms)	

3.3.2 USB-C socket

A standard USB-C socket is provided on the EVB. Users can use a USB-A/USB-C to USB-C cable to connect between PC and EVB for both power supply and LOGUART function.



Figure 3-3 USB-A to USB-C cable



Figure 3-4 USB-C to USB-C cable

3.3.3 MIPI DSI Interface

EVB has a MIPI DSI interface integrated with touch I2C interface, which can be connected with an LCD screen through FPC.

- The LCD display interface includes one pair of clock signals (MIPITX_CKP/ MIPITX_CKN), two pairs of data signals (MIPITX_DATAP_0/ MIPITX_DATAN_0, MIPITX_DATAP_1/ MIPITX_DATAN_1), LCD_RESET, VDD33_LCD, backlight LEDA and LEDK. LCD_TE and LCD_PWM are connected for future development.
- The LCD touch function interacts with RTL8730ELH through I2C protocol.
- The transmission rate of each data lane is up to 1Gbps. Data lane 0 supports bidirectional transmission and escape mode, while data lane1 only supports unidirectional transmission. The maximum XGA resolution of DSI is 1024x768 @ 60fps.

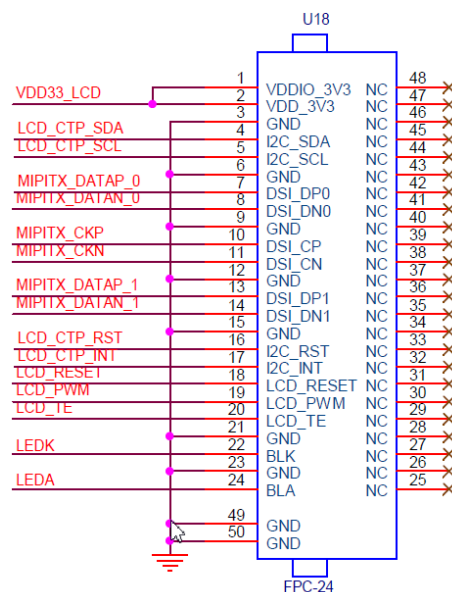


Figure 3-5 FPC signal distribution of display and touch interface

NOTE

When using, the cable should be carefully inserted into the connector to avoid damage to the golden finger. If other LCD screens are used, note that the cable size should not be too long, the time for the signal to pass through the connecting line should not exceed 2ns, and the length from the corresponding IC to the LCD screen should not exceed 25cm.

3.3.4 IPEX

IPEX1 and IPEX2 are reserved for Bluetooth and Wi-Fi RF respectively on the EVB. The IPEX female connector can be connected to an external antenna or an instrument to measure the RF characteristics.

Before using Wi-Fi or BT RF functions, please follow the instructions below:

- Wi-Fi and Bluetooth use external antennas connected to IPEX2 and IPEX1 by default.
- Two PCB antennas are designed for convenient use. If users want to use BT PCB antenna, R36 0 ohm resistor should be removed and R38 0 ohm resistor should be soldered. Similarly, when using the Wi-Fi PCB antenna, users need to remove the R37 0 ohm resistor and solder on the R39 0 ohm resistor.

Figure 3-6 shows the size of IPEX female connector. Pay attention to the size matching of the adapter when using it.

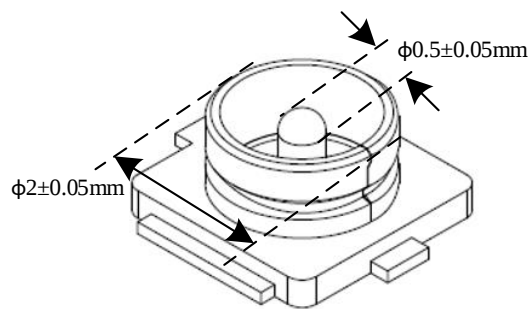


Figure 3-6 Size of IPEX female connector

3.3.5 Micro USB Socket

A standard micro USB socket is provided on the EVB for using USB function of RTL8730ELH.

3.3.6 Micro SD Socket

A standard micro SD card socket is provided on the EVB for using SD CARD storage function of RTL8730ELH.

3.3.7 Cap-touch Interface

A Cap-touch interface is provided on the EVB for extended use connected to a flexible PCB through FPC (10 pins total and the distance between adjacent pins is 1mm).

3.3.8 Speaker Jack

The speaker jack provided on the EVB is a 2-pin jack with a spacing of 1.5mm, connected with the P/N output of the power amplifier.

3.3.9 Earphone Jack

A 3.5mm earphone jack is provided on the EVB to expand the audio function of the RTL8730ELH. It can either play sound or collect sound through the connected earphone.

4 Basic Usage

4.1 Power Supply

4.1.1 USB Power

The 8730ELH EVB can be powered by connecting PC or adaptor to USB-C socket located in the lower left corner of the board.

i NOTE

- *The maximum theoretical power supply capacity of general USB-A 2.0 port is 500mA which is enough for the EVB without MIPI and Audio function under operation. If MIPI or Audio function is needed, please use a USB-C to USB-C cable and make sure the power source is enough for the consumption of EVB.*
- *If users want to drive a speaker of greater power through AD52058, please refer to the section 3.2.4 for detailed usage.*

4.1.2 LED Indicators

A single color LED is used to indicate whether 3.3V power supply of RTL8730ELH is available. Please refer to Figure 3-1 for the location of LED.

4.2 Reset

When the power supply is stable, RTL8730ELH can be reset by pressing and releasing the CHIP_EN button on the EVB, or powering the EVB off and then powering on.

The CHIP_EN button on the EVB is K1.

4.3 Communication

4.3.1 LOGUART

The 8730ELH EVB integrates a USB to UART chip so users can simply use a USB-A/USB-C to USB-C cable to connect EVB and PC. After that, users can communicate with RTL8730ELH through any serial tool on the PC.

Before using the serial tool, users should follow the below steps:

- (1) Select the correct serial port.
- (2) Configure the transmission baud rate and frame format.
- (3) Open the serial port to interact with the EVB.

i NOTE

The default transmission baud rate of LOGUART is 1.5Mbps

Take Trace Tool provided by REALTEK as an example, after the configurations above, the log window of the Trace Tool will display the data received/transmitted by PC and parse it into ASCII characters. Each line will display the time of receiving/transmitting this log.



RTL8730ELH supports 2-pins serial-wire debug (SWD) interface for users to access ARM Cortex®-M core integrated in the chip. For more information, please refer to ARM Debug Interface v6 Architecture Specification.

User Guide

5 Other Functions

5.1 Wi-Fi

RTL8730ELH supports up to Wi-Fi 802.11ax protocol and external antenna.

5.2 Bluetooth

RTL8730ELH supports up to Bluetooth protocol 5.2 and external antenna.

5.3 USB

RTL8730ELH supports up to USB protocol 2.0.

5.4 Cap-touch

RTL8730ELH supports 9 channels of Cap-touch or 6 channels of ADC.

i NOTE

If users want to use Cap-touch interface (refer to chapter 3.3.7) on the EVB and related Cap-touch daughter board provided by REALTEK, please make the modifications in the Table 5-1. In addition, please refer to Figure 3-1 and Figure 3-2 for the specific location of the components that need to be adjusted on the board.

Table 5-1 Circuit modification instructions of Cap-touch

FPC pin number	Function name	Resistors need to be soldered	Resistors need to be removed	Note
9	TOUCH0_ADC0	R132(0 ohm)	R135(0 ohm)	
10	TOUCH1_ADC1	R137(0 ohm)	R139(0 ohm)	
8	TOUCH2_ADC2	R141(0 ohm)	R144(0 ohm)	
7	TOUCH3_ADC3	R148(0 ohm)	R151(0 ohm)	
6	TOUCH4_ADC4	R130(0 ohm)	R134(0 ohm)	
2	TOUCH5_ADC5	R136(0 ohm)	R138(0 ohm)	
4	TOUCH6	R140(0 ohm)	R143(0 ohm)	
5	TOUCH7	R145(0 ohm)	R150(0 ohm)	
3	GTOUCH	R152(0 ohm)	R154(0 ohm)	

5.5 SD Card

RTL8730ELH supports up to SD protocol 2.0.

5.6 MIPI

RTL8730ELH supports MIPI Display Serial Interface (MIPI-DSI) which includes one clock lane and two data lanes. Both clock lane and data lane can operate in ultra-low-power mode.

5.7 Audio

5.7.1 Microphone

The RTL8730ELH can collect sound data through AMIC or DMIC.

5.7.2 Speaker

The RTL8730ELH can directly drive 4/8Ω impedance speaker with maximum power of 15W through AD52058.

5.7.3 Earphone

The EVB supports 32 and 16 ohms earphone audio output and earphone mic acquisition.

5.8 User Key

Three keys are provided on the EVB which can be detected by single ADC channel.

When different single key or keys combination are pressed, the voltage detected by ADC port is different. The relationship between keys combination and detected voltage is listed in Table 5-2.

Table 5-2 Key-pressing related detected voltage

Keys combinations	Detected voltage by ADC(V)
None	VDD33
K3	0.667*VD33
K4	0.706*VD33
K5	0.836*VD33
K3&K4	0.522*VD33
K3&K5	0.590*VD33
K4&K5	0.620*VD33
K3&K4&K5	0.473*VD33

i NOTE

If users want to use USER KEY circuit on the EVB, please solder on the R80 0 ohm resistor (see Figure 3-1 and Figure 3-2 for locations of each components).

5.9 User LED

A RGB LED and related driving circuit are provided on the EVB for free use. Users can set related pins to GPIO output mode and drive pins to low which connected to the LEDR/LEDG/LEDB ports to control the LED to emit red/green/blue colors of light. For further use, users can set related pins of RTL8730ELH to PWM function to obtain more display color combinations (see Figure 3-1 and Figure 3-2 for locations of each components).

i NOTE

If users want to use USER LED circuit on the EVB, please solder on R78, R83 and R87 of at least 470 ohm resistors (Used as current limit resistors to prevent LED from being damaged).

5.10 IO

The RTL8730ELH has many other functions such as SPI, I2C, I2S, ADC, PWM, etc., which can be expanded and used through the pins drawn by the jumper. Please refer to the content in Section 3.3.1 for the pins led out through the jumper.

i NOTE

For all the contents above, please refer to the datasheet (UM0601) for more detailed information.

Revision History

Date	Version	Description
2022-07-29	v1.0	Initial release
2023-11-22	V1.1	1. Correct some mistakes 2. Add contents in 3.3.1 and 5.4