

ESP32-S2-Kaluga-1 Kit v1.3

Older version: [ESP32-S2-Kaluga-1 Kit v1.2](#)

The ESP32-S2-Kaluga-1 kit v1.3 is a development kit by Espressif that is mainly created to:

- Demonstrate the ESP32-S2's human-computer interaction functionalities
- Provide the users with the tools for development of human-computer interaction applications based on the ESP32-S2

There are many ways of how the ESP32-S2's abundant functionalities can be used. For starters, the possible use cases may include:

- **Smart home:** From simplest smart lighting, smart door locks, smart sockets, to video streaming devices, security cameras, OTT devices, and home appliances
- **Battery-powered equipment:** Wi-Fi mesh sensor networks, Wi-Fi-networked toys, wearable devices, health management equipment
- **Industrial automation equipment:** Wireless control and robot technology, intelligent lighting, HVAC control equipment, etc.
- **Retail and catering industry:** POS machines and service robots



ESP32-S2-Kaluga-1-Kit Overview (click to enlarge)

The ESP32-S2-Kaluga-1 kit consists of the following boards:

- Main board: ESP32-S2-Kaluga-1
- Extension boards:

[ESP-LyraT-8311A v1.3](#) - audio player
[ESP-LyraP-TouchA v1.1](#) - touch panel
[ESP-LyraP-LCD32 v1.2](#) - 3.2" LCD screen
[ESP-LyraP-CAM v1.1](#) - camera board

- [Getting Started](#): Provides an overview of the ESP32-S2-Kaluga-1 and hardware/software setup instructions to get started.
- [Hardware reference](#): Provides more detailed information about the ESP32-S2-Kaluga-1's hardware.
- [Hardware Revision Details](#): Covers revision history, known issues, and links to user guides for previous versions of the ESP32-S2-Kaluga-1.
- [Related Documents](#): Gives links to related documentation.

Getting Started

This section describes how to get started with the ESP32-S2-Kaluga-1. It begins with a few introductory sections about the ESP32-S2-Kaluga-1, then Section [Start Application Development](#) provides instructions on how to do the initial hardware setup and then how to flash firmware onto the ESP32-S2-Kaluga-1.

Overview

The ESP32-S2-Kaluga-1 main board is the heart of the kit. It integrates the ESP32-S2-WROVER module and all the connectors for extension boards. This board is the key tool in prototyping human-computer interaction interfaces.

The ESP32-S2-Kaluga-1 board has connectors for boards with:

- Extension header (ESP-LyraT-8311A, ESP-LyraP-LCD32)
- Camera header (ESP-LyraP-CAM)
- Touch FPC connector (ESP-LyraP-TouchA)
- LCD FPC connector (no official extension boards yet)
- I2C FPC connector (no official extension boards yet)



ESP32-S2-Kaluga-1 (click to enlarge)

All the four extension boards are specially designed to support the following features:

- **Touch panel control**

- Six touch buttons

- Supports acrylic panels up to 5 mm

- Wet hand operation

- Water rejection, ESP32-S2 can be configured to disable all touchpads automatically if multiple pads are simultaneously covered with water and to re-enable touchpads if the water is removed

- **Audio playback**

- Connect speakers to play audio

- Use together with the Touch panel to control audio playback and adjust volume

- **LCD display**

- LCD interface (8-bit parallel RGB, 8080, and 6800 interface)

- **Camera image acquisition**

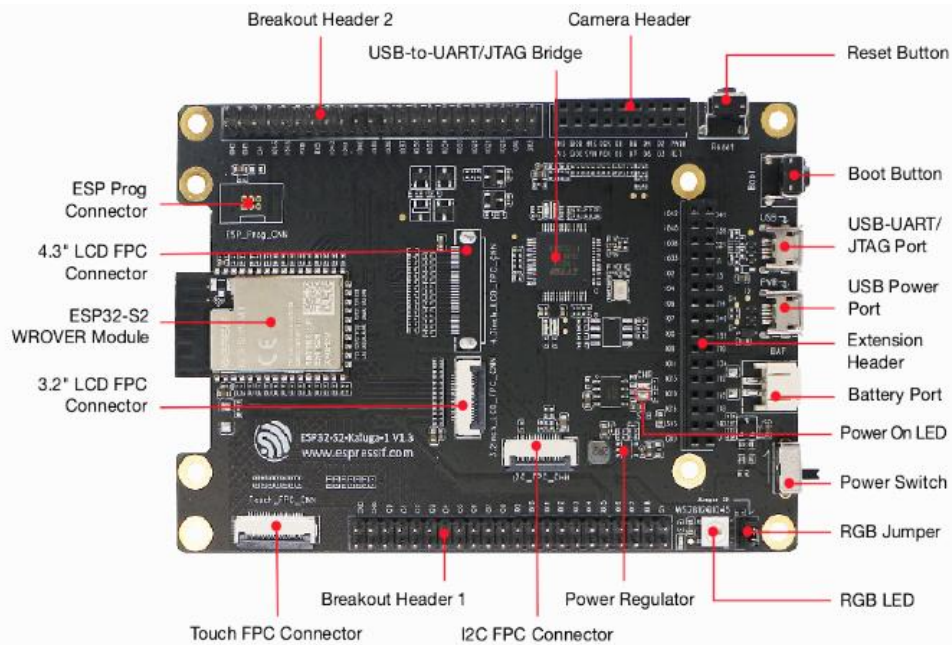
- Supports OV2640 and OV3660 camera modules

- 8-bit DVP image sensor interface (ESP32-S2 also supports 16-bit DVP image sensors, you can design it yourself)

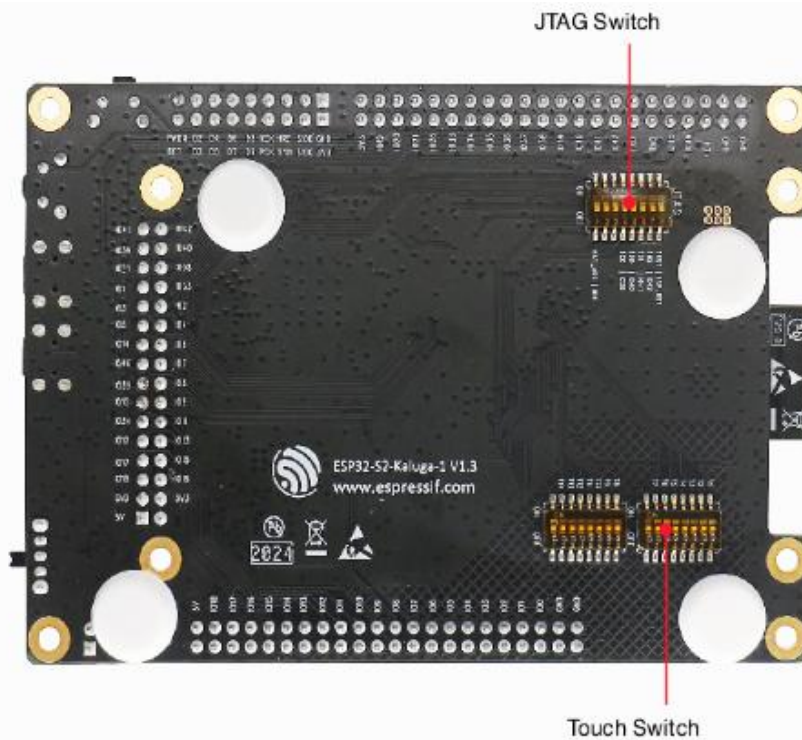
- Clock frequency up to 40 MHz

Optimized DMA transmission bandwidth for easier transmission of high-resolution images

Description of Components



ESP32-S2-Kaluga-1 - front (click to enlarge)



ESP32-S2-Kaluga-1 - back (click to enlarge)

The description of components starts from the ESP32-S2 module on the left side and then goes clockwise.

Reserved means that the functionality is available, but the current version of the kit does not use it.

Key Component	Description
ESP32-S2-WROVER Module	Module integrating the ESP32-S2 chip that provides Wi-Fi connectivity, data processing power, and flexible data storage.
4.3" LCD FPC Connector	(Reserved) Connect to a 4.3" LCD extension board using the FPC cable.
ESP Prog Connector	(Reserved) Connection for Espressif's download device (ESP-Prog) to flash ESP32-S2 system.
JTAG Switch	Switch to ON to enable connection between ESP32-S2 and FT2232; JTAG debugging will then be possible using USB-UART/JTAG Port. See also JTAG Debugging .
Breakout Header 2	Some GPIO pins of the ESP32-S2-WROVER module are broken out to this header, see labels on the board.
USB-to-UART/JTAG Bridge	FT2232 adapter board allowing for communication over USB port using UART/JTAG protocols.
Camera Header	Mount a camera extension board here (e.g., ESP-LyraP-CAM).
Extension Header	Mount the extension boards having such connectors here.
Reset Button	Press this button to restart the system
Boot Button	Holding down Boot and then pressing Reset initiates Firmware Download mode for downloading firmware through the serial port.
USB-UART/JTAG Port	Communication interface (UART or JTAG) between a PC and the ESP32-S2 module.
USB Power Port	Power supply for the board.
Battery Port	Connect an external battery to the 2-pin battery connector.
Power On LED	Turns on when the USB or an external power supply is connected to the board.

Key Component	Description
Power Switch	Switch to ON to power the system.
RGB Jumper	To have access to the RGB LED, place a jumper onto the pins.
RGB LED	Programmable RGB LED and controlled by GPIO45. Before using it, you need to put RGB Jumper ON.
Power Regulator	Regulator converts 5 V to 3.3 V.
I2C FPC Connector	(Reserved) Connect to other I2C extension boards using the FPC cable.
Breakout Header 1	Some GPIO pins of the ESP32-S2-WROVER module are broken out to this header, see labels on the board.
Touch FPC Connector	Connect the ESP-LyraP-TouchA extension board using the FPC cable.
Touch Switch	In OFF position, GPIO1 to GPIO14 are used for connection to touch sensors; switch to ON if you want to use them for other purposes.
3.2" LCD FPC connector	Connect a 3.2" LCD extension board (e.g., ESP-LyraP-LCD32) using the FPC cable.

Start Application Development

Before powering up your ESP32-S2-Kaluga-1, please make sure that it is in good condition with no obvious signs of damage.

Required Hardware

- ESP32-S2-Kaluga-1
- Two USB 2.0 cables (Standard-A to Micro-B)
 - For power supply
 - For UART/JTAG communication
- Computer running Windows, Linux, or macOS
- Any extension boards of your choice

Hardware Setup

1. Connect the extension board(s) of your choice (go to their respective user guides if necessary)
2. Plug in both USB cables
3. Turn the **Power Switch** to ON - the Power On LED will light up

Software Setup

Please proceed to [Get Started](#), where Section [Installation](#) will quickly help you set up the development environment.

The programming guide and application examples for your ESP32-S2-Kaluga-1 kit can be found in [esp-dev-kits](#) repository on GitHub.

A Board Support Package can be found in [ESP Component Registry](#).

Contents and Packaging

Retail Orders

If you order one or several samples of the kit, each ESP32-S2-Kaluga-1 development kit comes in an individual package.



ESP32-S2-Kaluga-1 - package

The contents are as follows:

- **Main Board**

- ESP32-S2-Kaluga-1

- **Extension Boards:**

- ESP-LyraT-8311A

- ESP-LyraP-CAM

- ESP-LyraP-TouchA

- ESP-LyraP-LCD32

- **Connectors**

- 20-pin FPC cable (to connect ESP32-S2-Kaluga-1 to ESP-LyraP-TouchA)

- **Fastener**

- Mounting bolts (x8)

- Screws (x4)

- Nuts (x4)

For retail orders, please go

to <https://www.espressif.com/en/contact-us/get-samples>.

Wholesale Orders

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

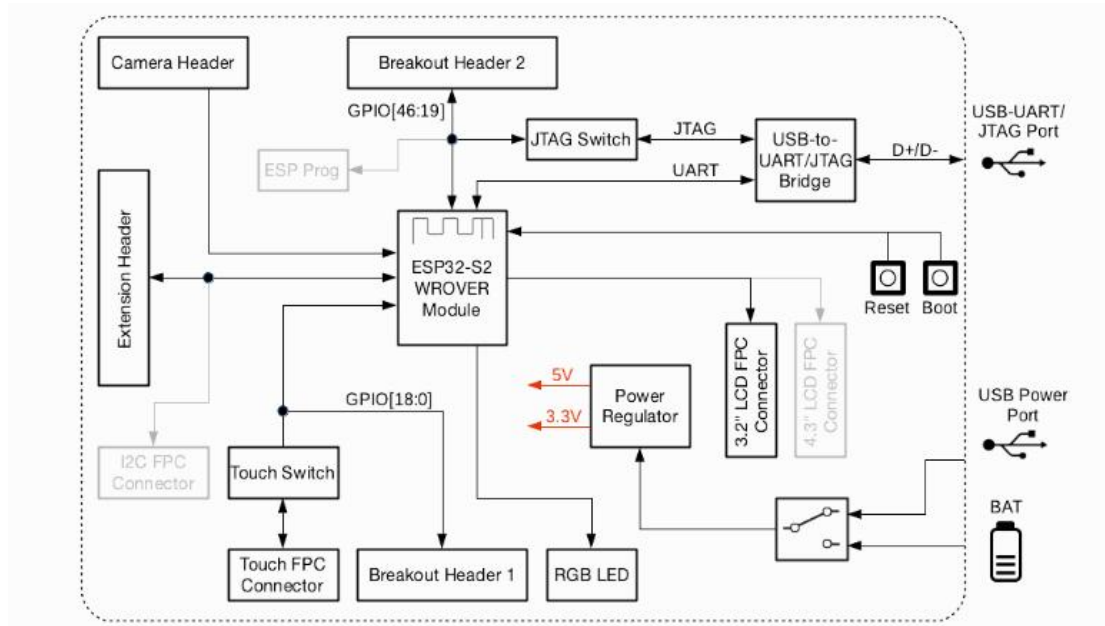
For wholesale orders, please go

to <https://www.espressif.com/en/contact-us/sales-questions>.

Hardware Reference

Block Diagram

A block diagram below shows the components of the ESP32-S2-Kaluga-1 and their interconnections.



ESP32-S2-Kaluga-1 block diagram

Power Supply Options

There are four ways to provide power to the board:

- Micro USB port, default power supply
- External battery via the 2-pin battery connector
- 5V and GND header pins
- 3V3 and GND header pins

Compatibility of Extension Boards

If you want to use more than one extension board at the same time, please check the table given below.

Boards Used	HW Conflict	Limitations	Solution
8311A v1.3 + CAM v1.1	I2S Controller	ESP32-S2 has only one I2S interface. But both extension boards require connection via the	Utilize time division multiple access, or use a different audio module that can be connected via other

Boards Used	HW Conflict	Limitations	Solution
		ESP32-S2's I2S interface (LyraT-8311A in Standard mode, ESP-LyraP-CAM in Camera mode).	GPIOs or DAC.
TouchA v1.1 + LCD32 v1.2	IO11, IO6	Touch actions cannot be triggered because of the multiplexed pin IO11. ESP-LyraP-LCD32 will not be affected because its BLCT pin will be disconnected from IO6.	Do not initialize IO11 (NETWORK) for your ESP-LyraP-TouchA, or configure the BLCT pin to -1 (= do not use BLCT) for your ESP-LyraP-LCD32.
8311A v1.3 + LCD32 v1.2	IO6	BLCT pin of ESP32-S2-Kaluga-1 will be disconnected from IO6.	Configure the BK pin to -1 (= do not use BLCT) for your ESP-LyraP-LCD32.
TouchA v1.1 + 8311A v1.3	Pin BT_ADC on ESP-LyraT-8311A	This pin is required for initialization of the six button on ESP-LyraT-8311A. At the same time, ESP-LyraP-TouchA needs this pin for its touch actions.	If you plan to use buttons on ESP-LyraT-8311A, do not initialize pin IO6 (PHOTO) for your ESP-LyraP-TouchA.
TouchA v1.1 + CAM v1.1	IO1, IO2, IO3	Cannot be used simultaneously because of the mentioned multiplexed pins.	For ESP-LyraP-TouchA, do not initialize IO1 (VOL_UP), IO2 (PLAY), and IO3 (VOL_DOWN).
TouchA v1.1 + LCD32 v1.2 + CAM v1.1	IO1, IO2, IO3, IO11	Conflicts on the mentioned multiplexed pins.	For ESP-LyraP-TouchA, do not initialize IO1 (VOL_UP), IO2 (PLAY), IO3

Boards Used	HW Conflict	Limitations	Solution
			(VOL_DOWN), and IO11 (NETWORK).
TouchA v1.1 + LCD32 v1.2 + 8311A v1.3	IO6, IO11	If ESP-LyraT-8311A's pin BT_ADC is used to initialize the board's six buttons, IO6 and IO11 will not be available for the other boards.	Do not initialize IO11 (NETWORK) for your ESP-LyraP-TouchA. Also, if you need to use BT_ADC, do not initialize IO6 (PHOTO).

Also, all extension boards and the [JTAG interface](#) share the same pins IO39, IO40, IO41 and IO42. For this reason, the following may disturb the JTAG operation:

- Plugging in any extension board
- Debugging an application that is using an extension board

Hardware Revision Details

ESP32-S2-Kaluga-1 Kit v1.3

- The following pins re-assigned to fix the download issue
 - Camera D2: GPIO36
 - Camera D3: GPIO37
 - AU_I2S1_SDI: GPIO34
 - AU_WAKE_INT: GPIO46
- RGB pin header moved to the board's edge
- All dip switches moved to the flip side for convenient operation

ESP32-S2-Kaluga-1 Kit v1.2

[Initial release](#)

Related Documents

- [ESP32-S2 Datasheet \(PDF\)](#)
- [ESP32-S2-WROVER Datasheet \(PDF\)](#)
- [ESP Product Selector](#)
- [JTAG Debugging](#)
- [ESP32-S2-Kaluga-1 Schematic \(PDF\)](#)
- [ESP32-S2-Kaluga-1 PCB Layout \(PDF\)](#)
- [ESP32-S2-Kaluga-1 Pin Mapping \(Excel\)](#)

For other design documentation for the board, please contact us at sales@espressif.com.