Type-C MINI ESP32-C3 Wi-Fi & Bluetooth Development Board Module – ESP32-C3-MINI-1

The **ESP32-C3-MINI-1** is a compact, high-performance development board designed for the next generation of IoT (Internet of Things) applications. Equipped with the powerful **ESP32-C3FN4 chip**, this module integrates a **32-bit RISC-V single-core processor** running up to 160 MHz, delivering industry-leading processing power while maintaining low energy consumption. Its small form factor, advanced connectivity, and rich peripheral interfaces make it an ideal choice for a wide range of applications including smart home devices, industrial automation, wearable electronics, and medical devices.

High-Performance Wi-Fi and Bluetooth Connectivity

The ESP32-C3-MINI-1 provides dual support for **2.4 GHz Wi-Fi** and **Bluetooth 5 (LE)**, ensuring seamless wireless communication for IoT devices. The Wi-Fi module supports IEEE 802.11 b/g/n protocols with data rates up to 150 Mbps, making it suitable for high-speed and low-latency communication. It supports **Station, SoftAP, and Mixed modes**, as well as multiple virtual interfaces for simultaneous connections. Advanced Wi-Fi features such as frame aggregation, beacon automatic monitoring, transmit opportunity (TXOP), and antenna diversity ensure robust and stable network performance even in dense wireless environments.

On the Bluetooth side, the module supports **Bluetooth Low Energy (BT LE)** and **Bluetooth Mesh**, enabling energy-efficient and long-range communication. It supports high-power transmission up to 18 dBm and multiple advertising sets, allowing the development of advanced IoT networks with reliable device-to-device communication. The coexistence of Wi-Fi and Bluetooth on a single antenna further reduces design complexity and maximizes performance.

Powerful RISC-V Processor and Memory

The ESP32-C3-MINI-1 features a **32-bit RISC-V single-core processor** capable of running at **160 MHz**, offering excellent computational power for a wide range of applications. The module comes with **400 KB of internal SRAM**, **384 KB ROM**, and **4 MB of external SPI flash**, providing ample memory for complex applications and large firmware projects. Additionally, **8 KB RTC SRAM** is available for real-time data storage, making this module highly versatile for data-intensive IoT applications.

Advanced Peripheral Interfaces

This development board is equipped with **22 GPIO pins** and a variety of peripheral interfaces, including:

- **3 × SPI**
- **2 × UART**

- **1 × I²C**
- **1 × I²S**
- **Infrared transceiver** with 2 transmit and 2 receive channels
- **LED PWM controller** supporting up to 6 channels
- **Analog interfaces**: 2 × 12-bit SAR ADCs, temperature sensor
- **Timers**: multiple general-purpose timers, watchdog timers, and system timers

It also supports **Full-Speed USB Serial/JTAG debugging**, **General Purpose DMA (GDMA)**, and **TWAIR controller**, offering flexibility for developers to integrate the module into complex IoT systems.

Security and Low Power Features

The ESP32-C3-MINI-1 is designed with **security in mind**, featuring **secure boot**, **AES-128/256 flash encryption**, RSA digital signature verification, SHA cryptography, HMAC, and a **hardware random number generator (RNG)**. The module also includes a **4096-bit OTP memory**, ensuring safe storage of sensitive data.

The module's **power management unit** supports multiple low-power modes, making it energy-efficient and ideal for battery-operated IoT devices. Its low-power design, combined with high computational power, enables long operational life in energy-constrained environments.

Compact Design and Versatility

Measuring only **31.5mm × 25.8mm**, the ESP32-C3-MINI-1 is extremely compact, making it perfect for embedded systems with space constraints. Its small size, combined with **Type-C interface connectivity**, allows easy integration into modern IoT designs.

Robust IoT Development Support

Developers can leverage the **ESP-IDF (Espressif IoT Development Framework)** to build applications efficiently. This proven framework, used in hundreds of millions of devices worldwide, provides APIs, libraries, and tools for both new and experienced developers. The module also supports **ESP-AT and ESP-Hosted SDKs**, enabling it to work as a slave device providing Wi-Fi and Bluetooth LE connectivity to other MCUs.

Applications

The ESP32-C3-MINI-1 is ideal for a wide range of IoT applications:

- **Smart Home**: Lighting control, smart plugs, sensors, and security systems

- **Industrial Automation**: Remote monitoring, industrial sensors, and controllers
- **Wearables and Health Devices**: Fitness trackers, medical monitoring devices
- **Networking Devices**: Mesh networks, wireless gateways, and IoT hubs

Conclusion

With its high-performance **RISC-V processor**, robust **Wi-Fi and Bluetooth 5 capabilities**, comprehensive peripheral interfaces, and advanced **security features**, the **ESP32-C3-MINI-1** is a versatile and powerful development board for IoT innovation. Its compact design, low power consumption, and extensive software support make it the perfect choice for engineers and developers looking to create reliable, scalable, and secure IoT solutions.