

Espressif SoC Product Portfolio

Comprehensive Connectivity, AI and HMI SoCs



Product Selector

| Feature | | P-Series | S-Series | | C-Series | | | | | H-Series | | 32-Series | | |
|----------------|-----------------------|---|-------------------------------------|--|--|--|--------------------------------|-------------------------------------|-----------------------------------|------------------------------|--|--------------------------------|-------------------------|----------|
| | | ESP32-P4 | ESP32-S3 | ESP32-S2 | ESP32-C5 | ESP32-C6 | ESP32-C61 | ESP32-C3 | ESP32-C2 | ESP32-H4 | ESP32-H2 | ESP32 | | |
| Connectivity | Wi-Fi | Wi-Fi Generation | 11b/g/n | 11b/g/n | 11a/b/g/n/ac/ax | 11b/g/n/ax | 11b/g/n/ax | 11b/g/n | 11b/g/n | | | 11b/g/n | | |
| | | Data Rate | 150 Mbps | 150 Mbps | 150 Mbps | 150 Mbps | 150 Mbps | 150 Mbps | 72.2 Mbps | | | 150 Mbps | | |
| | | Dual Band | | | | ✓ | ✓ | ✓ | | | | | | |
| | | Wi-Fi 6 | | | | ✓ | ✓ | ✓ | | | | | | |
| | | SoftAP | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | |
| | | Sniffing | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | |
| | Bluetooth | WPA Support | | WPA3 | WPA3 | WPA3 | WPA3 | WPA3 | WPA3 | | | | | |
| | | Wi-Fi CSI | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | | |
| | | Bluetooth Low Energy | | 5.0 | | 5.3 | 5.3 | 5.0 | 5.0 | 5.0 | 5.4 | 5.0 | BT Classic/ 4.2 | |
| | | LE-Audio | | | | | | | | | ✓ | | | |
| | | Direction Finding | | | | | | | | | ✓ | | | |
| | | Long Range | | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | |
| Type | 2Mbps Data Rate | | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | |
| | Extended Advertising | | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | |
| | BLE-Mesh | | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | |
| | Thread | | | | ✓ | ✓ | | | | ✓ | ✓ | | | |
| | Zigbee | | | | ✓ | ✓ | | | | ✓ | ✓ | | | |
| | Matter | | Wi-Fi | | Wi-Fi, Thread | Wi-Fi, Thread | Wi-Fi | Wi-Fi | Wi-Fi | Thread | Thread | Wi-Fi | | |
| Radio | Ethernet | ✓ | | | | | | | | | | ✓ | | |
| | SoC | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| | Module | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| | Frequency | | 2.4 GHz | 2.4 GHz | 2.4 GHz 5 GHz | 2.4 GHz | 2.4 GHz | 2.4 GHz | 2.4 GHz | 2.4 GHz | 2.4 GHz | 2.4 GHz | | |
| | Tx-Power | | 0 to 20 dBm | 0 to 20 dBm | 0 to 20 dBm | 0 to 20 dBm | 0 to 20 dBm | 0 to 20 dBm | 0 to 20 dBm | -15 to 9 dBm | -15 to 20 dBm | 0 to 20 dBm | | |
| | Rx-Sensitivity (dBm) | | -98.4 (Wi-Fi-1M) -104 (BLE-125k) | -97 (Wi-Fi-1M) | - (Wi-Fi-1M) - (BLE-125k) - (802.15.4) | -99.2 (Wi-Fi-1M) -106 (BLE-125k) -104 (802.15.4) | - (Wi-Fi-1M) - (BLE-125k) | -98.4 (Wi-Fi-1M) -105 (BLE-125k) | -99 (Wi-Fi-1M) -106 (BLE-125k) | - (BLE-125k) - (802.15.4) | -106.5 (BLE-125k) -102.5 (802.15.4) | -98 (Wi-Fi-1M) -94 (BLE-1M) | | |
| | CPU & Memory | CPU | Dual Core RISC-V | Dual Core Xtensa | Single Core Xtensa | Single Core RISC-V | Single Core RISC-V | Single Core RISC-V | Single Core RISC-V | Single Core RISC-V | Dual Core RISC-V | Single Core RISC-V | Single/Dual Core Xtensa | |
| | | Clock | 400MHz | 240MHz | 240MHz | 240MHz | 160MHz | 160MHz | 160MHz | 120MHz | 96MHz | 96MHz | 240MHz | |
| | | FPU Extension | ✓ | ✓ | | | | | | | ✓ | | ✓ | |
| | | AI Extensions | ✓ | ✓ | | | | | | | | | | |
| | | LP CPU | 40MHz RISC-V | 17.5MHz RISC-V ULP Core | | 40MHz RISC-V | 20MHz RISC-V | | | | | | | ULP Core |
| | | SRAM | 768KB (HP) 16KB (LP) | 512KB 16KB (LP) | 320KB | 384KB (HP) 16KB (LP) | 512KB (HP) 16KB (LP) | 320KB | 400KB 8KB (LP) | 272KB | 320KB | 320KB 4KB (LP) | 520KB 16KB (LP) | |
| Security | External Flash | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| | PSRAM Support | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| | Secure Boot | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| | Flash Encryption | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| | Crypto Accelerators | RSA, AES, ECC, HMAC | RSA, AES, HMAC | RSA, AES, HMAC | AES, ECC, HMAC, RSA | RSA, AES, ECC, HMAC | AES, HMAC, ECC | RSA, AES, HMAC | AES, ECC, SHA | AES, ECC, HMAC | RSA, AES, ECC, HMAC | RSA, AES, SHA | | |
| | Digital Signature | ECDSA, RSA | RSA | RSA | ECDSA, RSA | RSA | ECDSA | RSA | | ECDSA | ECDSA | | | |
| HMI | APM/TEE | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ | ✓ | | | | |
| | MIPI-CSI | 2-lane | | | | | | | | | | | | |
| | H.264 Encoder | 1080p@30fps | | | | | | | | | | | | |
| | MIPI-DSI | 2-lane | | | | | | | | | | | | |
| | RGB Display | ✓ | ✓ | ✓ | | | | | | | | ✓ | | |
| | Camera Interface | ✓ | ✓ | ✓ | | | | | | | | ✓ | | |
| Peripherals | Touch Inputs | 14 | 14 | 14 | | | | | | 14 | | 10 | | |
| | GPIO Pins | 55 | 45 | 43 | 29 | 30 or 22 | 22 or 18 | 22 or 16 | 14 | 35 | 19 | 34 | | |
| | SDIO Host | 1 | 1 | | | | | | | | | 1 | | |
| | SDIO Slave | | | | 1 | 1 | | | | | | 1 | | |
| | I3C | 1 | | | | | | | | | | | | |
| | SPI | 4x SPI 1x LP SPI | 4 | 4 | 2x SPI 1x GP SPI | 2x SPI 1x GP SPI | 3 | 3 | 3 | 4 | 3 | 4 | | |
| | USB OTG | 1x HS 1x FS | 1x FS | 1x FS | | | | | | 1 | | | | |
| | USB Serial | 1 | 1 | | 1 | 1 | 1 | 1 | | | 1 | | | |
| | CAN-FD/TWAI | 3x TWAI | 1x TWAI | 1x TWAIx1 | 2x CAN-FD | 2x TWAI | | 1x TWAI | | 1x CAN-FD | | 1x TWAI | | |
| | UART | 5x UART 1x LP UART | 3 | 2 | 2 | 2x UART 1x LP UART | 3 | 2 | 2 | 2 | 2 | 3 | | |
| | I2C | 2x I2C 2x LP I2C | 2 | 2 | 1x I2C 1x LP I2C | 1x I2C 1x LP I2C | 1 | 1 | 1 | 2 | 2 | 2 | | |
| | I2S | 3x I2S 1x LP I2S | 2 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 2 | | |
| | PWM | 1x LED 8ch 2x MCPWM 6ch | 1x LED 8ch 2x MCPWM | 1x LED 8ch | 1x LED 6ch 1x MCPWM 6ch | 1x LED 6ch 1x MCPWM | 1x LED 6ch | 1x LED 6ch | 1x LED 6ch | 1x LED 6ch | 1x LED 8ch 2x MCPWM | 1x LED 6ch 1x MCPWM | 1x LED 16ch 2x MCPWM | |
| | ADC | 2x 12 bit | 2x 12 bit | 2x 13 bit 20ch | 1x 12 bit 6ch | 1x 12 bit 7ch | 1x 12 bit | 2x 12 bit 6ch | 1x 12 bit 5ch | 1x 12 bit | 1x 12 bit 5ch | 1x 12 bit 18ch 2x 8 bit | | |
| | DAC | | | 2x 8 bit | | | | | | | | | | |
| | Timers, WDT | 4x HP GPT, 1x ST, 3x HP WDT, 1x LPST, 1x LPGPT, 1x LP WDT, 1x ASWDT | 4x GPT, 1x ST, 3x WDT | 1x GPT, 1x ST, 3x WDT, 1x SWDT, 2x XTAL32k WDT | 1x ST, 2x GPT, 1x RTCT, 3x DWDT, 1x AWDT | 1x ST, 2x GPT, 3x DWDT, 1x AWDT | 2x GPT, 1x ST, 2x SWDT, 3x WDT | 2x GPT, 3x DWDT, 1x ST | 1x GPT, 2x WDT, 1x ST | 2x GPT, 1x ST, 3x WDT | 2x GPT, 1x ST, 3x WDT | 3x WDT, 4x GPT | | |
| | Temp Sensor | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | Operating Temperature | -45 to 85 | -40 to 105 | -40 to 105 | -40 to 85 | -40 to 105 | -40 to 105 | -40 to 105 | -40 to 105 | -40 to 105 | -40 to 105 | -40 to 125 | | |
| Supply Voltage | 3.0 to 3.6 | 3.0 to 3.6 | 3.0 to 3.6 | 3.0 to 3.6 | 3.0 to 3.6 | 3.0 to 3.6 | 3.0 to 3.6 | 3.0 to 3.6 | 1.7 to 5.0 | 1.8 to 3.6 | 2.3/3.0 to 3.6 | | | |
| Package Type | QFN104 | QFN56 LGA56 | QFN56 | QFN48 | QFN40 QFN32 | QFN32 QFN28 | QFN28 QFN32 | QFN24 | QFN52 | QFN32 | QFN48 LGA48 | | | |