



ESP32-S3-Korvo-2 V3.0

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This user guide will help you get started with ESP32-S3-Korvo-2 V3.0 and will also provide more in-depth information.

The ESP32-S3-Korvo-2 is a multimedia development board based on the ESP32-S3 chip. It is equipped with a two-microphone array which is suitable for voice recognition and near/far-field voice wake-up applications. The board integrates multiple peripherals such as LCD, camera, and microSD card. It also supports JPEG video stream processing. With all of its outstanding features, the board is an ideal choice for the development of low-cost and low-power network-connected audio and video products.



ESP32-S3-Korvo-2 V3.0 with ESP32-S3-WROOM-1 module

This board mainly consists of the following parts:

- Main board: ESP32-S3-Korvo-2
- LCD extension board: [:doc:`ESP32-S3-Korvo-2-LCD <user-guide-esp32-s3-korvo-2-lcd>`](#)
- Camera

This document is mostly dedicated to the main board. For detailed information on other parts, click the links above.

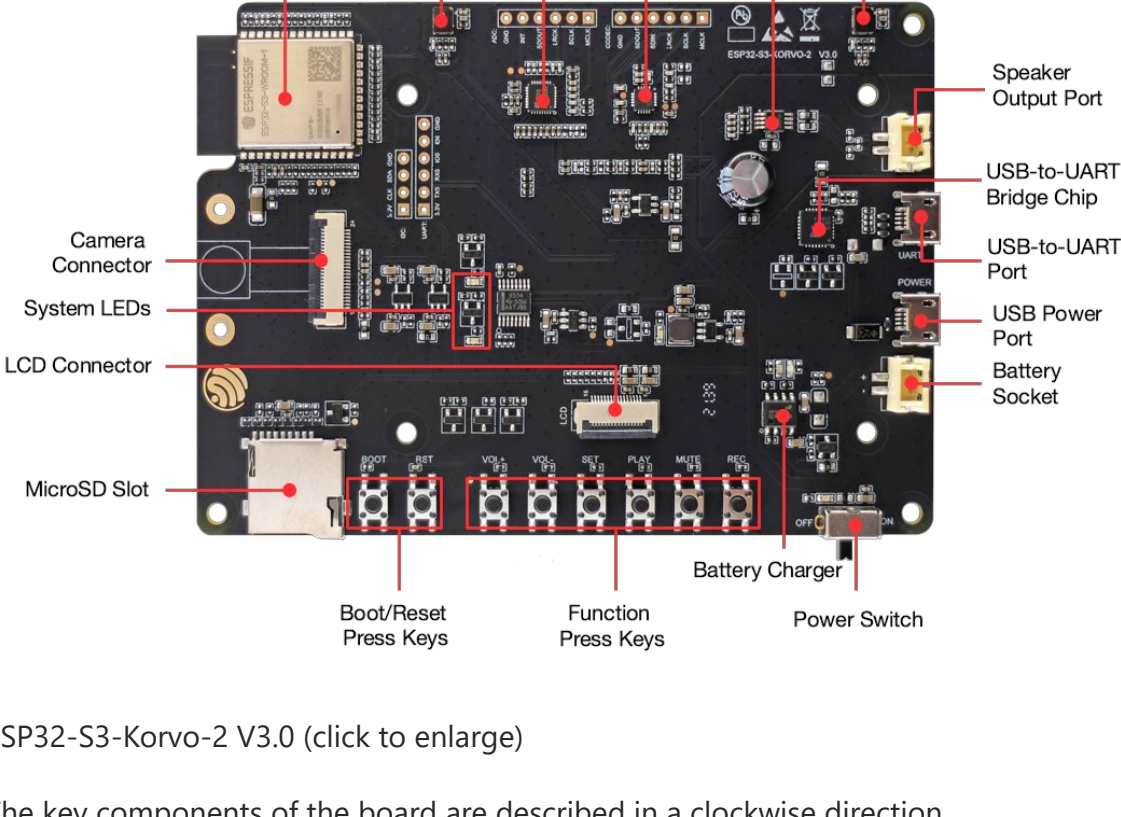
The document consists of the following sections:

- [Getting started](#): Overview of the board and hardware/software setup instructions to get started.
- [Hardware Reference](#): More detailed information about the board's hardware.
- [Hardware Revision Details](#): Hardware revision history, known issues, and links to user guides for previous versions (if any) of the board.
- [Related Documents](#): Links to related documentation.

Getting Started

This section provides a brief introduction of ESP32-S3-Korvo-2 V3.0, instructions on how to do the initial hardware setup and how to flash firmware onto it.

Description of Components



ESP32-S3-Korvo-2 V3.0 (click to enlarge)

The key components of the board are described in a clockwise direction.

Key Component	Description
ESP32-S3-WROOM-1 Module	The ESP32-S3-WROOM-1 is a powerful, generic Wi-Fi + Bluetooth LE MCU module that is built around the ESP32-S3 series of SoCs. On top of a rich set of peripherals, the acceleration for neural network computing and signal processing workloads provided by the SoC make the modules an ideal choice for a wide variety of application scenarios related to AI and Artificial Intelligence of Things (AIoT), such as wake word detection, speech commands recognition, face detection and recognition, smart home, smart appliances, smart control panel, smart speaker, etc.
Left Microphone	Onboard microphone connected to ADC.
Audio ADC Chip	ES7210 is a high-performance, low-power 4-channel audio analog-to-digital converter for microphone array applications. It is very suitable for music and speech applications. In addition, ES7210 can also be used to collect acoustic echo cancellation (AEC) echo reference signals.
Audio Codec Chip	The audio codec chip, ES8311 , is a low-power mono audio codec. It consists of 1-channel ADC, 1-channel DAC, low noise pre-amplifier, headphone driver, digital sound effects, analog mixing, and gain functions. It is interfaced with ESP32-S3-WROOM-1 module over I2S and I2C buses to provide audio processing in hardware independently from the audio application.
Audio PA Chip	NS4150 is an EMI, 3 W mono Class D audio power amplifier, amplifying audio signals from audio codec chips to drive speakers.
Right Microphone	Onboard microphone connected to ADC.
Speaker Output Port	Output socket to connect a speaker. The 4-ohm and 3-watt speaker is recommended. The pins have a 2.00 mm/0.08" pitch.
USB-to-UART Bridge Chip	A single chip USB-UART bridge CP2102N provides up to 3 Mbps transfer rates for software download and debugging.
USB-to-UART Port	Functions as the communication interface between a PC and the ESP32-S3-WROOM-1 module.
USB Power Port	Provides power to the board. It is recommended to use at least 5V/2A power adapter to ensure a stable power supply.
Battery Socket	Two pins socket to connect a single cell Li-ion battery.
Power Switch	Power on/off knob: toggling it down powers the board on; toggling it up powers the board off.
Battery Charger	AP5056 is a constant current and constant voltage linear charger for single cell lithium-ion batteries. Used for charging of a battery connected to the Battery Socket over the Micro USB Port.
Function Press Keys	Six press keys labeled REC, MUTE, PLAY, SET, VOL- and VOL+. They are routed to ESP32-S3-WROOM-1 module and intended for development and testing of a UI for audio applications using a dedicated API.
Boot/Reset Press Keys	Boot: holding down the Boot key and momentarily pressing the Reset key initiates the firmware upload mode. Then you can upload firmware through the serial port. Reset: pressing this button alone resets the system.
MicroSD Slot	The development board supports a microSD card in 1-bit mode, and can store or play audio files in the microSD card.
LCD Connector	A FPC connector with 0.5 mm pitch to connect to the LCD extension board.
System LEDs	Two general-purpose LEDs (green and red) controlled by ESP32-S3-WROOM-1 module to indicate certain operation states of the audio application using dedicated API.
Camera Connector	An external camera module that can be connected to the development board with the connector to transmit images.

Start Application Development

Before powering up your board, please make sure that it is in good condition with no obvious signs of damage.

Required Hardware

- 1 x ESP32-S3-Korvo-2 V3.0
- 1 x Speaker
- 2 x USB 2.0 cable (Standard-A to Micro-B)
- 1 x Computer running Windows, Linux, or macOS

Note

Be sure to use an appropriate USB cable. Some cables are for charging only and do not provide the needed data lines nor work for programming the boards.

Optional Hardware

- 1 x microSD card
- 1 x Li-ion battery

Note

Be sure to use a Li-ion battery that has a built-in protection circuit.

Hardware Setup

1. Connect the speaker to the **Speaker Output**.
2. Plug in the USB cables to the PC and to both USB ports of the board.
3. The standby LED (green) should turn on. Assuming that a battery is not connected, the charging LED (red) will blink every couple of seconds.
4. Toggle the **Power Switch**.
5. The red Power On LED should turn on.

Software Setup

Please proceed to [:doc:`../get-started/index`](#), where Section [:ref:`get-started-step-by-step`](#) will quickly help you set up the development environment and then flash an [:adf:`application example <examples>`](#) onto your board.

Contents and Packaging

The main board and its accessories can be ordered separately. The accessories include:

- LCD extension board: ESP32-S3-Korvo-2-LCD
- Camera
- Connectors:
 - 20-pin FPC cable
- Fasteners:
 - Copper standoffs (x8)
 - Screws (x4)

Retail Orders

If you order a few samples, each board comes in an individual package in either antistatic bag or any packaging depending on your retailer.

For retail orders, please go to <https://www.espressif.com/en/company/contact/buy-a-sample>.

Wholesale Orders

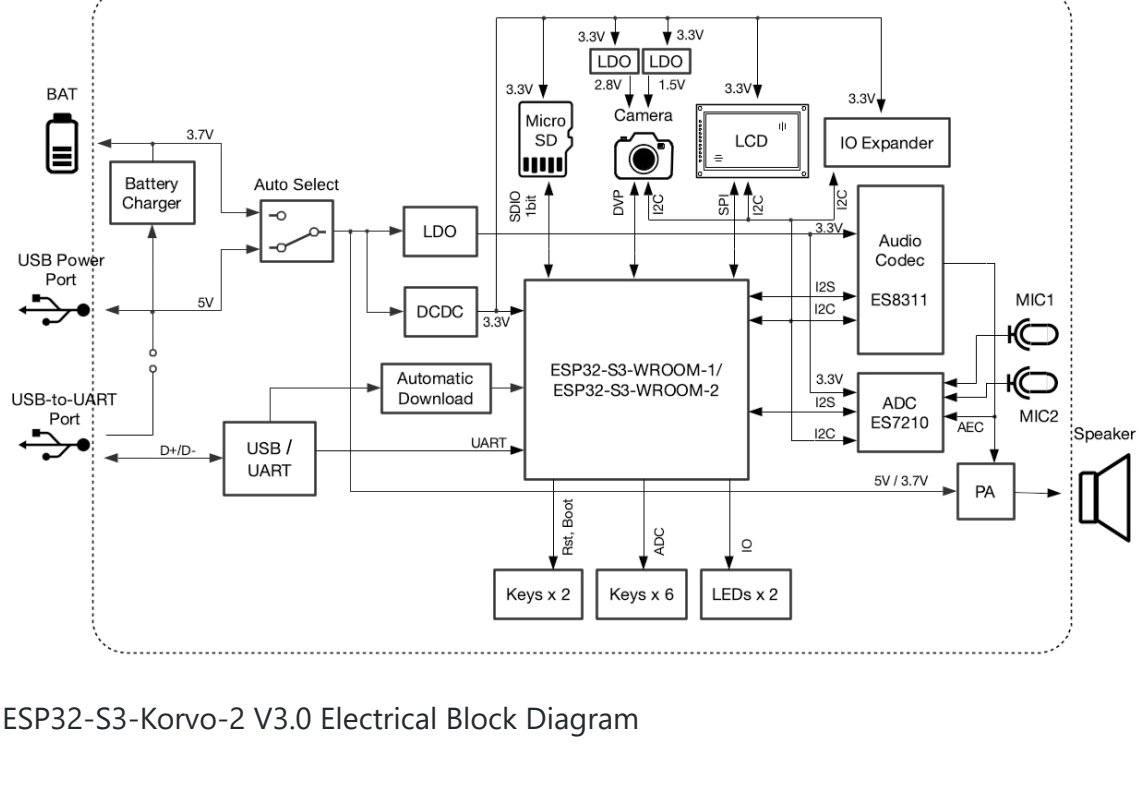
If you order in bulk, the boards come in large cardboard boxes.

For wholesale orders, please go to <https://www.espressif.com/en/contact-us/sales-questions>.

Hardware Reference

Block Diagram

The block diagram below shows the components of ESP32-S3-Korvo-2 V3.0 and their interconnections.

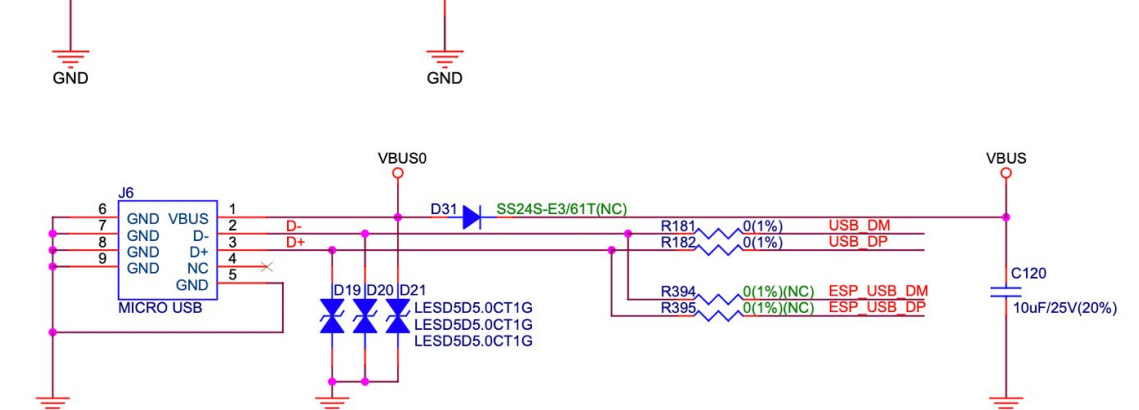


ESP32-S3-Korvo-2 V3.0 Electrical Block Diagram

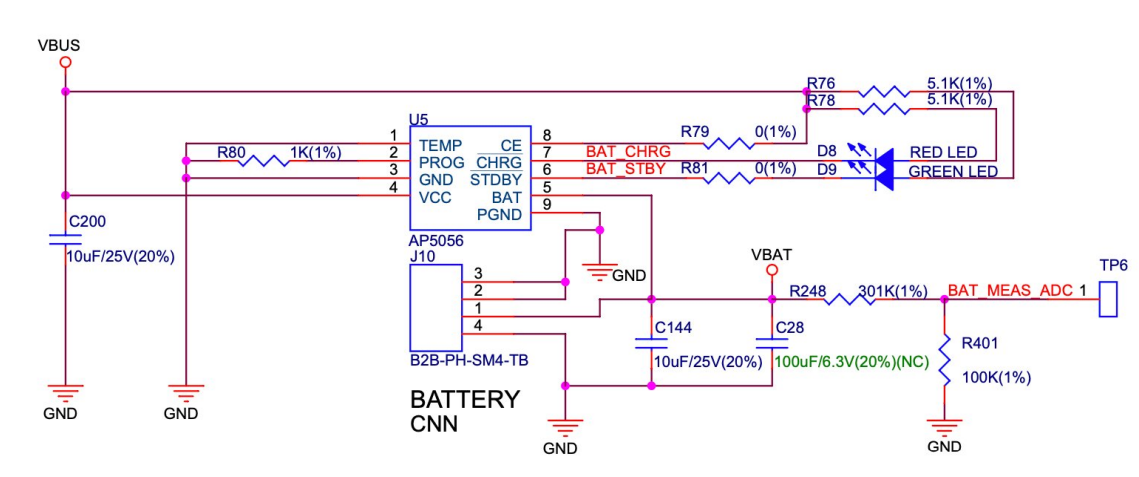
Notes on Power Distribution

Power Supply over USB and from Battery

The main power supply is 5 V and provided by a USB. The secondary power supply is 3.7 V and provided by an optional battery. The USB power itself is fed with a dedicated cable, separating from a USB cable used for an application upload. To further reduce noise from the USB, the battery may be used instead of the USB.

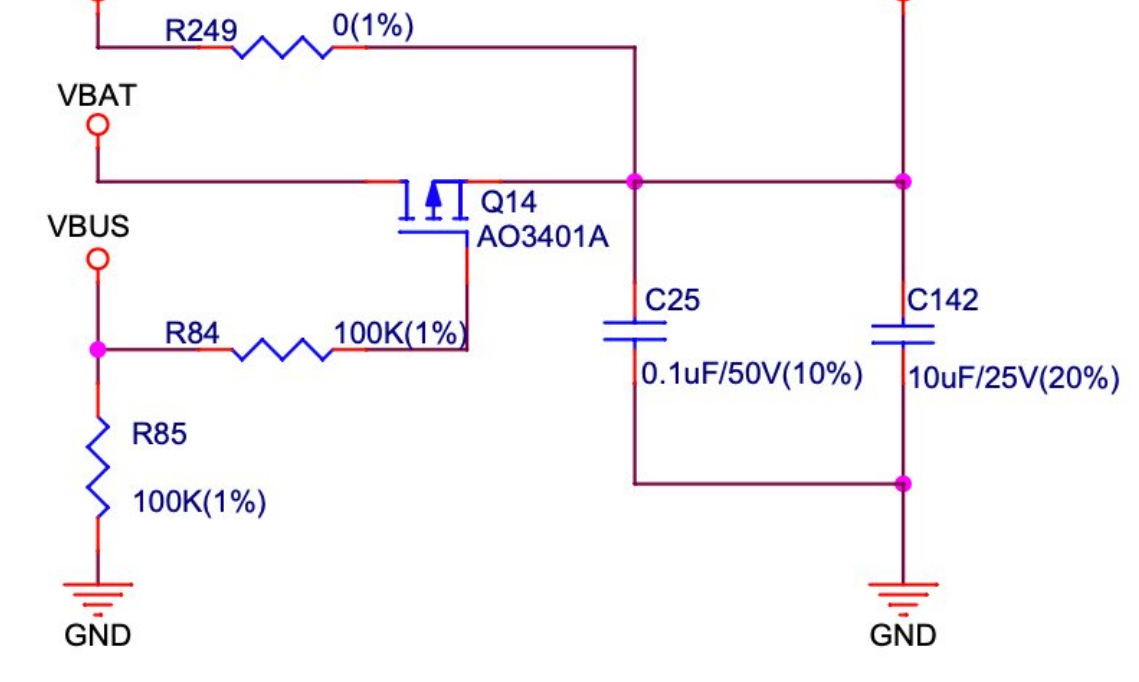


ESP32-S3-Korvo-2 V3.0 - Dedicated USB Power Supply Socket



ESP32-S3-Korvo-2 V3.0 - Power Supply from a Battery

As shown in the figure below, if the USB power supply and battery power supply are connected at the same time with a high VBUS, an off-state Q14, and an automatic cut-off VBAT, the USB becomes the power supply for the system.

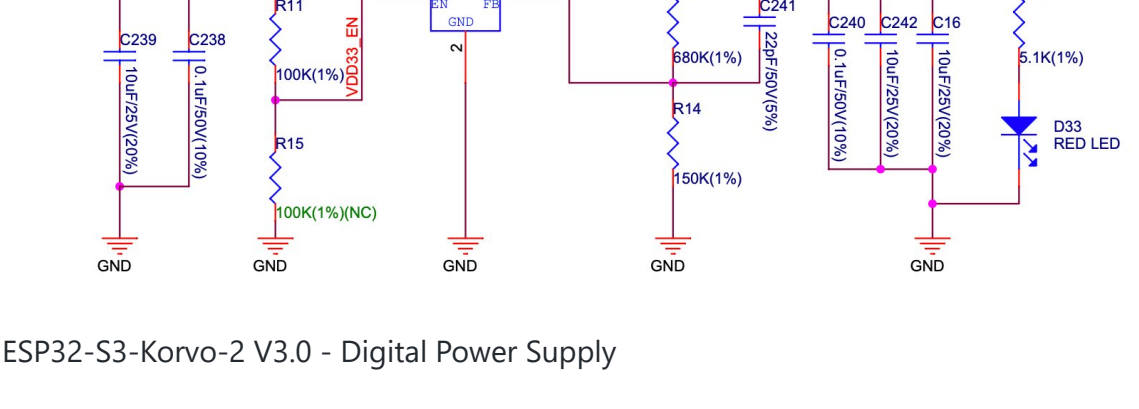


ESP32-S3-Korvo-2 V3.0 - Power Supply Options

Independent Audio and Digital Power Supply

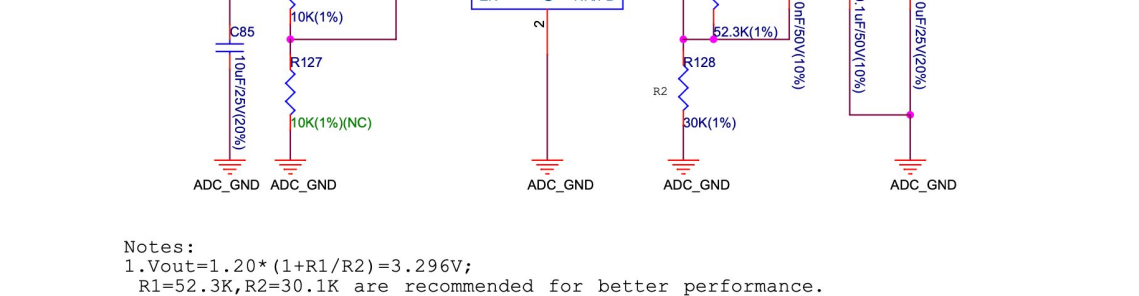
ESP32-S3-Korvo-2 V3.0 features independent power supplies to the audio components and ESP module. This should reduce noise in the audio signal from digital components and improve overall performance of the components.

Power for Digital:



ESP32-S3-Korvo-2 V3.0 - Digital Power Supply

Power for Audio:



ESP32-S3-Korvo-2 V3.0 - Audio Power Supply

GPIO Allocation Summary

The table below provides allocation of GPIOs exposed on terminals of ESP32-S3-WROOM-1 module to control specific components or functions of the board.

ESP32-S3-WROOM-1 GPIO Allocation

Pin [1]	Pin Name	ES8311	ES7210	Camera	LCD	Keys
3	EN					EN_KEY
4	IO4					
5	IO5					REC, MUTE, PLAY, SET VOL-, VOL+
6	IO6					
7	IO7					
8	IO15					
9	IO16	I2S0_MCLK	MCLK			
10	IO17	I2C_SDA	I2C_SDA	SIOD	TP_I2C_SDA	
11	IO18	I2C_CLK	I2C_CLK	SIOC	TP_I2C_CLK	
12	IO8	I2S0_DSDIN				
13	IO19					
14	IO20					
15	IO3			D5		
16	IO46					
17	IO9	I2S0_SCLK	SCLK			
18	IO10		SDOUT			
19	IO11			PCLK		
20	IO12			D6		
21	IO13			D2		
22	IO14			D4		
23	IO21			VSYNC		
24	IO47			D3		
25	IO48					
26	IO45	I2S0_LRCK	LRCK			
27	IO0				LCD_SPI_SDA	BOOT_KEY
28	IO35					
29	IO36					
30	IO37					
31	IO38			HREF		
32	IO39			D9		
33	IO40			XCLK		
34	IO41			D8		
35	IO42			D7		
36	RXD0					
37	TXD0					
38	IO2				LCD_SPI_DC	
39	IO1				LCD_SPI_CLK	
41	EPAD					

[1] Pin - ESP32-S3-WROOM-1 module pin number, GND and power supply pins are not listed.

The GPIOs allocated to the IO expander are further expanded to multiple GPIOs.

IO Expander GPIO Allocation

IO Expander Pin	Pin Name	LCD	Other
4	P0		PA_CTRL
5	P1	LCD_CTRL	
6	P2	LCD_RST	
7	P3	LCD_CS	
9	P4	TP_INT	
10	P5		PERI_PWR_ON
11	P6		LED1
12	P7		LED2

Connector

Camera Connector

No.	Camera Signal	ESP32-S3 Pin
1	SIOD	GPIO17
2	SIOC	GPIO18
3	D5	GPIO3
4	PCLK	GPIO11
5	D6	GPIO12
6	D2	GPIO13
7	D4	GPIO14
8	VSYNC	GPIO21
9	D3	GPIO47
10	HREF	GPIO38
11	D9	GPIO39
12	XCLK	GPIO40
13	D8	GPIO41
14	D7	GPIO42

LCD Connector

No.	LCD Signal	ESP32-S3 Pin
1	TP_I2C_SDA	GPIO17
2	TP_I2C_CLK	GPIO18
3	LCD_SPI_SDA	GPIO0
4	LCD_SPI_DC	GPIO2
5	LCD_SPI_CLK	GPIO1

No.	LCD Signal	IO Expander
1	ESP_LCD_CTRL	P1
2	ESP_LCD_RST	P2
3	ESP_LCD_CS	P3
4	ESP_TP_INT	P4

AEC Path

AEC path provides reference signals for AEC algorithm.

ESP32-S3-Korvo-2 provides two compatible echo reference signal source designs. One is Codec (ES8311) DAC output (DAC_AOUTLN/DAC_AOUTLP), the other is PA (NS4150) output (PA_OUTL+/PA_OUTL-). The former is the default and recommended selection. Resistors R132 and R140 marked NC (no component) in the figure below should not be installed.

