1. **Overview**

The ESP8266-12E/F is a low-cost Wi-Fi microcontroller with a full TCP/IP stack and microcontroller capability. It is widely used for IoT applications. When integrated with a 4-channel relay module, it allows for controlling four different devices (such as lights, fans, or other appliances) remotely via the Wi-Fi network.

2. Key Features

- **ESP8266-12E/F Features**:

  - Microcontroller: 32-bit, Tensilica LX106 architecture
  - Clock Speed: 80 MHz or 160 MHz
  - Flash Memory: 4 MB (varies by module)
  - GPIO Pins: 17 pins (with PWM, I2C, SPI, ADC capabilities)
  - Wi-Fi: 802.11 b/g/n
  - Operating Voltage: 3.3V
  - Power Consumption: 160mA (Max), Low Power Modes Supported
  - Programming Interface: UART (Serial Communication)
  - Onboard Antenna
  - Communication Protocols: SPI, I2C, UART
  - 10-bit ADC (Analog to Digital Conversion)

- **4-Channel Relay Module Features**:

  - Controls: 4 relays for switching high-voltage loads
  - Relay Type: Normally Open (NO) or Normally Closed (NC)
  - Input Voltage: 5V (Compatible with ESP8266)
  - Relay Rating: 10A at 250V AC or 30V DC (per relay)
  - Trigger Level: 3.3V (ESP8266 GPIO) to activate each relay
  - Optocoupler Isolation: For high-voltage protection
  - LED Indicators: Show status for each relay (On/Off)

3. Pinout and Connections

ESP8266-12E/12F Pinout:

- On Board USB Programming.

- GND: Ground

- 3.3V: 3.3V pinout

- Relay GPIO: IO16, IO14, IO12, IO13

- Extra GPIO: IO15, IO10, IO4, IO5

Relay Module Pinout:

- NO (Normally Open): Connect to the device to be controlled

- NC (Normally Closed): Optional alternative for relays

- COM (Common): Common terminal for the relay switch

4. Relay Control

Each relay can be controlled individually by setting the GPIO pin HIGH or LOW. When the GPIO pin is HIGH, the corresponding relay is triggered and can switch an appliance connected to the relay.

5. Applications

- Home Automation: Control home appliances remotely via Wi-Fi.
- IoT Projects: Automate devices based on sensor inputs or remote commands.
- Security Systems: Activate alarms, lights, or locks.
- Energy Management: Switch off unused devices to save power.

6. Power Consumption

- Operating Voltage: 5 ~ 30V
- Each Relay Current @5V: 120mA
- Total Relay Current @5V: 411mA
- Typical Power Consumption: 160mA during Wi-Fi transmission
- Low Power Consumption Mode: Can be used for energy-saving applications

- **Relay Module:**

  - Operating Voltage: 5V / 12V / 9V / 24V
  - Power Consumption: Each relay consumes around 100mA@5V during operation.
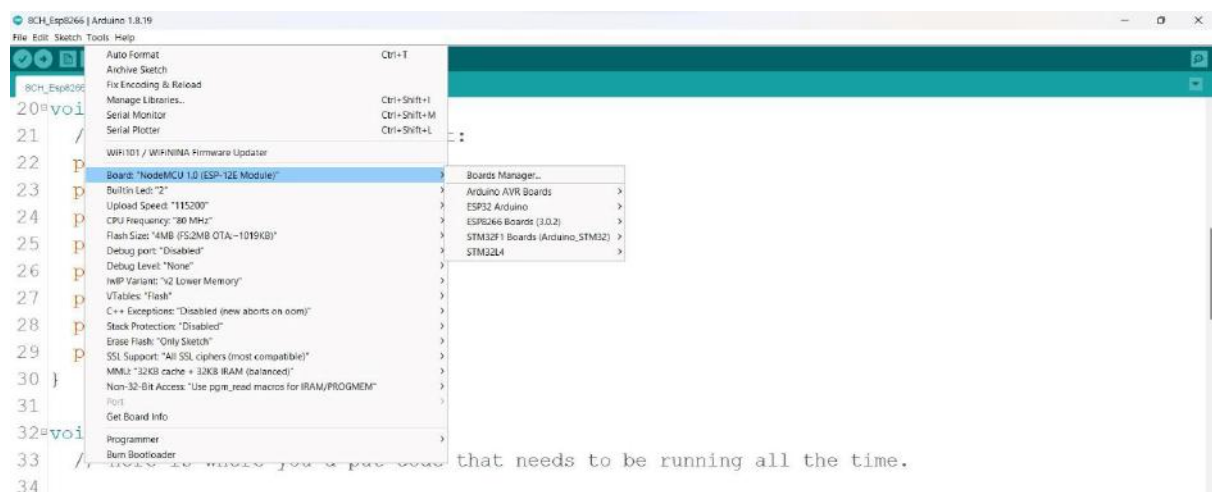
7. Programming and Control

The ESP8266-12E/F can be programmed via the Arduino IDE / Linux using the ESP8266 core. A common method for controlling the relay is through a simple web server or MQTT, where you can control each relay via a browser or an IoT application.

Programming Platform Compatible:

1. Arduino IDE

2. Linux via SLIP (Serial Line IP)

Board Setup In Arduino IDE:

Example Code to Control Relays: for more code visit our [GitHub directory](#).

Sample 1:

```cpp
#define RLY_1 16

#define RLY_2 14

#define RLY_3 12

#define RLY_4 13

// Variables will change:

int ledState = LOW; // ledState used to set the LED

unsigned long previousMillis = 0; // will store last time LED was updated

// constants won't change:

const long interval = 1000; // interval at which to blink (milliseconds)

void setup()

{
        // set the digital pin as output:

        pinMode(RLY_1, OUTPUT);

        pinMode(RLY_2, OUTPUT);

        pinMode(RLY_3, OUTPUT);

        pinMode(RLY_4, OUTPUT);

}

void loop()

{
        unsigned long currentMillis = millis();

        if (currentMillis - previousMillis >= interval) // save the last time you blinked the LED

        {
                previousMillis = currentMillis;

                if (ledState == LOW) {

                        ledState = HIGH;

                } else {

                        ledState = LOW;

        }

        // set the LED with the ledState of the variable:

        digitalWrite(RLY_1, ledState);

        digitalWrite(RLY_2, ledState);

        digitalWrite(RLY_3, ledState);

        digitalWrite(RLY_4, ledState);

}

}
```

9. Safety Considerations

- Voltage Handling: The relays are typically used to switch devices with high voltage (e.g., 220V AC), so make sure the system is handled safely.

- Isolation: The relay module should provide sufficient isolation (via optocouplers) to protect the ESP8266 from high-voltage spikes.

References

- ESP8266-12E/F datasheet and technical reference.

- Relay datasheet and specifications.

Pinout:

Terminal Block Connector:

Pin Number	Signal	Description
1	INPUT	5V ~ 30V (Depend on Relay Voltage)
2	GND	Power Ground
3	VDD	Voltage out for external device (Depend on Relay Voltage)

Electrical Characteristics:

Parameter	Value
Operating Voltage	5.0V to 30V
Operating Current @5V	420mA
Operating Current @12V	260mA
Operating Current @24V	110mA
No of Relay	4
Load Current Rating	230VAC @10A
Isolation Type	Optocoupler for All Channel
Programming Connector	Micro USB / C Type
Operating Temperature	-40°C to +85°C
Board Dimensions	100*80mm
No of Mounting Hole	4
Mounting Hole Size	M3

Ordering Information:

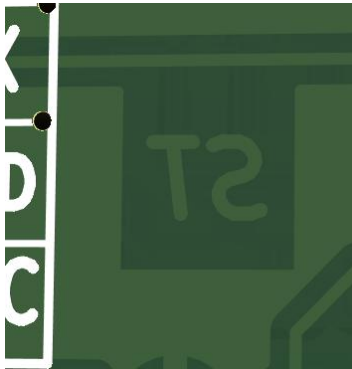# ST8266-12X-XX-XCH-X
① ② ③ ④

1 12(X) – 12E / 12F

2 (XX) – Relay Voltage

3 (X) – No of Relay

4 (X) – Type of USB use for Programming

Part Number	Description	VDD Out	Input	USB Type
ST8266-12F-05-4CH-M	5V Relay	5V	5 ~ 30V	Micro USB
ST8266-12F-09-4CH-M	9V Relay	9V	9 ~ 30V	Micro USB
ST8266-12F-12-4CH-M	12V Relay	12V	12 ~ 30V	Micro USB
ST8266-12E-24-4CH-M	24V Relay	24V	24 ~ 30V	Micro USB
ST8266-12F-05-4CH-C	5V Relay	5V	5 ~ 30V	C Type
ST8266-12F-09-4CH-C	9V Relay	9V	9 ~ 30V	C Type
ST8266-12F-12-4CH-C	12V Relay	12V	12 ~ 30V	C Type
ST8266-12F-24-4CH-C	24V Relay	24V	24 ~ 30V	C Type

Original Board Marking:

Board Dimension:

Input Supply
6 ~ 28V

Supply
Ground

Output
Voltage
depend on
Relay
Voltage
5V/12/24V
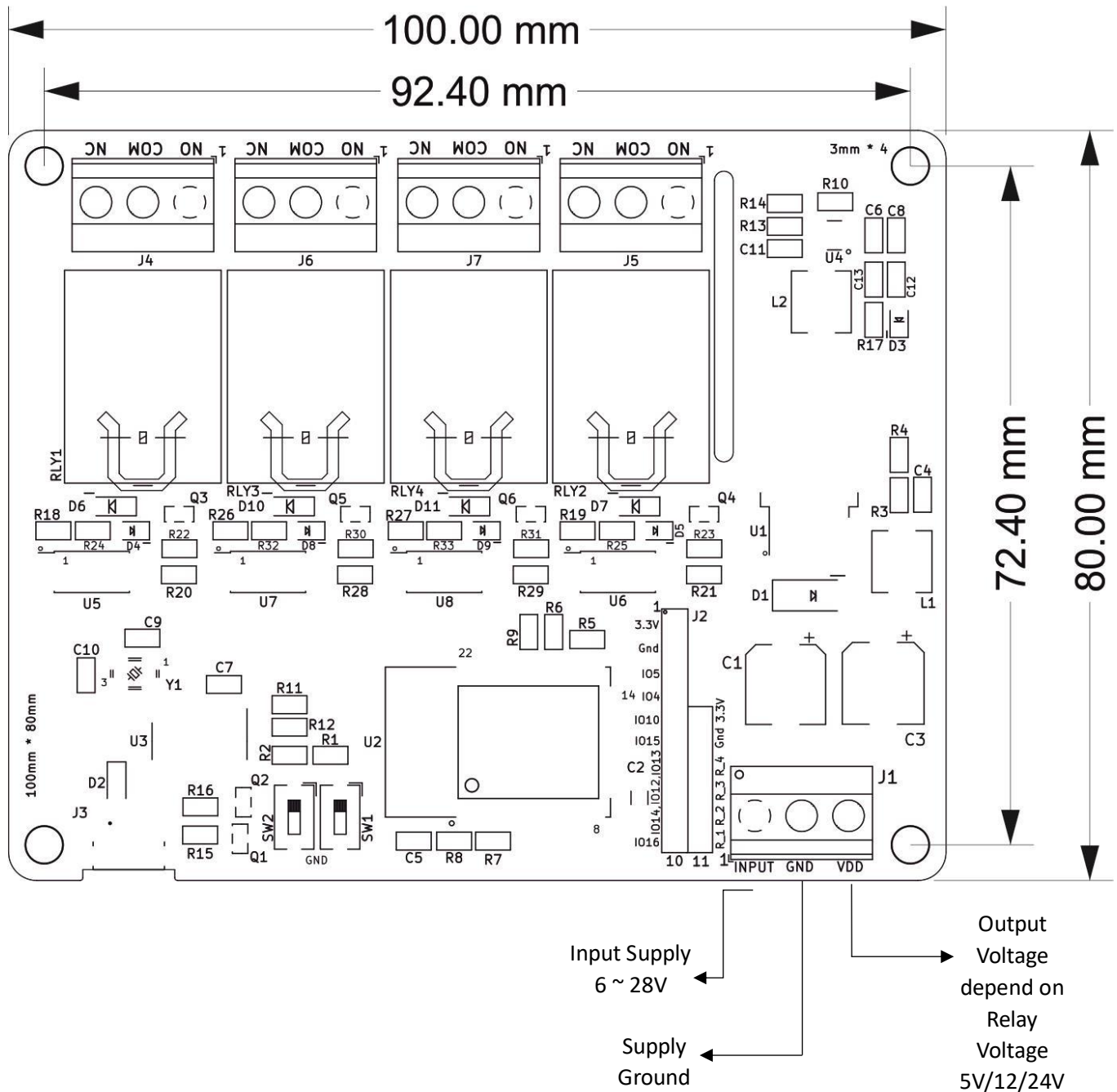
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Product Identification: ST8266-XXX-XX-XCH-X
Version: Rev1.1
Date: 19-12-2024
Prepared by: R&D Team

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