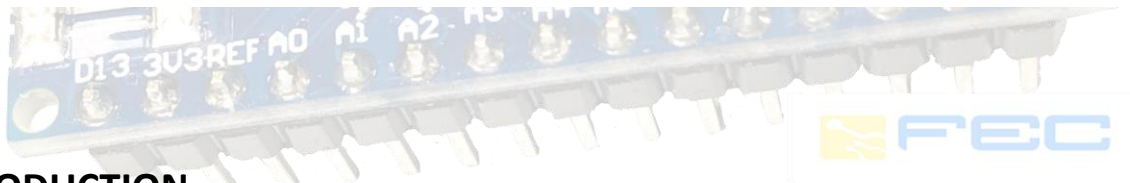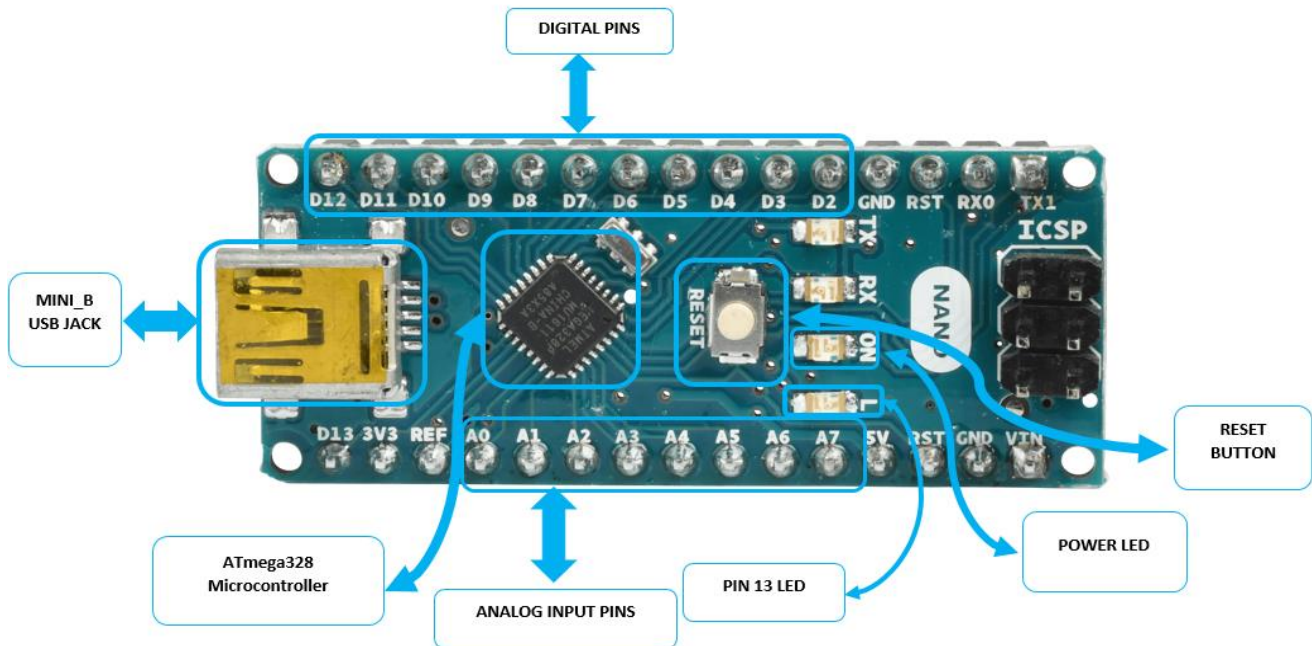# ARDUINO NANO

INTRODUCTION

Arduino nano differ from other Arduino as it very small so it suitable for small sized projects and it supports breadboards so it can be plugged with other components in only one breadboard.

ARDUINO NANO PHYSICAL COMPONENTS

Microcontroller

In Arduino Nano 2.x version, still used ATmega168 microcontroller while the Arduino Nano 3.x version already used ATmega328 microcontroller.

ATmega168 Microcontroller

ATmega168 is a low-power CMOS 8-bit microcontroller based on the AVR® enhanced RISC architecture. And its features as follow:

- **High Performance, Low Power Atmel®AVR® 8-Bit Microcontroller Family**
- **Advanced RISC Architecture**
  - 131 Powerful Instructions
  - Most Single Clock Cycle Execution
  - 32 x 8 General Purpose Working Registers
  - Fully Static Operation
  - Up to 20 MIPS Throughput at 20MHz
  - On-chip 2-cycle Multiplier

• **High Endurance Non-volatile Memory Segments**

  - 4K/8K/16KBytes of In-System Self-Programmable Flash Program Memory
  - 256/512/512Bytes EEPROM
  - 512/1K/1KBytes Internal SRAM
  - Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
  - Data Retention: 20 years at 85°C/100 years at 25°C
  - Optional Boot Code Section with Independent Lock Bits

- **In-System Programming by On-chip Boot Program**
- **True Read-While-Write Operation**
  - Programming Lock for Software Security

- **Atmel® QTouch® Library Support**
  - Capacitive Touch Buttons, Sliders and Wheels
  - QTouch and QMatrix® Acquisition
  - Up to 64 sense channels

- **Peripheral Features**
  - Two 8-bit Timer/Counters with Separate Prescaler and Compare Mode
  - One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
  - Real Time Counter with Separate Oscillator
  - Six PWM Channels
  - 8-channel 10-bit ADC in TQFP and QFN/MLF package

- **Temperature Measurement**
  - 6-channel 10-bit ADC in PDIP Package
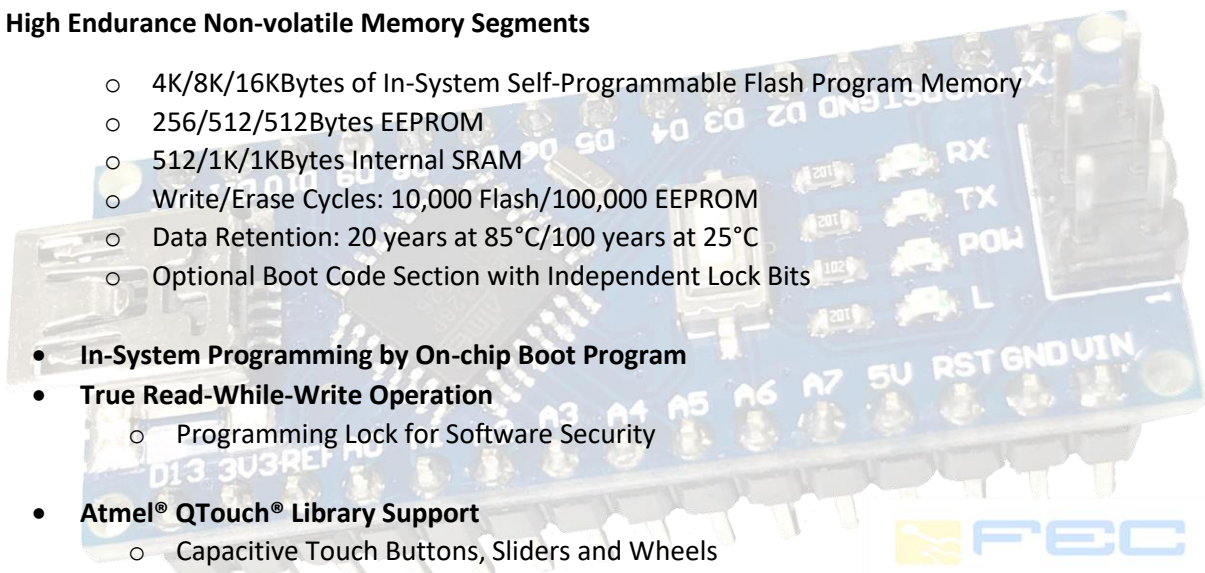
- **Temperature Measurement**
  - Two Master/Slave SPI Serial Interface
  - One Programmable Serial USART
  - One Byte-oriented 2-wire Serial Interface (Philips I2C compatible)
  - Programmable Watchdog Timer with Separate On-chip Oscillator
  - One On-chip Analog Comparator
  - Interrupt and Wake-up on Pin Change

- **Special Microcontroller Features**
  - Power-on Reset and Programmable Brown-out Detection
  - Internal Calibrated Oscillator
  - External and Internal Interrupt Sources
  - Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby, and Extended Standby

- **I/O and Packages**
  - 23 Programmable I/O Lines
  - 28-pin PDIP, 32-lead TQFP, 28-pad QFN/MLF and 32-pad QFN/MLF

- **Operating Voltage:**
  - 2.7 - 5.5V for ATmega48/88/168
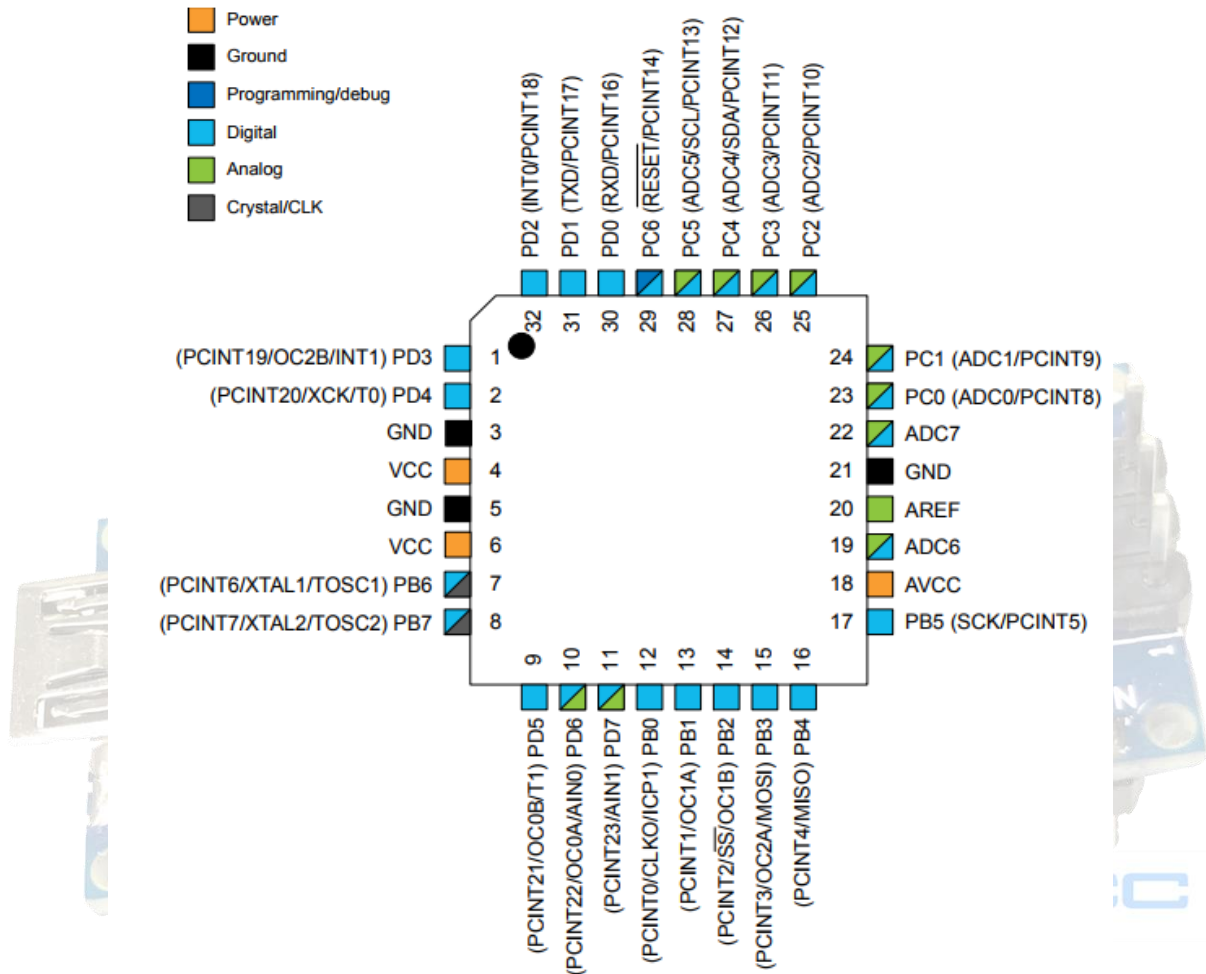 - 1.8 - 5.5V for ATmega48V/88V/168V

- **Temperature Range:** -40°C to 85°C

- **Speed Grade:** 0 - 10MHz @ 2.7V - 5.5V, 0 - 20MHz @ 4.5V - 5.5V

- **Power Consumption at 1MHz, 1.8V, 25°C**
  - Active Mode: 0.3mA
  - Power-down Mode: 0.1µA
  - Power-save Mode: 0.8µA (Including 32kHz RTC)

- **ATmega168 pin configuration**

Power
Ground
Programming/debug
Digital
Analog
Crystal/CLK

PD2 (INT0/PCINT18)
PD1 (TXD/PCINT17)
PD0 (RXD/PCINT16)
PC6 ($\overline{\text{RESET}}$/PCINT14)
PC5 (ADC5/SCL/PCINT13)
PC4 (ADC4/SDA/PCINT12)
PC3 (ADC3/PCINT11)
PC2 (ADC2/PCINT10)

32 31 30 29 28 27 26 25

(PCINT19/OC2B/INT1) PD3   1   24   PC1 (ADC1/PCINT9)
(PCINT20/XCK/T0) PD4   2   23   PC0 (ADC0/PCINT8)
GND   3   22   ADC7
VCC   4   21   GND
GND   5   20   AREF
VCC   6   19   ADC6
(PCINT6/XTAL1/TOSC1) PB6   7   18   AVCC
(PCINT7/XTAL2/TOSC2) PB7   8   17   PB5 (SCK/PCINT5)

9 10 11 12 13 14 15 16

(PCINT21/OC0B/T1) PD5
(PCINT22/OC0A/AIN0) PD6
(PCINT23/AIN1) PD7
(PCINT0/CLKO/ICP1) PB0
(PCINT1/OC1A) PB1
(PCINT2/$\overline{\text{SS}}$/OC1B) PB2
(PCINT3/OC2A/MOSI) PB3
(PCINT4/MISO) PB4
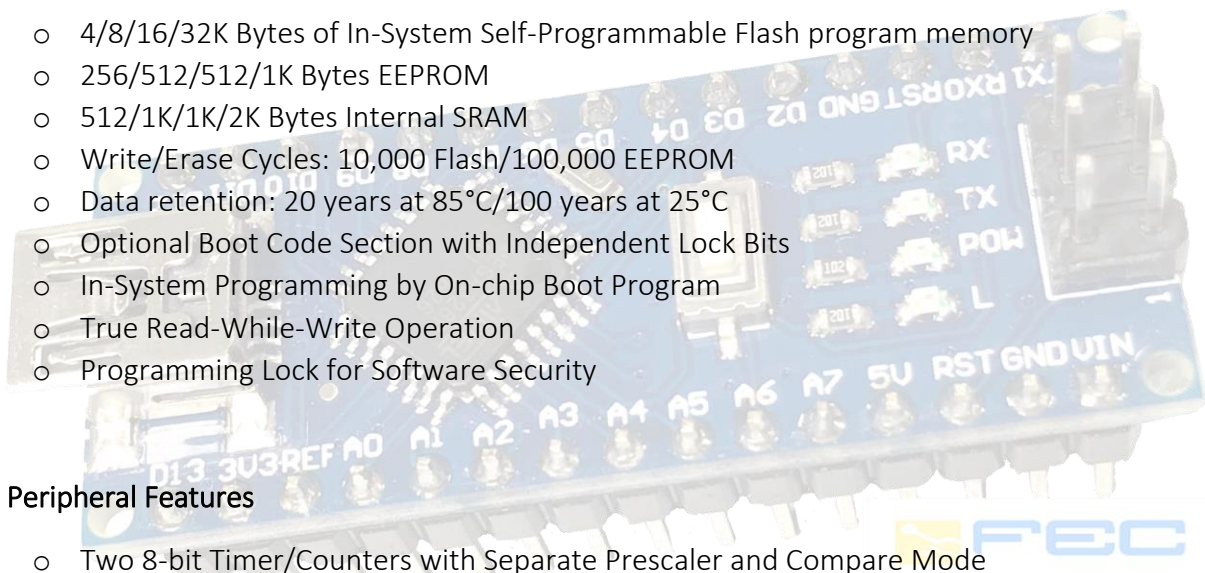
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ATmega328 Microcontroller features

• High Performance, Low Power AVR

• Advanced RISC Architecture

  o 131 Powerful Instructions – Most Single Clock Cycle Execution
  o 32 x 8 General Purpose Working Registers
  o Up to 20 MIPS Throughput at 20 MHz
  o On-chip 2-cycle Multiplier

• High Endurance Non-volatile Memory Segments

  o 4/8/16/32K Bytes of In-System Self-Programmable Flash program memory
  o 256/512/512/1K Bytes EEPROM
  o 512/1K/1K/2K Bytes Internal SRAM
  o Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
  o Data retention: 20 years at 85°C/100 years at 25°C
  o Optional Boot Code Section with Independent Lock Bits
  o In-System Programming by On-chip Boot Program
  o True Read-While-Write Operation
  o Programming Lock for Software Security

• Peripheral Features

  o Two 8-bit Timer/Counters with Separate Prescaler and Compare Mode
  o One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
  o Real Time Counter with Separate Oscillator
  o Six PWM Channels
  o 8-channel 10-bit ADC in TQFP and QFN/MLF package
  o Temperature Measurement
  o 6-channel 10-bit ADC in PDIP Package
  o Temperature Measurement
  o Programmable Serial USART
  o Master/Slave SPI Serial Interface
  o Byte-oriented 2-wire Serial Interface (Philips I2 C compatible)
  o Programmable Watchdog Timer with Separate On-chip Oscillator
  o On-chip Analog Comparator
  o Interrupt and Wake-up on Pin Change

- Special Microcontroller Features

  - Power-on Reset and Programmable Brown-out Detection
  - Internal Calibrated Oscillator
  - External and Internal Interrupt Sources
  - Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby, and Extended Standby

- I/O and Packages

  - 23 Programmable I/O Lines
  - 28-pin PDIP, 32-lead TQFP, 28-pad QFN/MLF and 32-pad QFN/MLF

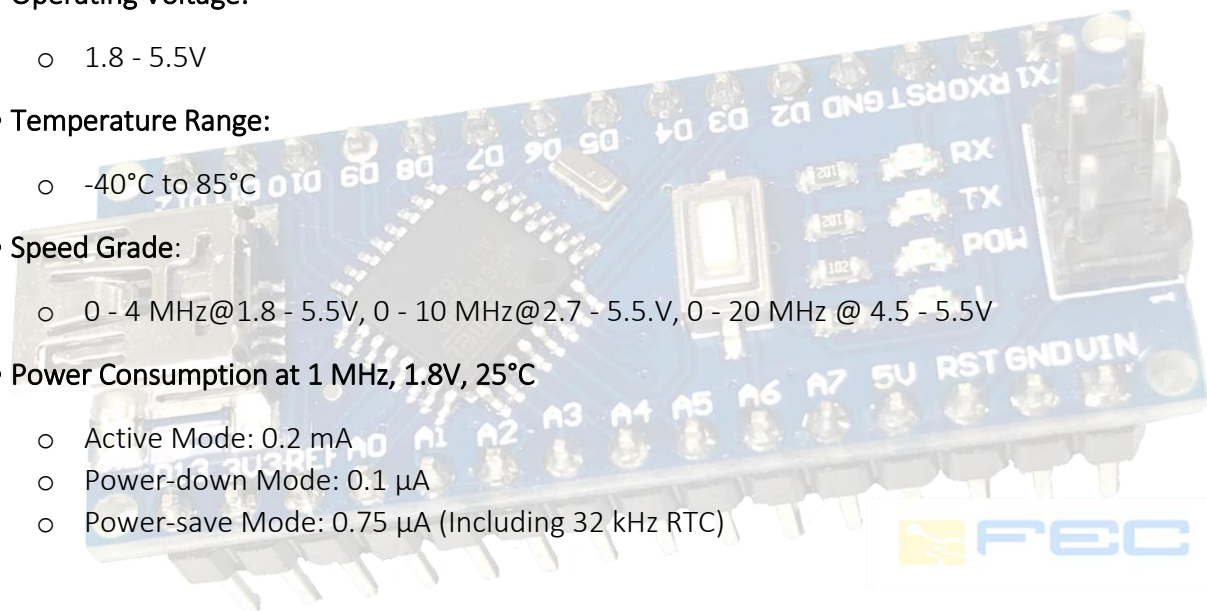- Operating Voltage:

  - 1.8 - 5.5V

- Temperature Range:

  - -40°C to 85°C

- Speed Grade:

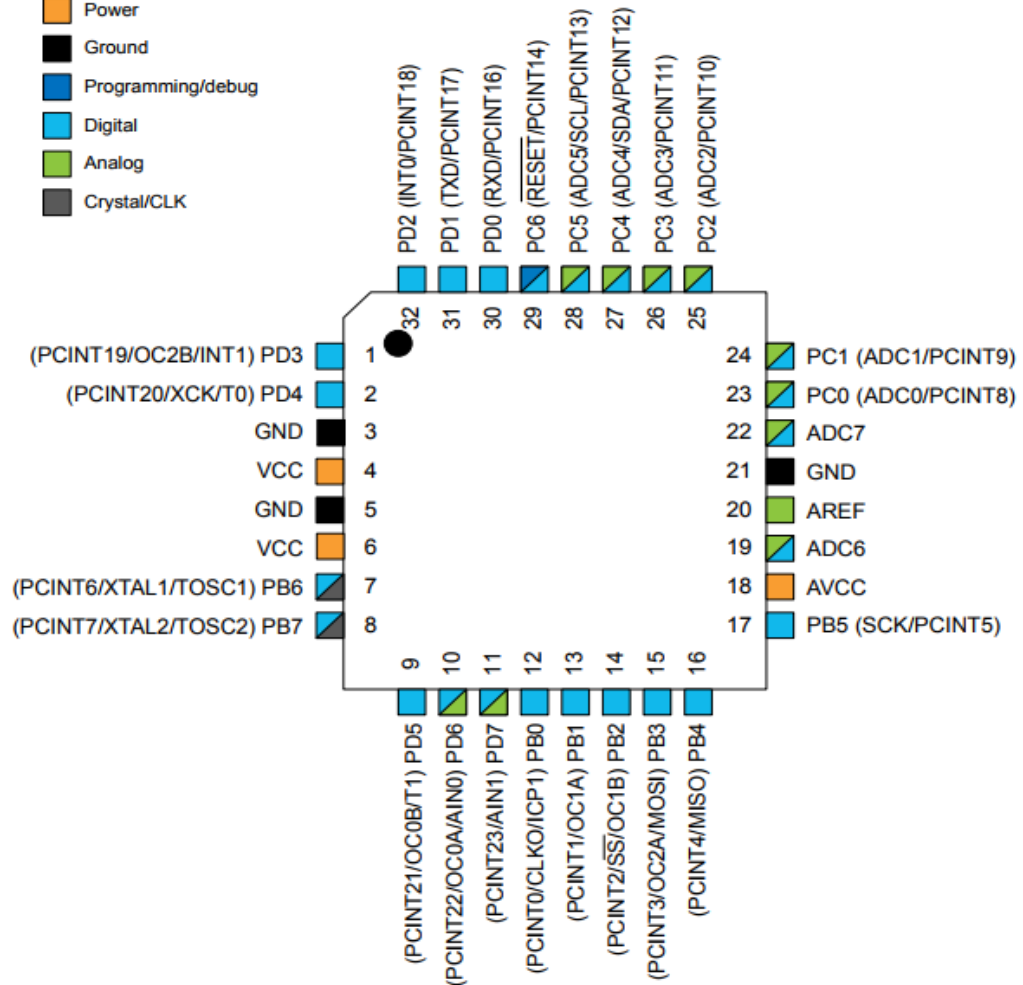 - 0 - 4 MHz@1.8 - 5.5V, 0 - 10 MHz@2.7 - 5.5.V, 0 - 20 MHz @ 4.5 - 5.5V

- Power Consumption at 1 MHz, 1.8V, 25°C

  - Active Mode: 0.2 mA
  - Power-down Mode: 0.1 µA
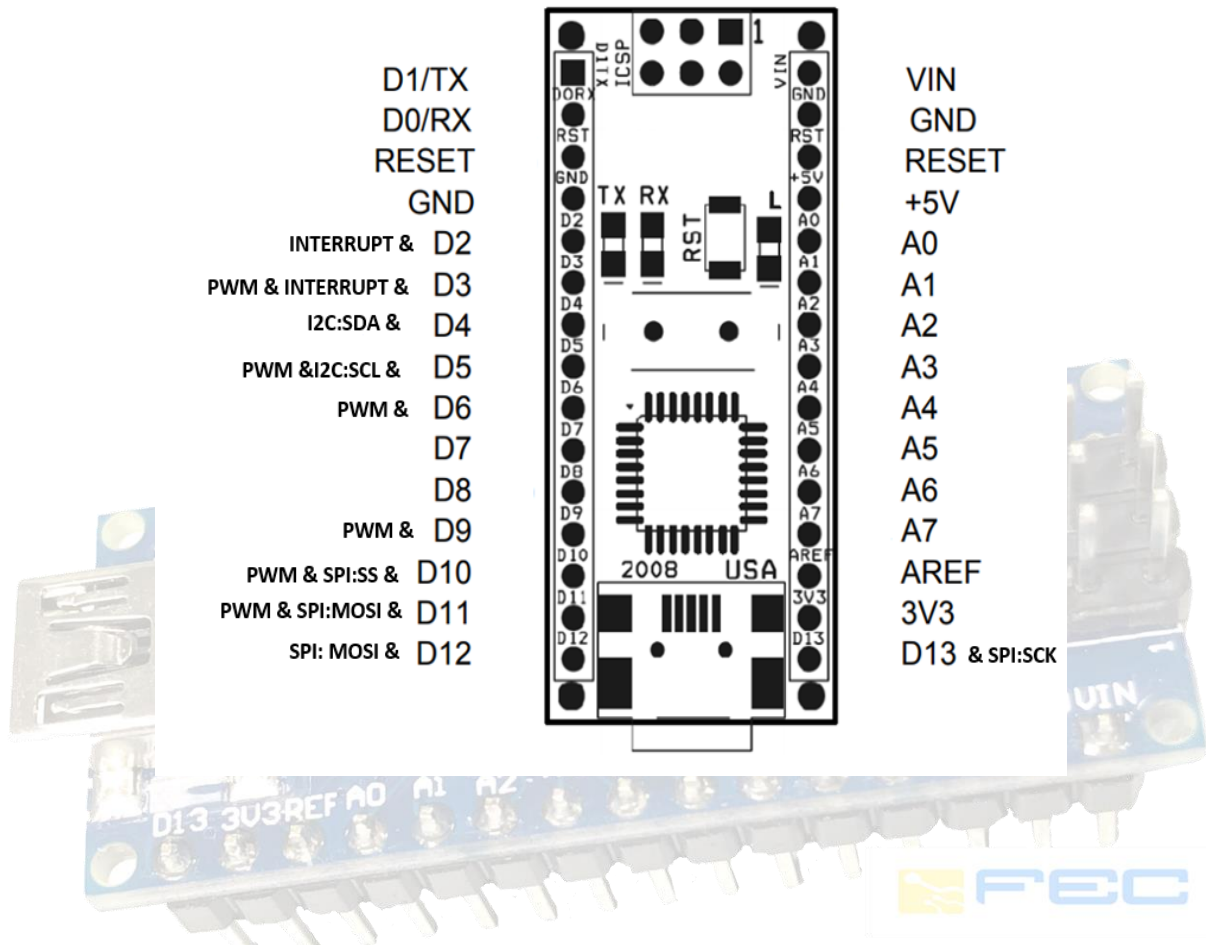 - Power-save Mode: 0.75 µA (Including 32 kHz RTC)

- Pin configuration

Power
Ground
Programming/debug
Digital
Analog
Crystal/CLK

(PCINT19/OC2B/INT1) PD3 — 1	24 — PC1 (ADC1/PCINT9)
(PCINT20/XCK/T0) PD4 — 2	23 — PC0 (ADC0/PCINT8)
GND — 3	22 — ADC7
VCC — 4	21 — GND
GND — 5	20 — AREF
VCC — 6	19 — ADC6
(PCINT6/XTAL1/TOSC1) PB6 — 7	18 — AVCC
(PCINT7/XTAL2/TOSC2) PB7 — 8	17 — PB5 (SCK/PCINT5)

Top pins (32, 31, 30, 29, 28, 27, 26, 25):
- PD2 (INT0/PCINT18)
- PD1 (TXD/PCINT17)
- PD0 (RXD/PCINT16)
- PC6 ($\overline{\text{RESET}}$/PCINT14)
- PC5 (ADC5/SCL/PCINT13)
- PC4 (ADC4/SDA/PCINT12)
- PC3 (ADC3/PCINT11)
- PC2 (ADC2/PCINT10)

Bottom pins (9, 10, 11, 12, 13, 14, 15, 16):
- (PCINT21/OC0B/T1) PD5
- (PCINT22/OC0A/AIN0) PD6
- (PCINT23/AIN1) PD7
- (PCINT0/CLKO/ICP1) PB0
- (PCINT1/OC1A) PB1
- (PCINT2/$\overline{\text{SS}}$/OC1B) PB2
- (PCINT3/OC2A/MOSI) PB3
- (PCINT4/MISO) PB4

ARDUINO NANO PIN CONFIGURATION

The Serial Peripheral Interface (SPI) IN PINS 7,8,13,14 AND 15

Serial Peripheral Interface (SPI) is a synchronous serial data protocol used by microcontrollers for communicating with one or more peripheral devices quickly over short distances. It can also be used for communication between two microcontrollers.

With an SPI connection there is always one master device (usually a microcontroller) which controls the peripheral devices. Typically, there are three lines common to all the devices:

- MISO (Master In Slave Out) - The Slave line for sending data to the master,
- MOSI (Master Out Slave In) - The Master line for sending data to the peripherals,

- SCK (Serial Clock) - The clock pulses which synchronize data transmission generated by the master and one-line specific for every device:

- SS (Slave Select) - the pin on each device that the master can use to enable and disable specific devices.

When a device's Slave Select pin is low, it communicates with the master. When it's high, it ignores the master. This allows you to have multiple SPI devices sharing the same MISO, MOSI, and CLK lines.

Arduino Nano Specifications

Microcontroller	Atmel ATmega168 or ATmega328
Operating Voltage (logic level)	5 V
Input Voltage (recommended)	7-12 V
Input Voltage (limits)	6-20 V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	8
DC Current per I/O Pin	40 mA
Flash Memory	16 KB (ATmega168) or 32 KB (ATmega328) of which 2 KB used by bootloader
SRAM	1 KB (ATmega168) or 2 KB (ATmega328)
EEPROM	512 bytes (ATmega168) or 1 KB (ATmega328)
Clock Speed	16 MHz
Dimensions	0.73" x 1.70"
Length	45 mm
Width	18 mm
Weigth	5 g