

NANO FACTOR SKU: UE0061

### Product Reference Manual (V1.0)

### Description

The **PULSAR NANO ESP32 C6** by UNIT Electronics is a compact and powerful development board designed for modern loT applications. Built around the **ESP32-C6** microcontroller, it supports **Wi-Fi 6, Bluetooth 5, Zigbee, Thread, and Matter**, making it an excellent choice for projects requiring efficient wireless communication.

With its Arduino Nano-compatible form factor, this board offers seamless integration with a wide range of existing shields and accessories. It features robust power management, including USB-C power delivery and LiPo battery support with an integrated charging circuit. Additionally, its CAN bus capability enables reliable communication in industrial and automotive environments.

The **PULSAR NANO ESP32 C6** is optimized for flexibility, supporting development in **C/C++**, **MicroPython**, and **ESP-IDF**, making it ideal for both beginners and advanced developers working on **IoT**, **smart home**, **sensor networks**, and embedded systems.

# Arduino NANO format compatibility.

This ultra-compact board follows the Arduino Nano form factor, offering 22 accessible GPIOs with support for I2C, SPI, UART, and CAN. Powered by the ESP32-C6's RISC-V processor running at 160 MHz, it ensures low power consumption and high efficiency in a



**compact 18mm x 43mm PCB**, making it a **versatile solution** for wireless and embedded applications.

The **PULSAR NANO ESP32 C6** is fully supported in the **Arduino development environment**, ensuring seamless integration with existing **Arduino projects and libraries**. Developers can easily program the board using the **official Arduino package**, which provides full compatibility with the **ESP32-C6 microcontroller**.

For details on installing the Arduino package and configuring the board, refer to **Section 5.1**.



# Advanced Wireless Communication Protocols

The **PULSAR NANO ESP32 C6** is equipped with cutting-edge **wireless communication capabilities**, making it a powerful choice for IoT, automation, and embedded applications. The **ESP32-C6** supports multiple wireless protocols, enabling seamless connectivity and high-performance data exchange between devices.

# Wi-Fi 6: High-Efficiency Wireless Networking

The ESP32-C6 integrates **Wi-Fi 6** (802.11ax), offering improved performance compared to previous Wi-Fi standards. This next-generation wireless protocol brings key advantages:

- Higher Network Efficiency Supports OFDMA (Orthogonal Frequency Division Multiple Access), allowing multiple devices to share the same channel efficiently, reducing network congestion.
- Lower Power Consumption Implements Target Wake Time (TWT), enabling energy-saving scheduling of transmissions, which is crucial for battery-powered IoT applications.
- Improved Coverage and Speed Operates in the 2.4 GHz band, ensuring better penetration through walls and objects while maintaining strong data transfer rates.

# Bluetooth 5.0 & BLE: Dual-Mode Connectivity

The **PULSAR NANO ESP32 C6** includes **Bluetooth 5.0**, providing robust and flexible communication for low-power and high-speed applications. This module supports:

- Bluetooth Low Energy (BLE) Ideal for low-power IoT devices such as sensors, wearables, and smart home applications.
- Extended Range and Speed BLE 5.0 enhances range by up to 4× compared to BLE 4.2, allowing communication over longer distances with lower energy consumption.
- Improved Throughput Enables
   2 Mbps PHY mode, doubling data transfer speeds for real-time applications.

# 802.15.4 & Thread: Secure Mesh Networking

The **ESP32-C6** supports **IEEE 802.15.4**, a foundational protocol for mesh networking technologies like **Thread** and **Zigbee**. This capability allows for:

- Reliable, Low-Power
   Communication Designed for smart home automation, industrial IoT, and sensor networks.
- Scalability Enables seamless communication between multiple nodes in a mesh network without reliance on a central router.



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# Matter Protocol: Interoperability Across Ecosystems

The **PULSAR NANO ESP32 C6** is fully compatible with the **Matter protocol**, an industry-unifying standard for **smart home devices**. With Matter, the board can seamlessly integrate with major ecosystems like:

- Apple HomeKit
- Google Home
- Amazon Alexa
- Samsung SmartThings

Matter runs over Wi-Fi 6 and Thread, enabling secure, fast, and energy-efficient communication between smart home devices, ensuring reliable interoperability across different manufacturers.

For implementation details, refer to Espressif's SDK for Matter

# **Optimized Wireless Coexistence**

The **ESP32-C6** features advanced **wireless coexistence mechanisms**, allowing multiple communication protocols to function simultaneously without interference. This enables:

 Concurrent Wi-Fi & Bluetooth Operations – Supports seamless operation of Wi-Fi 6 and BLE 5.0 in parallel, making it ideal for IoT applications that require dual connectivity.  Adaptive Frequency Hopping (AFH) – Minimizes interference between Bluetooth and Wi-Fi, ensuring stable and reliable communication in crowded environments.

The PULSAR NANO ESP32 C6 is a versatile communication hub, offering advanced Wi-Fi 6, Bluetooth 5.0, 802.15.4, and Matter support. These wireless capabilities enable scalable, secure, and power-efficient connectivity, making it ideal for IoT, smart home automation, and industrial applications.

# **I2C Connector:**

The PULSAR NANO ESP32 C6 features QWIIC-compatible JST-SH а 12C connector with a 1 mm pitch and 4 pins (GND, +V, SDA, and SCL), allowing easy integration with a wide range of I2C sensors and modules. This standardized QWIIC interface simplifies peripheral connections. enabling seamless expansion of IoT and embedded applications without the need for complex wiring.

For detailed pin mappings and configurations, refer to Table 4.3.1 - Pin Mapping and Connections for QWIIC Connector.

# **Dynamic Visual Feedback:**

To enhance usability and real-time monitoring, the **PULSAR NANO ESP32 C6** includes multiple onboard **LED indicators**, providing clear and immediate feedback for system status and interactions.



These LEDs serve various functions, including:

- Status Indications Power, connectivity, and processing activity.
- **Visual Alerts** Error notifications and event signaling.
- User Interaction Customizable visual feedback for engaging applications.

The onboard LEDs include:

- **PWR LED (Blue, 0603)** Indicates that the board is powered on.
- CHG LED (Orange, 0603) Shows battery charging status: On while charging, blinks when no battery is detected, and turns off when fully charged.
- BLINK-IN LED (Pink, 0603, D13)

   Can be used for general debugging or status feedback.
- WS2812-2020 RGB LED Fully addressable for dynamic color indications, ideal for status monitoring and interactive feedback.

For more details, refer to:

- Section 3.2 Board Topology
- Section 3.7 LED indicators

# Micro SD:

The **PULSAR NANO ESP32 C6** includes a **Micro SD card slot (47309-2651)** for expanded storage capabilities. This interface is directly connected to the **ESP32-C6** via **SPI**, enabling **faster data** access.

This feature is particularly useful for applications that require:

- **Data Logging** Storing sensor readings for IoT and industrial applications.
- Multimedia Handling Managing images, audio, or configuration files.
- Firmware Updates Local storage of update files for embedded systems.

For detailed pin mappings and installation guidelines, refer to **Table 4.4 - MicroSD Pin Assignments and SPI Mapping**.

# **Power Supply:**

The **PULSAR NANO ESP32 C6** is designed with an **efficient power management system** to ensure stable operation for various applications. It features a AP2112K **LDO regulator**, allowing it to accept a max 6V of input voltages while providing a **stable 3.3V output** for the ESP32-C6 microcontroller and connected peripherals. This power system enables **low power consumption**, making it ideal for IoT,





embedded systems, and battery-powered projects.

For more details on power distribution and consumption, refer to **3.8 AP2112K and MCP73831 Power Management System** and **4.5 Battery connections.** 

# **CAN Bus Connectivity:**

The PULSAR NANO ESP32 C6 includes native CAN bus support, enabling robust real-time communication for industrial, automotive, and automation applications. The ESP32-C6 integrates two built-in TWAI controllers, compatible with ISO 11898-1 (CAN Specifications 2.0), ensuring compatibility with industry-standard CAN transceivers for reliable data transmission over long distances.

Key features of the CAN bus interface:

- Supports high-speed data rates up to 1 Mbps.
- **3.3V logic level compatibility** for seamless integration with modern embedded systems.
- Reliable and noise-resistant communication, essential for automotive and industrial applications.

For detailed, refer to Section 3.5 - CAN Bus (Two TWAI Controllers Accessible via GPIO Multiplexing).

# **Development & IDE Support:**

The **PULSAR NANO ESP32 C6** supports multiple development environments, offering flexibility for both **beginner and advanced users**:

- Arduino IDE Fully compatible, allowing users to program the board using familiar Arduino libraries. For additional details, refer to 5.1 Getting Started with arduino IDE.
- Espressif IDF (ESP-IDF) Provides full access to advanced ESP32-C6 features for optimized performance.
- MicroPython & CircuitPython Enables rapid development for IoT and scripting-based applications using Python.
- PlatformIO & VS Code Ideal for professional development, offering advanced debugging and cross-platform support.

This broad **IDE compatibility** ensures that users can **easily transition from Arduino-based development** to more advanced C/C++ and Python programming environments.



# Applications of the PULSAR NANO ESP32 C6

The **PULSAR NANO ESP32 C6** is a **versatile development board** suitable for a wide range of applications, bridging the gap between beginner-friendly development and professional-grade embedded solutions.

With low power consumption, flexible connectivity options, and extensive software support, the PULSAR NANO ESP32 C6 empowers developers to create innovative, real-world solutions with ease.

# **Key Application Areas**

- Education & Learning Perfect for students, hobbyists, and makers exploring wireless communication and microcontroller programming.
- IoT & Smart Devices Built-in Wi-Fi 6, Thread (802.15.4) and BLE 5.0 enable seamless connectivity for cloud-based applications, smart home automation, and remote monitoring.
- Prototyping & Embedded Systems – Compact form factor and extensive peripheral support make it ideal for rapid prototyping and product development.
- Robotics & Automation Integrated CAN, I2C, SPI, and UART interfaces provide easy sensor and actuator integration for robotic control systems.



# Features

# CPU:

- Espressif ESP32-C6FH4
- Single-core 32-bit RISC-V processor
- Up to 160 MHz operating frequency

# **Internal Memory:**

- 512 KB of internal SRAM
- 320 KB of ROM (for boot and system functions)
- 4 MB of integrated SPI Flash (in the ESP32-C6FH4 module)
- 1 Kbit EFUSE: stores MAC addresses, module configuration, flash encryption, chip ID

# Wireless Connectivity:

- Wi-Fi 6 (802.11 b/g/n/ax) in the 2.4 GHz band, up to 150 Mbps
- Bluetooth® 5.0 LE, supports LE 2M, LE Coded PHY, Extended Advertising, and Advertising Extensions
- IEEE 802.15.4 for Zigbee and Thread, with support for Matter over Thread and WiFi

### Peripheral Interfaces:

- 12-bit ADC
- SPI, UART, I2C, I2S, PWM
- USB 2.0 Full-Speed (with integrated PHY)
- SDIO, JTAG, GPIO
- Two TWAI® Controllers (compatible with CAN 2.0)

# **Built-in Security:**

- Hardware Flash Encryption
- Secure Boot
- RNG (Random Number Generator)
- Hardware Cryptography: AES, SHA, RSA, ECC, HMAC

# **Operating Voltage:**

- Core at 1.1 V (with internal LDO)
- I/O at 3.3 V

#### **Ultra-Low Power Consumption:**

- Low power modes: Modem-sleep, Light-sleep, and Deep-sleep
- Independent RTC for data and event retention during **Deep-sleep**



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### Antenna:

• Integrated PCB antenna (no external antenna required)

# Storage

 Integrated microSD card slot via SPI for data logging, multimedia storage, and firmware updates. Connected to GPIO (2), GPIO (6), GPIO (7), and GPIO (19)

# I/O

- 22 digital pins and 7 analog pins (compatible with the Arduino NANO pinout). Supporting ADC, PWM, I2C, SPI, UART, CAN
- 2 × standard UARTs (UART0 and UART1)
- **1 × LP UART** (Low-Power UART)
- 1 x SPI
- 1 x standard I2C
- 1 x LP I2C (which have a JST-1.0 mm pitch on-board connectors, compatible with STEMMA QT and QWIIC devices)
- LED PWM Controller and Motor Control PWM, and most GPIO pins can be assigned to generate PWM signals.
- CAN bus via integrated TWAI® controller (ISO11898-1 compliant)

### **Power Management:**

- Vin: Up to 6V via pin header
- USB-C powered (5V input) VUSB Output: Available
- 3.3V AP2112K 3.3V LDO Regulator (max input 6V):
   350 mA nominal current, up to 600 mA peak with thermal protection
- Supports LiPo battery charging with an onboard power management circuit. Charging current: 200 mA.

### **Interfaces and Connectors**

- 1 × I2C JST-SH (1.0 mm pitch): Qwiic-compatible connector wired to GPIO6 and GPIO7 for Low-Power I2C
- 1 × microSD Card Holder
- **1 × Auxiliary Battery Connector:** Supports both 2.0 mm and 1.25 mm pitch options
- 1 × USB Type-C Connector
- 2 × 15-pin Header Connectors: With castellated holes for easy surface mounting

#### **Communication and Connectivity**

- USB-C connector for programming and power
- Reset button and Flash/Boot button for manually entering flash mode



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# **LED Indicators:**

- Blue PWR LED (0603) Power indication
- Orange CHG LED (0603) LiPo charging status
- Pink BLINK LED (0603, GPIO (6)) – User-programmable
- WS2812 RGB LED (2020) Fully addressable for status or visual feedback connected to GPIO (8)

# Software Support:

- Arduino IDE (official ESP32-C6 board package)
- **ESP-IDF** for advanced native development
- MicroPython and CircuitPython support
- PlatformIO / VS Code for professional development

# Applications:

- Smart Home (Matter, Thread, Wi-Fi 6)
- Home and Industrial Automation (including CAN Bus and low-power systems)
- IoT Prototyping and Embedded Development
- Multi-radio Devices and Mesh Communication
- Robotics and Sensor Networks



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# 1 The Board

### 1.1 Accessories

2x15-pin 2.54mm female headers

# 2 Ratings

# 2.1 Recommended Operating Conditions

Symbol	Description	Min	Тур	Max	Unit
VIN	Output/Input System Voltage (Vsys rail) <sup>♦</sup>	VBAT	VBUS -0.3	6V	V
I <sub>sys(IN)</sub>	System input current from <b>VIN</b> pin (without battery) <sup>◆</sup>	-	-	500	mA
I <sub>sys(OUT)</sub>	System output current through <b>VIN</b> pin <sup>+</sup>	-	-	500	mA
VBUS	USB supply voltage (VUSB)	4.5V	VUSB	5.5V	V
IBUS	USB input/output current from VBUS pin ( <b>VUSB</b> ) <sup>◆◆</sup>	-	-	500	mA
V3v3	3.3V output to user application	3.25	3.3	3.35	V
<b>I</b> 3v3	3v3 output current (AP2112K) <sup>◆◆◆</sup>	300	350	600	mA
VIH (ESP32-C6)	High-level input voltage	2.475	-	3.6	V
VIL (ESP32-C6)	Low-level input voltage	-0.3	-	0.825	V
liH (ESP32-C6)	High-level input current	-	-	50 nA	A
liL (ESP32-C6)	Low-level input current	-	-	50 nA	А
VOH (ESP32-C6)	High - level output voltage*	2.64	-	3.3	V
VOL (ESP32-C6)	Low - level output voltage*	-	-	0.33	V
IOH Max (ESP32-C6)	High-level source current at VDD=3.3V, VOH >=2.64V, output set high**	-	20	40	mA
IOL Max (ESP32-C6)	Low-level sink current at VDD = 3.3 V, VOL =0.495 V, output set low	-	28	-	mA



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I <sub>output</sub>	Cumulative IO output current***	500	-	1000	mA
RPU (ESP32-C6)	Internal weak pull-up resistor	-	45	-	kΩ
RPD (ESP32-C6)	Internal weak pull-down resistor	-	45	-	kΩ
TOP (ESP32-C6)	Operating temperature	-40	-	105	°C

\* VOH and VOL are measured using high-impedance load.

\*\* Except for GPIO12 and GPIO13 whose default drive strength is 40 mA, the default drive strength for all the other pins is 20 mA.

\*\*\* Sum of all current being sourced by GPIO. The product proved to be fully functional after all its IO pins were pulled high while being connected to ground for 24 consecutive hours at ambient temperature of 25 °C.

• The **VIN** pin is internally connected to the system power bus (**VSYS rail**), which means it can function as both an input and an output power pin. Please consider the following guidelines:

- When using VIN as a power input (e.g., when connected from an external shield or power source), do not exceed 6 V, or you may damage the AP2112K voltage regulator.
- **Do not connect a battery** when supplying power via VIN, as this may stress or damage the battery charging circuit. In such cases, we recommend powering the board through the **VBUS** pin instead, which is designed to handle power input alongside battery charging.
- When using VIN as a power output, the voltage available on the pin will correspond to either VBAT (from the battery) or VUSB (from USB power), depending on the active source. The maximum output current from the VIN pin is 500 mA.

♦ When using the VBUS pin (VUSB) as a power input, keep in mind that the system may draw up to **200 mA** for battery charging and approximately **300 mA** for the ESP32-C6 and other integrated components through the AP2112K voltage regulator. The AP2112K supports a maximum output of **600 mA** at 3.3 V, which limits the total current available from the USB input.

If your application requires sourcing current through the VBUS pin as an output (e.g., to power external devices), ensure that the total current drawn does not exceed **500 mA**. This recommendation considers standard USB Type-C power supplies rated at **1 A**, where **500 mA** may be used for the internal system and **500 mA** for external loads.

♦ ♦ ♦ When operating at 600mA, the AP2112K regulator requires the implementation of heat dissipation or proper cooling to ensure safe operation.

- If the component temperature reaches **110°C**, thermal protection will activate, halting operation to prevent damage.

- To maintain optimal performance, it is recommended to add a heatsink or enhance airflow.



# PULSAR ESP32-C6 NANO FACTOR SKU: UE0061

# **3 Functional Overview**

The **PULSAR NANO ESP32 C6** is an advanced development board engineered by UNIT Electronics, delivering next-generation wireless capabilities in an ultra-compact Arduino Nano-compatible form factor. Built around the ESP32-C6 microcontroller, this board offers powerful connectivity with support for **Wi-Fi 6**, **Bluetooth 5**, **Zigbee**, **Thread**, and **Matter**, making it a premier solution for modern IoT, smart home, and industrial automation projects.

Key features include **native CAN bus support** for robust communication in automotive and industrial environments, **QWIIC-compatible I2C connector** for sensor expansion, and **USB Type-C with LiPo battery charging** for flexible and reliable power management. The board integrates visual feedback via **multiple LED indicators** including a WS2812 RGB LED, enhancing usability and system interaction. Additionally, a **Micro SD slot** supports extended storage for data logging and multimedia handling.

Despite its small 18mm x 43mm footprint, the PULSAR NANO C6 offers **22 accessible GPIOs** with support for I2C, SPI, UART, PWM, ADC, and CAN interfaces, providing exceptional versatility for embedded and connected applications. Powered by a 160 MHz RISC-V core, it combines energy efficiency with high performance, ideal for edge computing and battery-powered systems.

The board is fully compatible with a wide range of programming environments including the **Arduino IDE**, **ESP-IDF**, **MicroPython**, **CircuitPython**, and **PlatformIO**, offering developers maximum flexibility and ease of integration. With full support for Matter and mesh networking technologies like Thread, the PULSAR NANO C6 is future-ready and interoperable across major smart home ecosystems such as **Apple HomeKit**, **Google Home**, **Amazon Alexa**, and **Samsung SmartThings**.

Thanks to its compact form factor, advanced connectivity, and extensive development support, the **PULSAR NANO ESP32 C6** is the ideal platform for wireless prototyping, automation, education, and IoT innovation — serving both beginner and professional developers.



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# 3.1 Block Diagram



Block Diagram of PULSAR NANO ESP32-C6



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# 3.2 Board Topology





Views of Pulsar NANO ESP32-C6 Topology

	Table	3.2.1	- Components	Overview
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Ref.	Description
U1	Espressif ESP32-C6FH4
U2	AP2112K 3.3V LDO Voltage Regulator
U3	MCP73831 Battery Charge Management IC
A1	SMD Antenna
L1	Power On LED
L2	Built-in LED (GPIO 6 or D13)
L3	Charge On LED



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L4	WS2812B-2020 LED
J1	Male USB Type-C Connector
J2	Low-Power I2C-QWIIC JST Connector
PB1	ESP32 Flash Button
PB2	ESP32 Reset Button
JP1	Micro SD Card Socket
JP2	2.0 mm or 1.25 mm Pitch Battery Connector
JP3	JP3-1, JP3-2: Female Castelled Headers 2.54 mm, compatible with Arduino Nano Pinout

# 3.3 Processor

The PULSAR NANO ESP32-C6 board is powered by the **Espressif ESP32-C6FH4** microcontroller (U1), a powerful and modern SoC designed for wireless and secure embedded applications. Built on a 40 nm process node, the ESP32-C6 is part of Espressif's next-generation lineup, bringing together Wi-Fi 6, Bluetooth® 5, and robust processing capabilities in a single chip.

# Key features include:

- **CPU**: 32-bit **RISC-V single-core processor** operating at up to **160 MHz**, optimized for low power consumption and efficient embedded processing.
- Memory:
  - **512 KB** of on-chip SRAM.
  - **4 MB Flash memory** embedded in the same package (FH4 variant).
- Security:
  - Integrated hardware crypto accelerators (AES, SHA, RSA, HMAC).
  - Secure boot and Flash encryption support.



- Connectivity:
  - Integrated Wi-Fi 6 (802.11ax) supporting 20 MHz bandwidth in 2.4 GHz.
  - Integrated **Bluetooth® 5.0 LE**, compliant with BLE Mesh.
- Low Power: Multiple power domains with advanced sleep modes for battery-powered applications.
- USB Interface: Native USB 2.0 Full-Speed device interface available through the USB Type-C (J1) connector. Capable of up to 12 Mbit/s transfer speed (Note that this controller does not support the faster 480 Mbit/s high-speed transfer mode.
- **GPIO and I/O**: Multiplexed GPIOs capable of digital I/O, PWM, ADC, UART, TWAI, I2C, and SPI.

The ESP32-C6FH4 microcontroller combines performance, wireless connectivity, and integrated security features, making it ideal for IoT applications, secure edge devices, and advanced wireless projects.

3.4 Wireless Connectivity: Wi-Fi 6, Bluetooth LE 5, and IEEE 802.15.4

The ESP32-C6 provides an extensive suite of wireless communication capabilities, making it a powerful and flexible choice for a wide range of IoT and embedded applications. It supports Wi-Fi 6 (802.11ax) in 2.4 GHz, Bluetooth® Low Energy (LE), and IEEE 802.15.4, enabling compatibility with modern wireless standards and protocols used in smart home, industrial, and wearable devices.

The Wi-Fi subsystem includes full support for TCP/IP networking, ESP-WIFI-MESH, and other protocols. It enables secure connections using TLS 1.0, 1.1, and 1.2, and supports both Station and SoftAP modes. This allows devices to operate as clients, access points, or mesh nodes in complex network topologies. It supports up to 150 Mbps (802.11n), MU-MIMO, OFDMA, beamforming, antenna diversity with external RF switch, and enhanced MAC features like multiple virtual interfaces, QoS (WMM), A-MPDU/A-MSDU, and advanced security protocols such as WPA3 and WAPI. These features ensure robust, efficient, and secure wireless communication in high-density environments.

The **Bluetooth LE** capabilities of the ESP32-C6 are equally robust, integrating a **hardware link controller**, **RF/modem**, and a **feature-rich software stack**. It supports core features of **Bluetooth 5**, including:

- 1 Mbps and 2 Mbps PHY for higher throughput
- Coded PHY (125 Kbps / 500 Kbps) for extended range
- Hardware Listen Before Talk (LBT)
- LE Advertising Extensions and Multiple Advertisement Sets





- Simultaneous advertising and scanning
- · Multiple simultaneous connections in central and peripheral roles
- LE Data Length Extension and LE Power Control
- LE Privacy 1.2, LE Ping, and Link Layer Encryption

These features enable the ESP32-C6 to support **sophisticated BLE topologies**, such as **device beacons**, **mesh networking**, and **secure multi-node systems**.

In addition to Wi-Fi and BLE, the **ESP32-C6** supports the **IEEE 802.15.4 protocol**, which underpins connectivity for **Thread**, **Zigbee**, **Matter**, **MQTT**, and other **low-power mesh networking standards**. Its **PHY layer** supports:

- O-QPSK modulation in the 2.4 GHz band
- 250 Kbps data rate
- RSSI and LQI for signal quality measurement

And the **MAC layer** includes features such as:

- CSMA/CA for channel access
- Active scan and energy detection
- · Hardware frame filtering and auto acknowledgment
- Auto frame pending and Coordinated Sampled Listening (CSL)

These capabilities make the ESP32-C6 an ideal candidate for secure, low-power, and reliable communication in constrained and dense wireless environments. It brings together three major wireless technologies into a single chip—Wi-Fi, BLE, and 802.15.4—offering unparalleled flexibility for developers working on next-generation connected devices.

#### 3.5 CAN Bus (Two TWAI Controllers Accessible via GPIO Multiplexing)

The **ESP32-C6** features two **TWAI** (Two-wire Automotive Interface) controllers, enabling the use of the **CAN protocol** in automotive and industrial applications. These controllers can operate in multiple modes, including **Normal**, **Listen-only**, and **Self-test**, and are compatible with the **ISO 11898-1 protocol (CAN 2.0)**. They support data rates up to **1 Mbps** and offer advanced features such as error detection, acceptance filters, and special message transmissions like **Single-shot** and **Self Reception**.

A notable feature of the ESP32-C6 is its ability to connect to a **TWAI bus** via an external **transceiver**, such as the **TCAN1051HVD** or **SN65HVD230**, which can be connected to **GPIO6** and **GPIO7** through the dedicated JST-SH 1 mm QWIIC connector for **low-power I2C (J2)** and multiplexing one of the two TWAI controllers (refer to Section 4.3 - QWIIC Connector). Alternatively, the **2.54mm castellated headers (JP3-1 and JP3-2)** can be used to connect the second TWAI controller, expanding communication capabilities for bus-based applications.



For more details on pin assignments and using TWAI, refer to the <u>ESP32-C6 Technical</u> <u>Reference Manual</u>, specifically Chapter Two-wire Automotive Interface and Section <u>2.3.5 Peripheral Pin Assignment</u>.

# 3.6 MicroSD Card Integration Overview

PULSAR NANO ESP32-C6 is The equipped with a 47309-2651 MicroSD card socket, allowing seamless integration of external storage via SPI communication. This is essential for systems where internal flash is insufficient, offering reliable and scalable storage for complex data structures or frequent read/write operations. The interface supports microSD cards up to 64 GB (validated in field tests), with optimal performance when formatted in FAT32. Typical applications include persistent data logging, storage of multimedia content. and offline firmware management. The MicroSD socket is directly connected to the SPI bus of the ESP32-C6, ensuring low-latency access and broad compatibility with ESP-IDF and

# 3.7 LED Indicators

The WS2812-2020 RGB LED on the PULSAR NANO ESP32-C6 is a fully addressable NeoPixel capable of generating millions of color combinations. It is ideal for real-time visual feedback, such as system states, error conditions, or interactive effects. Connected via GPIO8, this compact LED can be controlled through popular libraries like Adafruit NeoPixel or FastLED, making it highly adaptable for custom UI indicators in embedded projects. Arduino libraries. For hardware-level details, refer to **Table 4.4 - MicroSD Pin Assignments and SPI Mapping**.







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### Power, Charge, and Built-in LEDs:

The board integrates three discrete status LEDs for essential system feedback. The **PWR LED** (red, 0603) lights up when the board is powered. The **CHG LED** (orange, 0603) provides **battery charging status**, turning **on while charging**, **blinking** when

no battery is detected, and **off when fully charged**. The **BLINK-IN LED** (blue, 0603, connected to GPIO 6) serves as a **built-in user LED**, useful for **debugging or custom activity indicators**. These LEDs ensure quick visual diagnostics without the need for external equipment.

3.8 AP2112K and MCP73831 Power Management System

The **AP2112K** low-dropout (LDO) regulator and **MCP73831** battery management IC provide a **stable and efficient power delivery system** for the PULSAR NANO ESP32-C6. The board accepts input voltages of **up to 6V via Vin or USB-C**, and delivers a **regulated 3.3V output** with a nominal current of **350 mA** and peak support up to **600 mA**, protected by internal thermal shutdown.

The **MCP73831** enables safe and reliable **LiPo battery charging** at **200 mA**, making the board ideal for **portable, battery-powered IoT applications**. With onboard voltage regulation, USB power management, and battery integration, the system ensures consistent and **low-noise power** for all core and peripheral operations.



3.9 Power Tree

The **PULSAR NANO ESP32-C6** supports dual power input sources: it can be powered via the USB-C connector (VBUS, 5V) or through the VBAT connetor, which typically receives power from a single-cell LiPo battery (3.7V - 4.2V nominal).

Power source selection is managed by the FDN338P P-MOSFET, which seamlessly switches between VBUS and VBAT. When USB power is present, it is prioritized; otherwise, the system draws power from the battery.

Battery charging is handled by the MCP73831 linear charger, which supports charging currents up to 200 mA, enabling safe LiPo charging when USB is connected.

VBUS is further protected and regulated by the NSR0320MW2T1G Schottky diode, ensuring low forward voltage drop (0.5V) and supporting up to **1A of current**.

The selected supply voltage (VBUS or VBAT) is routed to the VSYS rail, which serves as the main intermediate supply line. This VSYS voltage is then regulated down to 3.3V by the AP2112K Low Dropout (LDO) Regulator, capable of supplying up to 600 mA of current.

The regulated 3.3V rail powers the ESP32-C6 microcontroller, along with all onboard peripherals including the Qwiic connector, WS2812B LED, and Micro SD slot, ensuring stable operation throughout the board.

This power architecture offers flexible, efficient, and safe power management for portable and USB-powered applications.



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# 4 Connectors & Pinouts

# 4.1 General Pinout



PULSAR NANO ESP32-C6 General Pinout



PULSAR ESP32-C6 NANO FACTOR SKU: UE0061

# 4.2 PULSAR NANO C6: Arduino NANO Pinout Compatibility

Table 4.2.1 - Pin Mapping and Connections for the Arduino NANO-Compatible Pinout

Arduino Nano Pin	Arduino NANO (Function)	PULSAR Nano C6 (Function)	ESP32 C6 GPIO	GPIO Function
1	D13 (SCK/LED)	D13/SCK/A7	GPIO6/A6/(SCK)	ADC1_CH6/LP_I2C_SDA/LP_GPIO6/MTCK/FS PICLK
2	3.3V	3.3V	3.3V	3.3V
3	AREF	-	GPIO14	GPIO14
4	A0 (Analog)/D14	A0 /D14	GPIO0	ADC1_CH0/LP_UART_DTRN/LP_GPIO0/XTAL _32K_P
5	A1 (Analog)/D15	A1/D15	GPIO1	ADC1_CH1/LP_UART_DSRN/LP_GPIO1/XTAL _32K_N
6	A2 (Analog)/D16	A2/D16	GPIO3	ADC1_CH3/LP_UART_CTSN/LP_GPIO3
7	A3 (Analog)/D17	A3/D17	GPIO4	ADC1_CH4/LP_UART_RXD/LP_GPIO4/MTMS/ FSPIHD/SDIO
8	A4 (SDA)/D18	(SDA)/D18	GPIO22	SDIO_DATA2
9	A5 (SCL)/D19	(SCL)/D19	GPIO23	SDIO_DATA3
10	A6 (Analog)	A6/D21	GPIO5	ADC1_CH5/LP_UART_TXD/LP_GPIO5/MTDI/F SPIWP/SDIO
11	A7 (Analog)	NEOP_DO	NC	WS2812B-2020 OUT (DO)
12	5V	5V	5V	5V
13	RESET	RST	RST	RESET





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14	GND	GND	GND	GND
15	VIN	VIN	VIN	VIN
16	D0 (RX)	D0/RX	GPIO17	U0RXD/FSPICS1
17	D1 (TX)	D1/TX	GPIO16	U0TXD/FSPICS0
18	RESET	RST	RST	RESET
19	GND	GND	GND	GND
20	D2	D2/NEOP	GPIO8	GPIO8/BOOT/ROM
21	D3 (PWM)	D3	GPIO9	GPIO9/BOOT
22	D4	D4	GPIO15	GPIO15/JTAG
23	D5 (PWM)	D5	GPIO19	SDIO_CLK/FSPICS3
24	D6 (PWM)	D6	GPIO20	SDIO_DATA0/FSPICS4
25	D7	D7	GPIO21	SDIO_DATA1/FSPICS5
26	D8	D8	GPIO12	USB_D-
27	D9 (PWM)	D9	GPIO13	USB_D+
28	D10 (PWM/SS)	D10/SS	GPIO18	SDIO_CMD/FSPICS2



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29	D11 (PWM/MO SI)	D11/MOSI	GPIO7/(MOSI)	LP_I2C_SCL/LP_GPIO7/MTDO/FSPID
30	D12 (MISO)	D12/MISO/A8	gpi02/A2/(MISO)	ADC1_CH2/LP_UART_RTSN/LP_GPIO2/FS PIQ

# 4.3 QWIIC Connector

JST Pin	JST Function	Header Connection	ESP32 C6 GPIO	GPIO Function
1	GND	GND	GND	GND
2	3.3V	3.3V	3.3V	3.3V
3	LP_SDA/ MUX IO	D13	GPIO6	LP_SDA/ADC1_CH6/MTCK/PWM
4	LP_SCL/ MUX IO	D11	GPIO7	LP_SCL/MTDO/PWM

Table 4.3.1 - Pin Mapping and Connections for QWIIC Connector



**GPIO6 (D13)** and **GPIO7 (D11)** on the ESP32-C6, accessible via the **QWIIC connector (J2)**, support **functional multiplexing**. While commonly used as **LP\_SDA / LP\_SCL** for low-power I<sup>2</sup>C, these pins can also be repurposed for other functions such as **PWM, UART, ADC**, or to enable one of the two onboard **TWAI (CAN Bus) controllers**. This flexibility allows developers to tailor the board's I/O capabilities to fit a wide range of application needs, from serial communication to industrial CAN-based networks.



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# 4.4 MicroSD Connector

microSD Connector Pin	microSD Pin Name	SPI Function	ESP32 C6 GPIO	Arduino NANO (Function)
1	DAT2	Not used in SPI	-	-
2	CD/DAT3	CS (Chip Select)	GPIO19	D5
3	CMD	<b>MOSI</b> (Master Out Slave In)	GPIO7	D11/MOSI
4	VDD	VDD	3.3V	-
5	CLK	SCLK (Serial Clock)	GPIO6	D13(SCK/LED)
6	VSS	GND	GND	GND
7	DAT0	<b>MISO</b> (Master In Slave Out)	GPIO2	D12/MISO
8	DAT1	Not used in SPI	-	-

Table 4.4 - MicroSD Pin Assignments and SPI Mapping.



Pin	SD	SPI
1	DAT2	x
2	CD/DAT3	CS
3	CMD	DI
4	VDD	VDD
5	CLK	SCLK
6	VSS	VSS
7	DAT0	DO
8	DAT1	х

MicroSD Pinout



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# 4.5 Battery connections



On the back of the PULSAR NANO ESP32 C6, users can solder either a **PH 2.0 mm** or **JST 1.25 mm** connector to add a **3.7V–4.2V LiPo battery**. These connectors are **not included** with the board but can be purchased separately and soldered based on the user's preference.

The battery charging is managed by the **MCP73831** IC with a **charging current of 200 mA**. Alternatively, the battery can also be soldered directly to the designated pads (+ and -) if no connector is required, providing flexibility for both prototyping and final designs.

Important: Always double-check the battery connector polarity before soldering. Incorrect polarity can damage the onboard Battery Management System (BMS) and render the board inoperable.





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# **5 Board Operation**

5.1 Getting Started with arduino IDE

To configure the **PULSAR NANO C6** in the Arduino IDE (version 2.0 or higher is recommended), follow these steps:

- 1. Adding the UNIT Electronics Boards Package:
  - **Open Preferences**, go to the **File** menu and select **Preferences** (or **Settings** on some systems).
- 2. Add Board Manager URLs:
  - In the Additional Board Manager URLs field, add the following links:
    - ESP32 JSON URL:

https://raw.githubusercontent.com/UNIT-Electronics/Uelect ronics-ESP32-Arduino-Package/main/package\_Uelectronics\_es p32\_index.json

- Click **OK** to save.
- 3. Tip: If there are multiple URLs to add, separate them with commas.

ences	
Settings Netwo	rk
book location	
Additional Boards Manager URLs	
Enter additional URLs, one for each row	
https://dl.espressif.com/dl/package_esp32_index.json	
https://github.com/UNIT-Electronics/Uelectronics-ESP32-Arduino	-Package/releases/download/v1.0.0/package_
https://github.com/UNIT-Electronics/Uelectronics-RP2040-Arduin	o-Package/raw/main/package_Uelectronics_r
Click for a list of unofficial board support URLS	
Click for a list of unomicial board support URLS	
Click for a list of unomicial board support UKLS	
Click for a list of unomcial board support UKLS	
Click for a list of unomcial board support UKLS	
Click for a list of unomcial board support UKLS	CANCEL OK CANCEL



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- 4. Installing the Board Packages
  - Open Board Manager: Go to Tools > Board > Board Manager.
  - Search for UNIT Electronics Boards: In the search bar, type UNIT Electronics ESP32.
  - Install the Latest Version: Select the latest available version and click Install. (The PULSAR NANO C6 board is supported starting from version 3.0.1.)

Note: Make sure you have an active internet connection during installation.

BOARDS MANAGER		
unit		
Type: All 🗸		
CH55x SketchLab by Unit Electronics		
0.0.1 installed		
Boards included in this package: CH552 Board More info		
0.0.1 V REMOVE		
UNIT Electronics ESP32 by Unit Electronics		
1.0.0 installed		
Boards included in this package: UNIT DualMCU ESP32, ESP32S3 Dev Module, ESP32C3 Dev Module, ESP32S2 Dev Module, ESP32 Dev Module More info		
3.0.1 V UPDATE		
UNIT Electronics RP2040 by Unit Electronics		
2.0.0 installed		
Boards included in this package: Raspberry Pi Pico, Raspberry Pi Pico W, Raspberry Pi Pico 2, Generic RP2040, Generic RP2350, UNIT DualMCU RP2040, UNIT Dual ONE RP2040 More info		
2.0.0 V REMOVE		



# 5. Selecting the Board

• Set Your Board: Go to Tools > Board, and select the UNIT Electronics ESP32 category. Once inside the selected category, choose the PULSAR NANO ESP32-C6 board.



# 6. Connect the Board:

• Use a USB Type-C cable to connect the PULSAR NANO C6 to your computer. Ensure the correct port is selected under **Tools > Port**.

# 7. Getting Started with Examples:

 To start programming your PULSAR NANO C6 using the Arduino IDE, go to File > Examples. You'll find a wide variety of example sketches tailored for the board—perfect for exploring its capabilities and getting started with your first projects.

"By completing these steps, you'll be ready to start programming your PULSAR NANO C6 using Arduino IDE".



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# **6 Mechanical Information**



Mechanical dimensions in millimeters of PULSAR NANO ESP32-C6

# 7 Company Information

Company name	UNIT Electronics
Company website	https://uelectronics.com/
Company Address	Salvador 19, Cuauhtémoc, 06000 Mexico City, CDMX



# 8 Reference Documentation

Ref	Link
PULSAR NANO ESP32-C6 Documentation	https://github.com/UNIT-Electronics-MX/unit_nano_esp32_c6
Uelectronics-ESP32 Arduino Package	https://github.com/UNIT-Electronics/Uelectronics-ESP32-Arduino -Package
PULSAR NANO C6 Getting Started Guide	https://unit-electronics-mx.github.io/unit_nano_esp32_c6/
Thonny IDE	https://thonny.org/
Arduino IDE	https://www.arduino.cc/en/software
Visual Studio Code	https://code.visualstudio.com/download
ESP32-C6FH4	https://www.espressif.com/sites/default/files/documentation/esp3 2-c6_datasheet_en.pdf





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# 9 Appendix

9.1 Schematic (https://github.com/UNIT-Electronics-MX/unit\_nano\_esp32\_c6/blob/main/hardware/Schematics\_UNIT%20NANO\_C6\_V1\_6.pdf)



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