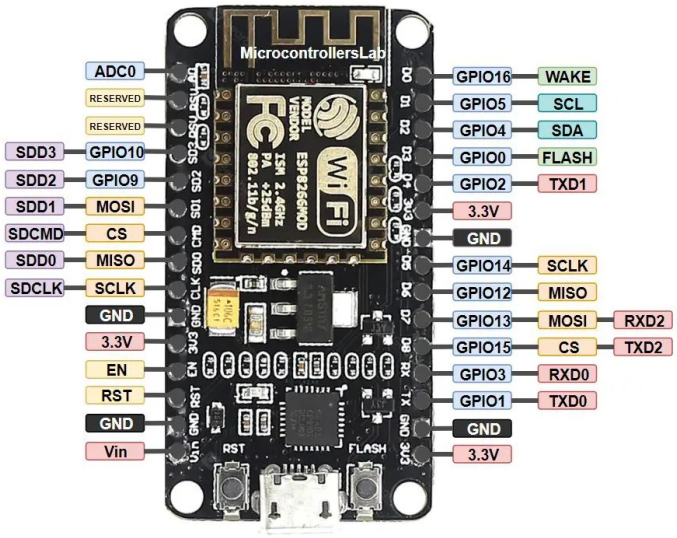
ESP8266

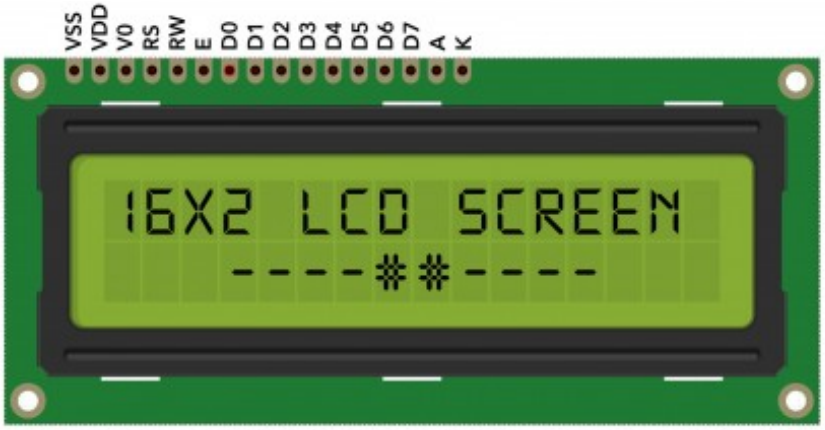


The **ESP8266 NodeMCU** is a low-cost, open-source microcontroller board with built-in Wi-Fi capabilities, designed for IoT projects. It is based on the **ESP8266 Wi-Fi module** and uses the **Lua scripting language** or can be programmed using **Arduino IDE**.

Key Features

1. Wi-Fi Connectivity: Supports 802.11 b/g/n for wireless communication.
2. GPIO Pins: Has several general-purpose input/output pins for connecting sensors, actuators, and other devices.
3. USB Interface: Comes with a built-in USB-to-Serial adapter for easy programming and debugging.
4. Memory: Includes flash memory for program storage.
5. Power Supply: Operates at 3.3V and can be powered via USB or external sources.

16x2 LCD Display



No	Symbol	Function
1	VSS	Ground
2	VDD	5V +
3	V0	Contrast
4	RS	Register
5	RW	Read/Write
6	E	Enable
7	D0	Data bus
8	D1	Data bus
9	D2	Data bus
10	D3	Data bus
11	D4	Data bus
12	D5	Data bus
13	D6	Data bus
14	D7	Data bus
15	A	Anode (5V+)
16	K	Cathode (GND)

A **16x2 LCD Display** is a commonly used alphanumeric liquid crystal display that can show **16 characters per row on 2 rows**, making it ideal for simple text-based output in embedded systems.

Key Features

1. Character Display: Can display a total of 32 characters (16 in each row).
2. Interface: Operates in 4-bit or 8-bit mode, with control via microcontrollers like Arduino or ESP modules.
3. Pins:
    - VSS/VDD: Power supply (5V and GND).
    - VO: Contrast adjustment.
    - RS, RW, E: Control pins for operation (Register Select, Read/Write, Enable).
    - D0-D7: Data pins (for sending commands and characters).
4. Backlight: Includes an optional backlight for better visibility in low light.
5. Driver IC: Usually uses the HD44780 driver for communication.

Applications

- Displaying sensor data
- Showing messages in IoT projects
- Menu navigation for user interfaces

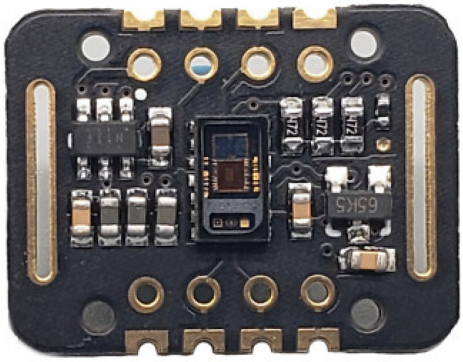
I2C Module

An **I2C Module** (Inter-Integrated Circuit module) is an add-on board used to simplify the connection of a 16x2 or 20x4 LCD to a microcontroller, reducing the number of required pins and enabling efficient communication via the **I2C protocol**.

Key Features

1. Pin Reduction: Requires only 2 pins (SDA and SCL) for communication instead of 6-8 pins for direct LCD connection.
2. I2C Communication:
    - SDA: Serial Data Line (for transferring data).
    - SCL: Serial Clock Line (for timing signals).
3. PCF8574 IC: Commonly uses the PCF8574 I/O expander IC to control the LCD.
4. Adjustable Contrast: Includes a potentiometer to adjust the LCD contrast.
5. Backlight Control: Allows control over the LCD backlight via software.

MAX30102 Sensor



The MAX30102 is a compact, low-power, and highly accurate sensor module designed to measure heart rate and blood oxygen levels (SpO_2) using photoplethysmography (PPG). It is widely used in wearable devices, fitness trackers, and medical applications.

Key Features

1. Dual LED System:
    - Includes Red (660 nm) and Infrared (IR) (880 nm) LEDs.
    - Red light is used to measure blood oxygen saturation (SpO_2).
    - Infrared light is used to measure heart rate (pulse).
2. Photodetector:
    - Measures the amount of light absorbed by blood, which varies with oxygen levels and heartbeats.
3. I^2C Interface:
    - Communicates with microcontrollers (like Arduino, ESP32) via I^2C protocol, requiring only two pins (SDA and SCL).
4. Integrated Algorithm:

- Contains a built-in algorithm for noise reduction and signal filtering to improve measurement accuracy.

5. Low Power Consumption:
   - Ideal for battery-powered applications, consuming minimal energy during operation.
6. Wide Operating Voltage:
   - Operates on 1.8V for logic and 3.3V or 5V for power supply.

DS18b20 Sensor

The DS18B20 is a digital temperature sensor that provides accurate and reliable temperature measurements over a wide range. It uses the 1-Wire communication protocol, requiring only one data pin for communication.

Key Features

1. Temperature Range:
   - Measures temperatures from -55°C to +125°C.
   - Accuracy: ±0.5°C from -10°C to +85°C.
2. 1-Wire Interface:
   - Requires only one data pin (along with power and ground).
   - Supports multiple sensors on the same data line, as each sensor has a unique 64-bit serial code.
3. Power Supply:
   - Operates on 3.0V to 5.5V.
   - Can be powered directly or via parasite power mode (using only two wires: Data and Ground).
4. Data Format:
   - Outputs temperature in 9- to 12-bit resolution (programmable).