

Report about MicroController families and brands

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- Introduction about Microcontrollers :

A **microcontroller (MC, UC, or μ C)** or **microcontroller unit (MCU)** is a small computer on a single integrated circuit.

A microcontroller contains one or more CPU (processor cores)

along with memory and programmable input/output peripherals. Microcontrollers are designed for embedded applications.

Microcontrollers are used for a specific purpose as in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, mobile devices , smart watches , office machines, appliances, power tools, toys, and an infinite number of embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make digital control of more devices and processes more practical and easier .

- Microcontrollers families and brands:

There are many different families of microcontrollers, each with its own unique features and capabilities. Here are some of the most popular microcontroller families:

1. **AVR:** AVR microcontrollers are produced by Atmel Corporation. These are modified Harvard architecture 8-bit RISC single-chip microcontrollers and are widely used in hobbyist , industrial applications and educational embedded applications. They are popular for their low power consumption, high performance, and ease of use.



It has many families that differ in no of pins , flash size , SRAM as we see :

1 - TinyAVR :

Flash size	Frequency [MHz]	Package	SRAM	EEPROM
0.5–32 KB	1.6–20	6–32-pin package	32–3072 bytes	64–512 bytes

2- MegaAVR :

Flash size	Frequency [MHz]	Package	SRAM	EEPROM
4–256 KB	1.6–20	28–100-pin package	256–16384 bytes	256–4096 bytes

3- AVR Dx

Flash size	Frequency [MHz]	Package	SRAM	EEPROM	Release year
16–128 KB	20–24 at 1.8–5.5 V	14–64-pin package	4–16 KB	512 bytes	2020

2. **PIC:** PIC microcontrollers are manufactured by **Microchip Technology**.

It has many families:

- 1- PIC10, PIC12, PIC16 (8-bit) which are Ideal for simple control tasks, home appliances, and automotive sensors.
- 2- PIC24 Series (16-bit): Suitable for motor control, industrial automation, and communication applications.
- 3- PIC32 Series(32-bit): Target high-performance needs in networking, IoT, and advanced industrial applications.



They are also known for their low cost, low power consumption, and ease of use.

3. **ARM: Advanced RISC Machines** microcontrollers is a family of RISC instruction set architectures are produced by ARM Holdings that develops the ISAs and licenses them to other companies, and are widely used in mobile devices, embedded systems, and other applications. They are known for their high performance, low power consumption, and versatility. ARM has many families for ex **ARM Cortex-M** (Microcontrollers)Series, **ARM Cortex-R** (Real Time) series, **ARM Cortex-A** (Application) Series.



4. **STM32:**

* STM32 microcontroller is a family of 32-bit are that is produced by **STMicroelectronics**, based on the ARM Cortex-M 32-bit processor core

* They offer many serial and parallel communication peripherals.

* it has many types: STM32F0 (Mainstream) , STM32U5 , STM32L5 , STM32L4+ (Ultra-low-power) .

* They are used in a wide range of applications, including industrial automation, consumer electronics, and IoT Applications. They are known for



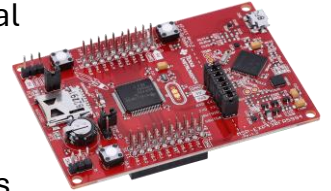
their high performance, low power consumption, and extensive range of peripherals.

5. **MSP430 :**

- * The MSP430 family of ultra-low-power 16-bit RISC mixed-signal processors from **Texas Instruments**.

- * TI has created the MSP430 family which enables system designers to simultaneously interface to analog signals, sensors and digital components while maintaining unmatched low power.

- * The MSP430 family is suitable for applications such as: Portable instrumentation— glucose meters, heart-rate monitors, thermometers, multi-meters, weight scales, Intelligent sensing— security systems, smoke detectors, electronic tags.



6. **8051:**

- * 8051 microcontroller is designed by **Intel** in 1981. It is an 8-bit microcontroller. It is a complex instruction set computer, but also has some of the features of RISC architectures. It is built with 40 pins DIP (dual inline package), 4kb of ROM storage and 128 bytes of RAM storage, 2 16-bit timers.



- * It is used in **Industrial Control Systems** specially Used in PLCs, **Touch screen, Medical Devices , Energy Management .**

7. **Arduino** microcontrollers:

- * They are produced by **Arduino LLC** and are widely used in hobbyist and educational applications. They are known for their ease of use, low cost, and extensive range of libraries and shields.



- * They offers some advantages: Inexpensive, Cross-platform, Simple, clear programming environment , Open source and extensible software

- * They have many types: Arduino Uno Rev3, Arduino Nano, Arduino Micro, Arduino Mega2560

- Comparison between PIC16F877A and TM4C123GH6PM:

The two microcontrollers belong to different families and have different features and here's a comparison between the two microcontrollers based on many areas.

(Architecture, Data Memory, Flash Memory , Operating Frequency , EEPROM Data Memory , I/O ports , no of timers, no of pins , Instruction Set , Computer Architecture , Power Consumption , Development Environment)

1- PIC16F877A:

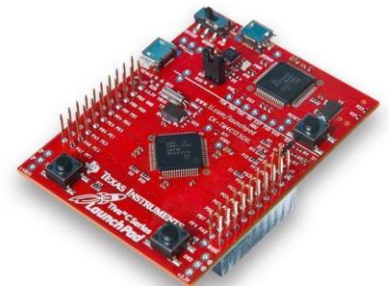
- * it is an 8-bit microcontroller manufactured by **Microchip** Technology.
- * it uses Harvard architecture, which means data stored on ram and program coding stored in rom
- * it has 368 bytes of RAM.
- * it has 8K Flash Program Memory.
- * it works on DC__ 20MHZ.
- * It has a smaller data bus (8-bits), that limits of data to 8 bits.
- * it has 256 bytes of EEPROM Data Memory.
- * it has 5 I/O ports (A , B , C , D ,E).
- * it has 3 timers.
- * it has 40 pins.
- * it has 2 instruction sets
- * power consumption is around 300-400uA
- * Programmed using MPLAB® X Integrated Development Environment



2- TM4C123GH6PM:

- * it is a 32-bit microcontroller manufactured by Texas Instruments.
- * it also uses Harvard architecture, which means data stored on ram and program coding stored in rom.

- * it has 32 KB of RAM
- * it has 256 KB single-cycle Flash memory.
- * It works on 80-MHz operation, 100 DMIPS performance.
- * it has larger data bus (32-bits) , allowing efficient processing of large data.
- * It has 2KB of EEPROM Data Memory.
- * it has 6 physical GPIO blocks (ports A, B,C,D,F,E)
- * Up to 43 GPIOs.
- *Thumb-2 mixed 16-/32-bit instruction set
- * Low power consumption but still higher than pic 16F877A
- * programmed using TivaWare and developed using IDEs like keil .



- Conclusion

the choice between the pic 16F877A and the TM4C123GH6PM depends on the what your project exactly needs . If you need a simple, lower cost, something for basic tasks , take the PIC16F877A. in contrast, if your project require more memory, higher performance, and more advanced peripherals, choose the TM4C123GH6PM .

- References

https://en.wikipedia.org/wiki/ARM_architecture_family

https://en.wikipedia.org/wiki/AVR_microcontrollers

<https://en.wikipedia.org/wiki/MCS-51>

<https://en.wikipedia.org/wiki/STM32#:~:text=The%20STM32%20H7%2Dseries%20is,M4F%20%2D%20up%20to%20240%20MHz.>

<https://www.ti.com/sc/docs/products/micro/msp430/msp430bulletin.pdf>

<https://www.peulic.com/about-microcontrollers/starting-with-microcontrollers/types-of-microcontrollers/families-of-microcontrollers/>

<https://www.alldatasheet.com/datasheet-pdf/view/115039/MICROCHIP/PIC16F877A.html>

https://www.ti.com/lit/ds/symlink/tm4c123gh6pm.pdf?ts=1729436564815&ref_url=https%253A%252F%252Fwww.ti.com%252Fproduct%252FTM4C123GH6PM