

ESP32 Real-Time Clock (RTC)

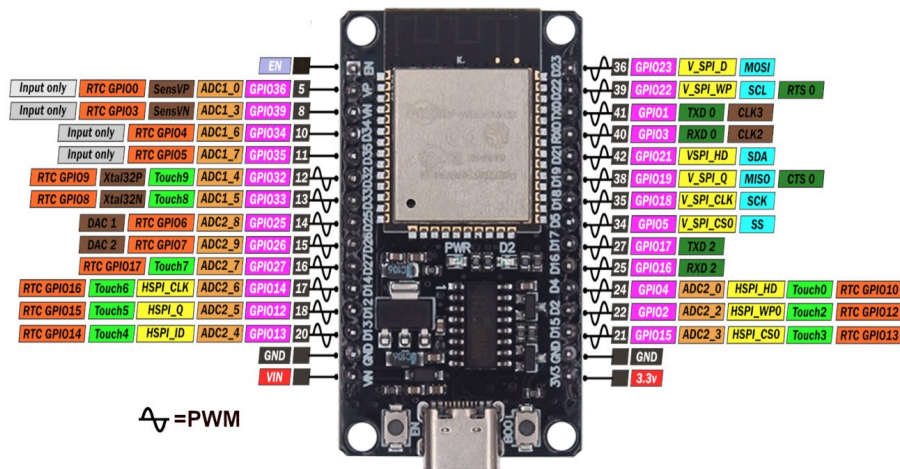


Figure 1: ESP32 UART Communication Pins

The ESP32 includes an integrated **Real-Time Clock (RTC)** module that keeps track of time even when the main CPU is in deep sleep mode. The RTC is essential for low-power applications, scheduling tasks, and timekeeping.

Key Features of the RTC

- **Low-power operation:** RTC continues running even when the main CPU cores are in deep sleep, conserving energy.
- **Timekeeping:** Maintains date, time, and calendar functions.
- **RTC Memory:** A small portion of SRAM (usually 8 KB) dedicated to storing variables that persist during deep sleep.
- **Alarms and Timers:** Can wake the ESP32 from deep sleep at a scheduled time using RTC timers.
- **Touch and Sensor Integration:** RTC pins can support capacitive touch, Hall sensor, and ultra-low-power ADC readings.

RTC Pins

- Certain GPIO pins are connected to the RTC subsystem for low-power sensor reading and touch sensing.

- Examples include: GPIO0, GPIO2, GPIO4, GPIO12–15, GPIO25–27, GPIO32–39 (also ADC or touch-capable pins).
- RTC pins allow the ESP32 to monitor sensors while the main CPU is powered down, reducing overall energy consumption.

Deep Sleep and Wake-up

- RTC can set a **wake-up timer** for periodic tasks without staying fully powered.
- Example: wake up every 10 minutes to read a sensor and send data, then return to deep sleep.
- Wake-up sources include: RTC timer, touchpad, external pins (EXT0/EXT1), or ultra-low-power (ULP) co-processor events.

Example Usage (Arduino IDE)

```
// ESP32 deep sleep with RTC wake-up
void setup() {
  Serial.begin(115200);
  Serial.println("Going to sleep for 10 seconds...");

  // Set RTC wake-up timer for 10 seconds
  esp_sleep_enable_timer_wakeup(10 * 1000000); // microseconds
  esp_deep_sleep_start(); // Enter deep sleep
}

void loop() {
  // This code runs after wake-up
  Serial.println("Woke up from deep sleep!");
}
```

Applications

- Battery-powered IoT devices with periodic sensor readings.
- Alarm clocks or time-based automation systems.
- Energy-efficient data logging and environmental monitoring.
- Low-power touch or capacitive sensing applications using RTC pins.