



# 88MW320/322

## WLAN Microcontroller

### Technical Product Brief

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## PRODUCT OVERVIEW

The Marvell® 88MW320/322 is a highly integrated, low-power WLAN Microcontroller System-on-Chip (SoC) solution designed for a broad array of smart devices for home, enterprise and industrial automation, smart accessories, and smart energy applications.

A high degree of integration enables very low system costs requiring only a single 3.3V power input, a 38.4 MHz crystal, and SPI Flash. The RF path needs only a low pass filter for antenna connection.

The SoC includes a full-featured WLAN subsystem powered by proven and mature IEEE 802.11n/g/b Marvell technology. The WLAN subsystem integrates a WLAN MAC, baseband, and direct-conversion RF radio with integrated PA, LNA, and transmit/receive switch. It also integrates a CPU subsystem with integrated memory to run Marvell WLAN firmware to handle real time WLAN protocol processing to off-load many WLAN functions from the main application CPU.

The 88MW320/322 application subsystem is powered by an ARM Cortex-M4F CPU that operates up to 200 MHz. The device supports an integrated 512 KB SRAM, 128 KB mask ROM, and a QSPI interface to external Flash. An integrated Flash Controller with a 32 KB SRAM cache enables eXecute In Place (XIP) support for firmware from Flash.

The SoC is designed for low-power operation and includes several low-power states and fast wake-up times. Multiple power domains and clocks can be individually shut down to save power. The SoC also has a high-efficiency internal PA that can be operated in low-power mode to save power. The microcontroller and WLAN subsystems can be placed into low-power states, independently, supporting a variety of application use cases. An internal DC-DC regulator provides the 1.8V rail for the WLAN subsystem.

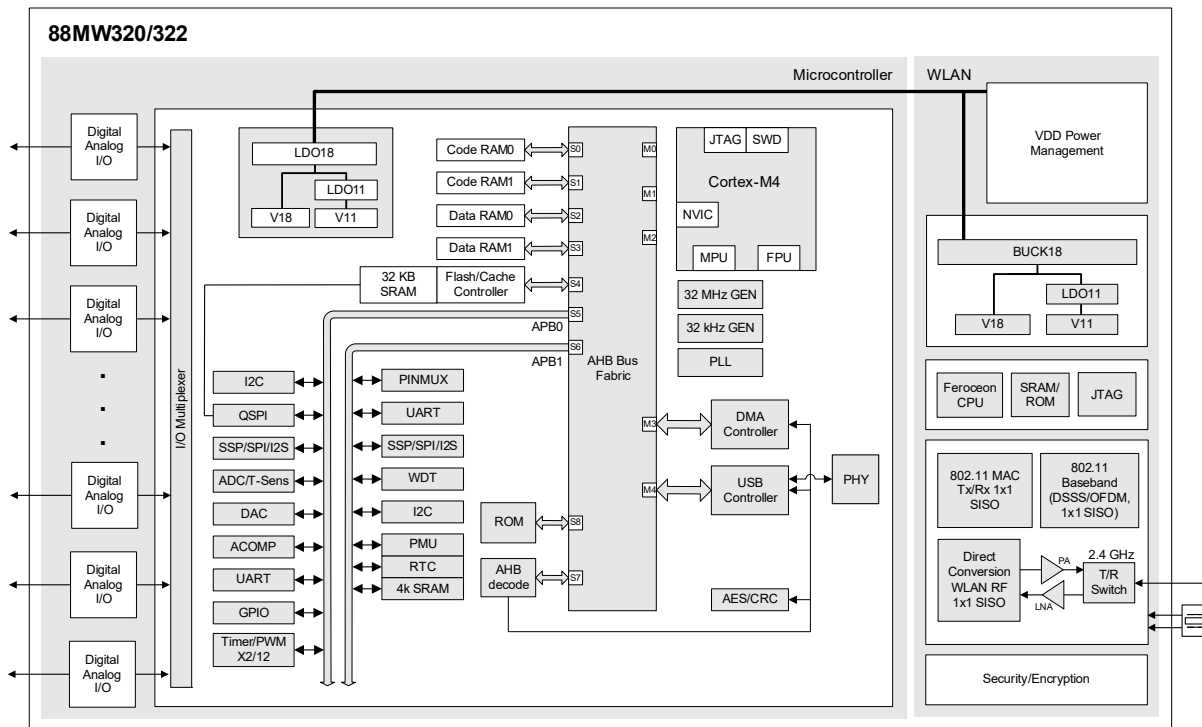
The SoC provides a full array of peripheral interfaces including SSP/SPI/I<sup>2</sup>S (3x), UART (3x), I<sup>2</sup>C (2x), General Purpose Timers and PWM, ADC, DAC, Analog Comparator, and GPIOs. It also includes a hardware cryptographic engine, RTC, and Watchdog Timer.

The 88MW322 includes a high-speed USB On-The-Go (OTG) interface to enable USB audio, video, and other applications.

A complete set of digital and analog interfaces enable direct interfacing for I/O avoiding the need for external chips. The application CPU can be used to support custom application development avoiding the need for another microcontroller or processor.

[Figure 1](#) shows an overall block diagram of the device.

**Figure 1: Block Diagram**



## Applications

- Smart Home—smart outlet, light switch, security camera, thermostat, sprinkler controller, sensor, door lock, door bell, garage door, security system
- Industrial—building automation, smart lighting, Wi-Fi to other radio bridge, Point of Sale (POS) terminals
- Smart Devices—coffee pot, rice cooker, vacuum cleaner, air purifier, pet monitor, weighing scale, glucometer, blood pressure monitor, fitness equipment
- Smart Appliances—refrigerator, washer, dryer, oven range, microwave, dishwasher, water heater, air conditioner
- Smart Accessories—smart speakers, headset, alarm clock, gaming accessory, remote control
- Gateways—Bluetooth Smart Mesh and other radios to Wi-Fi/IP network

## Key Features

- Highly integrated SoC requiring very few external components for a full system operation
- Multiple low-power modes and fast wake-up times
- Full-featured, single stream 802.11n/g/b WLAN
- High-efficiency PA with a low-power (10 dB) mode
- Cortex-M4F application CPU for applications with integrated 512 KB SRAM and 128 KB mask ROM
- Flash Controller with embedded 32 KB SRAM cache to support XIP from external SPI Flash
- Secure boot
- Full set of digital and analog I/O interfaces

## Power Management

- Power modes—active, idle, standby, sleep, shutoff, power-down
- Integrated high-efficiency buck DC-DC converter
- Independent power domains
- Brown-out detection
- Integrated POR
- Wake-up through dedicated GPIO, IRQ, and RTC

## Chip Package

- 88MW320—68-pin QFN, 8x8 mm
  - USB OTG not supported
  - 35 GPIOs
  - 2 GPTs
- 88MW322—88-pin QFN, 10x10 mm
  - USB OTG supported
  - 50 GPIOs
  - 4 GPTs

**Table 1: Package Feature Differences<sup>1</sup>**

| Feature        | 68-Pin   | 88-Pin                           |
|----------------|--|----------------------------------|
| GPIO           | 35 total<br>GPIO_0 to GPIO_10<br>GPIO_16<br>GPIO_22 to GPIO_33<br>GPIO_39 to GPIO_49 | 50 total<br>GPIO_0 to<br>GPIO_49 |
| USB 2.0<br>OTG | --   | 1                                |
| GPT            | 2  | 4                                |

1. All I/O features are muxed on GPIOs, except WLAN RF TX/RX, USB, reference clock, and reset functionality.

## Temperature

- Commercial: 0 to 70°C
- Extended: -30 to 85°C
- Industrial: -40 to 105°C
- Storage: -55 to 125°C

## Wireless

- IEEE 802.11n/g/b, 1x1 SISO 2.4 GHz and HT20
- Integrated CPU, memory, MAC, DSSS/OFDM baseband, direct conversion RF radio, encryption
- Antenna diversity
- CMOS and low-swing sine wave input clock
- Low-power with deep sleep and standby modes
- Pre-regulated supplies
- Integrated T/R switch, PA, and LNA
- Optional 802.11n features
- One Time Programmable (OTP) memory to eliminate need for external EEPROM

## WLAN Rx Path

- Direct conversion architecture eliminates need for external SAW filter
- On-chip gain selectable LNA with optimized noise figure and power consumption
- High dynamic range AGC function in receive mode

## WLAN Tx Path

- Integrated PA with power control
- Optimized Tx gain distribution for linearity and noise performance

## WLAN Local Oscillator

- Fractional-N for multiple reference clock support
- Fine channel step

## WLAN Encryption

- WEP 64- and 128-bit encryption with hardware TKIP processing (WPA)
- AES-CCMP hardware implementation as part of 802.11i security standard (WPA2)
- Enhanced AES engine performance
- AES-Cipher-Based Message Authentication Code (CMAC) as part of the 802.11w security standard
- WLAN Authentication and Privacy Infrastructure (WAPI)

## IEEE 802.11 Standards

- 802.11 data rates of 1 and 2 Mbps
- 802.11b data rates of 5.5 and 11 Mbps
- 802.11g data rates 6, 9, 12, 18, 24, 36, 48, and 54 Mbps for multimedia content transmission
- 802.11g/b performance enhancements
- 802.11n compliant with maximum data rates up to 72.2 Mbps (20 MHz channel)
- 802.11d international roaming
- 802.11e quality of service
- 802.11h transmit power control
- 802.11i enhanced security
- 802.11k radio resource measurement
- 802.11n block acknowledgment extension
- 802.11r fast hand-off for AP roaming
- 802.11w protected management frames
- Fully supports clients (stations) implementing IEEE Power Save mode
- Wi-Fi direct connectivity



## Microprocessor

### Processor

- ARM Cortex-M4F, 32-bit
- 200 MHz main bus clock

### Memory

- 128 KB ROM
- 512 KB RAM

### Flash Controller

- Supports QSPI Flash devices
- Memory-mapped access to QSPI Flash devices
- 32 KB SRAM cache

### Digital Interfaces

- 3x I<sup>2</sup>S stereo
- 3x SPI master/slave
- 2x I<sup>2</sup>C master/slave
- 3x UART
- 1x USB OTG 2.0, high-speed
- 1x QSPI
- Up to 50 GPIOs
- 2x wake-up pins

### Analog

- 2-step ADC with integrated PGA and configurable resolution/speed
  - 12-bit/2 MHz sample(s) for fast conversion
  - 16-bit/16 kHz sample/s with voice quality
  - 8 single channels or 4 differential channels
- 2-Channel or 1 differential channel DAC, 10-bit/500 ksps
- 2 Analog Comparators with programmable speed/current
- On-die/off-chip temperature sensing and battery monitor

### Counters/Timers/PWM

- General Purpose Timers (GPT) with LED PWM support
- Real Time Clock (RTC)
- CM4 system tick
- Watchdog Timer

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