

به نام خدا

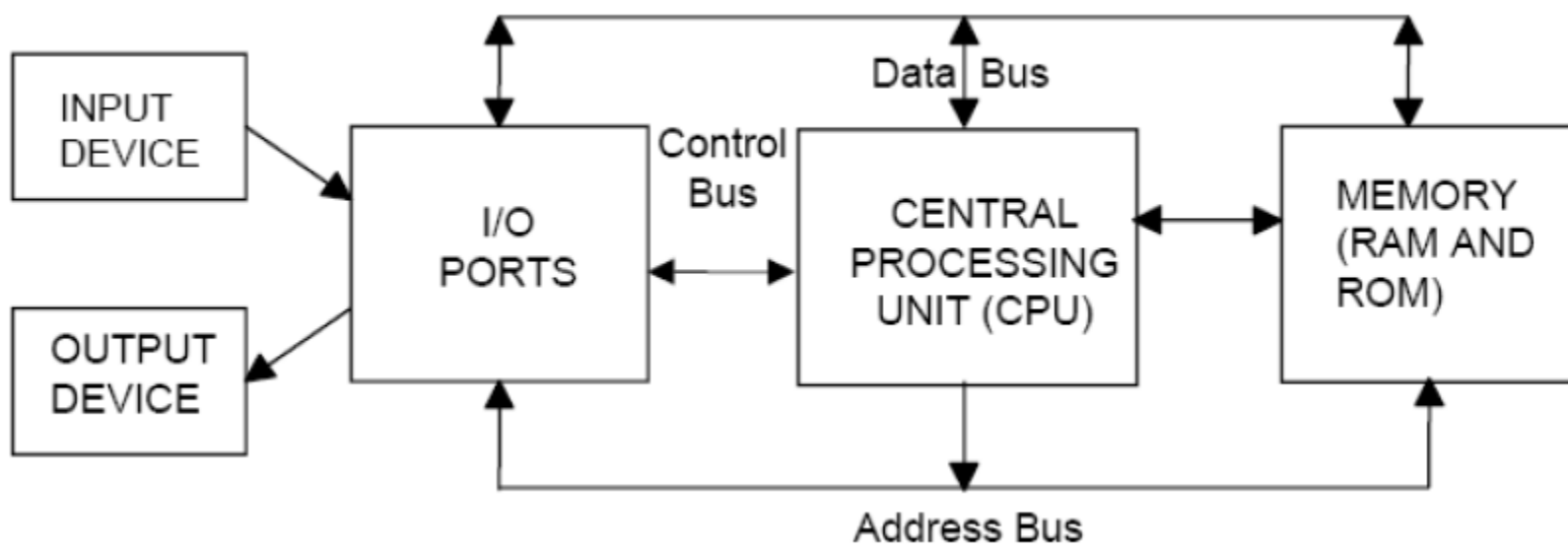
میکروکنترلرها

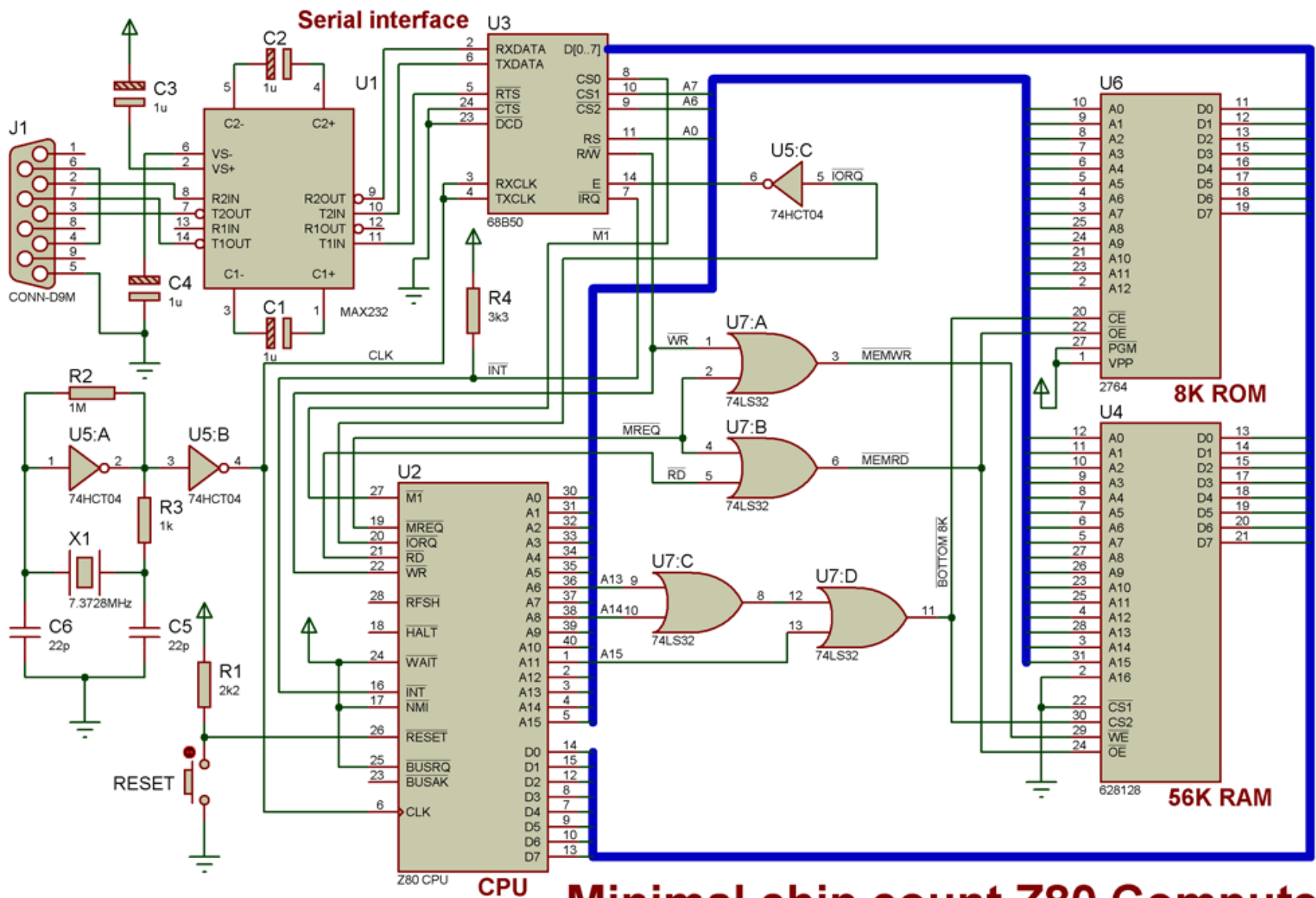
خانواده AVR

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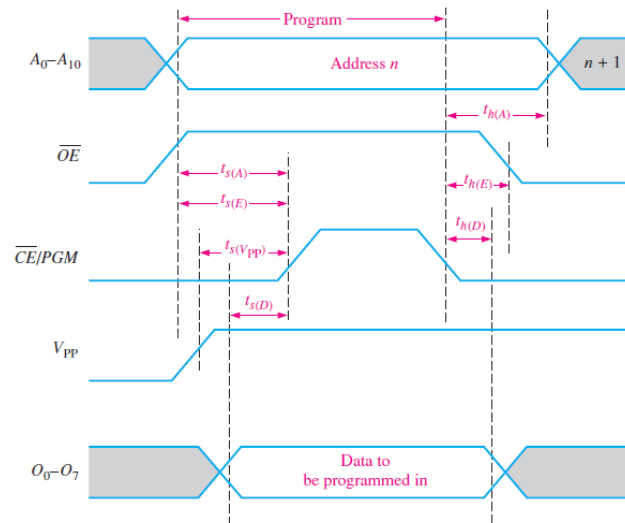
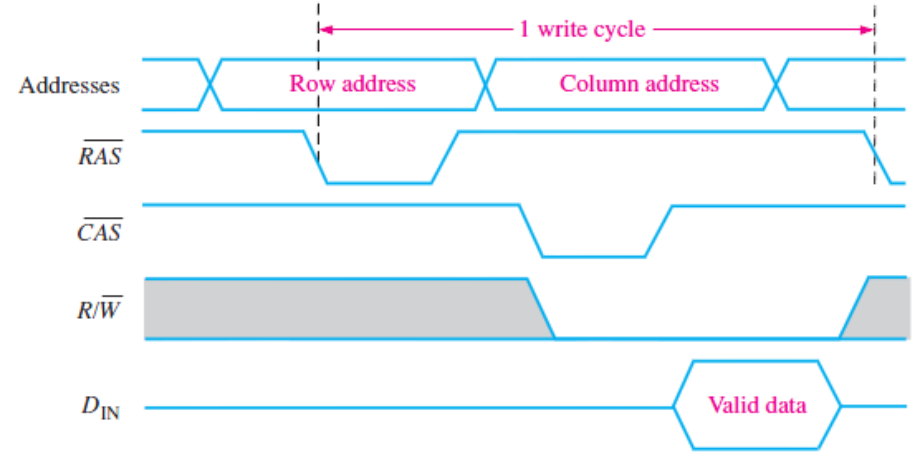
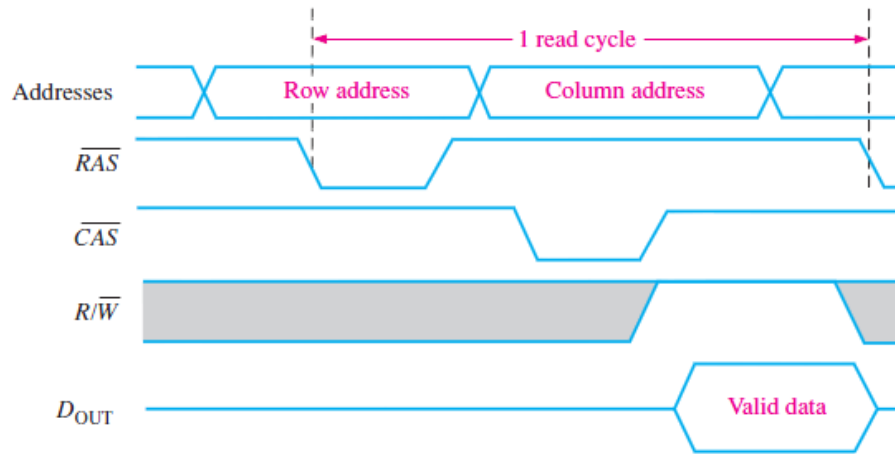


ساختار یک سیستم کامپیوتری





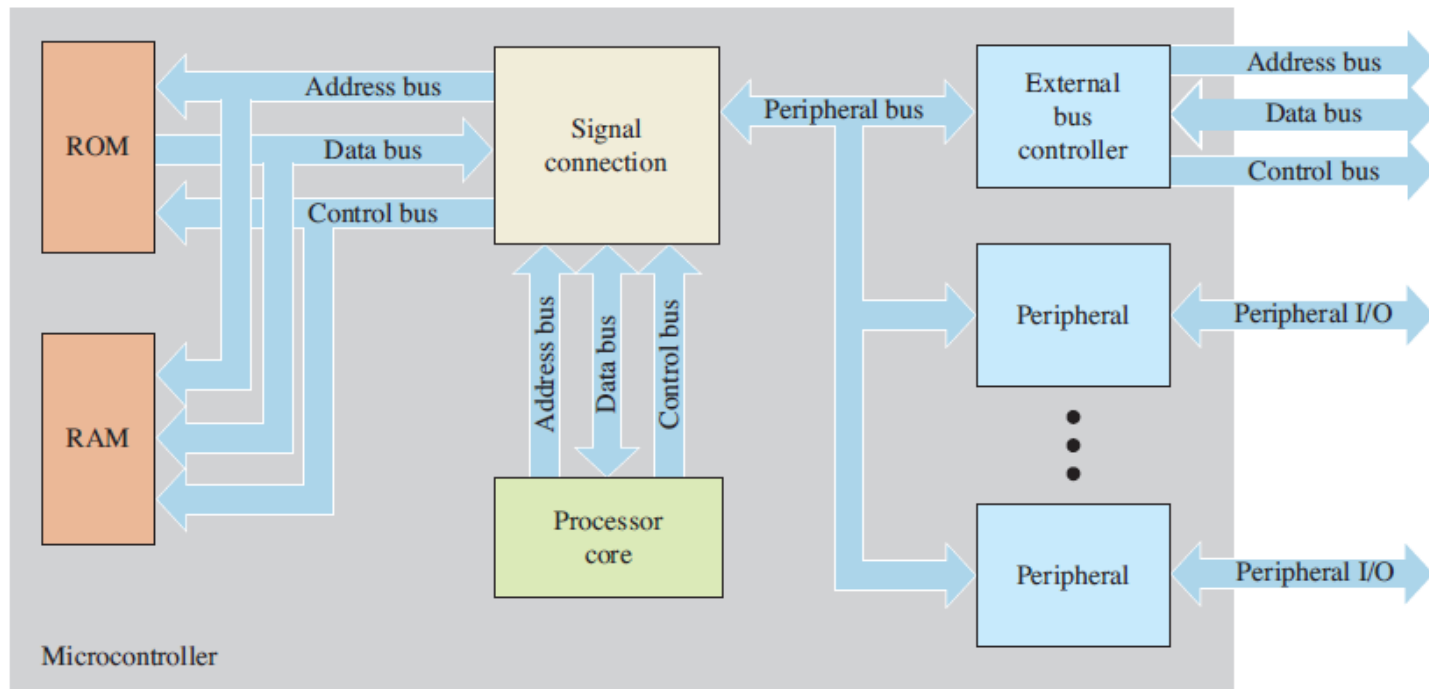
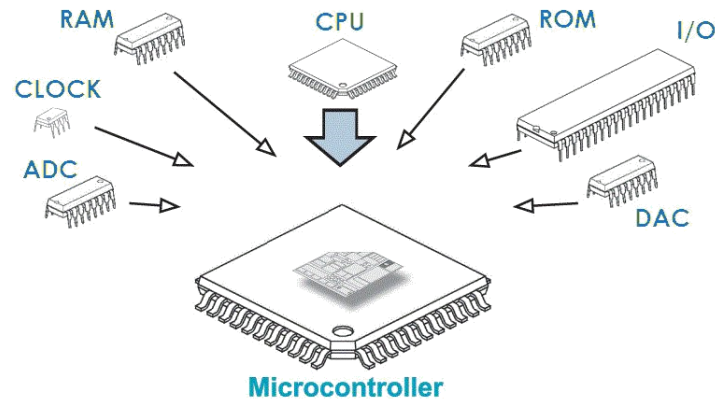
زمانبندی‌های دقیق



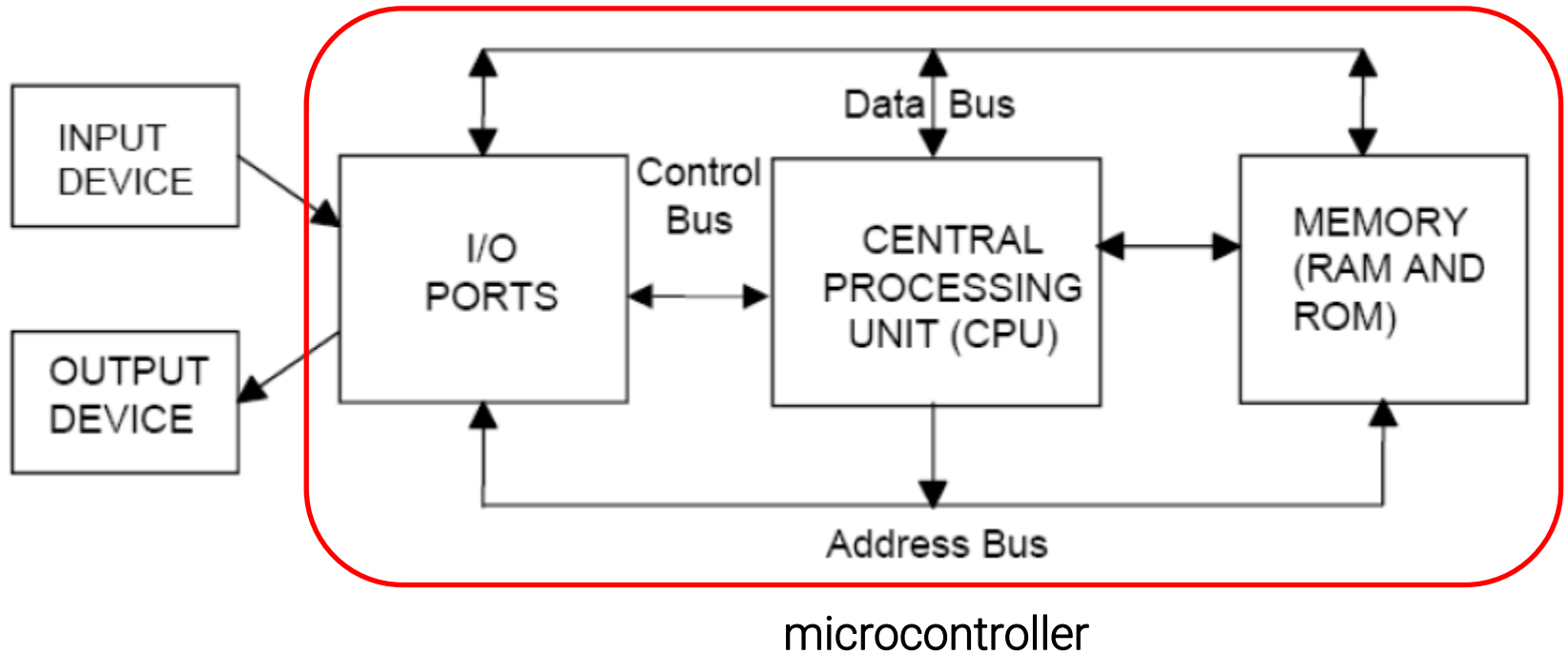
پردازش داده‌های دنیای واقعی

- Although a general-purpose microprocessor can interface with a variety of devices over its system buses
 - Its ability to interface with the real world is limited
- To process real world information, must use
 - Analog-to-digital converters (ADCs)
 - Digital-to-analog converters (DACs)
 - Universal asynchronous receiver and transmitter (UARTs)
 - External timers
 - Peripheral interface adaptors
 - Other specialized peripherals

میکروکنترلر



میکروکنٹرلر



The diagram illustrates the internal architecture of an AVR microcontroller. At the top, the **UPDI** (Universal Peripheral Device Interface) and **CPU** (Central Processing Unit) are shown. The **UPDI** is connected to **UPDI/RESET** and **To detectors**. The **CPU** is connected to **UPDI**, **CRC** (Cyclic Redundancy Check), **ODD** (Oscillator Drive Duty), and **Flash**. The **Flash** is connected to **EEPROM** and **NVMCTRL** (Non-Volatile Memory Control). The **Flash** and **EEPROM** are connected to the **BUS Matrix**. The **BUS Matrix** is connected to **SRAM** (Static Random Access Memory) and **PORTS** (I/O Ports). The **BUS Matrix** is also connected to the **DATA BUS** and **ADDRESS BUS**. The **DATA BUS** is connected to **GP I/O R** (General Purpose I/O Register), **CPU INT** (CPU Interrupt), **System Management** (containing **RSTCTRL**, **CLKCTRL**, and **SLEEPCTRL**), **WDT** (Watchdog Timer), **RTC** (Real-Time Counter), and **EVSYSYS** (Event System). The **ADDRESS BUS** is connected to **AC0** (Analog Comparator), **DAC0** (Digital-to-Analog Converter), **ADC0** (Analog-to-Digital Converter), **CCL** (Circuit Configuration Library), **TCA0** (Timer/Counter), **TCB0** (Timer/Counter), **TCD0** (Timer/Counter), **USART0** (Universal Serial Asynchronous Receiver/Transmitter), **SPI0** (Serial Peripheral Interface), and **TWI0** (Two-Wire Interface). The **DATA BUS** is connected to **AC0**, **DAC0**, **ADC0**, **CCL**, **TCA0**, **TCB0**, **TCD0**, **USART0**, **SPI0**, and **TWI0**. The **DATA BUS** is also connected to the **Detectors/references** block, which contains **RST** (Reset), **POR** (Power-On Reset), **Bandgap**, **BOD** (Brown-Out Detector), and **VLM** (Voltage Level Monitor). The **Detectors/references** block is connected to the **DATA BUS** and **FA[7:0]** (Fault Address). The **DATA BUS** is also connected to the **Clock generation** block, which contains **OSC20M** (20 MHz Oscillator), **OSC32K** (32 kHz Oscillator), and **XOSC32K** (32 kHz External Oscillator). The **Clock generation** block is connected to the **DATA BUS** and **CLKOUT** (Clock Output), **EXTCLK** (External Clock), **TOSC1** (On-Chip Oscillator), **TOSC2** (On-Chip Oscillator), and **EVOUT[7:0]** (Event Output).



خانواده‌های مختلف میکروکنترلر

• خانواده‌های:

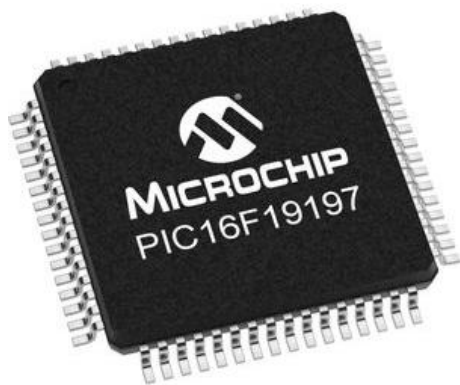
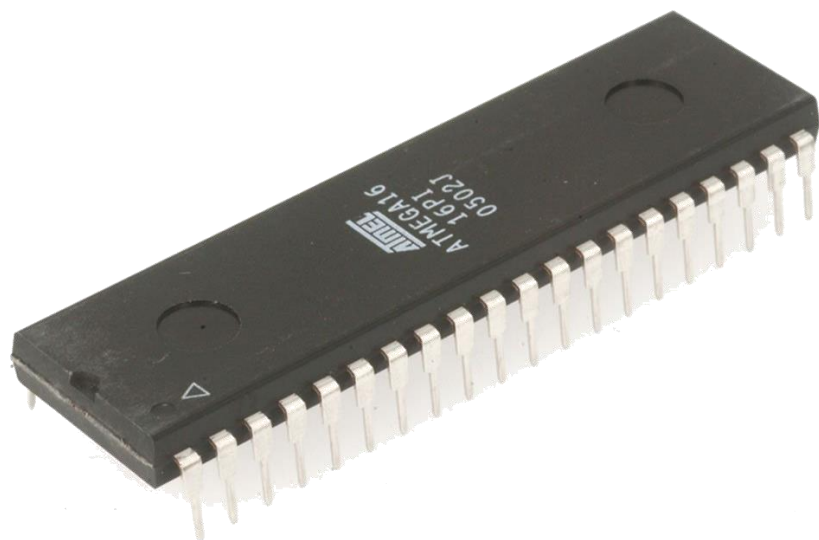
PIC •

ARM •

8051 •

AVR •


MSP •



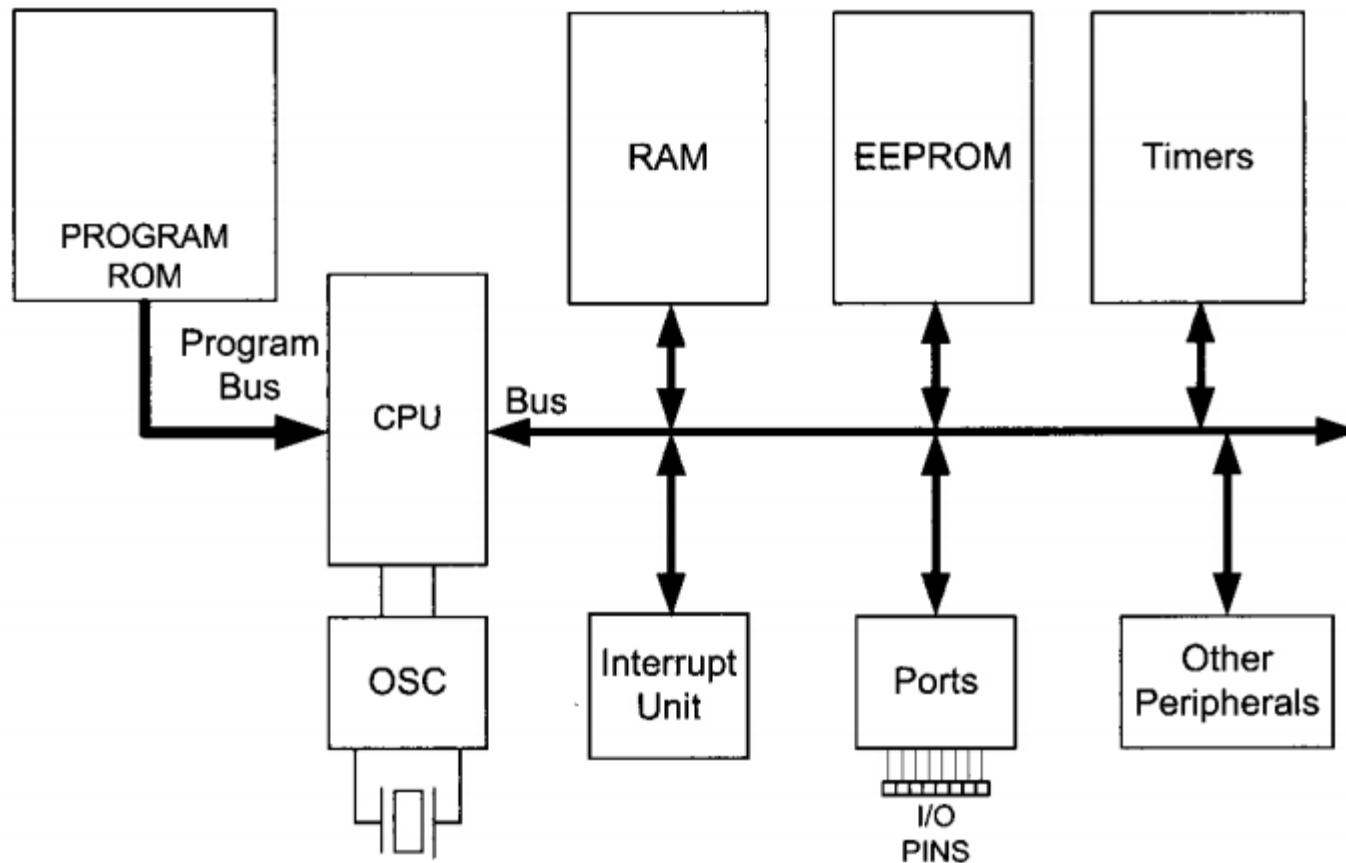
تاریخچه میکروکنترلر AVR

- معماری اولیه AVR توسط دو دانشجوی موسسه فناوری نروژ طراحی و سپس در سال 1996 توسط شرکت Atmel خریداری و توسعه داده شد.
- به استثنای AVR32 که 32 بیتی است، بقیه AVRها همگی 8 بیتی هستند.
- یکی از مشکلات سری AVR این است که از لحاظ نرمافزاری از یکسری به سری دیگر سازگار نیستند.
- چهار دسته اصلی
 - Classic AVR
 - Mega
 - Tiny
 - Special Purpose AVR

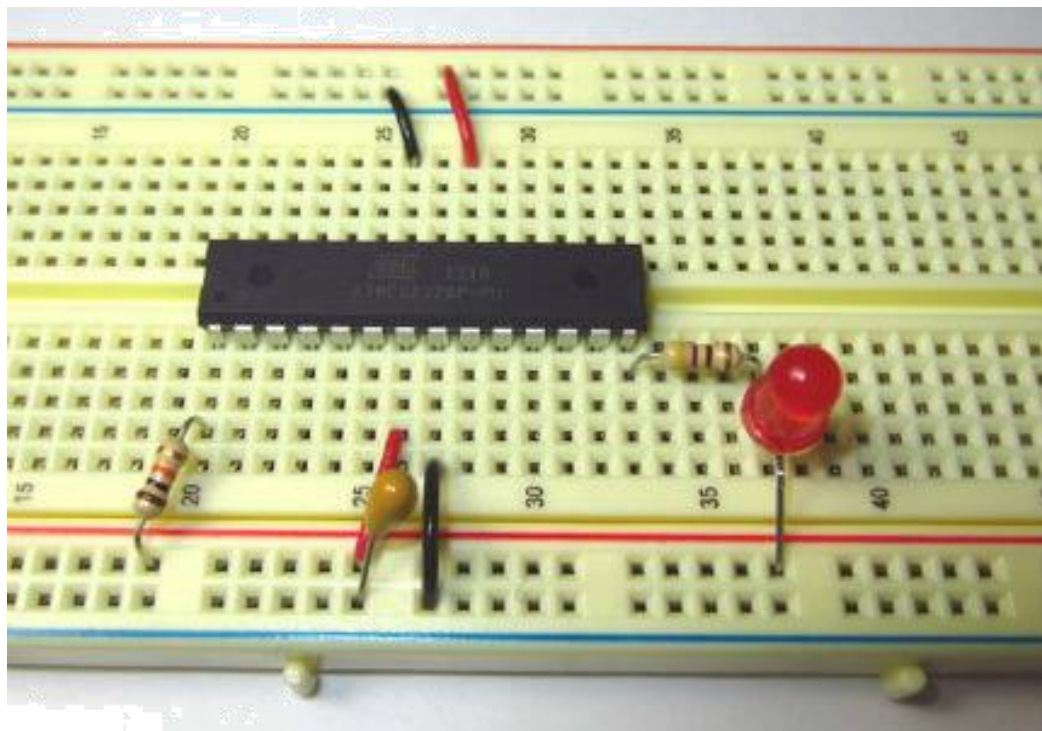
مشخصات AVR

- AVR یک میکروکنترلر با معماری RISC (کامپیوتر با مجموعه دستورات کم) و از نوع هاروارد است
- امکانات استاندارد از قبیل:
 - ROM برنامه (کد)
 - RAM داده
 - EEPROM داده 
 - تایمرها
 - پورت‌های I/O داخلی

نمای ساده از AVR

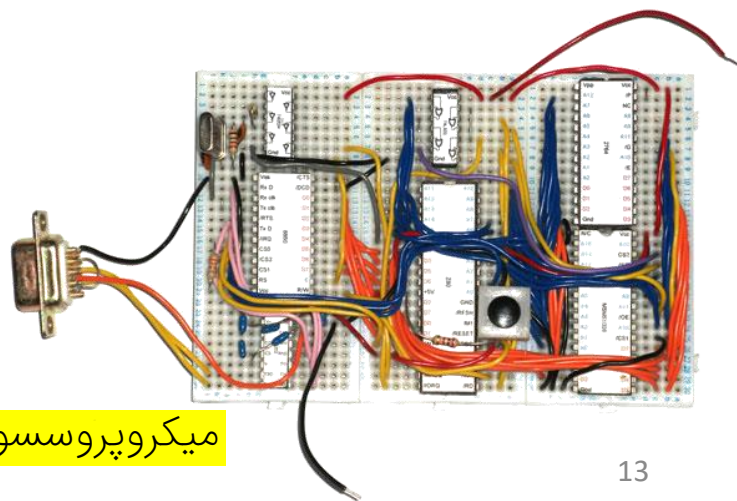


حداقل مدارات لازم برای راه اندازی AVR



میکروکنترلر

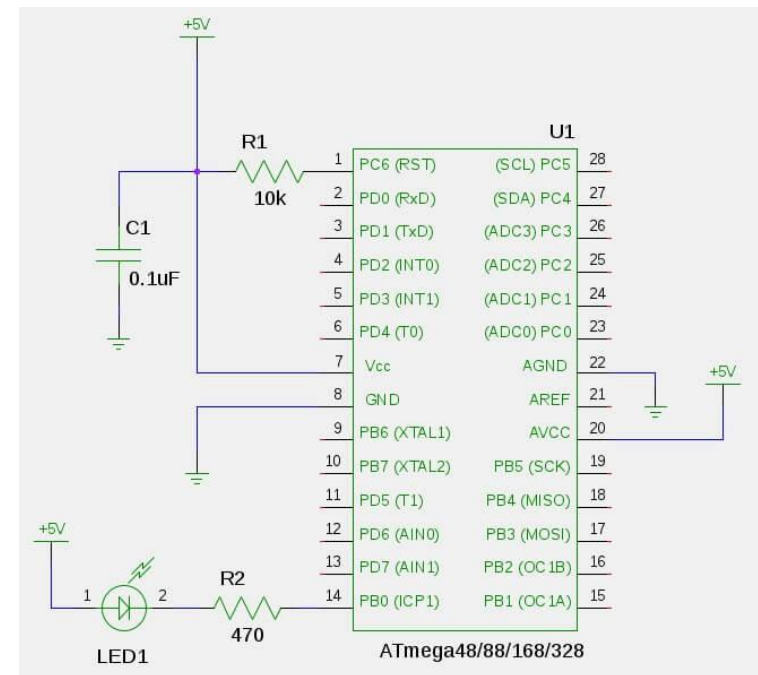
انبوه سیم‌کشی‌های لازم برای راه‌اندازی میکروپروسسور در مقابل حداقل سیم‌کشی‌های لازم برای راه‌اندازی میکروکنترلر!!



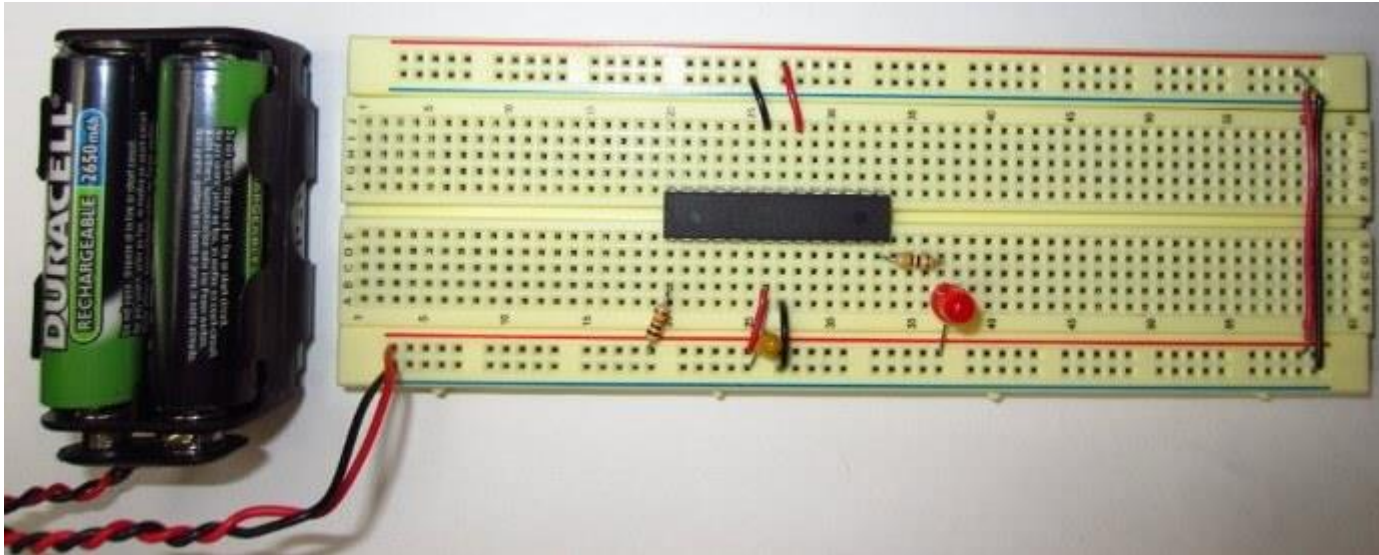
میکروپروسسور

حداقل مدارات لازم برای راه اندازی AVR

- A $10\text{k}\Omega$ "pull-up resistor" (R1) is connected to the RESET pin to keep the pin in a digital high state
- A 470Ω resistor (R2) and an LED (LED1) are connected to pin PB0
 - The resistor is a "current limiting" resistor to limit the current (mA) passing through the LED so that it doesn't burn out
 - When PB0 goes low (0V) the LED will turn on
 - When PB0 goes high (+5V) the LED turns off
- A $0.1\mu\text{F}$ "bypass capacitor" (C1) helps prevent noise or "ripple" on the +5V line from effecting the microcontroller

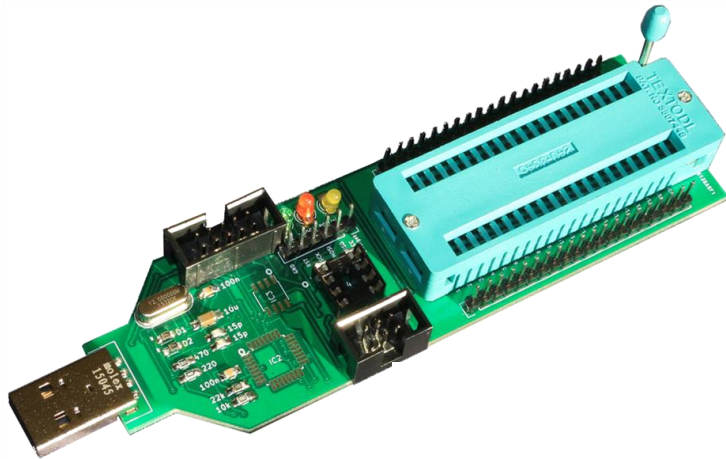


does not work!



کد برنامه باید توسط یک پروگرامر بر روی حافظه میکروکنترلر بارگذاری شود!

AVR programmer

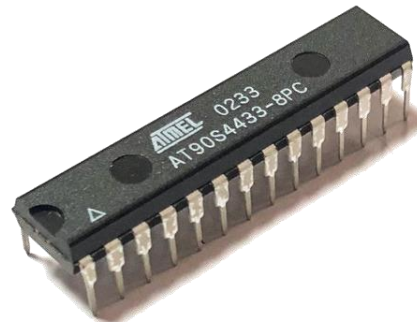


Classic AVR

- Classic AVR (AT90Sxxxx)
 - This is the original AVR chip
 - Has been replaced by newer AVR chips
 - These are not recommended for new designs

Some Members of the Classic Family

Part Num	Code ROM	Data RAM	Data EEPROM	I/O pins pins	ADC	Timers	Pin numbers & Package
AT90S2313	2K	128	128	15	0	2	SOIC20,PDIP20
AT90S2323	2K	128	128	3	0	1	SOIC8,PDIP8
AT90S4433	4K	128	256	20	6	2	TQFP32,PDIP28



Mega AVR

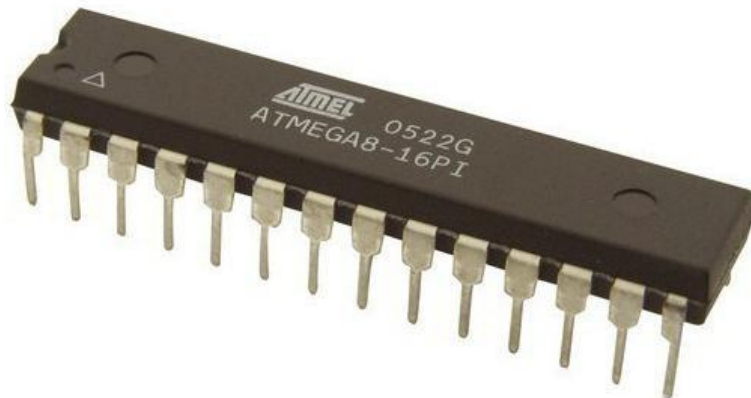


- Mega AVR (ATmegaxxxx)
 - These are powerful microcontrollers with more than 120 instructions and lots of different peripheral capabilities, which can be used in different designs.
- Some of their characteristics are as follows:
 - Program memory: 4K to 256K bytes
 - Package: 28 to 100 pins
 - Extensive peripheral set
 - Extended instruction set: They have rich instruction sets.

Mega AVR

Some Members of the Mega Family

Part Num	Code ROM	Data RAM	Data EEPROM	I/O pins pins	ADC	Timers	Pin numbers & Package
ATmega8	8K	1K	0.5K	23	8	3	TQFP32,PDIP28
ATmega16	16K	1K	0.5K	32	8	3	TQFP44,PDIP40
ATmega32	32K	2K	1K	32	8	3	TQFP44,PDIP40
ATmega64	64K	4K	2K	54	8	4	TQFP64,MLF64
ATmega1280	128K	8K	4K	86	16	6	TQFP100,CBGA



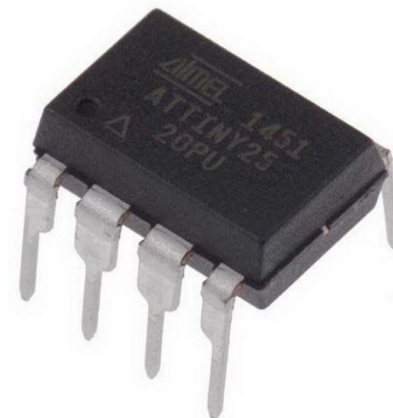
Tiny AVR

- Tiny AVR (ATtinyxxxx)
 - This group have less instructions and smaller packages in comparison to mega family. You can design systems with low costs and power consumptions using the Tiny AVR.
- Some of their characteristics are as follows:
 - Program memory: 1K to 8K bytes
 - Package: 8 to 28 pins
 - Limited peripheral set
 - Limited instruction set
 - For example, some of them do not have the multiply instruction

Tiny AVR

Some Members of the Tiny Family

Part Num	Code ROM	Data RAM	Data EEPROM	I/O pins pins	ADC	Timers	Pin numbers & Package
ATtiny13	1K	64	64	6	4	1	SOIC8,PDIP8
ATtiny25	2K	128	128	6	4	2	SOIC8,PDIP8
ATtiny44	4K	256	256	12	8	2	SOIC14,PDIP14
ATtiny84	8K	512	512	12	8	2	SOIC14,PDIP14



Special Purpose AVR

- Special purpose AVR
 - The ICs of this group can be considered as a subset of other groups
 - Their special capabilities are made for designing specific applications
 - Some of the special capabilities are:
 - USB controller
 - CAN controller
 - LCD controller
 - Zigbee
 - Ethernet controller
 - FPGA
 - Advanced PWM

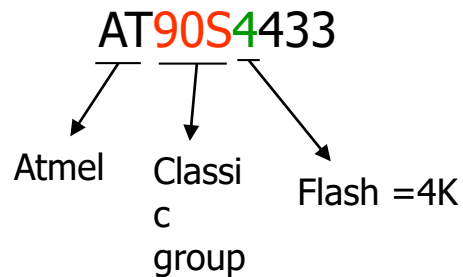
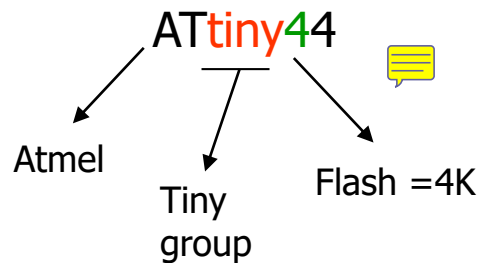
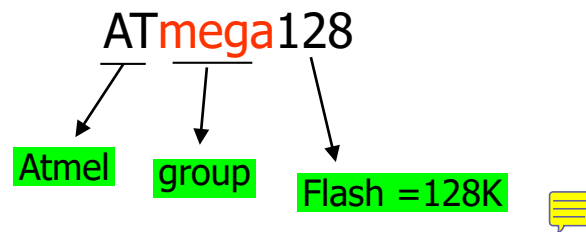
Special Purpose AVR

Some Members of the Special purpose Family

Part Num	Code ROM	Data RAM	Data EEPROM	Max I/O pins	Special Capabilities	Timers	Pin numbers & Package
AT90CAN128	128K	4K	4K	53	CAN	4	LQFP64
AT90USB1287	128K	8K	4K	48	USB Host	4	TQFP64
AT90PWM216	16K	1K	0.5K	19	Advanced PWM	2	SOIC24
ATmega169	16K	1K	0.5K	54	LCD	3	TQFP64,MLF64

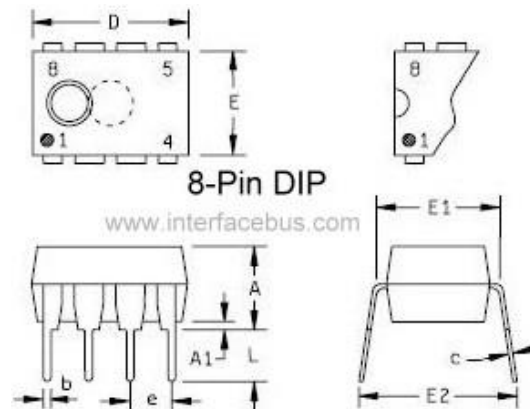


AVR part numbers



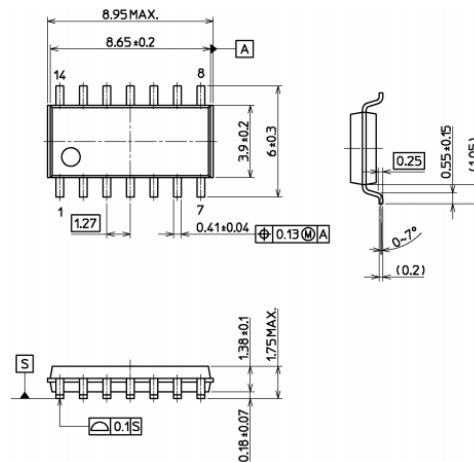
Packages

- Dual In-line Package (DIP)
 - Plastic DIP (PDIP)
 - To keep the cost low
 - Plastic does not protect an IC from higher humidity conditions as does Ceramic packages
 - Ceramic DIP (CDIP)
 - Military designs would use ceramic packages
 - It is rectangular in shape and has leads extending from both sides along its length, thus forming two sets of in-line pins.



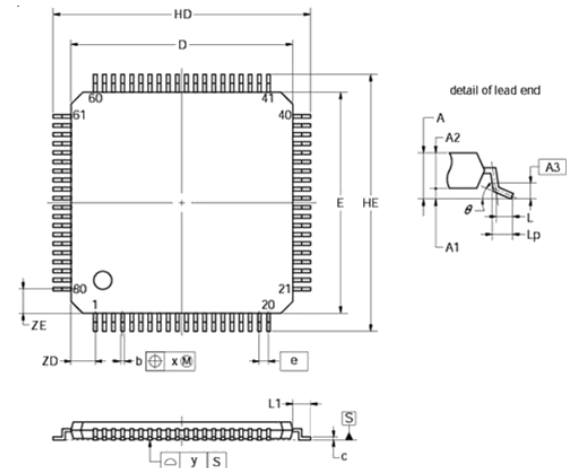
Packages

- Small outline integrated circuit (SOIC)
 - Occupies an area about 30–50% less than an equivalent dual in-line package (DIP)
 - Typical thickness being 70% less
 - Generally available in the same pin-outs as their counterpart DIP ICs
 - The convention for naming the package is SOIC or SO followed by the number of pins
 - For example, 14-pin 4011 would be housed in an SOIC-14 or SO-14 package



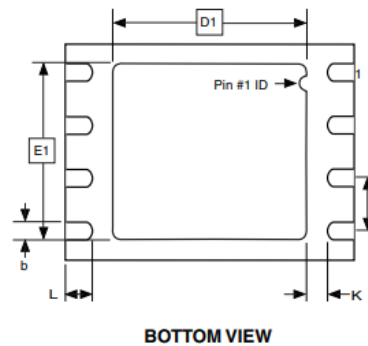
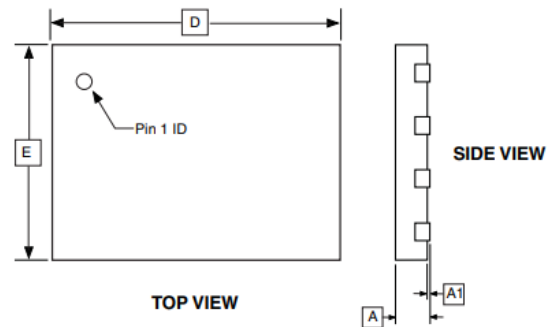
Packages

- Quad flat package (QFP)
 - Metric quad flat package (MQFP)
 - Low-profile QFP (LQFP)
 - Thin QFP (TQFP)
- consists of a rectangular package a few millimetres thick. The package may be square with the same number of pins emanating from each edge or rectangular with different numbers of pins on each pair of sides
- solve issues such as increasing board density
 - high numbers of interconnections



Packages

- Micro lead frame (MLF)

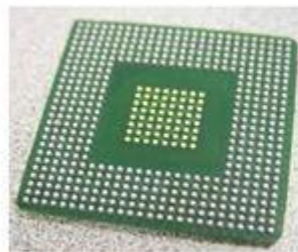


COMMON DIMENSIONS
(Unit of Measure = mm)

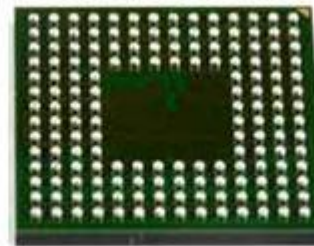
SYMBOL	MIN	NOM	MAX	NOTE
A	—	—	1.00	
A1	—	—	0.05	
b	0.35	0.40	0.48	
D	7.90	8.00	8.10	
D1	6.30	6.40	6.50	
E	5.90	6.00	6.10	
E1	4.70	4.80	4.90	
e	1.27			
L	0.45	0.50	0.55	
K	0.30 REF			

Packages

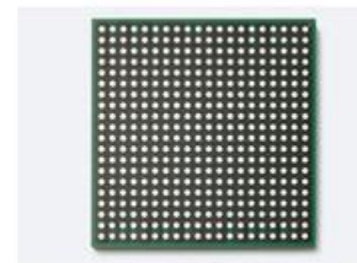
- Ceramic ball grid array (CBGA)
 - Can provide more interconnection pins than can be put on a dual in-line or flat package.
 - The whole bottom surface of the device can be used, instead of just the perimeter.



Staggered Type BGA



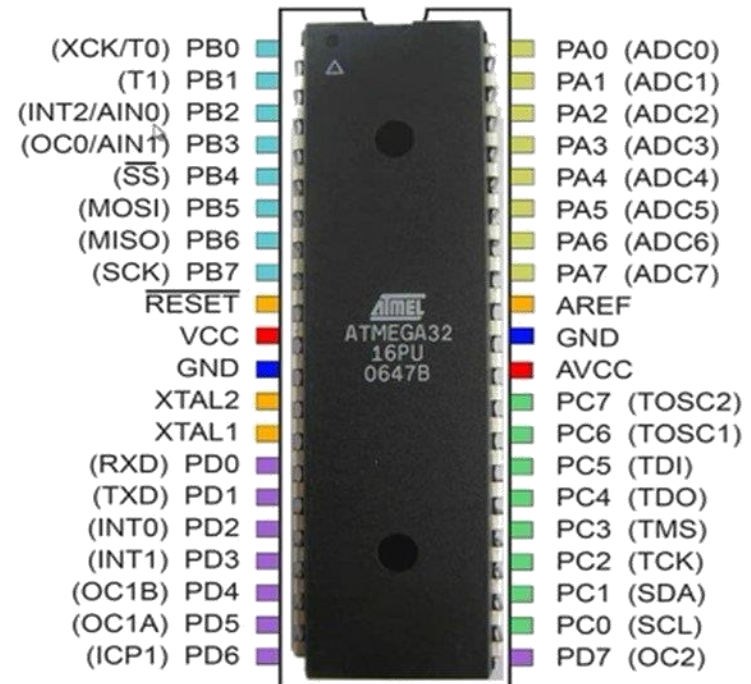
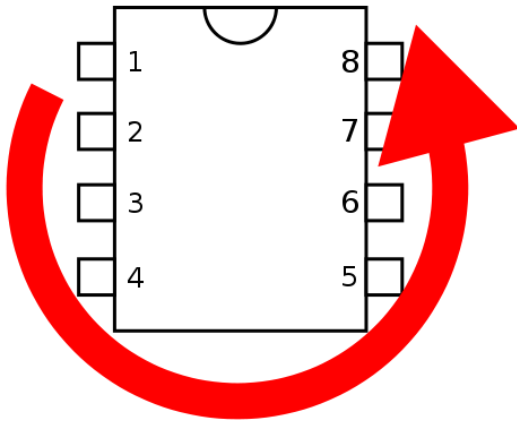
Peripheral Type BGA



Full Array Type BGA

شماره گذاری پایه ها

- The AVR chip have a **little notch** at one end to designate the "top".
- The pin numbering **starts at 1** on the top left, progress sequentially down the left side, and then back up the right side as shown in the schematic above.



پایان

موفق و پیروز باشید