



Cocket Nova Development Board

Release 0.0.1

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CONTENTS

1	About the Cocket Nova CH552 Guide	3
1.1	Requirements	4
1.2	PinOut	4
2	CH55x with SDCC and Ubuntu	7
2.1	Install pyusb	8
2.2	Error with pip	8
3	CH55x with SDCC and Windows	9
3.1	Compiler Installation	9
3.2	Configuring MAKE	9
3.3	Install pyusb	13
3.4	Update driver	13
4	Compile and Flash CH55x with SDCC	15
4.1	Running a Program	15
4.2	Flashing the Program	16
4.3	Software Development prototype	16
5	General Board Control	19
5.1	Recommended Operating Conditions	19
5.2	Operating Mode	19
6	Analog to Digital Converter (ADC)	23
7	I2C (Inter-Integrated Circuit)	25
7.1	SSD1306 Display	25
8	Interrupts	27
8.1	Timer 0/1 Interrupts	27
8.2	External Interrupts	28
9	PWM (Pulse Width Modulation)	29
10	WS2812	31

ABOUT THE COCKET NOVA CH552 GUIDE

This is an excellent guide for beginner programmers, focused on using the SDCC compiler in both Windows and Linux environments. Here, you can find excellent references and examples along with comprehensive documentation focusing on developing technology for embedded systems. This course covers everything from installation and setting up the compiler to managing project dependencies and developing code. It's a valuable resource that will guide you through the development process using high-quality technology, ensuring long-lasting and robust projects.

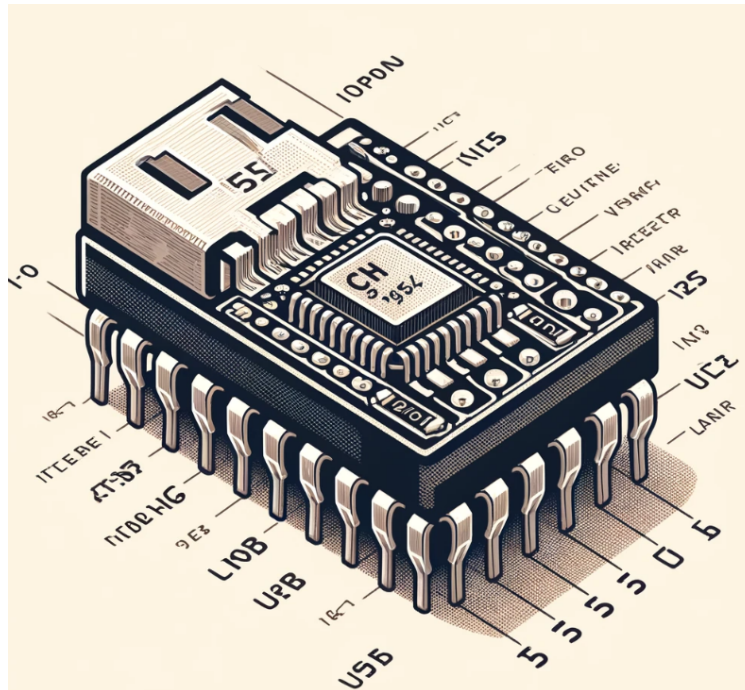


Fig. 1.1: CH552 Microcontroller (image generated by DALLE AI)

1.1 Requirements

- Python (Package Installation and Environments)
- Utilization of Operating System Controllers
- Understanding of Basic Electronics

Tip: This guide is tailored for individuals with a basic understanding of programming and electronics. It's ideal for those interested in diving into embedded systems and programming microcontrollers.

1.2 PinOut

The CH552 microcontroller development board has a total of 16 pins, each with a specific function. The following is a list of the pins and their respective functions:

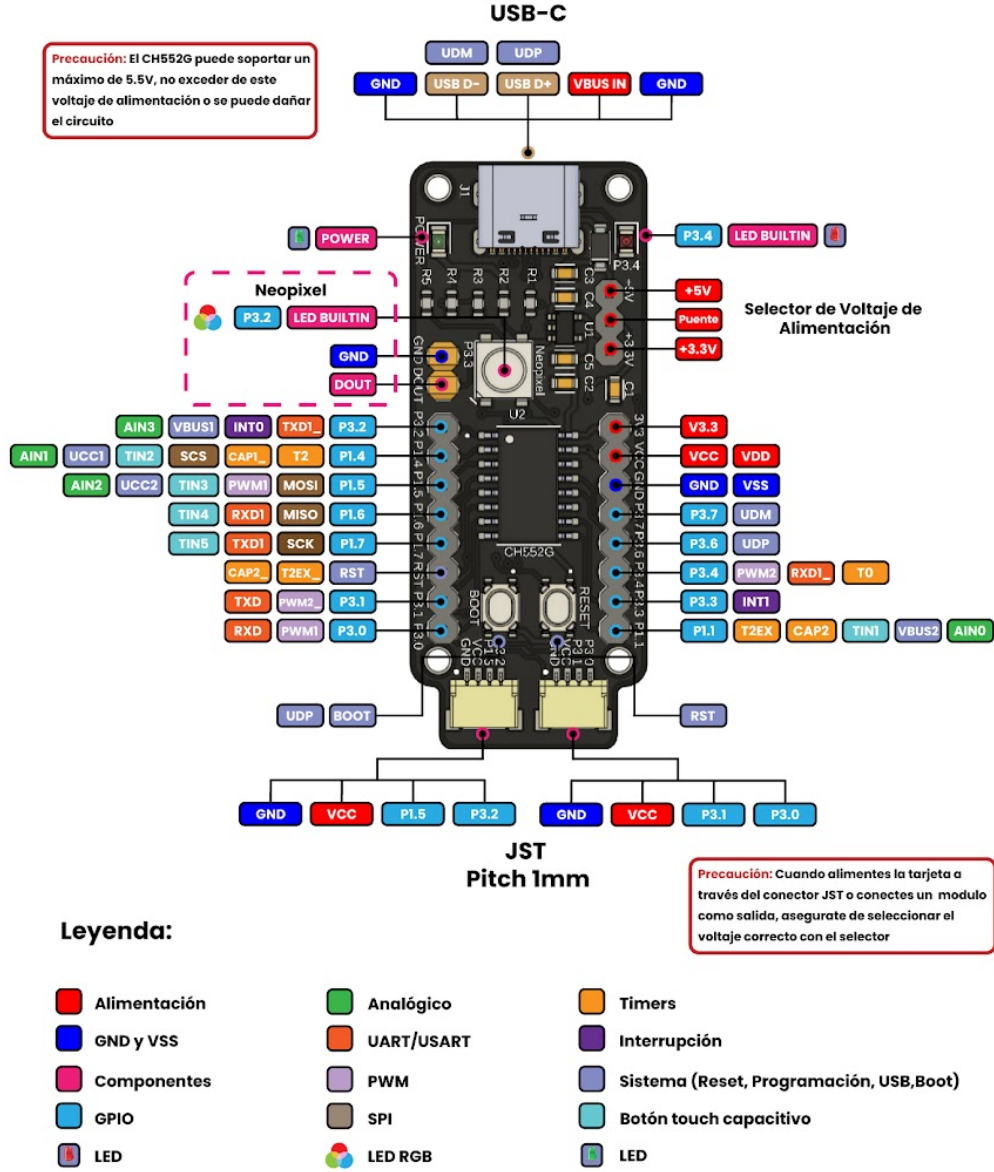


Fig. 1.2: Cocket Nova CH552 PinOut

CH55X WITH SDCC AND UBUNTU

Caution: This project is under active development. The information provided here is subject to change.

Update the operating system:

```
sudo apt update
```

Install *make*, *binutils* and *sdcc*:

```
sudo apt install make
sudo apt install binutils
sudo apt install sdcc
```

Clone the examples with the main code:

```
git clone https://github.com/UNIT-Electronics/CH55x_SDCC_Examples.git
```

Navigate to the path:

```
cd CH55x_SDCC_Examples/Software/examples/Blink
```

Execute the command:

```
make help
```

You will see:

```
Use the following commands:
make all      compile, build, and keep all files
make hex      compile and build blink.hex
make bin      compile and build blink.bin
make flash    compile, build, and upload blink.bin to the device
make clean    remove all build files
```

Connect a device with the BOOT button pressed:

```
lsusb
```

The device will be shown with this description:

```
pc@LAPTOP:~$ lsusb
Bus 002 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub
Bus 001 Device 002: ID 4348:55e0 WinChipHead
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
```

2.1 Install pyusb

Verify the installation with *python --version*. If not installed, run:

```
sudo apt install python3-pip
```

Then verify the installation:

```
python3 -m pip show pyusb
```

2.2 Error with pip

If you encounter this error, we recommend installing the Python environment:

```
sudo apt install python3-venv
```

Create an environment:

```
python3 -m venv .venv
```

Activate the environment:

```
source .venv/bin/activate
```

And install *pyusb*:

```
pip install pyusb
```

CH55X WITH SDCC AND WINDOWS

3.1 Compiler Installation

Follow the steps below to install the necessary tools

- **Installing Git for Windows**

Download and install [Git](#) for Windows from the official Git website.

- **Installing SDCC**

Download and install the latest version of SDCC. You can find the latest version on the SDCC downloads page. [here a alternative](#)

- **Installing MinGW**

Install MinGW, which is a set of tools for software development on Windows. You can download the installer from the official MinGW website. [here a alternative](#)

- **Installig Zadig**

Download the latest version of [Zadig](#). You can download in a official website.

3.2 Configuring MAKE

Remember that for Windows operating systems, an extra step is necessary, which is to open the environment variable
-> Edit environment variable:

C:\MinGW\bin

Locate the file

Rename it:

Warning: Sometimes, it is necessary to create a copy of the file and rename it to make.exe.

path:

C:\MinGW\bin\make

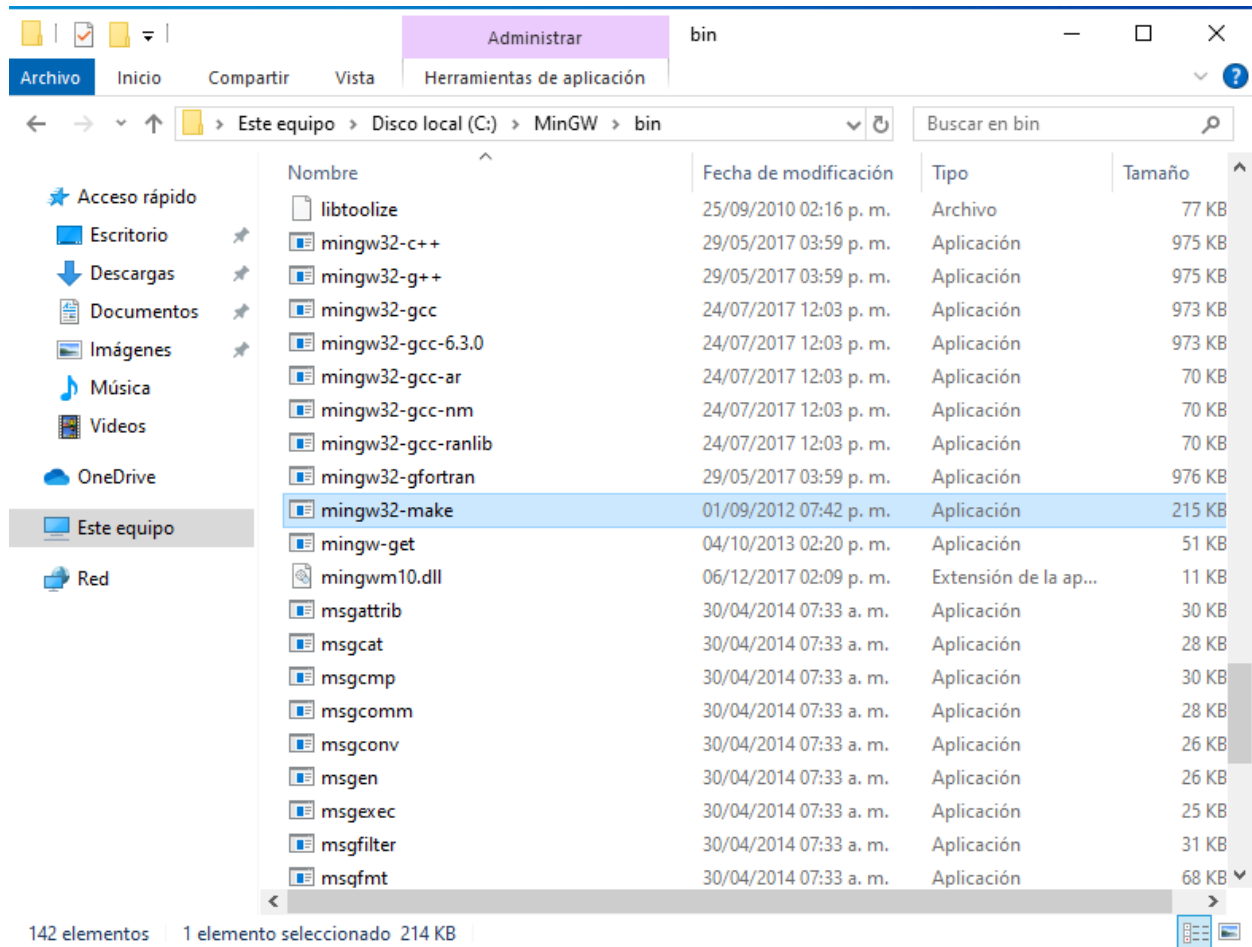


Fig. 3.1: make file

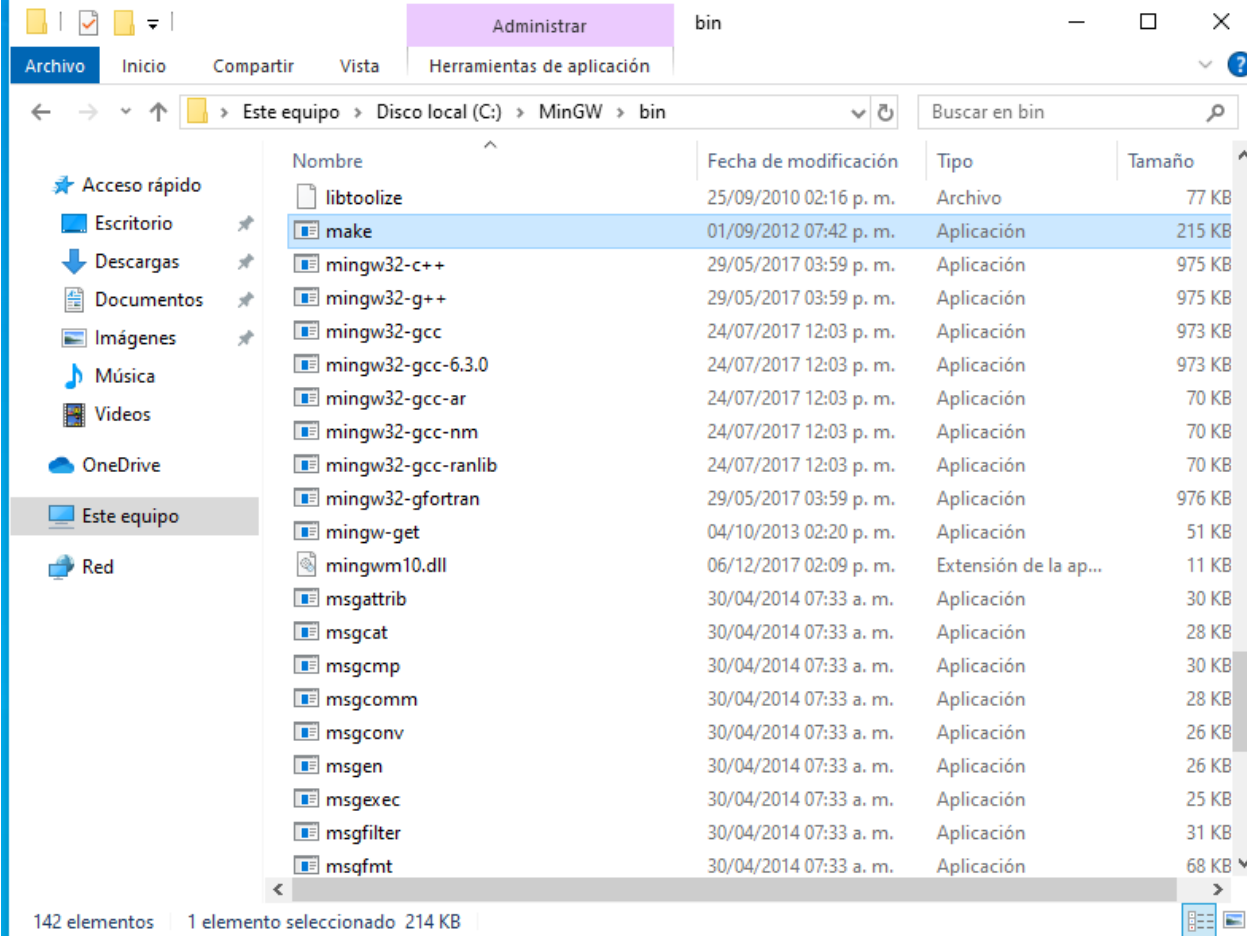


Fig. 3.2: rename make

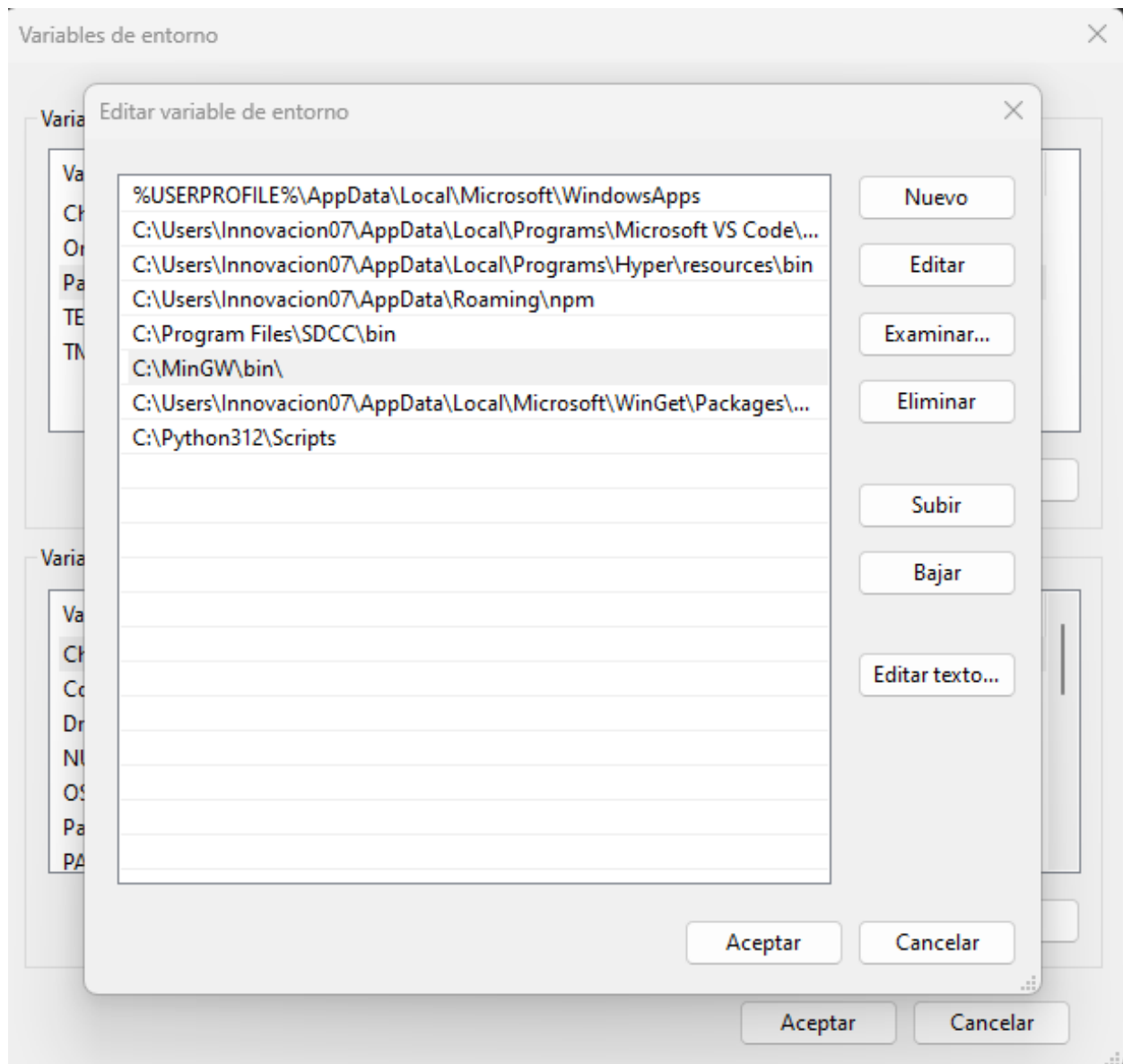


Fig. 3.3: var_env

3.3 Install pyusb

Verify the installation with *python --version*.

If not installed, download and install: - Python

Use pip for install py usb:

```
pip install pyusb
```

3.4 Update driver

The current loading tool can utilize the default driver and coexist with the official WCHISPTool. In case the driver encounters issues, it is advisable to switch the driver version to libusb-win32 using Zadig.

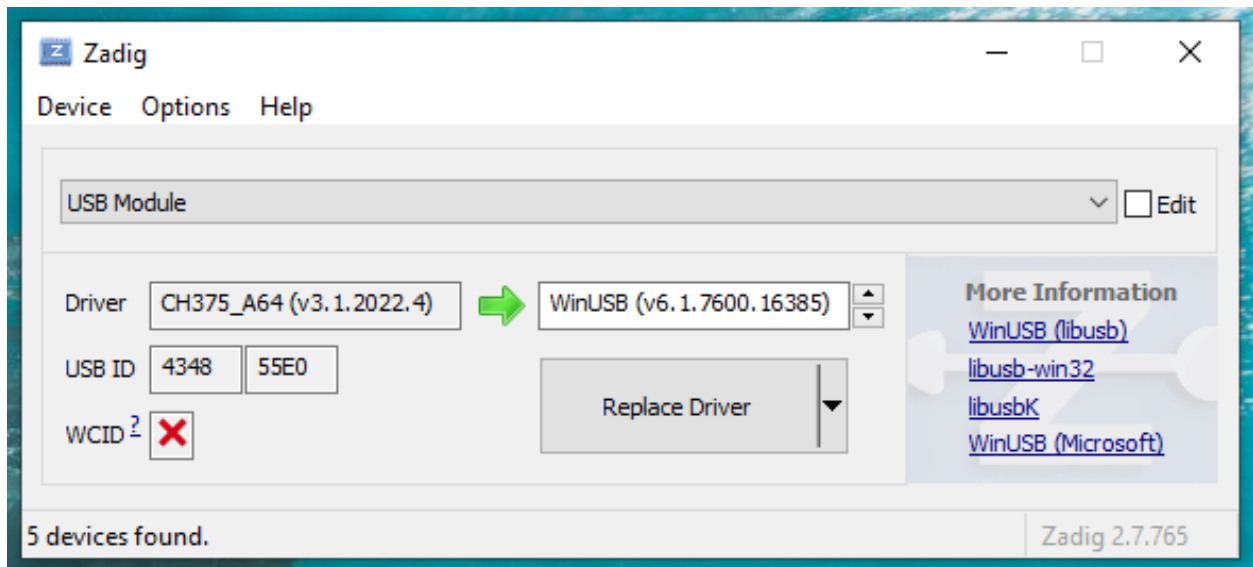


Fig. 3.4: driver

COMPILE AND FLASH CH55X WITH SDCC

4.1 Running a Program

To run the program, use a bash terminal.

Clone the examples with the main code:

```
git clone https://github.com/Cesarbautista10/ESE_CH552_Examples_C.git
```

Navigate to the path:

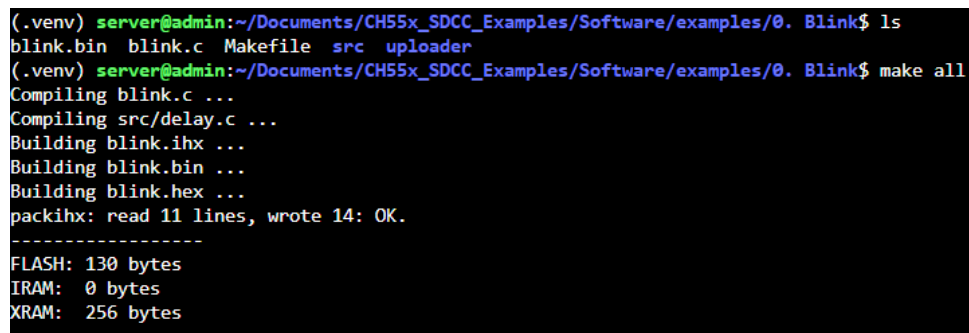
```
cd ~/CH55x_SDCC_Examples/Software/examples/Blink/
```

Connect a device with the BOOT button pressed.

Execute the command:

```
make all
```

This will compile the project and generate files with the following extensions:

A terminal window with a black background and green text. It shows the execution of 'ls' and 'make all' commands. The 'ls' command lists 'blink.bin', 'blink.c', 'Makefile', 'src', and 'uploader'. The 'make all' command triggers a series of compilation steps: 'Compiling blink.c ...', 'Compiling src/delay.c ...', 'Building blink.ihx ...', 'Building blink.bin ...', and 'Building blink.hex ...'. It also shows 'packihx: read 11 lines, wrote 14: OK.' and a memory layout summary: 'FLASH: 130 bytes', 'IRAM: 0 bytes', and 'XRAM: 256 bytes'.

```
(.venv) server@admin:~/Documents/CH55x_SDCC_Examples/Software/examples/0. Blink$ ls
blink.bin blink.c Makefile src uploader
(.venv) server@admin:~/Documents/CH55x_SDCC_Examples/Software/examples/0. Blink$ make all
Compiling blink.c ...
Compiling src/delay.c ...
Building blink.ihx ...
Building blink.bin ...
Building blink.hex ...
packihx: read 11 lines, wrote 14: OK.
-----
FLASH: 130 bytes
IRAM: 0 bytes
XRAM: 256 bytes
-----
```

Fig. 4.1: command line

4.2 Flashing the Program

Connect a device and press the BOOT button, then write the command:

```
make flash
```

If the project is successful, the code will generate a blinking effect as shown below:

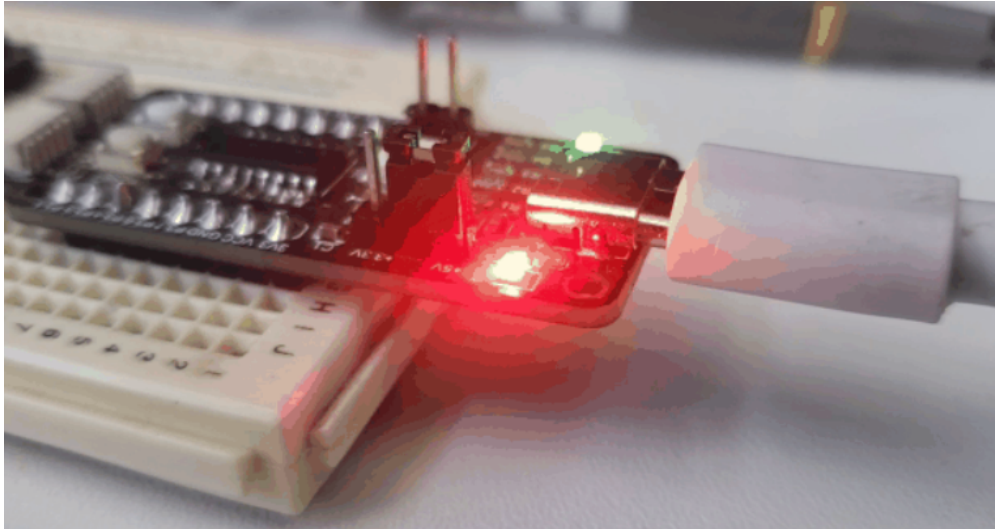


Fig. 4.2: LED blinking

4.3 Software Development prototype

4.3.1 Loadupch

The Loadupch is a software development prototype that allows users to upload code to the CH552 microcontroller. It is a simple and easy-to-use tool that provides a graphical interface for uploading code to the microcontroller. The Loadupch tool is available for Windows and Linux operating systems.

4.3.2 Installing Loadupch

Warning: The Loadupch tool is still under development and may contain bugs. Use it at your own risk.

Use pypi to install the [Loadupch tool](#):

```
pip install loadupch
```

run the Loadupch tool:

```
python -m loadupch
```

Tip: To uninstall the Loadupch tool, use the following command:

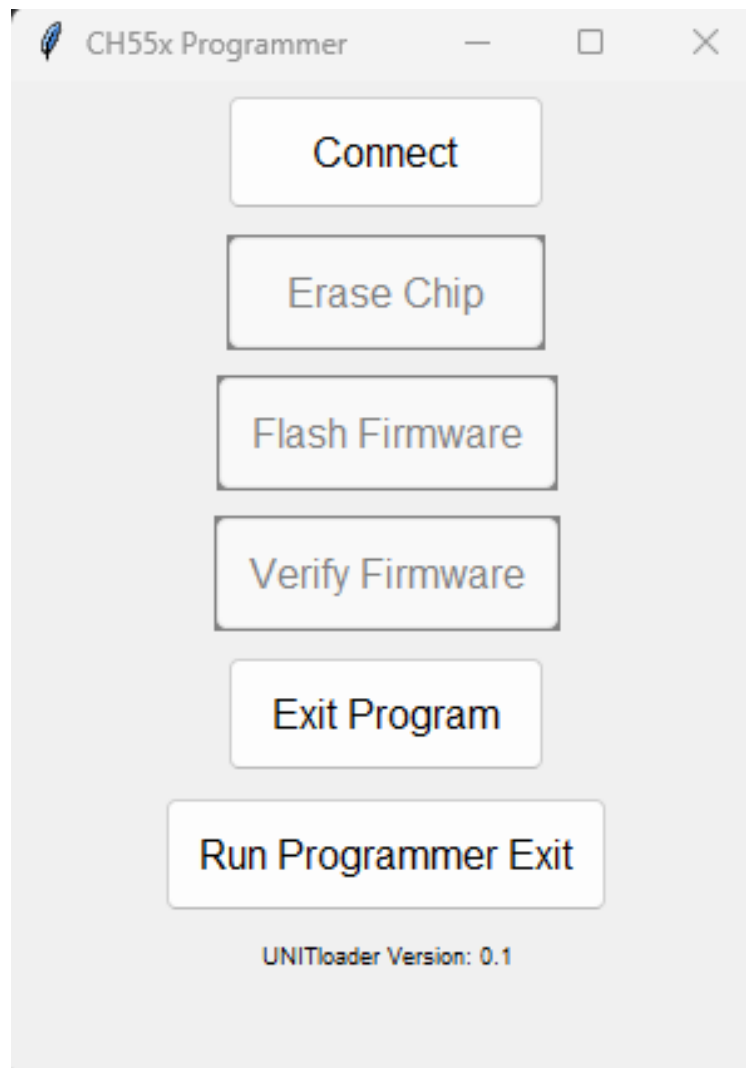


Fig. 4.3: Loadupch tool

```
pip uninstall loadupch
```

GENERAL BOARD CONTROL

The CH552, characterized by its compact size, native USB connectivity, and 16 KB memory (with 14 KB usable), enables the creation of simple yet effective programs. This allows for greater control in implementing various applications. The choice of this microcontroller is based on its affordability, ease of connection, and compatibility with various operating systems.

5.1 Recommended Operating Conditions

Table 5.1: Recommended Operating Conditions

Symbol	Description	Range
VUSB	Voltage supply via USB	3.14 to 5.255 V
VIn	Voltage supply from pins	2.7 to 5.5 V
Top	Operating temperature	-40 to 85 °C

5.2 Operating Mode

5.2.1 Voltage Selector

The development board utilizes a clever voltage selector system consisting of three pins and a jumper switch. The configuration of these pins determines the operating voltage of the board. By connecting the central pin to the +5V pin via the jumper, the board operates at 5V. On the other hand, by connecting the central pin to the +3.3V pin, the APK2112K regulator is activated, powering the board at 3.3V. It is crucial to ensure that the jumper switch is in the correct position according to the desired voltage to avoid possible damage to modules, components, and the board itself.

5.2.2 JST Connectors

The board features two 1mm JST connectors, linked to different pins. The first connector directly connects to GPIO 3.0 and 3.1 of the microcontroller, while the second one is linked to pins 3.2 and 1.5. Both connectors operate in parallel to the selected power supply voltage via the jumper switch. These connectors are compatible with QWIIC, STEMMA QT, or similar pin distribution protocols. It is essential to verify that the selector voltage matches the system voltage to avoid circuit damage. Additionally, these connectors allow the board to be powered and offer functionalities such as PWM and serial communication.

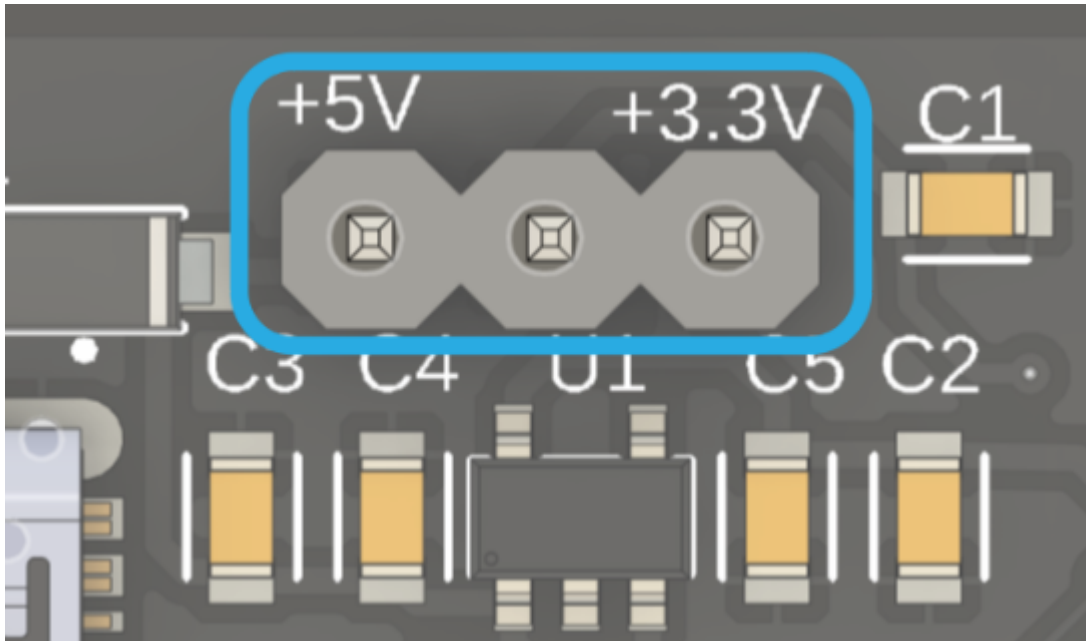


Fig. 5.1: USB Connector

5.2.3 Built-In LEDs

The board features two LEDs directly linked to the microcontroller. The first one is connected to pin 3.4, while the second one is a Neopixel LED connected to pin 3.3. This Neopixel provides an output with two headers, one connected to the data output and the other to the board's ground, allowing for the external connection of more LEDs. To use this output, simply connect the DOUT pin to the DIN pin of the next LED in the row. As for power supply, you can use the VCC pin, provided that the external LEDs can operate at this voltage. Otherwise, it will be necessary to power them using an external source.

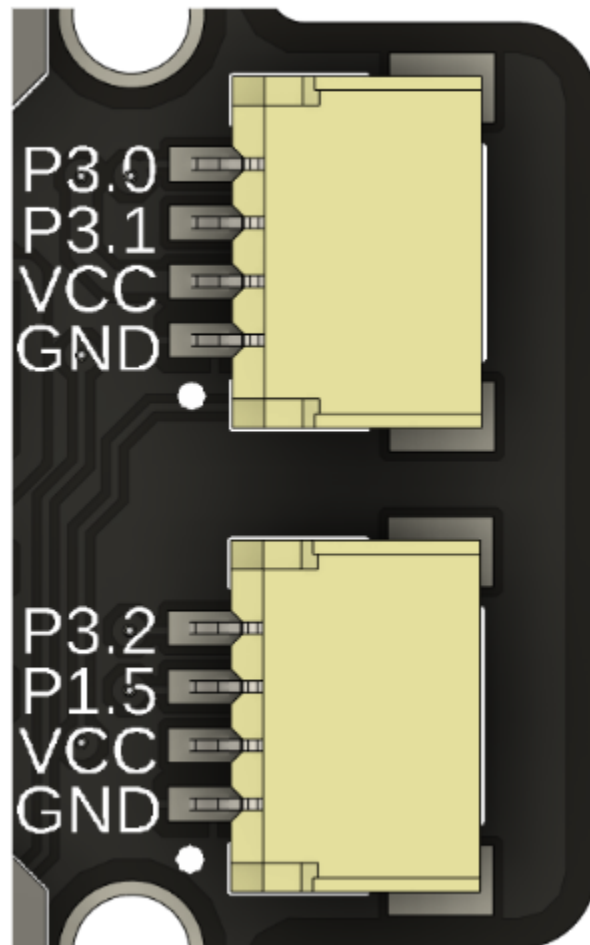


Fig. 5.2: JST Connectors

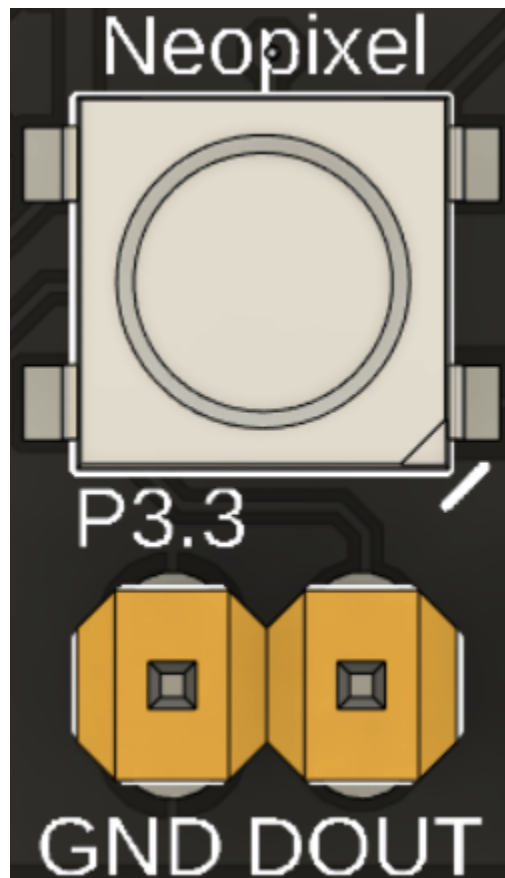


Fig. 5.3: Neopixel LED

ANALOG TO DIGITAL CONVERTER (ADC)

The CH552 has four ADC channels, which can be used to read analog values from sensors. The ADC channels are multiplexed with the GPIO pins, so you can use any GPIO pin as an ADC input. the distribution of the ADC channels is as follows.

Table 6.1: Pin Mapping

PIN	ADC Channel
A0	P1.1
A1	P1.4
A2	P1.5
A3	P3.2

The ADC has a resolution of 8 bits, which means it can read values from 0 to 255. The ADC can be configured to read values from 0 to 5V, or from 0 to 3.3V, depending on the VCC voltage:

```
#include "src/config.h" // user configurations
#include "src/system.h" // system functions
#include "src/gpio.h"   // for GPIO
#include "src/delay.h"  // for delays

void main(void)
{
    CLK_config();
    DLY_ms(5);

    ADC_input(PIN_ADC);

    ADC_enable();
    while (1)
    {
        int data = ADC_read(); // Assuming ADC_read() returns an int
    }
}
```


I2C (INTER-INTEGRATED CIRCUIT)

I2C is a serial communication protocol, so data is transferred bit by bit along a single wire (the SDA line). The SCL line is used to synchronize the data transfer. The I2C protocol is a master-slave protocol, which means that the communication is always initiated by the master device. A master device can communicate with one or multiple slave devices.

Note: The microcontroller use bit banging to communicate with the I2C devices.

All pin configurations are defined in the *config.h* file. The I2C pins are defined as follows

Table 7.1: I2C Pinout

PIN	I2C 1	I2C 2
SDA	P15	P31
SCLK	P32	P30

7.1 SSD1306 Display

The OLED display is a 128x64 pixel monochrome display that uses the I2C protocol for communication:

```
void beep(void) {
uint8_t i;
for(i=255; i; i--) {
    PIN_low(PIN_BUZZER);
    DLY_us(125);
    PIN_high(PIN_BUZZER);
    DLY_us(125);
}
}

void main(void) {
// Setup
CLK_config();           // configure system clock
DLY_ms(5);              // wait for clock to stabilize

OLED_init();            // init OLED

OLED_print("*  UNITElectronics  *");
```

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Fig. 7.1: SSD1306 Display

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```
OLED_print("-----\n");  
OLED_print("Ready\n");  
beep();  
while(1) {  
  
}  
}
```

INTERRUPTS

The CH552 microcontroller supports 14 sets of interrupt signal sources. These include 6 sets of interrupts (INT0, T0, INT1, T1, UART0, and T2), which are compatible with the standard MCS51, and 8 sets of extended interrupts (SPI0, TKEY, USB, ADC, UART1, PWMX, GPIO, and WDOG). The GPIO interrupt can be chosen from 7 I/O pins.

Table 8.1: Default priority sequence of interrupt sources

Interrupt src.	Entry addr.	Inter- rupt #	Description	Default prio. seq.
INT_NO_INT0	0x0003	0	External interrupt 0	High priority
INT_NO_TMR0	0x000B	1	Timer 0 interrupt	↓
INT_NO_INT1	0x0013	2	External interrupt 1	↓
INT_NO_TMR1	0x001B	3	Timer 1 interrupt	↓
INT_NO_UART0	0x0023	4	UART0 interrupt	↓
INT_NO_TMR2	0x002B	5	Timer 2 interrupt	↓
INT_NO_SPI0	0x0033	6	SPI0 interrupt	↓
INT_NO_TKEY	0x003B	7	Touch key timer interrupt	↓
INT_NO_USB	0x0043	8	USB interrupt	↓
INT_NO_ADC	0x004B	9	ADC interrupt	↓
INT_NO_UART1	0x0053	10	UART1 interrupt	↓
INT_NO_PWMX	0x005B	11	PWM1/PWM2 interrupt	↓
INT_NO_GPIO	0x0063	12	GPIO Interrupt	↓
INT_NO_WDOG	0x006B	13	Watchdog timer interrupt	Low priority

The interrupt priority is determined by the interrupt number.

8.1 Timer 0/1 Interrupts

Timer0 and Timer1 are 16-bit timers/counters controlled by TCON and TMOD. TCON is responsible for timer/counter T0 and T1 startup control, overflow interrupt, and external interrupt control. Each timer consists of dual 8-bit registers forming a 16-bit timing unit. Timer 0's high byte counter is TH0, and its low byte counter is TL0. Similarly, Timer 1's high byte counter is TH1, and its low byte counter is TL1. Timer 1 can also serve as the baud rate generator for UART0. code example:

```
void timer0_interrupt(void) __interrupt(INT_NO_TMR0)    /* Timer0 interrupt service_
↪ routine (ISR) */
{
    PIN_toggle(PIN_BUZZER);
    TH0 = 0xFF;    /* 50ms timer value */
}
```

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```

    TL0 = 0x00;
}

int main(void)
{
    CLK_config();
    DLY_ms(5);
    PIN_output(PIN_BUZZER);
    EA = 1;          /* Enable global interrupt */
    ET0 = 1;         /* Enable timer0 interrupt */

    TH0 = 0xFF;      /* 50ms timer value */
    TL0 = 0x00;
    TMOD = 0x01;     /* Timer0 model */
    TR0 = 1;         /* Start timer0 */
    while(1);
}

```

8.2 External Interrupts

INT0 and INT1 are external interrupt input pins. When an external interrupt occurs, the corresponding interrupt service routine is executed. The external interrupt can be triggered by the falling edge, rising edge, or both edges of the external interrupt input signal. The trigger mode is determined by the external interrupt input pin.

code example:

```

void ext0_interrupt(void) __interrupt(INT_NO_INT0)
{
    PIN_toggle(PIN_LED);
}

int main(void)
{
    CLK_config();
    DLY_ms(5);
    PIN_output_OD(PIN_INT);
    PIN_output(PIN_LED);

    EA = 1;          /* Enable global interrupt */
    EX0 = 1;         /* Enable INT0 */
    IT0 = 1;         /* INT0 is edge triggered */

    while(1)
    {
        // Do nothing
    }
}

```


PWM (PULSE WIDTH MODULATION)

The PWM module is used to generate a PWM signal on a pin. The PWM signal is generated by changing the duty cycle of the signal. The duty cycle is the ratio of the time the signal is high to the total time of the signal. The PWM module can be used to control the brightness of an LED, the speed of a motor, or the position of a servo motor.

The board contain two PWM pins, which are PIN_PWM and PIN_PWM2. The PWM module can be used to generate a PWM signal on these pins:

```
PWM 1 : P30/P15
PWM 2 : P31/P34
```

Some of the functions provided by the PWM module are:

```
#define MIN_COUNTER 10
#define MAX_COUNTER 254
#define STEP_SIZE 10

void change_pwm(int hex_value)
{
    PWM_write(PIN_PWM, hex_value);
}

void main(void)
{
    CLK_config();
    DLY_ms(5);
    PWM_set_freq(1);
    PIN_output(PIN_PWM);
    PWM_start(PIN_PWM);
    PWM_write(PIN_PWM, 0);
    while (1)
    {
        for (int i = MIN_COUNTER; i < MAX_COUNTER; i+=STEP_SIZE)
        {
            change_pwm(i);
            DLY_ms(20);
        }
        for (int i = MAX_COUNTER; i > MIN_COUNTER; i-=STEP_SIZE)
        {
            change_pwm(i);
            DLY_ms(20);
        }
    }
}
```

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```
}
```

WS2812

This is a simple library for controlling WS2812 LEDs with an CH552 microcontroller. It is based on the [WS2812 datasheet](#) and the [CH552 datasheet](#).

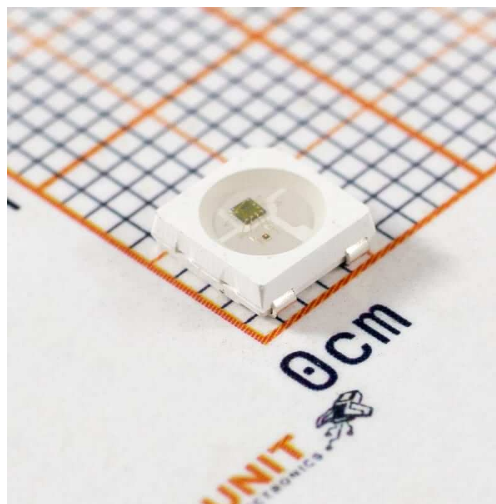


Fig. 10.1: WS2812 LED Strip

Table 10.1: Pin Mapping for WS2812

PIN	GPIO CH552
DOUT	P3.3

```
#define delay 100
#define NeoPixel 16 // Number Neopixel conect
#define level 100 // Illumination level 0 to 255

void randomColorSequence(void) {
    for(int j=0;j<NeoPixel;j++){
        uint8_t red = rand() % level;
        uint8_t green = rand() % level;
        uint8_t blue = rand() % level;
        uint8_t num = rand() % NeoPixel;
```

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```

    for(int i=0; i<num; i++){
        NEO_writeColor(0, 0, 0);
    }
    NEO_writeColor(red, green, blue);
    DLY_ms(delay);
    NEO_writeColor(0, 0, 0);
}

for(int l=0; l<9; l++){
    NEO_writeColor(0, 0, 0);
}

}

void colorSequence(void) {

for(int j=0; j<=NeoPixel; j++){
    uint8_t red = rand() % level;
    uint8_t green = rand() % level;
    uint8_t blue = rand() % level;
    for(int i=0; i<j; i++){
        NEO_writeColor(red, green, blue);
    }
    DLY_ms(delay);
    for(int l=0; l<j; l++){
        NEO_writeColor(0, 0, 0);
    }
}
}

// =====
// Main Function
// =====

void main(void) {
NEO_init();           // init NeoPixels
CLK_config();         // configure system clock
DLY_ms(delay);        // wait for clock to settle

// Loop
while (1) {
    randomColorSequence();
    DLY_ms(100);
    colorSequence();
    DLY_ms(100);
}
}

```