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C8051F120/1/2/3/4/5/6/7

8K ISP FLASH MCU Family

Analog Peripherals
- **10 or 12-bit SAR ADC**
  - ± 1 LSB INL
  - Programmable throughput up to 100 ksps
  - Up to 8 external inputs; programmable as single-ended or differential
  - Programmable amplifier gain: 16, 8, 4, 2, 1, 0.5
  - Data-dependent windowed interrupt generator
  - Built-in temperature sensor
- **8-bit SAR ADC ('F12x Only)**
  - Programmable throughput up to 500 ksps
  - 8 external inputs (single-ended or differential)
  - Programmable amplifier gain: 4, 2, 1, 0.5
- **Two 12-bit DACs ('F12x Only)**
  - Can synchronize outputs to timers for jitter-free waveform generation
- **Two Analog Comparators**
- **Voltage Reference**
- **V_{DD} Monitor/Brown-Out Detector**

On-Chip JTAG Debug & Boundary Scan
- On-chip debug circuitry facilitates full-speed, non-intrusive in-circuit/in-system debugging
- Provides breakpoints, single-stepping, watchpoints, stack monitor; inspect/modify memory and registers
- Superior performance to emulation systems using ICE-chips, target pods, and sockets
- IEEE1149.1 compliant boundary scan
- Complete development kit

100-Pin TQFP or 64-Pin TQFP Packaging
- Temperature Range: –40 to +85 °C
- RoHS Available

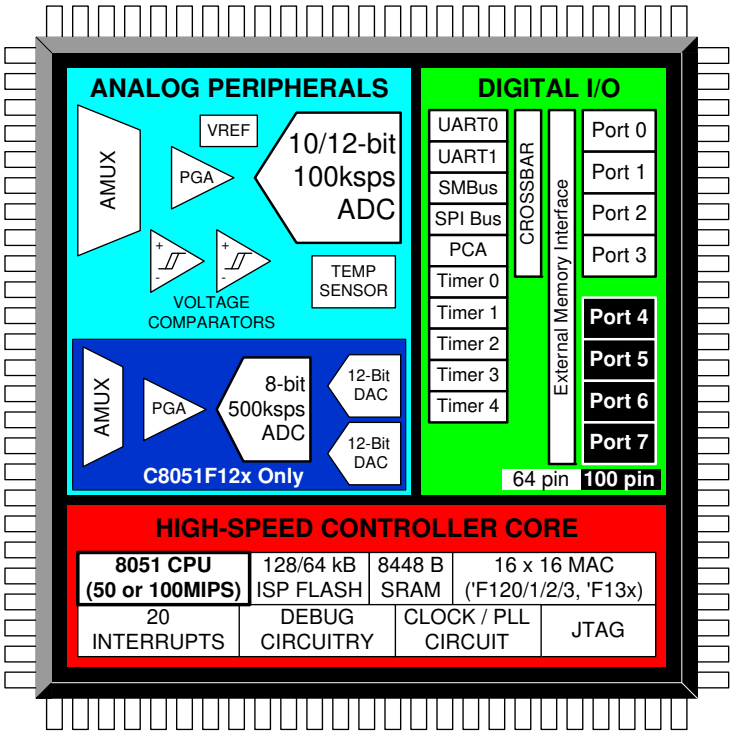
High Speed 8051 µC Core
- Pipelined instruction architecture; executes 70% of instruction set in 1 or 2 system clocks
- 100 MIPS or 50 MIPS throughput with on-chip PLL
- 2-cycle 16 x 16 MAC engine (C8051F120/1/2/3 and C8051F130/1/2/3 only)

Memory
- 8448 bytes internal data RAM (8 k + 256)
- 128 or 64 kB Banked Flash; in-system programmable in 1024-byte sectors
- External 64 kB data memory interface (programmable multiplexed or non-multiplexed modes)

Digital Peripherals
- 8 byte-wide port I/O (100TQFP); 5 V tolerant
- 4 Byte-wide port I/O (64TQFP); 5 V tolerant
- Hardware SMBus™ (I2C™ Compatible), SPI™, and two UART serial ports available concurrently
- Programmable 16-bit counter/timer array with 6 capture/compare modules
- 5 general purpose 16-bit counter/timers
- Dedicated watchdog timer; bi-directional reset pin

Clock Sources
- Internal precision oscillator: 24.5 MHz
- Flexible PLL technology
- External Oscillator: Crystal, RC, C, or clock

Voltage Supples
- Range: 2.7–3.6 V (50 MIPS) 3.0–3.6 V (100 MIPS)
- Power saving sleep and shutdown modes



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1. System Overview

The C8051F12x and C8051F13x device families are fully integrated mixed-signal System-on-a-Chip MCUs with 64 digital I/O pins (100-pin TQFP) or 32 digital I/O pins (64-pin TQFP).

Highlighted features are listed below. Refer to Table 1.1 for specific product feature selection.

- High-Speed pipelined 8051-compatible CIP-51 microcontroller core (100 MIPS or 50 MIPS)
- In-system, full-speed, non-intrusive debug interface (on-chip)
- True 12 or 10-bit 100 ksps ADC with PGA and 8-channel analog multiplexer
- True 8-bit 500 ksps ADC with PGA and 8-channel analog multiplexer (C8051F12x Family)
- Two 12-bit DACs with programmable update scheduling (C8051F12x Family)
- 2-cycle 16 by 16 Multiply and Accumulate Engine (C8051F120/1/2/3 and C8051F130/1/2/3)
- 128 or 64 kB of in-system programmable Flash memory
- 8448 (8 k + 256) bytes of on-chip RAM
- External Data Memory Interface with 64 kB address space
- SPI, SMBus/I2C, and (2) UART serial interfaces implemented in hardware
- Five general purpose 16-bit Timers
- Programmable Counter/Timer Array with 6 capture/compare modules
- On-chip Watchdog Timer, V_{DD} Monitor, and Temperature Sensor

With on-chip V_{DD} monitor, Watchdog Timer, and clock oscillator, the C8051F12x and C8051F13x devices are truly stand-alone System-on-a-Chip solutions. All analog and digital peripherals are enabled/disabled and configured by user firmware. The Flash memory can be reprogrammed even in-circuit, providing non-volatile data storage, and also allowing field upgrades of the 8051 firmware.

On-board JTAG debug circuitry allows non-intrusive (uses no on-chip resources), full speed, in-circuit debugging using the production MCU installed in the final application. This debug system supports inspection and modification of memory and registers, setting breakpoints, watchpoints, single stepping, run and halt commands. All analog and digital peripherals are fully functional while debugging using JTAG.

Each MCU is specified for operation over the industrial temperature range (–45 to +85 °C). The Port I/O, $\overline{RST}$, and JTAG pins are tolerant for input signals up to 5 V. The devices are available in 100-pin TQFP or 64-pin TQFP packaging. Table 1.1 lists the specific device features and package offerings for each part number. Figure 1.1 through Figure 1.6 show functional block diagrams for each device.

Table 1.1. Product Selection Guide

Ordering Part Number	MIPS (Peak)	Flash Memory	RAM	2-cycle 16 by 16 MAC	External Memory Interface	SMBus/I2C	SPI	UARTS	Timers (16-bit)	Programmable Counter Array	Digital Port I/O's	12-bit 100ksps ADC Inputs	10-bit 100ksps ADC Inputs	8-bit 500ksps ADC Inputs	Voltage Reference	Temperature Sensor	DAC Resolution (bits)	DAC Outputs	Analog Comparators	Lead-Free (RoHS Compliant)	Package
C8051F120	100	128 k	8448	✓	✓	✓	✓	2	5	✓	64	8	-	8	✓	✓	12	2	2	-	100TQFP
C8051F120-GQ	100	128 k	8448	✓	✓	✓	✓	2	5	✓	64	8	-	8	✓	✓	12	2	2	✓	100TQFP
C8051F121	100	128 k	8448	✓	✓	✓	✓	2	5	✓	32	8	-	8	✓	✓	12	2	2	-	64TQFP
C8051F121-GQ	100	128 k	8448	✓	✓	✓	✓	2	5	✓	32	8	-	8	✓	✓	12	2	2	✓	64TQFP
C8051F122	100	128 k	8448	✓	✓	✓	✓	2	5	✓	64	-	8	8	✓	✓	12	2	2	-	100TQFP
C8051F122-GQ	100	128 k	8448	✓	✓	✓	✓	2	5	✓	64	-	8	8	✓	✓	12	2	2	✓	100TQFP
C8051F123	100	128 k	8448	✓	✓	✓	✓	2	5	✓	32	-	8	8	✓	✓	12	2	2	-	64TQFP
C8051F123-GQ	100	128 k	8448	✓	✓	✓	✓	2	5	✓	32	-	8	8	✓	✓	12	2	2	✓	64TQFP
C8051F124	50	128 k	8448	-	✓	✓	✓	2	5	✓	64	8	-	8	✓	✓	12	2	2	-	100TQFP
C8051F124-GQ	50	128 k	8448	-	✓	✓	✓	2	5	✓	64	8	-	8	✓	✓	12	2	2	✓	100TQFP
C8051F125	50	128 k	8448	-	✓	✓	✓	2	5	✓	32	8	-	8	✓	✓	12	2	2	-	64TQFP
C8051F125-GQ	50	128 k	8448	-	✓	✓	✓	2	5	✓	32	8	-	8	✓	✓	12	2	2	✓	64TQFP
C8051F126	50	128 k	8448	-	✓	✓	✓	2	5	✓	64	-	8	8	✓	✓	12	2	2	-	100TQFP
C8051F126-GQ	50	128 k	8448	-	✓	✓	✓	2	5	✓	64	-	8	8	✓	✓	12	2	2	✓	100TQFP
C8051F127	50	128 k	8448	-	✓	✓	✓	2	5	✓	32	-	8	8	✓	✓	12	2	2	-	64TQFP
C8051F127-GQ	50	128 k	8448	-	✓	✓	✓	2	5	✓	32	-	8	8	✓	✓	12	2	2	✓	64TQFP
C8051F130	100	128 k	8448	✓	✓	✓	✓	2	5	✓	64	-	8	-	✓	✓	-	-	2	-	100TQFP
C8051F130-GQ	100	128 k	8448	✓	✓	✓	✓	2	5	✓	64	-	8	-	✓	✓	-	-	2	✓	100TQFP
C8051F131	100	128 k	8448	✓	✓	✓	✓	2	5	✓	32	-	8	-	✓	✓	-	-	2	-	64TQFP
C8051F131-GQ	100	128 k	8448	✓	✓	✓	✓	2	5	✓	32	-	8	-	✓	✓	-	-	2	✓	64TQFP
C8051F132	100	64 k	8448	✓	✓	✓	✓	2	5	✓	64	-	8	-	✓	✓	-	-	2	-	100TQFP
C8051F132-GQ	100	64 k	8448	✓	✓	✓	✓	2	5	✓	64	-	8	-	✓	✓	-	-	2	✓	100TQFP
C8051F133	100	64 k	8448	✓	✓	✓	✓	2	5	✓	32	-	8	-	✓	✓	-	-	2	-	64TQFP
C8051F133-GQ	100	64 k	8448	✓	✓	✓	✓	2	5	✓	32	-	8	-	✓	✓	-	-	2	✓	64TQFP

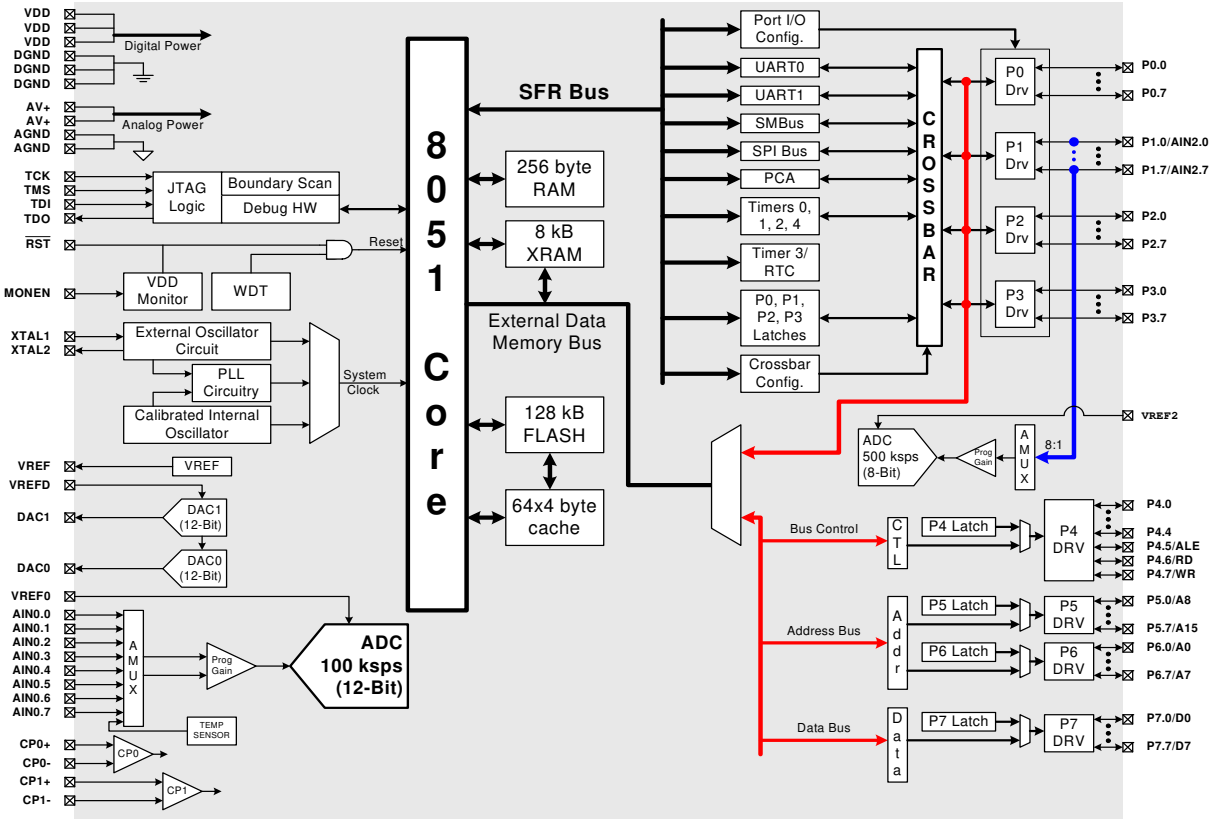

Figure 1.1. C8051F120/124 Block Diagram

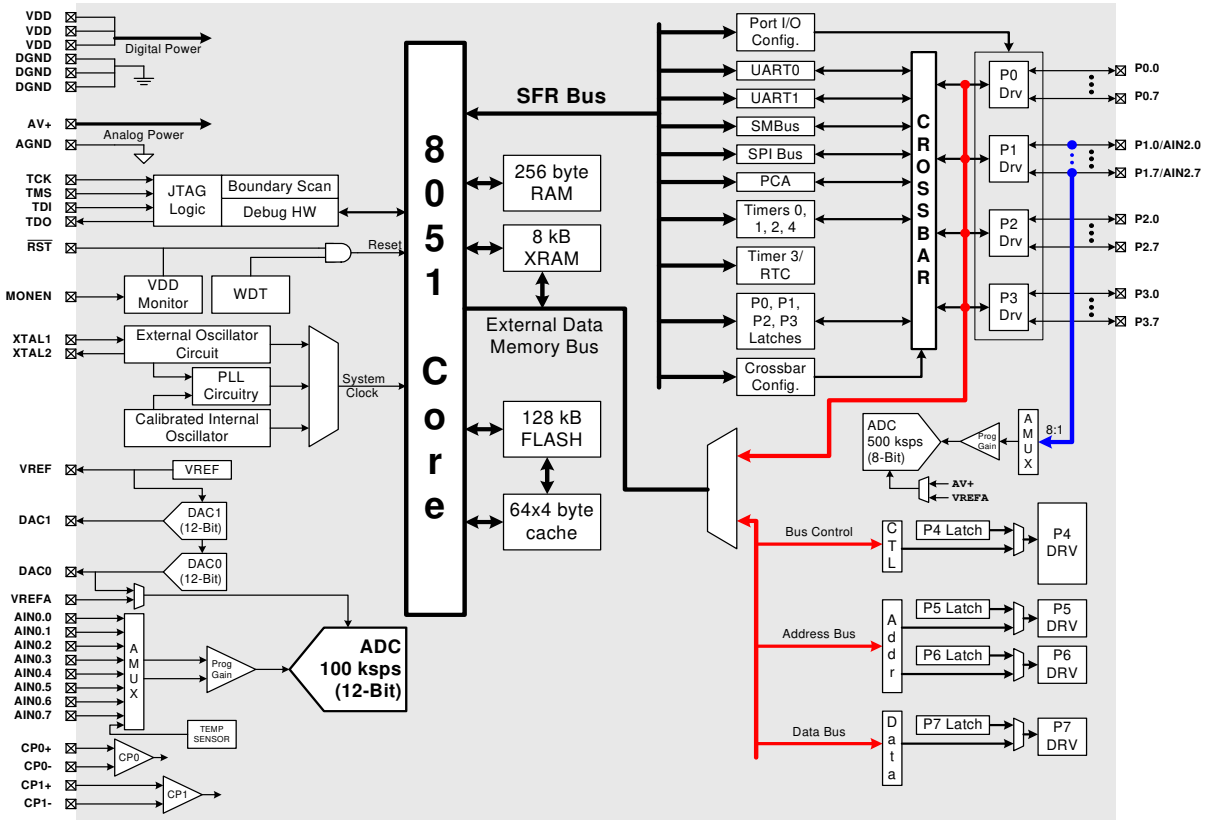

Figure 1.2. C8051F121/125 Block Diagram

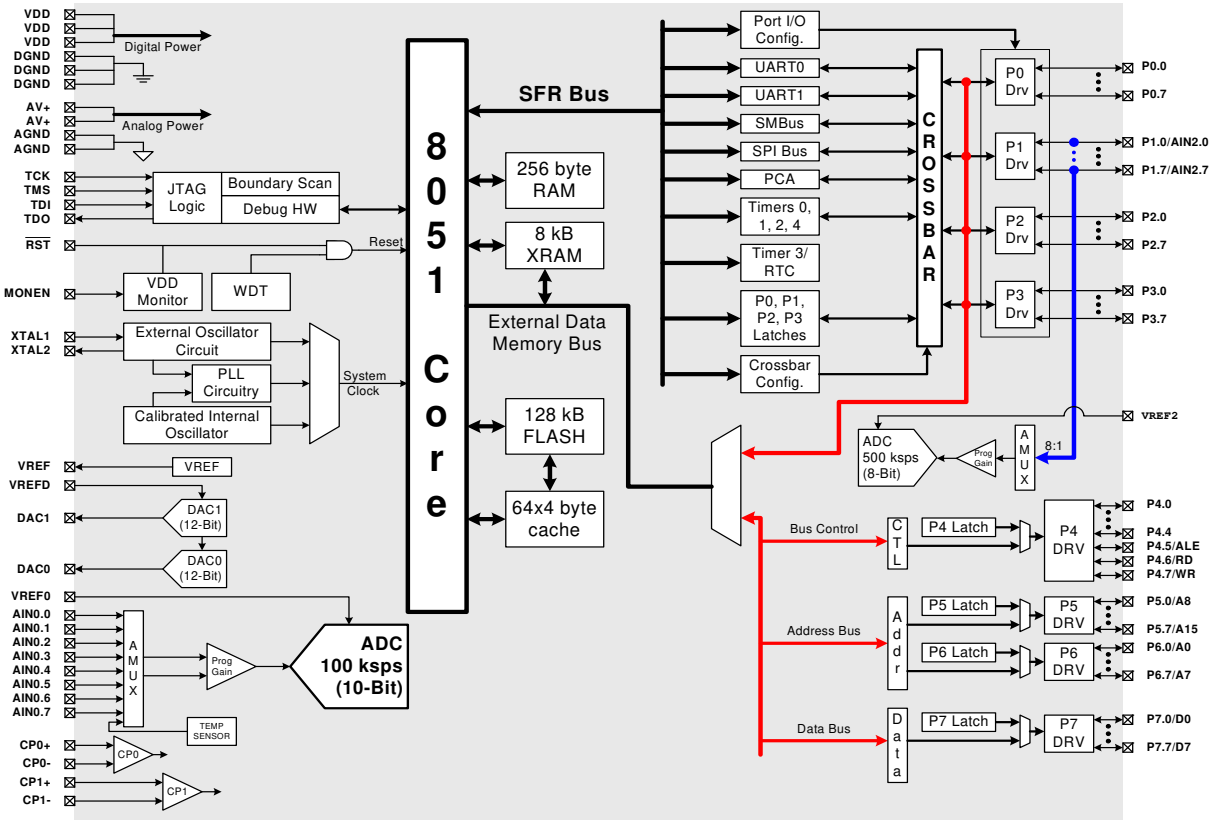

Figure 1.3. C8051F122/126 Block Diagram

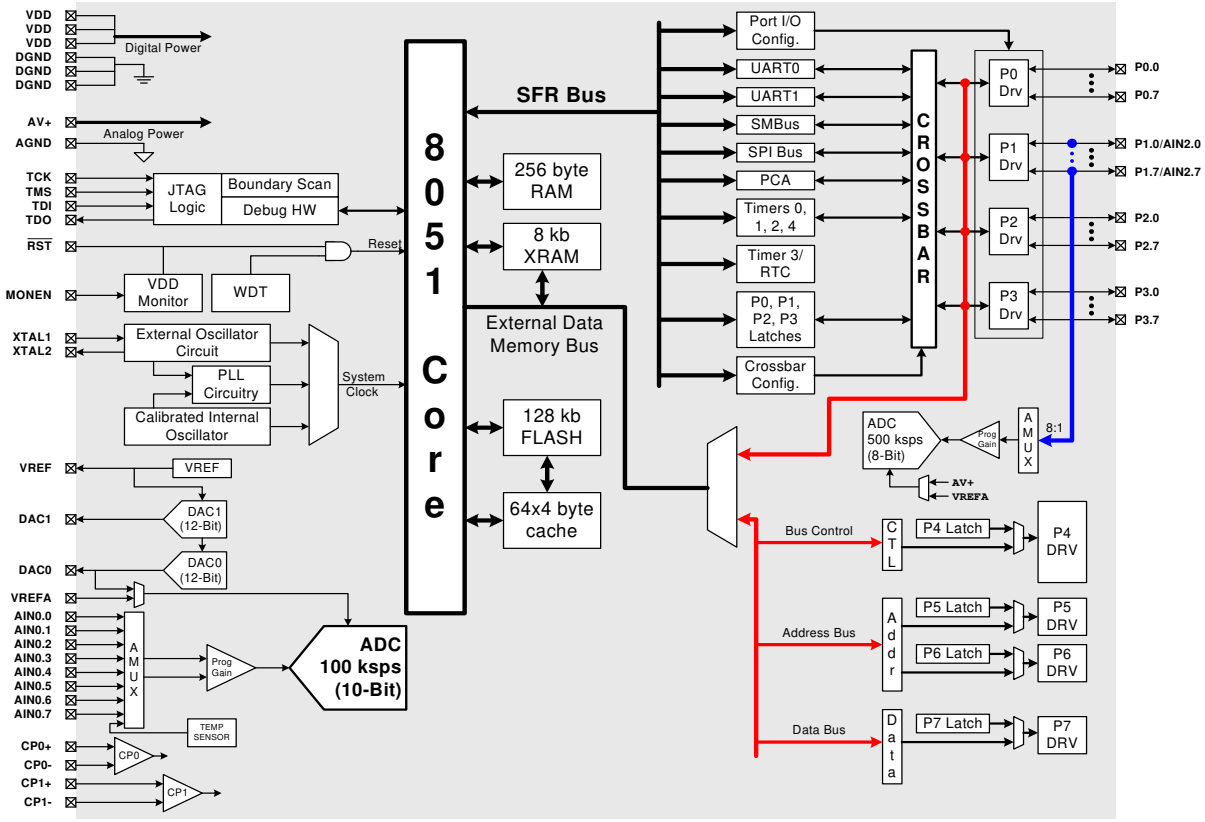

Figure 1.4. C8051F123/127 Block Diagram

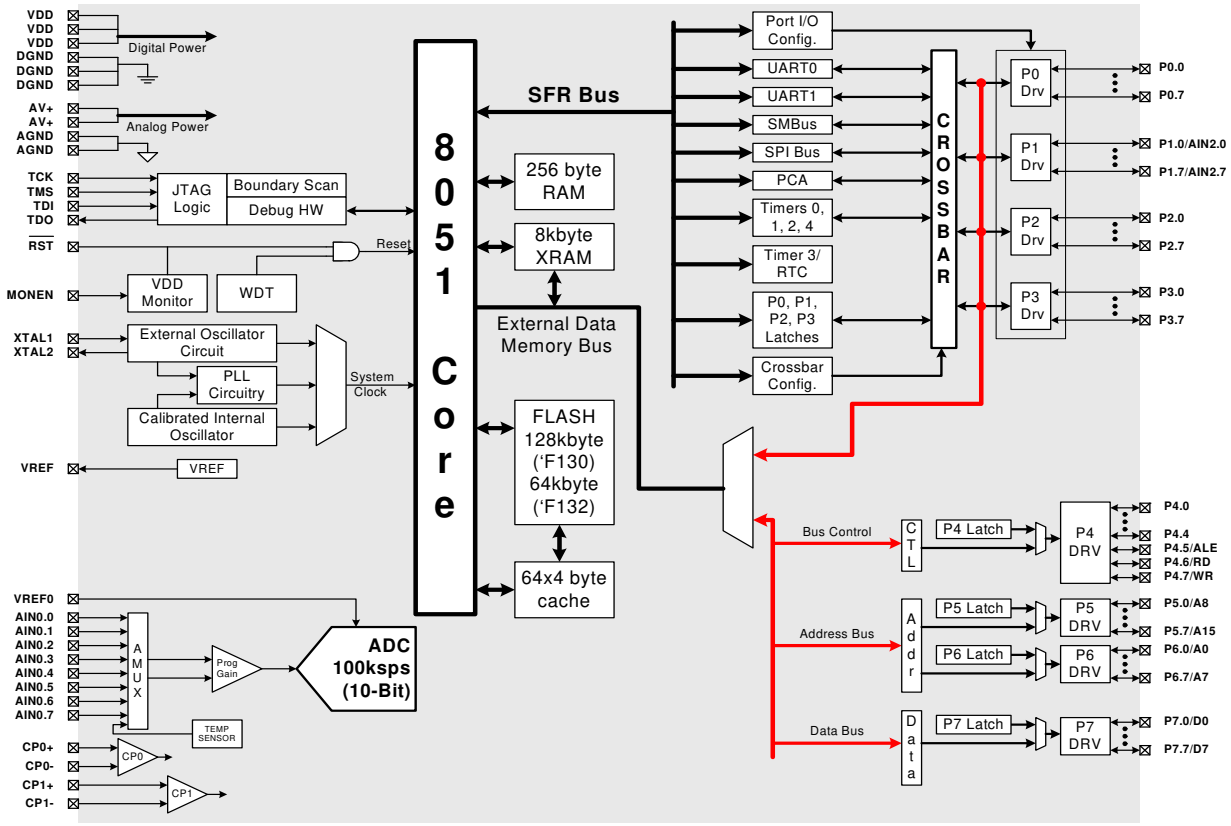

Figure 1.5. C8051F130/132 Block Diagram