



Telink

B91 Wearable EVK V5.0 User Guide

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Keyword

Features, Pin layout, Audio, Amoled

Brief

This is a user guide for B91 wearable EVK V5.0. This document is dedicated for wearable application development based on TLSR9518A SoC.

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Revision History

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Section	Change Description

Version 0.1.0 (2020-08-26)

This is the Initial release.

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1. Product Introduction

This is a user guide document for Telink B91 wearable EVK5.0. A 454*454 amoled screen is placed on the EVK, which users can use to develop GUI. At the same time, a g-sensor chip is placed to facilitate user development of scenes. In addition, heart rate interface and motor interface are reserved. EVK also supports audio scene development.

1.1 General Description

The EVK is based on Telink TLSR9518A platform, provides a Bluetooth Classic and Bluetooth Low Energy wireless system.

The TLSR9518A integrates a powerful 32-bit RISC-V (RISC-Five) MCU, DSP, AI Engine, 2.4 GHz ISM Radio, 256 KB SRAM, stereo audio codec, 14 bit AUX ADC, analog and digital Microphone input, PWM, flexible IO interfaces, and other peripheral blocks required for advanced audio applications.

The TLSR9518A also includes multi-stage power management design with near-threshold level power consumption allowing ultra-low power operation and making it the ideal candidate for wearable and power-constraint applications.

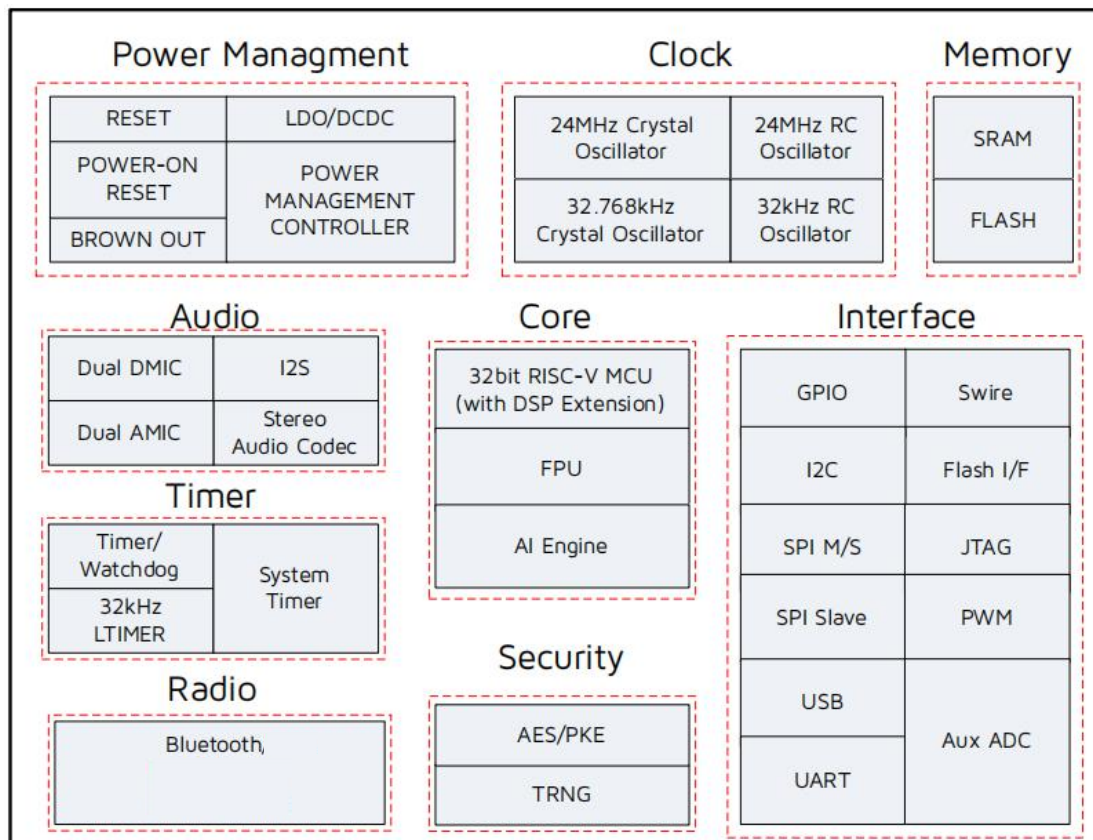
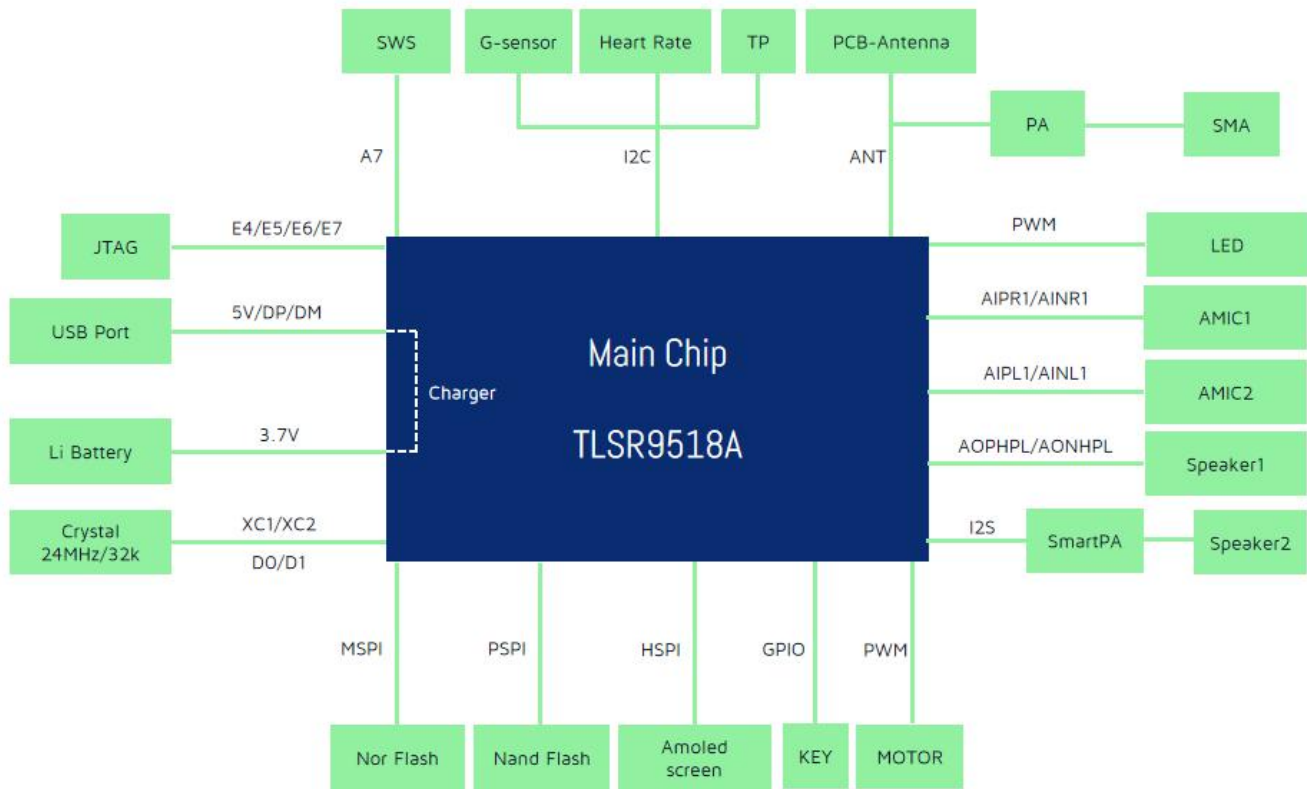
Figure 1-1 TLSR9518A Block diagram (without internal flash)


Figure 1-2 EVK Hardware interface


1.2 Key Features

1. TLSR9518A Embedded 32-bit RISC-V micro-controller
 - Better power-balanced performance than ARM M4
 - Instruction and Data cache controller
 - Maximum running speed up to 96 MHz
 - Integrated DSP extensions instructions
 - Integrated "F" standard extensions for single-precision floating-point
2. Bluetooth Compliant
 - BR, EDR 2 Mbps and 3 Mbps
 - BLE 1 Mbps and 2 Mbps, Long Range 125 kbps and 500 kbps
3. External RF PA support, TX power up to +20dbm
4. Up to 256 KB SRAM including up to 64 KB retention SRAM
5. Mass storage

- Placed 16MB external nor flash
 - Placed 256MB external nand flash
6. Rich peripheral modules and interfaces
- A amoled screen is playced on the EVK, up to 454*454 resolution
 - Two LEDs for state indicator
 - Two buttons for scene development
 - A MCU reset button
 - A motor interface
 - Two speaker interfaces for audio
 - Two kinds of heart rate interfaces support for different FPC module
 - Two analog mems mic for audio
 - Placed a g-sensor chip, model is DA217
 - A usb2.0 interface
 - Two types of debug interfaces, SWIRE and JTAG

1.3 Mechanical and PCB Fabrication Specifications

PCB dimension: 64.25mm*101.45mm*1.6mm

PCB layer: 4 layers

Figure 1-3 EVK photo

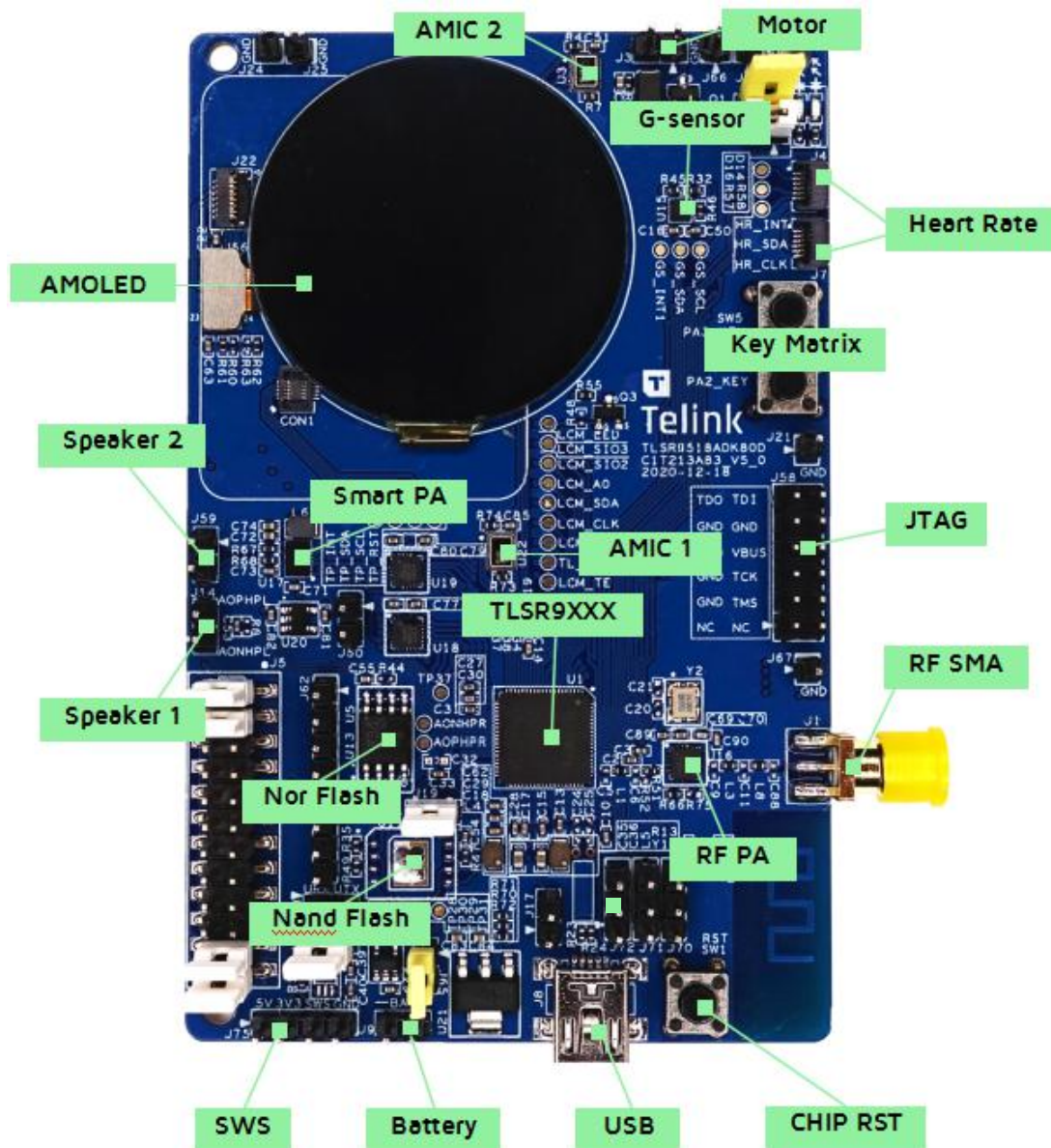
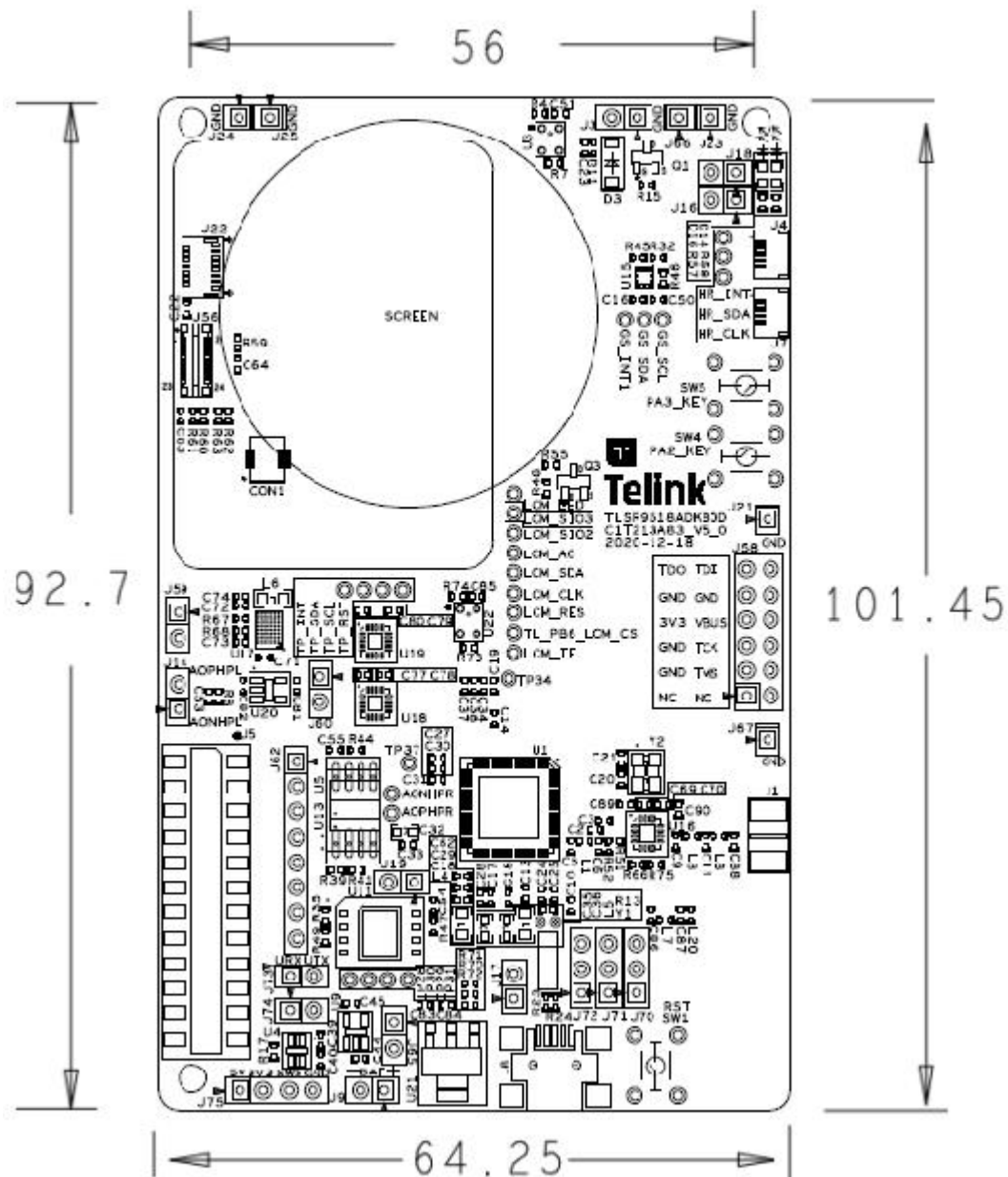
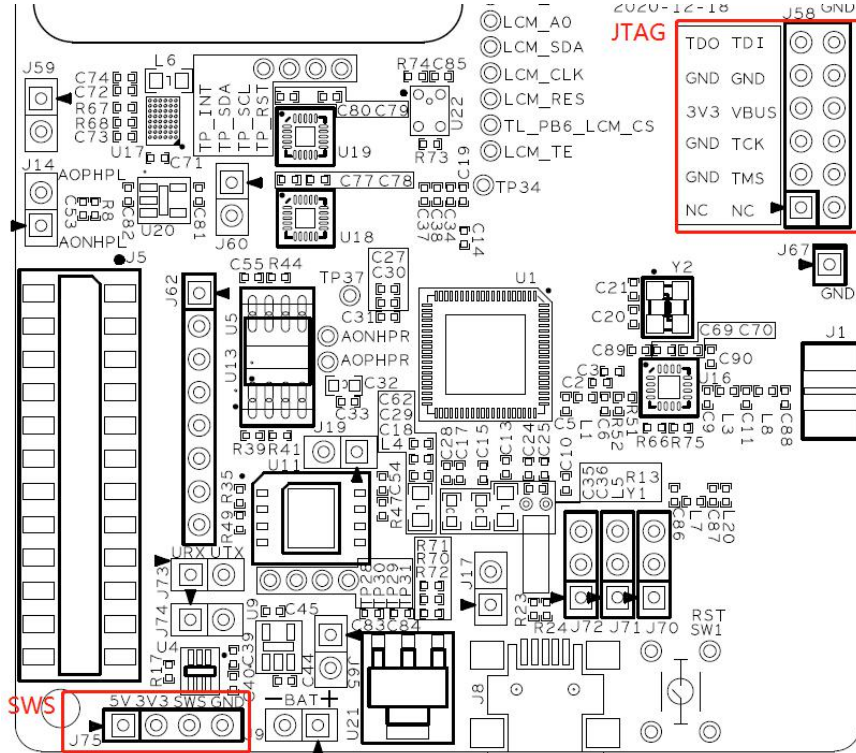


Figure 1-4 Mechanical dimensions



1.4 Pin layout

1.4.1 Debug interface

Figure 1-5 Debug pin layout


Pin definition is shown as the Table 1-1 and Table 1-2:

Table 1-1 J58 JTAG pin header

Pin No	Pin Name	Pin Description
1	NA	NC
2	NA	NC
3	NA	Connect to GND of TLSR9 DEV KEY
4	NA	Connect to TMS of TLSR9 DEV KEY
5	NA	Connect to GND of TLSR9 DEV KEY
6	NA	Connect to TCK of TLSR9 DEV KEY

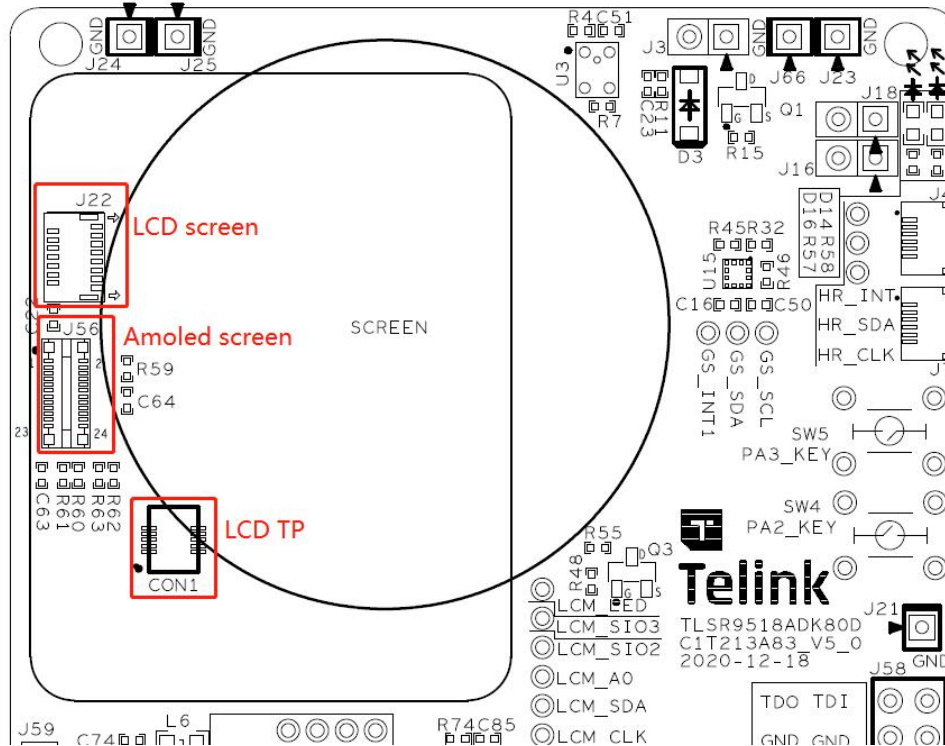
7	NA	TLSR9 DEV KEY 3V3 reference voltage input from EVK
8	NA	TLSR9 DEV KEY 5V voltage output to EVK
9	NA	Connect to GND of TLSR9 DEV KEY
10	NA	Connect to GND of TLSR9 DEV KEY
11	NA	Connect to TDO of TLSR9 DEV KEY
12	NA	Connect to TDI of TLSR9 DEV KEY

Table 1-2 J75 SWS pin header

Pin No	Pin Name	Pin Description
1	NA	Telink Burning Board 5V voltage output to EVK
2	NA	Telink Burning Board 3V3 voltage output to EVK
3	NA	Connect to SWM of Telink Burning Board
4	NA	Connect to GND of Telink Burning Board

1.4.2 Screen Interface

Figure 1-6 Screen pin layout



Pin definition is shown as the Table1-2 and Table1-3 and Table1-4:

Table 1-3 J22 LCD screen connector

Pin No	Pin Name	Pin Description
1	LEDK1	LED negative pole
2	LEDK2	LED negative pole
3	GND	Ground
4	GND	Ground

5	TE	NC
6	SDA	HSPI_SDO
7	A0	HSPI_SDI
8	SCLK	HSPI_SCLK
9	CS	HSPI_CS
10	RESET	Signal is active low
11	IOVCC18	3.3V supply
12	VCC28	3.3V supply
13	VCC28	3.3V supply
14	LEDA1	3.3V supply
15	LEDA2	3.3V supply

Table 1-4 CON1 LCD TP connector

Pin No	Pin Name	Pin Description
1	VDD	3.3V supply
2	TP_SCL	I2C_SCL
3	TP_SDA	I2C_SDA
4	TP_INT	TP module IRQ output
5	TP_RST	Signal is active low

6	GND	Ground
7	GND	Ground
8	GND	Ground
9	GND	Ground
10	GND	Ground

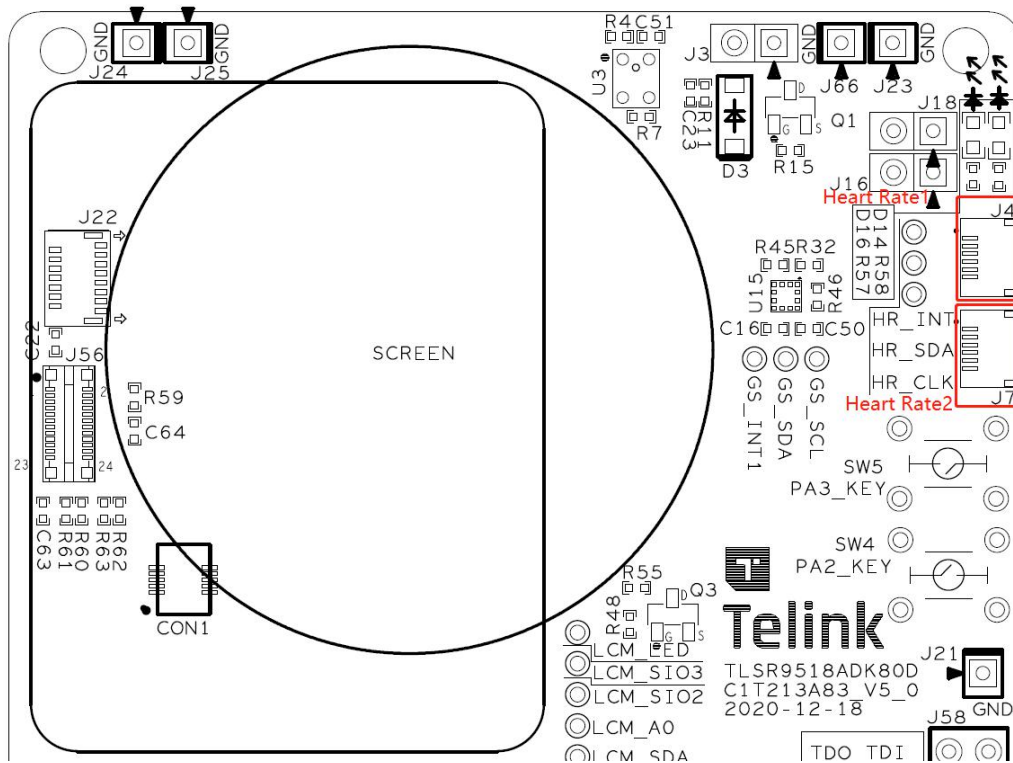
Table 1-5 J56 Amoled Screen connector

Pin No	Pin Name	Pin Description
1	RESET	Device reset signal(0:enable;1:disable)
2	VCI_EN	Enable signal for pwr IC control(1:enable)
3	MTP_PWR	NC
4	D0	Bit data bus/Input data bus for QSPI
5	TE	Output a frame head pulse signal
6	D1	Bit data bus/Input data bus for QSPI
7	CSX	Chip select signal input
8	D2	Bit data bus
9	SCL	Serial interface clock
10	D3	Bit data bus
11	DCX	Data/Command select signal

12	D4	Bit data bus
13	SD1	Serial input signal in serial interface mode
14	D5	Bit data bus
15	SD0	Serial output signal in serial interface mode
16	D6	Bit data bus
17	IM1	Interface type selection
18	D7	Bit data bus
19	IM0	Interface type selection
20	IOVCC	Power Supply for I/O system
21	VBAT	Driver analog power supply
22	GND	Ground
23	VBAT	Driver analog power supply
24	GND	Ground

1.4.3 Heart Rate Interface

EVK provides two type of heart rate interfaces to support a variety of heart rate modules.

Figure 1-7 Heart rate pin layout


Pin definition is shown as the Table1-5 and table1-6:

Table 1-6 J4 heart rate connector

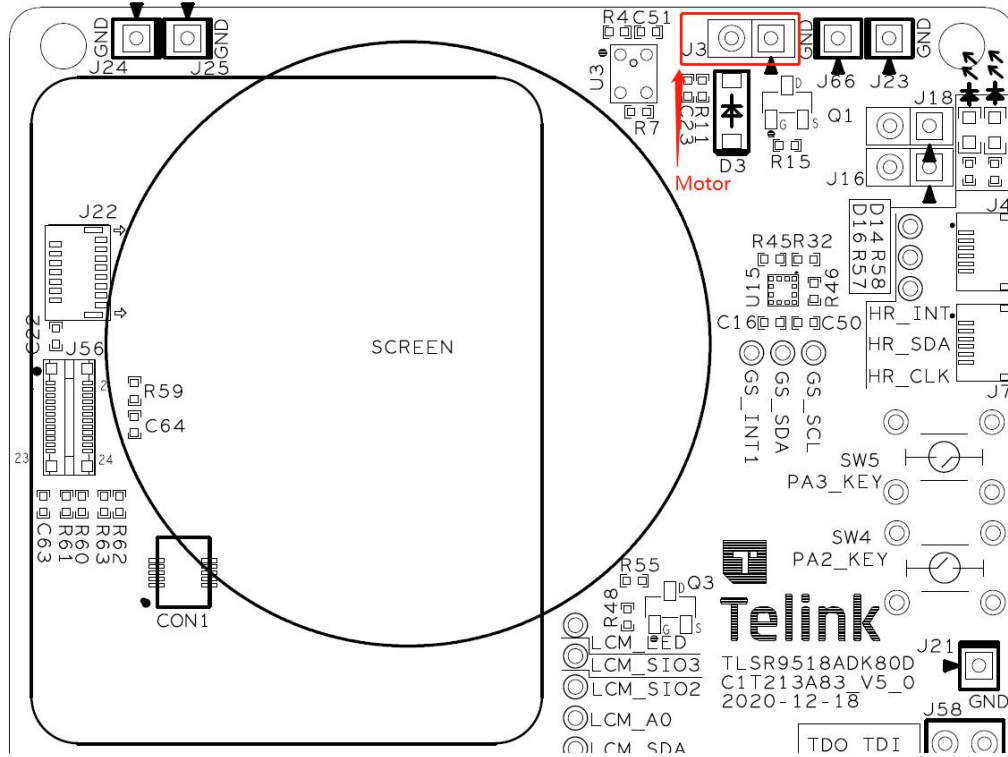
Pin No	Pin Name	Pin Description
1	NA	Ground
2	NA	IRQ output
3	NA	NC
4	NA	3.3V supply
5	NA	I2C_SDA
6	NA	I2C_SCL

Table 1-7 J7 heart rate connector

Pin No	Pin Name	Pin Description
1	NC	Ground
2	NC	3.3V supply
3	NC	IRQ output
4	NC	I2C_SDA
5	NC	I2C_SCL
6	NC	Ground

1.4.4 Motor Interface

Figure 1-8 Motor pin layout



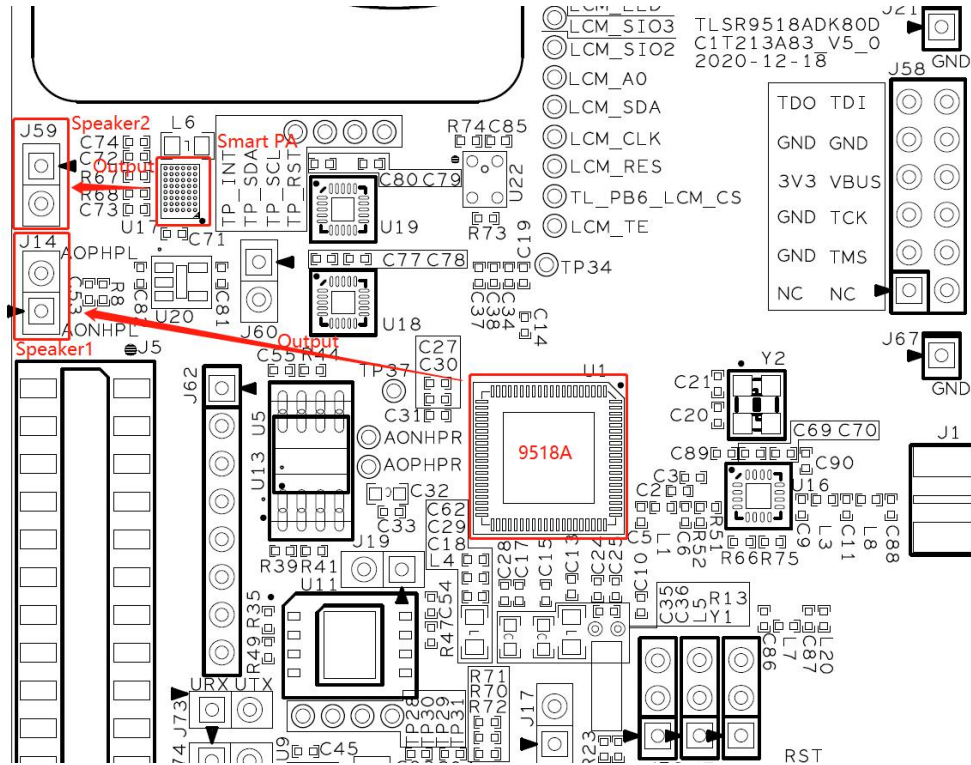
Pin definition is shown as the Table1-7:

Table 1-8 J3 Motor pin header

Pin No	Pin Name	Pin Description
1	NC	Connect to motor
2	NC	Connect to motor

1.4.5 Speaker Interface

EVK has 2 speaker connectors, one is the 9518A main chip analog output (Speaker1), and the other is the i2s interface through smartPA output (Speaker2)

Figure 1-9 Speaker pin layout


Pin definition is shown as the Table1-8 and Table1-9:

Table 1-9 J14 speaker pin header

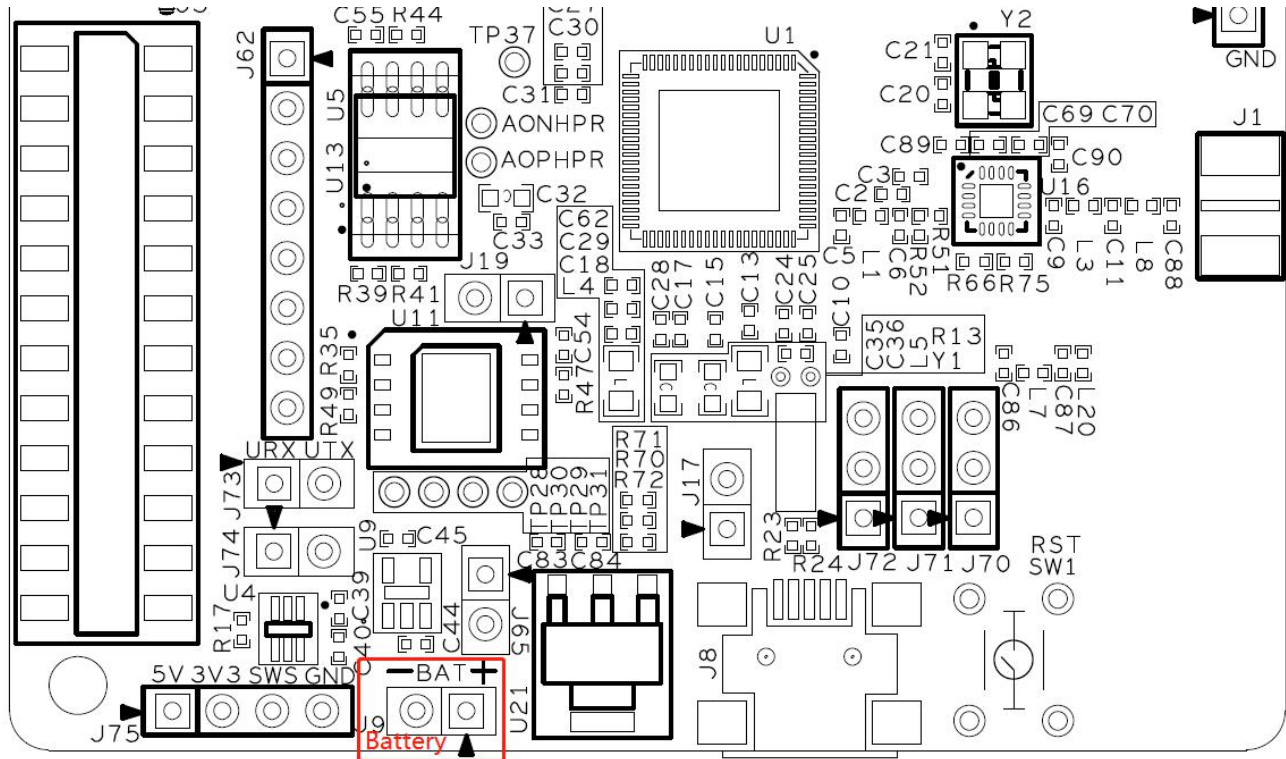
Pin No	Pin Name	Pin Description
1	NC	Left channel negative headphone output
2	NC	Left channel positive headphone output

Table 1-10 J59 speaker pin header

Pin No	Pin Name	Pin Description
1	NC	OUTP of TFA9894
2	NC	OUTN of TFA9894

1.4.6 Lion-Battery Interface

Figure 1-10 Lion-Battery pin layout



Pin definition is shown as the Table1-9:

Table 1-11 J9 battery pin header

Pin No	Pin Name	Pin Description
1	NC	Lion-Battery positive
2	NC	Lion-Battery negative

2. Jumper Connection Guide

There are 3 parts of EVK that use jumper, namely power supply, LED, RF PA.

2.1 Power Supply

There are four methods supported to supply power for the EVK.

- Via Telink Burning Board
- Via TLSR9 DEV KEY
- Via usb
- Via li battery

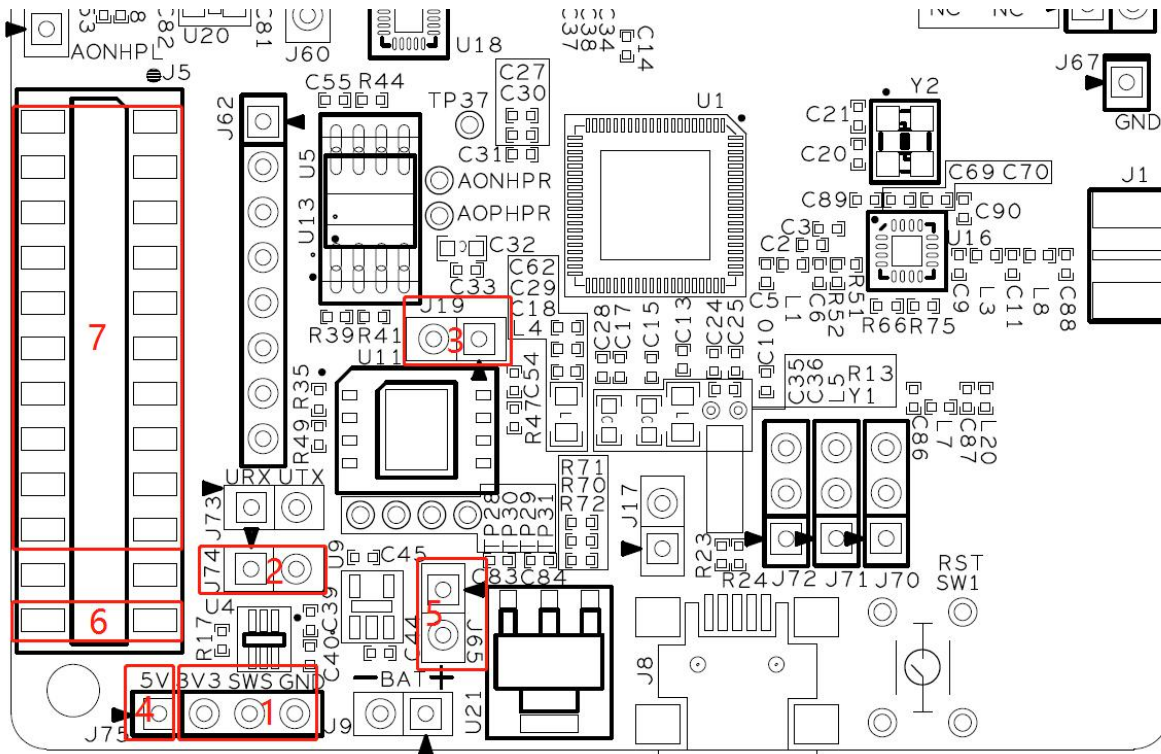
2.1.1 Via Telink Burning Board Power Supply

TLSR9518A power supply:

1. 3V3/SWS/GND of J75 corresponds to Burning Board 3V3/SWM/GND;
2. J74 short connection;
3. J19 short connection;

Simultaneously supply power to peripheral modules (3V3):

4. Connect 5V of J75 to Burning Board 5V;
5. J65 short connection;
6. Short connect the "BAT_LDO_3V3" of J5;
7. According to the silk screen on the back of J5, short connect correspondingly to supply power to the peripheral module;

Figure 2-1 Via Telink Burning Board Power Supply


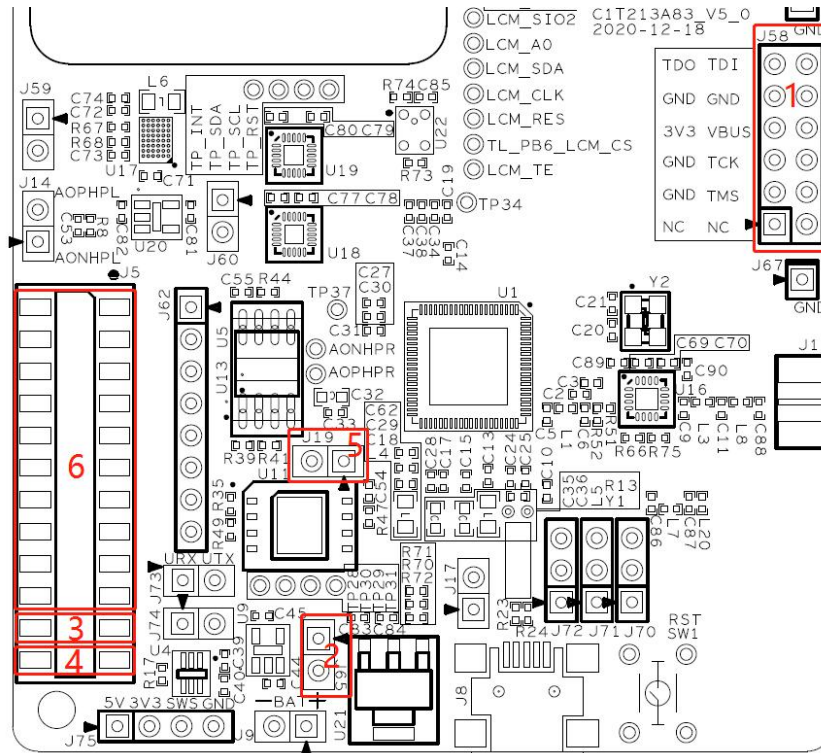
2.1.2 Via TLSR9 DEV KEY Power Supply

TLSR9518A power supply:

1. J58 connects to TLSR9 DEV KEY through proprietary DuPont wires;
2. J65 short connection;
3. Short connect the "TL_VBAT" of J5;
4. Short connect the "BAT_LDO_3V3" of J5;
5. J19 short connection;

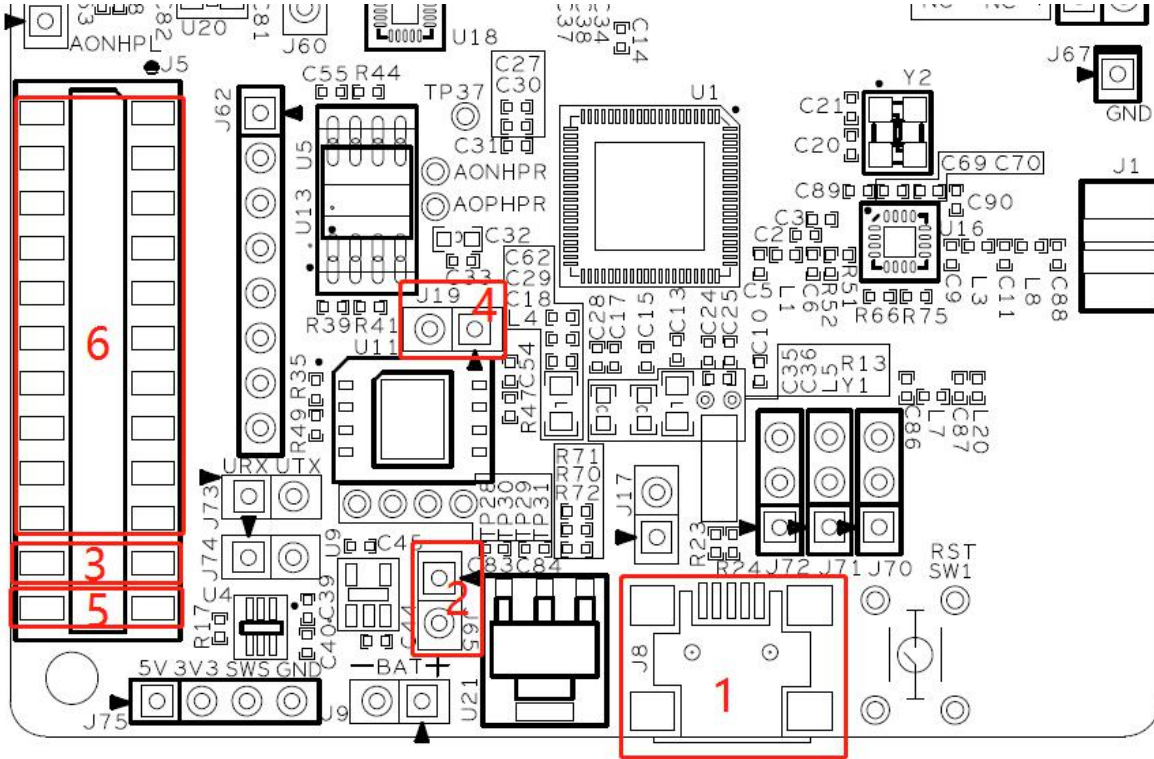
Simultaneously supply power to peripheral modules (3V3):

6. According to the silk screen on the back of J5, short connect correspondingly to supply power to the peripheral module;

Figure 2-2 Via TLSR9 DEV KEY Power Supply


2.1.3 Via USB

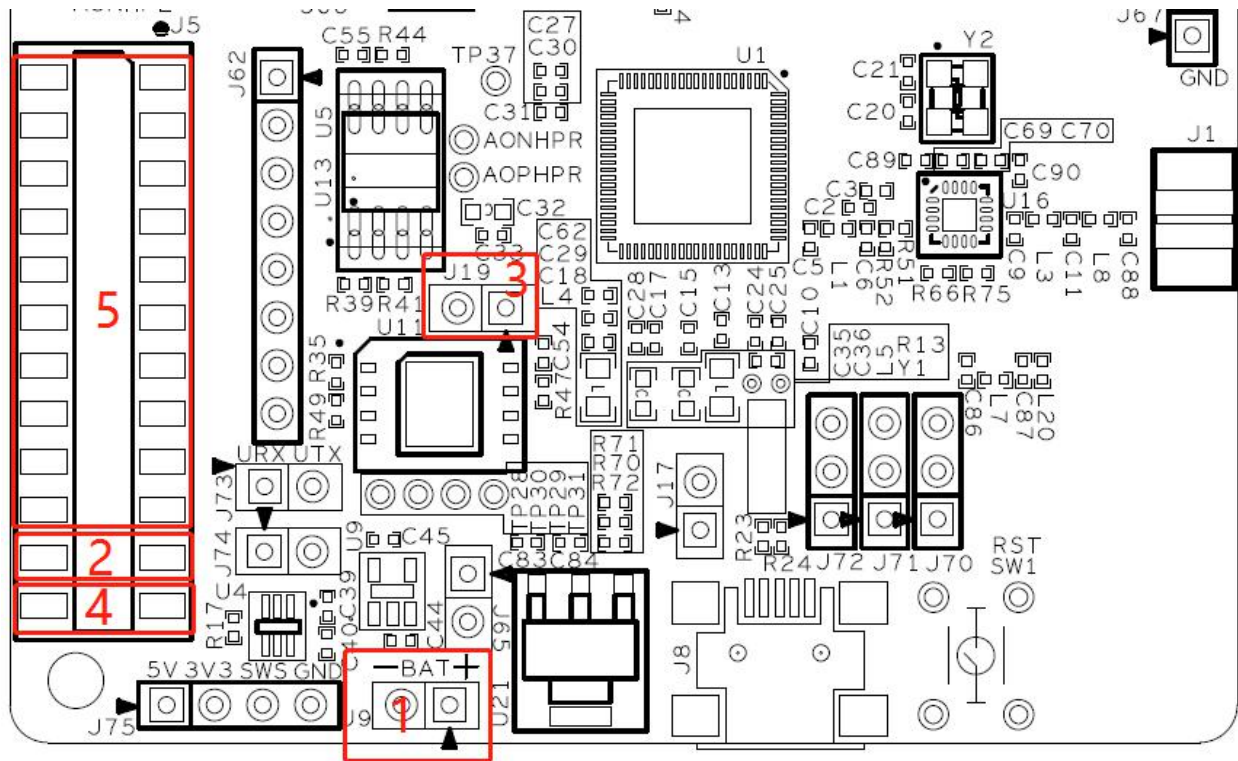
1. J8 is connected to a power adapter or PC through a USB cable;
2. J65 short connection;
3. Short connect the "TL_VBAT" of J5;
4. J19 short connection;
5. Short connect the "BAT_LDO_3V3" of J5;
6. According to the silk screen on the back of J5, short connect correspondingly to supply power to the peripheral module;

Figure 2-3 Via USB Power Supply


2.1.4 Via LI Battery

1. Connect J9 to LI battery (note the positive and negative poles);
2. Short connect "TL_VBAT" of J5;
3. J19 short connection;
4. Short connect "BAT_LDO_3V3" of J5;
5. According to the silk screen on the back of J5, short connect correspondingly to supply power to the peripheral module;

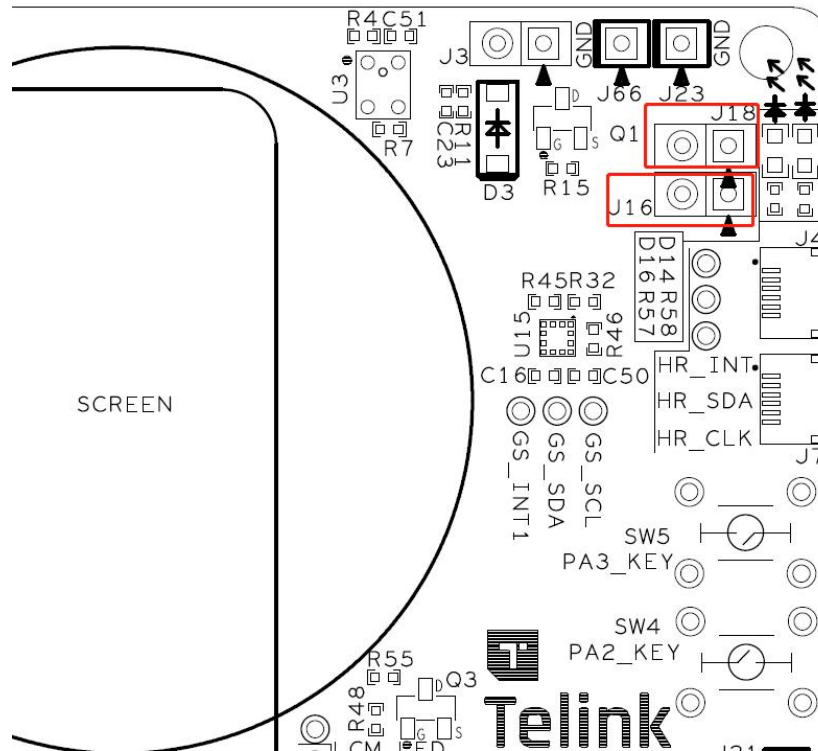
Figure 2-4 Via LI Battery Power Supply



2.2 LED

Short J16 to light D14, short J18 to light D16.

Figure 2-5 LED Jumper



2.3 RF PA

In order to facilitate manual debugging of the PA, EVK reserves TXEN, RXEN, BYPASS up and down jumpers.

- Pin1 and pin2 of J70 are short-circuited, PD7 is pulled up to 3V3 (TXEN=1), pin2 and pin3 are short-circuited, and PD7 is pulled down to GND (TXEN=0).
- Pin1 and pin2 of J71 are shorted, PD6 is pulled up to 3V3 (RXEN=1), pin2 and pin3 are shorted, PD6 is pulled down to GND (RXEN=0).
- Pin1 and pin2 of J72 are shorted, PD5 is pulled up to 3V3 (BYPASS=1), pin2 and pin3 are shorted, PD5 is pulled down to GND (BYPASS=0).

Table 2-1 Manual controller table

TX_EN	RX_EN	Bypass	Mode
-------	-------	--------	------



1	X	X	TX Mode
0	1	NC/0	RX Mode
0	1	1	Bypass Mode
0	0	0	Shutdown

Note

EVK is soldered by KCT8201L by default. If it is another type of chip, the control logic will be different from the above table.

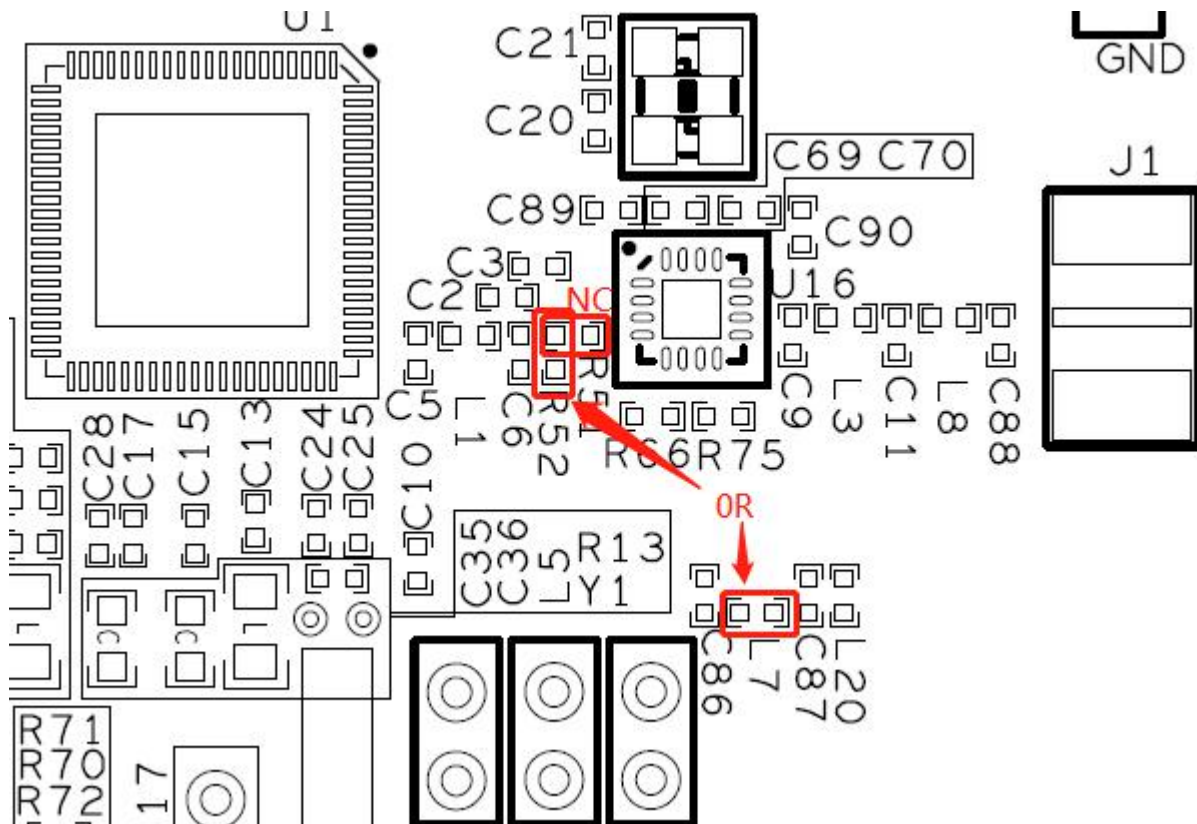
3. Bluetooth RF path selection

EVK has designed two RF paths, one is from the 9518 ANT pin to the onboard antenna through the LC matching circuit. The other is that the 9518 ANT pin comes out through the RF PA to the SMA connector, and then connects to the 2.4G whip antenna.

3.1 Chose onboard antenna

R51 does not place components (NC), R52 and L7 place OR resistors.

Figure 3-1 Chose onboard antenna



3.2 Chose 2.4G whip antenna

No components (NC) are placed on R52, OR resistors are placed on R51, and whip antennas are connected to J1.

Figure 3-2 Chose 2.4G glue stick antenna



4. Download Firmware

4.1 Download Via Telink Burning Board

Follow the steps below to download the program to the TLSR9518A chip:

1. Connect to EVK via Telink Burning Board(refer to 2.1.1);
2. From Telink website Download the BDT tool;
3. Download the BIN file according to the introduction of Step2 on the page;

Note

<http://wiki.telink-semi.cn/wiki/IDE-and-Tools/Burning-and-Debugging-Tools-for-all-Series/>:

4.2 Download Via TLSR9 DEV KEY

Follow the steps below to download the program to the TLSR9518A chip:

1. Connect to EVK via TLSR9 DEV KEY(refer to 2.1.2);
2. From Telink website Download Download Telink_v323_rds_official_windows, and install;
3. Download the BIN file according to the introduction on the page;

Note

<http://wiki.telink-semi.cn/wiki/IDE-and-Tools/Burning-and-Debugging-Tools-for-TLSR9-Series/>:

5. Demo Firmware Instruction

Currently, two demo firmwares are provided, and users can realize simple functions after burning them to EVK.

5.1 "_proj_smart_watch_nosniff.bin"

Feature:

- Realize the connection with the mobile phone to make calls and play music operations.
- Realize the connection with the headset and make a call.

5.1.1 How to connect EVK to phone

1. Download the BIN file to EVK(refer to chapter4);

Figure 5-1 Firmware download success

```
Flash Sector (4K) Erase at address 4d000
Flash Page Program at address 4d000
Flash Page Program at address 4d400
Flash Page Program at address 4d800
File Download to Flash at address 0x000000: 318060 bytes
Total Time: 26120 ms
```

2. Re-power on EVK or short press sw1 (reset) to let the chip program run;
3. Use the phone to connect, turn on the phone's Bluetooth, scan and find the device with the Bluetooth name "tlk_dev";

Figure 5-2 Find the device



4. Connect the device on the mobile phone;

Figure 5-3 Connect device success

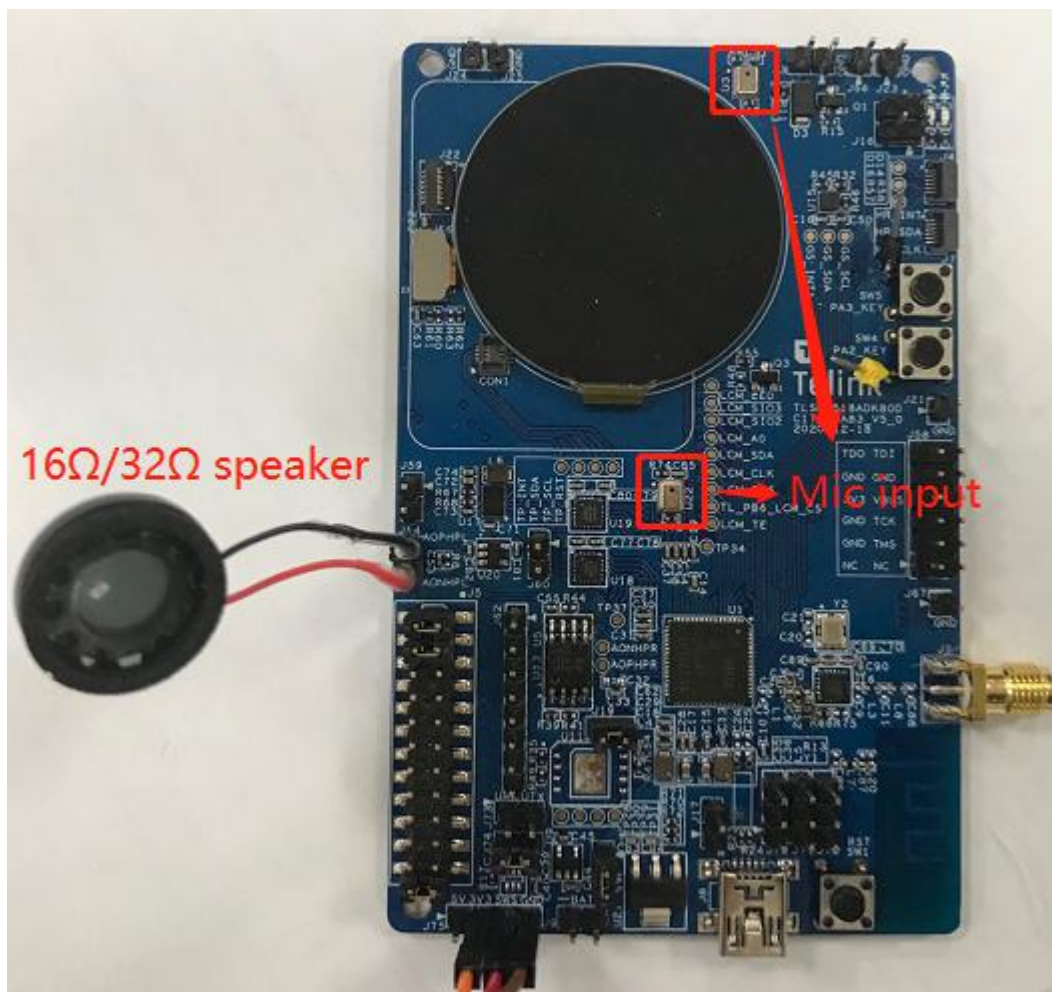


5. Make calls and play music operations;

5.1.2 How to connect EVK to headset

1. First, re-power on EVK or short press sw1 (reset) ;
2. Leave the headset in pairing state;
3. Double-click sw4, EVK will start scanning and automatically connect the headset;
4. Double click SW5, EVK and headset realize the call, single click SW5 to hang up;

Figure 5-4 Audio components



Note

Currently, this program does not support local music playback, and will support it in the future. If users need, please confirm with Telink FAE.

5.2 "B91_SPI_Demo.bin"

Feature:

- Realize amoled screen display.

Intructions:

1. Download the BIN file to EVK(refer to chapter4);

Figure 5-5 Firmware download success

```
Flash Sector (4K) Erase at address 3000  
Flash Page Program at address 3000  
File Download to Flash at address 0x000000: 12752 bytes  
Total Time: 1072 ms
```

2. Power on peripheral modules(Refer to 2.1.1);
3. Re-power on EVK or short press sw1 (reset) to let the chip program run;
4. Check the display;



Figure 5-6 Amoled display

confidential



6. Reference Design

6.1 Schematic

Figure 6-1 Schematic

confidential



confidential



confidential



confidential



confidential



confidential



confidential



6.2 Bill Of Materials

confidential



confidential



confidential



confidential

FCC Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

External antenna specification

Antenna manufacturer: RTANT COMMUNICATIONS co.,LTD

Building E, Shalong Ludlang Industrial Innovation Park, Shatang Industrial Zone,
Houjie Town, Dongguan City



antenna model: BT External Antenna

Antenna Gain: 0 dBi