National Military University "Vasil Levski"

"Artillery, Air Defence and CIS" Faculty

Acronym: NMU

Address: 1 Karel Shkorpil str., P.O. Box 9700

City: Shumen

Country: BULGARIA

Co-funded by the Erasmus+ Programme of the European Union

National Military University "Vasil Levski"

NMU has two faculties – "Land Forces" Faculty and "Artillery, Air Defence and CIS" Faculty.

The "Artillery, Air Defence and CIS" Faculty in Shumen is involved in the EuCTS_DS project.

The faculty has seven departments:

- Field Artillery;
- Military Armament;
- Anti-aircraft defense;
- Computer systems and technologies;
- Communication networks and systems;
- Information security;
- Foreign language department.

Co-funded by the Erasmus+ Programme of the European Union

National Military University "Vasil Levski"

"Artillery, Air Defence and CIS" Faculty

The "Artillery, Air Defence and CIS" Faculty offers the following military specialties for a Bachelor degree:

- Field Artillery;
- Military Armament;
- Topo geodetic instrumental intelligence;
- Aircraft defense;
- Missile troops
- Radiolocation;
- Military communication and information systems.

Co-funded by the Erasmus+ Programme of the European Union

National Military University "Vasil Levski"

"Artillery, Air Defence and CIS" Faculty

The "Artillery, Air Defence and CIS" Faculty offers the following civil specialties for a Bachelor degree:

- Computer systems and technologies;
- Communication equipment and technologies;
- Cybersecurity;
- Administrative and information security;
- Computer aided design.

Co-funded by the Erasmus+ Programme of the European Union

National Military University "Vasil Levski"

"Artillery, Air Defence and CIS" Faculty

Scientific research for mechanical and aerospace engineering fields:

- Use of unmanned aerial vehicles for reconnaissance, surveillance and location of targets and objects in order to increase existing and acquire new capabilities in field artillery;
- Specialized software for research of the variation of the intraballistic parameters of artillery systems in the operation process;
- 82 mm multiple use training practical mine designed for short-range shooting and mortar crew training.

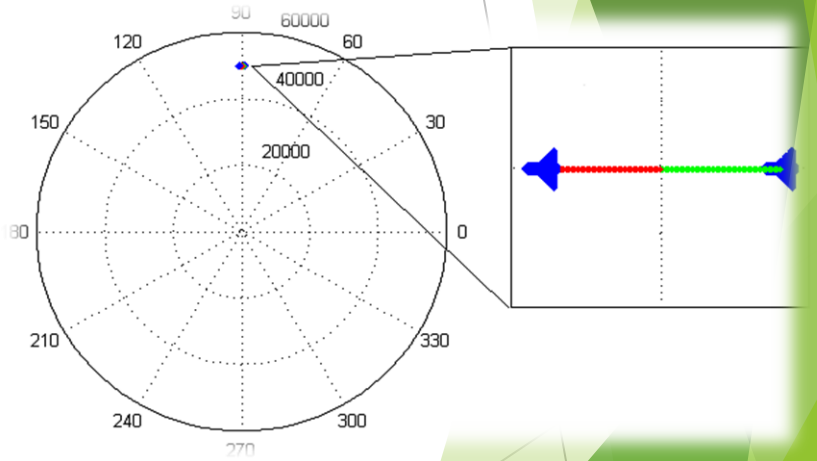
Co-funded by the Erasmus+ Programme of the European Union

National Military University "Vasil Levski"

"Artillery, Air Defence and CIS" Faculty

Scientific research for electrical engineering and computer science fields:

- Automatic system for inverse synthetic aperture radars image reconstruction and object identification;
- Complex with voice controlled devices;
- Mobile technological complex "Smart Home";
- An application of steganography methods for information hiding in communication and information systems of the Bulgarian army;
- A software system for scripting confidential information by combining cryptographic and stenographic methods;
- Improvement of the management systems of the National Military University" Vasil Levski".



Co-funded by the Erasmus+ Programme of the European Union

KA2 Project EUCTSDS
Electronic Engineering and Computer Science

TPM
BG NMU – Shumen
26.09.2022

Co-funded by the
Erasmus+ Programme
of the European Union

KA2 Project EUCTSDS
Electronic Engineering and Computer Science

Multiplier Event
BG NMU – Shumen
27.09.2022

Co-funded by the
Erasmus+ Programme
of the European Union

KA2 Project EUCTSDS
European Common Technical Semester for Defence and Security

No.	Subjects	ECTS
1	Applied Informatics	3
2	Applied Automation for Engineering Systems	3
3	Integrated Weapon Systems	3
4	CSDP for Technical Systems	3
5a	Computer Networks	3
6a	Programming Languages	3
7a	Signal Processing	3
8a	Microcontrollers	3
5b	Propulsion Systems	3
6b	Dynamic of Flight	3
7b	Mechanics and Material Science	3
8b	Computer-Aided-Design and Numerical Analysis	3
9	Interdisciplinary Scientific Project	6
10	Foreign Languages (Bulgarian/French/Greek/Polish/Romanian)	2
11	Physical Education and Sports	2
	TOTAL	34

Co-funded by the Erasmus+ Programme of the European Union

MICROCONTROLLERS

- A Microcontroller is a computer dedicated to a single task

- Fundamental components:

Central Processing Unit

Memory

System Clock (Oscillator)

Peripherals

MICROCONTROLLERS

PIC is a family of Harvard architecture microcontrollers made by Microchip Technology, originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to **"Programmable Interface Controller"**.

PICs are popular with both industrial developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability.

Core architecture: The PIC architecture is distinctively minimalist:

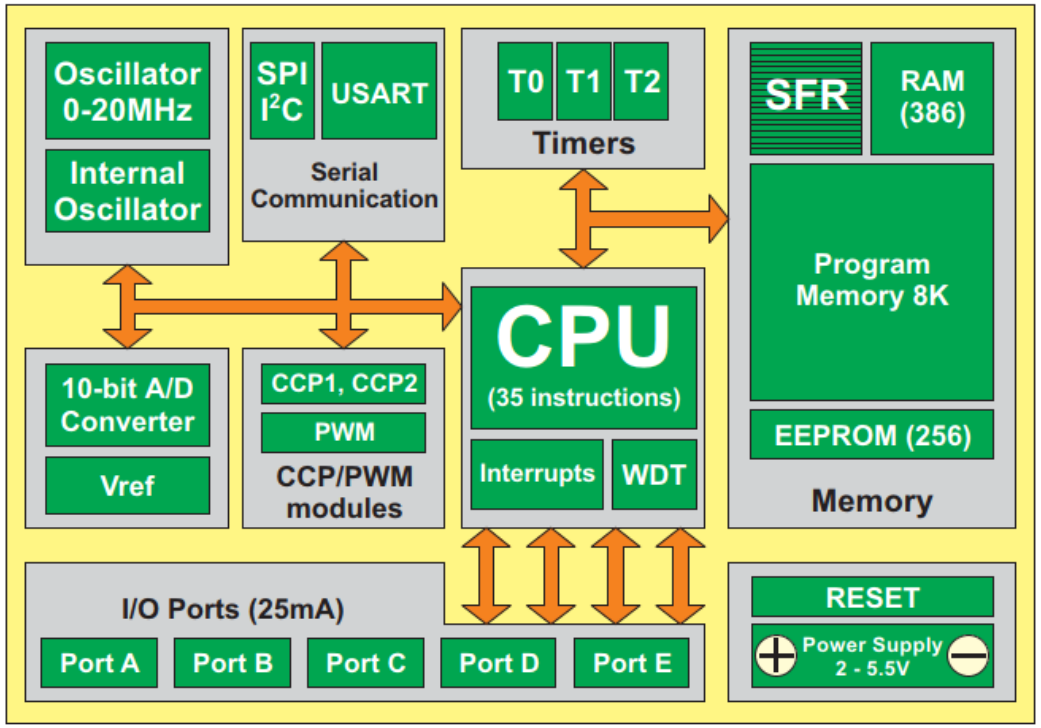
- Separate code and data spaces (Harvard architecture)
- A small number of fixed length instructions
- Most instructions are single cycle execution (4 clock cycles), with single delay cycles upon branches and skips
- A single accumulator (W), the use of which (as source operand) is implied (i.e. is not encoded in the opcode)
- All RAM locations function as registers as both source and/or destination of math and other functions
- A hardware stack for storing return addresses
- A fairly small amount of addressable data space (typically 256 bytes), extended through banking
- Data space mapped CPU, port, and peripheral registers
- The program counter is also mapped into the data space and writable (this is used to implement indirect jumps).

Instruction set: A PIC's instructions vary from about 35 instructions for the low-end PICs to over 80 instructions for the high-end PICs. The instruction set includes instructions to perform a variety of operations on registers directly, the accumulator and a literal constant or the accumulator and a register, as well as for conditional execution, and program branching.

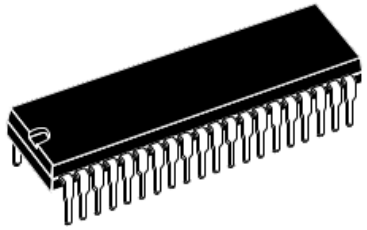
MICROCONTROLLERS

Family	ROM [Kbytes]	RAM [bytes]	Pins	Clock [MHz]	A/D Inputs	A/D Resolution	Comparators	8/16-bit Timers	Serial Communications	PWM Outputs	Others
Base-Line 8-bit architecture, 12-bit Instruction Word Length											
PIC10Fxxx	0.375-0.75	16-24	6-8	4-8	0-2	8	0-1	1 x 8	-	-	-
PIC12Fxxx	0.75-1.5	25-38	8	4-8	0-3	8	0-1	1 x 8	-	-	EEPROM
PIC16Fxxx	0.75-3	25-134	14-44	20	0-3	8	0-2	1 x 8	-	-	EEPROM
PIC16HVxxx	1.5	25	18-20	20	-	-	-	1 x 8	-	-	Vdd=15V
Mid-Range 8-bit architecture, 14-bit Instruction Word Length											
PIC12Fxxx	1.75-3.5	64-128	8	20	0-4	10	1	1-2 x 8, 1 x 16	-	0-1	EEPROM
PIC12HVxxx	1.75	64	8	20	0-4	10	1	1-2 x 8, 1 x 16	-	0-1	-
PIC16Fxxx	1.75-14	64-368	14-64	20	0-13	8 or 10	0-2	1-2 x 8, 1 x 16	USART, I2C, SPI	0-3	-
PIC16HVxxx	1.75-3.5	64-128	14-20	20	0-12	10	2	2 x 8, 1 x 16	USART, I2C, SPI	-	-
High-End 8-bit architecture, 16-bit Instruction Word Length											
PIC18Fxxx	4-128	256-3936	18-80	32-48	4-16	10 or 12	0-3	0-2 x 8, 2-3 x 16	USB 2.0, CAN 2.0, USART, I2C, SPI	0-5	-
PIC18FxxJxx	8-128	1024-3936	28-100	40-48	10-16	10	2	0-2 x 8, 2-3 x 16	USB 2.0, CAN 2.0, Ethernet, I2C, SPI	2-5	-
PIC18FxxKxx	8-64	768-3936	28-44	64	10-13	10	2	1 x 8, 3 x 16	USART, I2C, SPI	2	-

MICROCONTROLLERS



PIC 16F887



RISC architecture
- 35 instructions
- All single-cycle instructions (4 clock cycles) except branches and skips
- One accumulator (W)

Operating frequency 0-20 MHZ

Precision internal oscillator
- Factory calibrated
- Software selectable frequency range of 8MHz to 31KHz

Power supply voltage 2.0-5.5V
- Consumption: 220uA (2.0V, 4MHz), 11uA (2.0 V, 32 KHz) 50nA (stand-by mode)

Power-Saving Sleep Mode
Brown-out Reset with software control option

35 input/output pins
- High current source/sink for direct LED drive
- software and individually programmable pull-up resistor
- Interrupt-on-Change pin

8K ROM memory in FLASH technology
- Chip can be reprogrammed up to 100.000 times

256 bytes EEPROM memory
- Data can be written more than 1.000.000 times

368 bytes RAM memory

A/D converter:
- 14-channels
- 10-bit resolution

3 independent timers/counters
Watch-dog timer

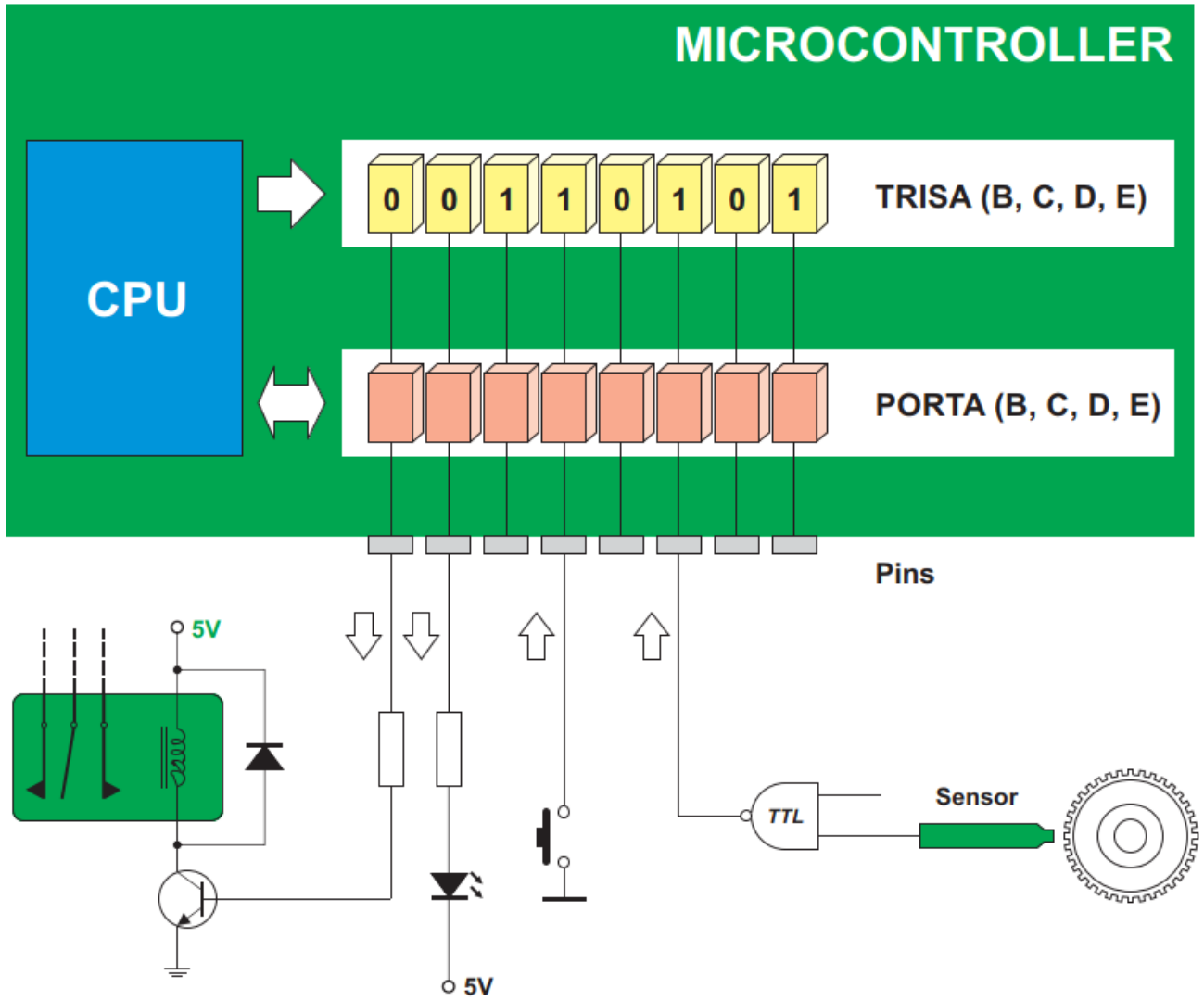
Analogue comparator module with
- Two analogue comparators
- Fixed voltage reference (0.6V)
- Programmable on-chip voltage reference

PWM output steering control

Enhanced USART module
- Supports RS-485, RS-232 and LIN2.0
- Auto-Baud Detect

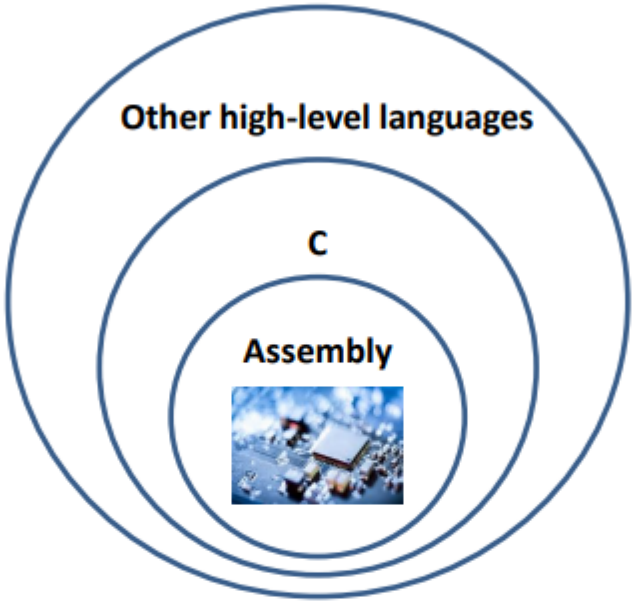
Master Synchronous Serial Port (MSSP)
- supports SPI and I2C mode

MICROCONTROLLERS

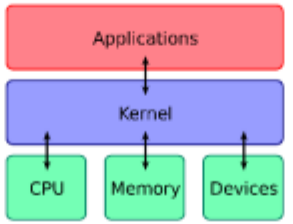


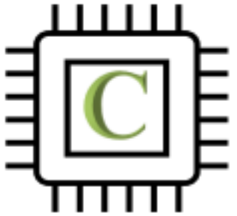
The C programming language

- The C programming language has some characteristics that make it a bridge between machine language and high-level languages. Hence, one can use C for both general purpose programs (e.g., *Doom*, *git*) and system programs (e.g., *the Linux kernel*, *device drivers*)



- It widely used in **embedded systems** (automotive, communications, radars etc.)





SIGNAL PROCESSING

- Definitions and Some Properties
- The Matlab Functions rand, randn, awgn, fft and ifft
- Example1: DTFT and DFT of a Finite-Duration Signal
- Example2: FFT of Sinusoidal Signal with DC Offset
- Example3: Magnitude Spectrum Representations
- Example4: Spectrum of Unit-Impulse and Unit-Step Functions
- Example5: Signal with Two Frequencies and Noise
- Example6: Power Spectrum and Parseval's Theorem
- Spectrum Leakage
- Example7: FFT size not equal to the signal length
- Example8: Signal length non-integer multiple of signal period
- Example9: Windowing for reducing spectral leakage

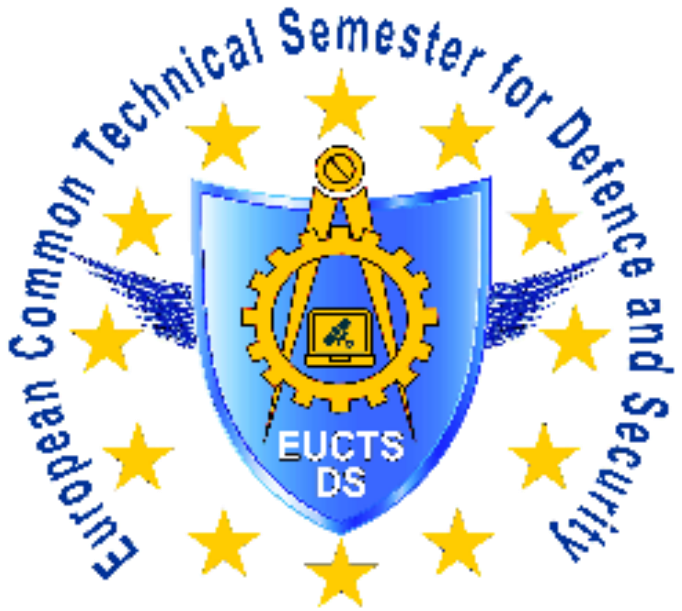
Co-funded by the

KA2 Project EUCTSDS
Electronic Engineering and Computer Science

LTTA
BG NMU – Shumen
28.09 – 02.10.2022

Co-funded by the
Erasmus+ Programme
of the European Union

KA2 Project EUCTSDS
Electronic Engineering and Computer Science



Co-funded by the
Erasmus+ Programme
of the European Union