



# RISC-V + HiFi5 Wi-Fi/BT SoC

*for high-performance far-field and artificial intelligence (AI)-based speech recognition applications*

R128 is a highly integrated wireless audio SoC with high performance. It features a XuanTie RISC-V CPU, a HiFi5 DSP, an Arm M33 star MCU, an 802.11b/g/n WLAN & Dual-mode Bluetooth subsystem, a Voice & Audio CODEC subsystem, and a Power Management Unit (PMU). RISC-V C906 CPU and HiFi5 DSP provide powerful and energy-efficient computing power for applications and audio processing respectively. R128 integrates 3 differential ADCs and 2 differential DACs and can be applied to microphone array-based voice recognition and stereo audio playback solutions. Wi-Fi and bluetooth enable R128 to implement various network applications with an exclusive antenna for each to simultaneously transmit and receive data on 2.4 GHz. R128 also integrates a JPEG encoder, a RGB display engine, and a 2D graphics acceleration system, making it possible to achieve some display applications.

Memory	XuanTie RISC-V C906, 600 MHz		Peripheral
1 MB SRAM	32 KB I-Cache	32 KB D-Cache	UART x 3
SIP 8 MB/16 MB Flash	HiFi5 Audio DSP, 400 MHz		SPI x 2
SIP 8 MB/16 MB/32 MB PSRAM	32KB I-Cache	32KB D-Cache	PWM x 8
Security	ARM M33 Star, 240 MHz		TWI x 2
Secure JTAG	32 KB I-Cache	32 KB D-Cache	IR TX/RX
Secure Memory	WLAN	Bluetooth	GPADC x 8
Crypto Engine	TCP/IP	BR/EDR/BLE5.0	DBI x 1
Image and Display	Supplicant	Host Profile	SDIO x 1
Display Engine + TCON RGB	MAC	Controller	QPI Flash Controller
G2D Accelerator	Baseband	Modem	OPI Psram Controller
CSI + JPEG Encoder	Co-Existence System		LEDC
AUDIO	Wi-Fi/BT & BT RADIO		OWA x 1
3 ADCs	Always On		USB 2.0
2 DACs	PMU 3.0 V to 5.5 V	CLK	ISO 7816
I2S x 1		RCOSC	
DMIC		RTC	

## Highlight

- **High Integration:** R128 integrates powerful processors, high-quality audio CODEC, WiFi, Bluetooth, power supply, graphic and display system, and rich peripheral interfaces. It provides the perfect voice interaction solutions.
- **High Performance:** 64-bit RISC-V CPU up to 600 MHz, HiFi5 DSP up to 400 MHz, and ARM M33 star MCU up to 240 MHz provide the powerful computing power. Cadence's Tensilica HiFi 5 DSP is optimised for high-performance far-field processing and artificial intelligence (AI)-based speech recognition processing, and has doubled the audio processing power and quadrupled the neural network (NN) processing power as its predecessor, the HiFi 4 DSP. The 105 dBc SNR@A-Weight and -90 dBc THD+N of Audio DACs bring us the best audio experience.
- **Network:** Wi-Fi and Bluetooth combo technology makes network connection and transmission more simple and efficient.
- **High Security:** TrustZone-based architecture and multiple secure designs provide a secure runtime environment for the application system.

## Features

### CPUs, DSP and Memory

- XuanTie 64-bit RISC-V CPU up to 600 MHz
- Cadence HiFi5 DSP, up to 400 MHz, 2x the audio processing power and 4x the NN processing power as HiFi4
- Arm-Star ARMv8-M MCU up to 240 MHz
- 1MB SRAM
- SiP 8 MB/16 MB Flash
- SiP 8 MB OPI PSRAM in R128-S1
- SiP 16 MB OPI PSRAM in R128-S2
- SiP 32 MB OPI PSRAM in R128-S3
- 2048-bit efuse

### WLAN

- Compatible with 802.11b/g/n standard
- Single-band 2.4G 1T1R WLAN
- WPA/WPA2/WPA3 personal, WPS
- Integrated LNA PA and T/R switch
- STA, AP, STA/AP, and Monitor modes
- Supports Wi-Fi and Bluetooth Co-existence
- TX Power:
  - \* 20 dBm@11b, 1M
  - \* 15 dBm@11n, MCS7
- RX Sensitivity:
  - \* -98.5 dBm@11b, 1M
  - \* -74.5 dBm@11n, MCS7

### Bluetooth

- Dual-mode BT5.0
- Bluetooth specification v5.0, and compatible with v4.0/4.1/4.2 devices
- Bluetooth Low Energy 1 Mbps, 2 Mbps, and long range
- TX Power: -20 dBm to 20 dBm
- RX Sensitivity:
  - \* -95.0 dBm@BR
  - \* -99.5 dBm@BLE 1 Mbps
  - \* -106 dBm@BLE S = 8

### Power Management

- 3.0 V to 5.5 V single power supply integrated with DC-DC
- Supports DCXO with internal oscillator circuit, 24/26/40 MHz
- Internal LPO for low power mode
- Internal temperature sensor

### Audio

- 3 ADCs, 95 dBc SNR, 24-bit, 8 KHz to 96 KHz sample rate
- 2 DACs, 105 dBc SNR, 110 dBc DNR, 24-bit, 8 KHz to 384 KHz sample rate
- 5-band DRC and 20-band hardware EQ
- I2S/TDM/PCM: 8-32 bit, TDM supports 16 channels
- DMIC: 4 channels support max 8 DMICs input
- Supports hardware voice activation detection (VAD)

### Image and Graphic

- Supports 8-bit parallel camera interface
- Supports JPEG encoder, 1920 x 1088@15fps
- Supports Graphic 2D accelerator with rotate, mixer
- Supports RGB output interface, up to 1024 x 768@60fps

### Security

- TEE: TrustZone-M
- Secure boot
- Secure memory/eFuse
- JTAG/SWD protection
- HW crypto engine (RSA/AES/DES/3DES/MD5/SHA/SHA256/TRNG)

### Peripherals

- USB 2.0 DRD
- 3 UART interfaces, with RTS/CTS
- 2 SPI interfaces
- 8 PWM out
- 8 10-bit SAR GPADC
- 2 TWI interfaces
- 1 SD2.0/SDIO2.0 Host Controller
- 1 CSI interface
- 1 TCON interface
- Multi-channel DMA

### Package

- QFN80 8 mm x 8 mm