

- Sniff mode
- Connectionless Slave Broadcast (transmitter and receiver)
- Enhanced power control
- Ping
- Bluetooth Low Energy
  - Advertising
  - Scanning
  - Simultaneous advertising and scanning
  - Multiple connections
  - Asynchronous data reception and transmission
  - Adaptive Frequency Hopping and Channel assessment
  - Connection parameter update
  - Data Length Extension
  - Link Layer Encryption
  - LE Ping

### 3.7 RTC and Low-Power Management

With the use of advanced power-management technologies, ESP32 can switch between different power modes.

- Power modes
  - **Active mode:** The chip radio is powered on. The chip can receive, transmit, or listen.
  - **Modem-sleep mode:** The CPU is operational and the clock is configurable. The Wi-Fi/Bluetooth baseband and radio are disabled.
  - **Light-sleep mode:** The CPU is paused. The RTC memory and RTC peripherals, as well as the ULP coprocessor are running. Any wake-up events (MAC, host, RTC timer, or external interrupts) will wake up the chip.
  - **Deep-sleep mode:** Only the RTC memory and RTC peripherals are powered on. Wi-Fi and Bluetooth connection data are stored in the RTC memory. The ULP coprocessor is functional.
  - **Hibernation mode:** The internal 8 MHz oscillator and ULP coprocessor are disabled. The RTC recovery memory is powered down. Only one RTC timer on the slow clock and certain RTC GPIOs are active. The RTC timer or the RTC GPIOs can wake up the chip from the Hibernation mode.

**Table 8: Power Consumption by Power Modes**

Power mode	Description	Power consumption
Active (RF working)	Wi-Fi Tx packet	Please refer to Table 17 for details.
	Wi-Fi/BT Tx packet	
	Wi-Fi/BT Rx and listening	

Power mode	Description			Power consumption
Modem-sleep	The CPU is powered on.	240 MHz <sup>*</sup>	Dual-core chip(s)	30 mA ~ 68 mA
			Single-core chip(s)	N/A
		160 MHz <sup>*</sup>	Dual-core chip(s)	27 mA ~ 44 mA
			Single-core chip(s)	27 mA ~ 34 mA
		Normal speed: 80 MHz	Dual-core chip(s)	20 mA ~ 31 mA
			Single-core chip(s)	20 mA ~ 25 mA
Light-sleep	-			0.8 mA
Deep-sleep	The ULP coprocessor is powered on.			150 $\mu$ A
	ULP sensor-monitored pattern			100 $\mu$ A @1% duty
	RTC timer + RTC memory			10 $\mu$ A
Hibernation	RTC timer only			5 $\mu$ A
Power off	CHIP_PU is set to low level, the chip is powered off.			1 $\mu$ A

**Note:**

- \* Among the ESP32 series of SoCs, ESP32-D0WD-V3, ESP32-D0WDR2-V3, ESP32-U4WDH, ESP32-D0WD (NRND), ESP32-D0WDQ6 (NRND), and ESP32-D0WDQ6-V3 (NRND) have a maximum CPU frequency of 240 MHz, ESP32-S0WD has a maximum CPU frequency of 160 MHz.
- When Wi-Fi is enabled, the chip switches between Active and Modem-sleep modes. Therefore, power consumption changes accordingly.
- In Modem-sleep mode, the CPU frequency changes automatically. The frequency depends on the CPU load and the peripherals used.
- During Deep-sleep, when the ULP coprocessor is powered on, peripherals such as GPIO and RTC I2C are able to operate.
- When the system works in the ULP sensor-monitored pattern, the ULP coprocessor works with the ULP sensor periodically and the ADC works with a duty cycle of 1%, so the power consumption is 100  $\mu$ A.