ECE3411 – Fall 2016

Lab 2a.

AVR Board Setup
General Purpose Digital Output

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Adopted from Lab 2a slides "AVR Board Setup General Purpose Digital Output" by Marten van Dijk and Syed Kamran Haider, Fall 2015.

Development Board Setup

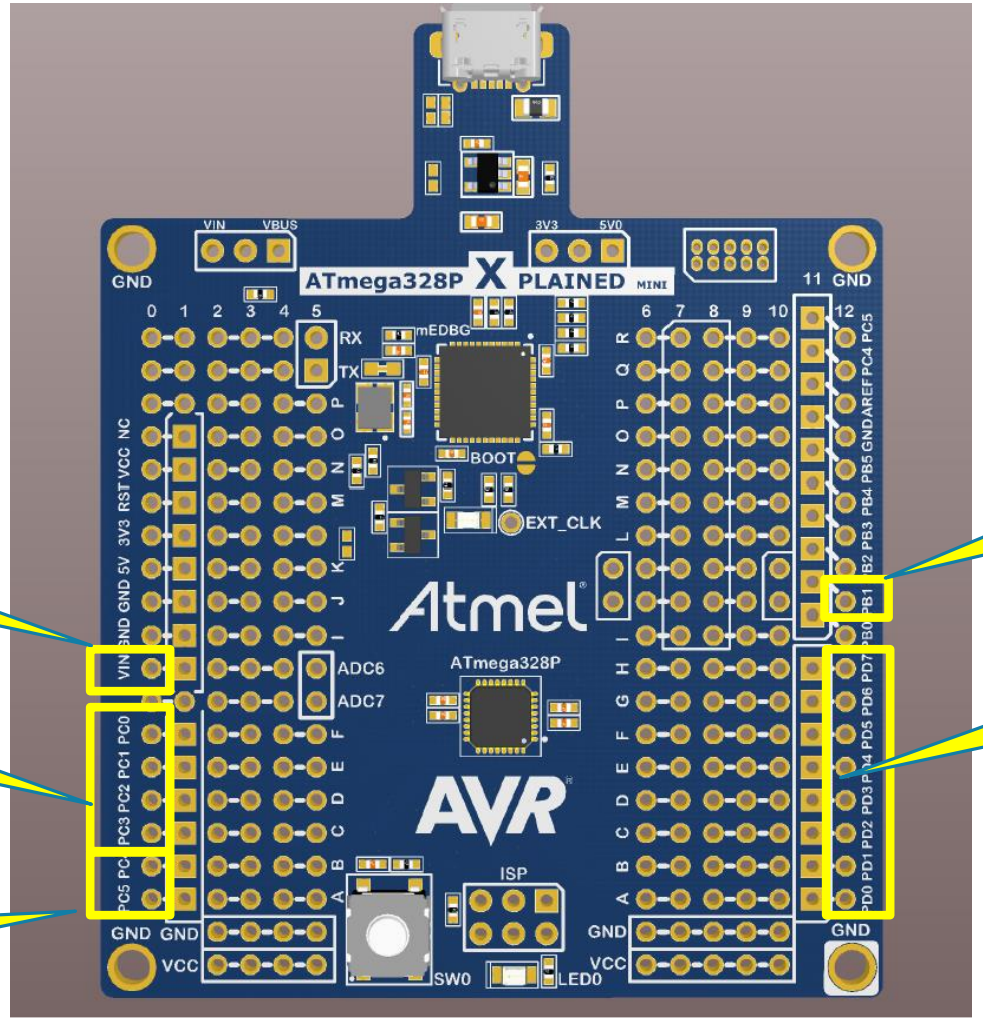
Development Board Setup has three steps

1. Soldering connectors for Xplained Mini kit
2. Soldering connectors for LCD
3. Putting everything together on the breadboard

Basics of Soldering

1. Heat the iron to 750F.
2. The LED will stop blinking once the iron has reached the desired temperature.
3. Heat the pad briefly.
4. With the iron sitting on the pad, push solder into the tip of the soldering iron.

ATmega328P Xplained Mini Pin Allocation



VIN
5V Input

PC0-PC3
LCD Data Pins

PC4-PC5
LCD Control Pins

PB1
External Switch

PD0-PD7
External LEDs

Initial board setup

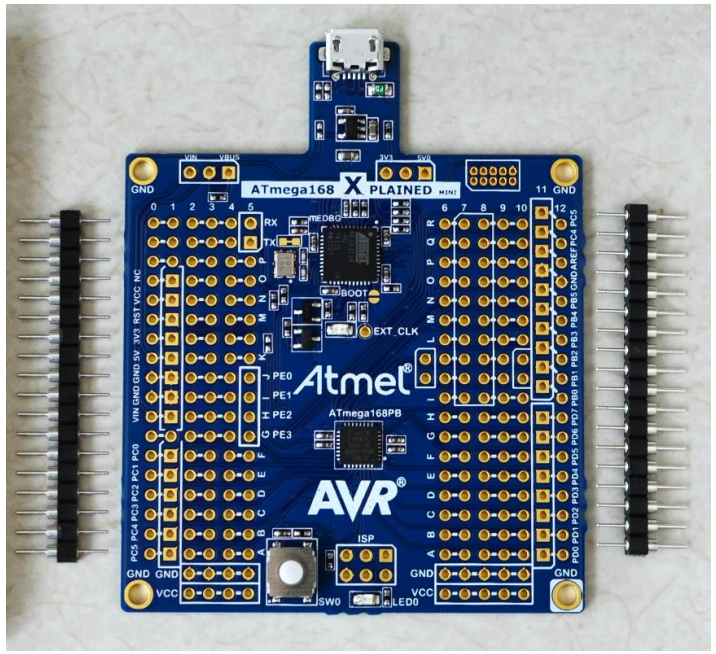
- Setup Atmel studio
  - Atmel Studio is available for download at the following link: http://www.atmel.com/tools/ATMELSTUDIO.aspx
  - You need to download **"Atmel Studio 6.2 sp2 (build 1563) Installer"** which is the first one in the list of available downloads
- As general guidelines for installation and getting familiar with Atmel Studio, please follow the Getting_Started_with_ATmega168PB_Application_Note.pdf document (from page 7 onward) posted under General Resources section.
  - Although this document targets ATmega168PB Xplained Mini kit, the exact same steps apply for ATmega328P Xplained Mini kit.
- Before you start soldering the board make sure the board is working fine.
  - Get the test code provided on the next slide working for your board.

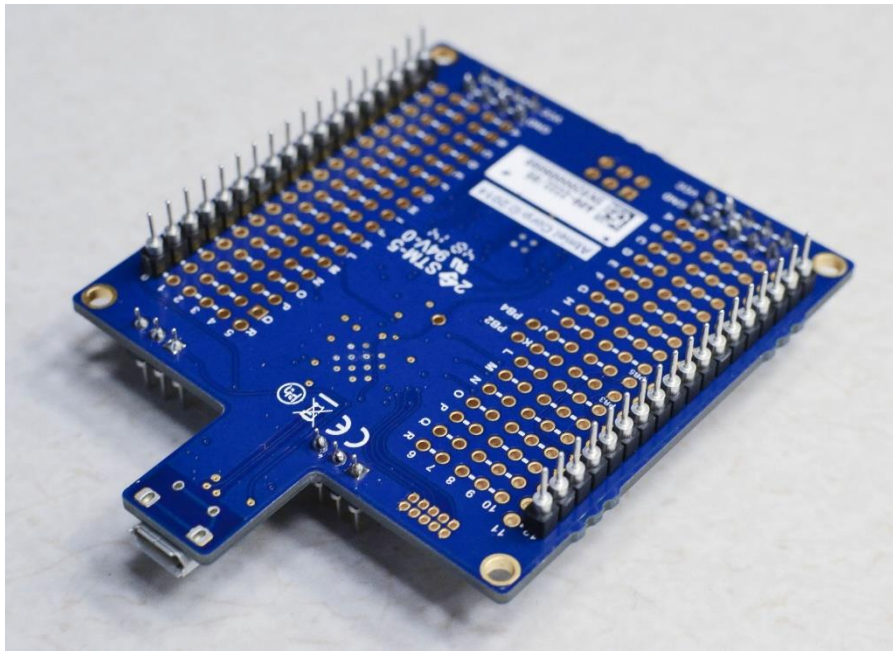
Test code

```
#include <avr/io.h>
int main(void)
{
//configure LED pin as output
DDRB |= 1<<DDB5;
   while(1)
    {
        /* check the button status (press - 0 , release - 1 ) */
        if(!(PINB & (1<<PINB7))) {
              /* switch off (0) the LED until key is pressed */
              PORTB &= ~(1<<PORTB5);
        }
        else {
              /* switch on (1) the LED*/
              PORTB |= 1<<PORTB5;
        }
    } return 0;
}
```

Soldering connectors for Xplained Mini kit

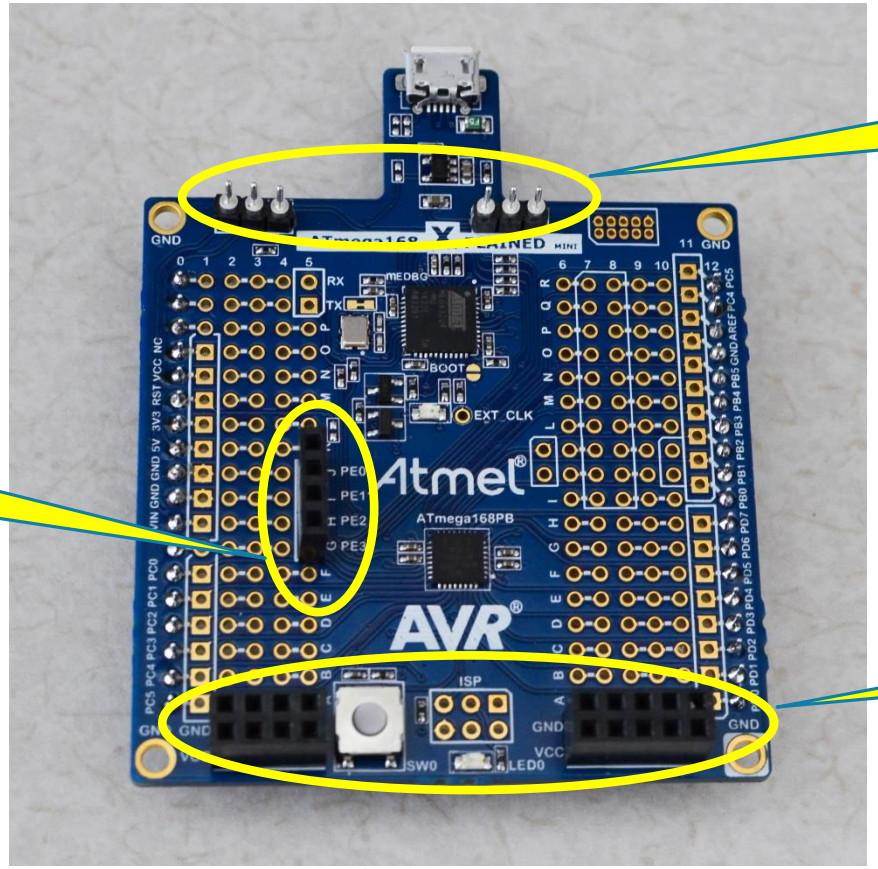
- Take 2 male headers each of 18-pins.
- Insert the thin side of the headers to outermost ports on both left and right side as shown in the bottom view of Xplained Mini.
- Solder the headers to the Xplained Mini pads from the top.





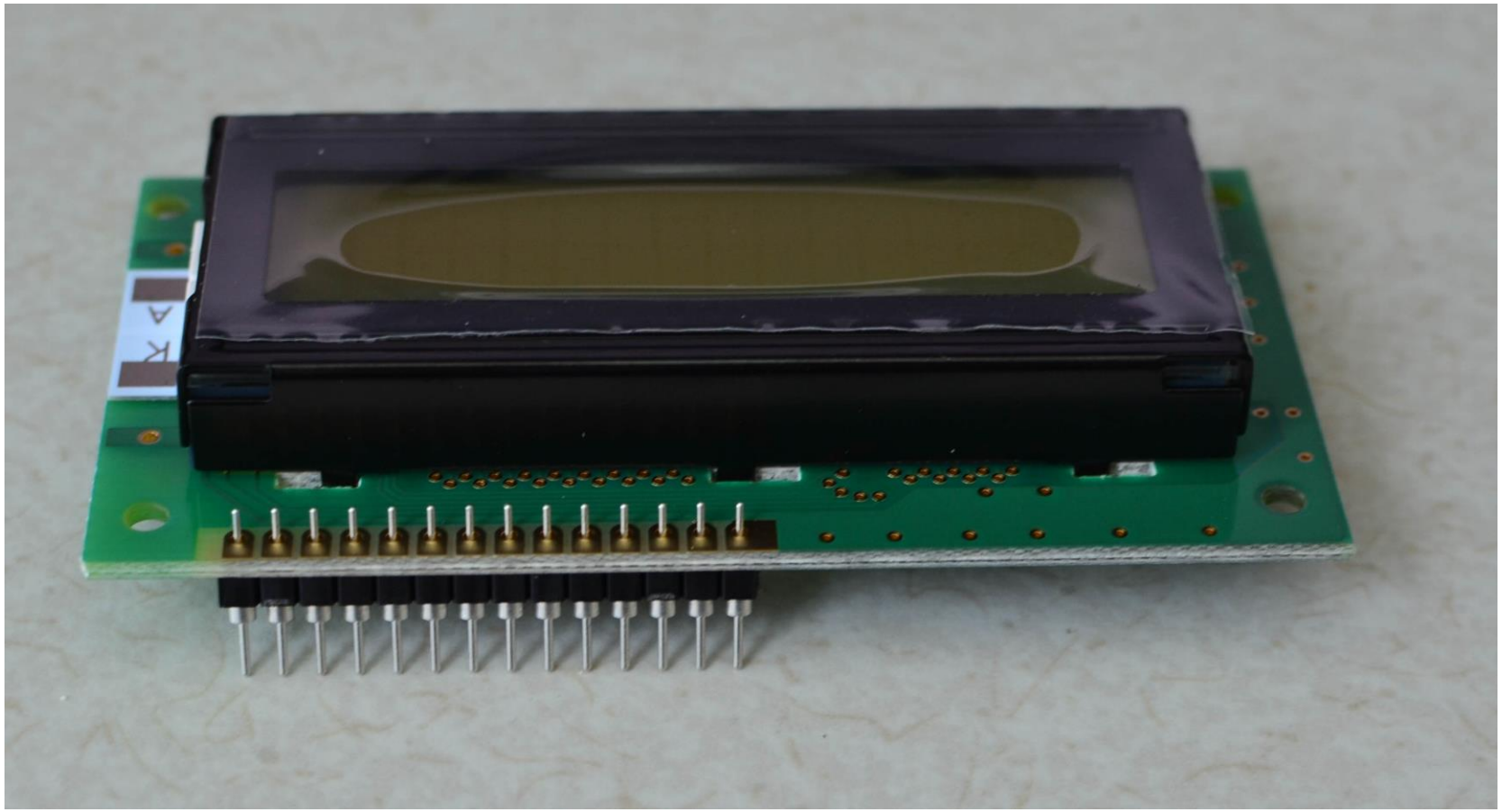
Soldering connectors for Xplained Mini kit

- Insert two 3-pin male headers from the top as shown, and solder from the bottom.
- Similarly Insert the three female headers from the top and solder from the bottom.



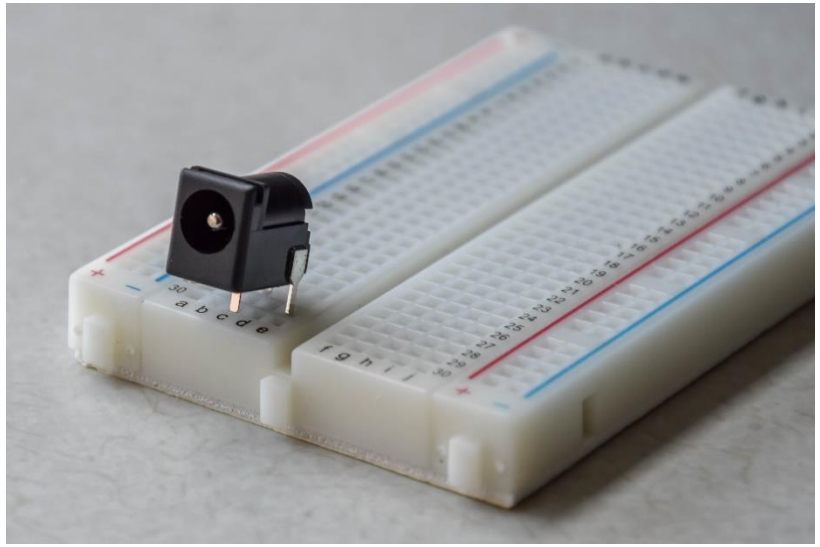
Soldering the Connectors for LCD

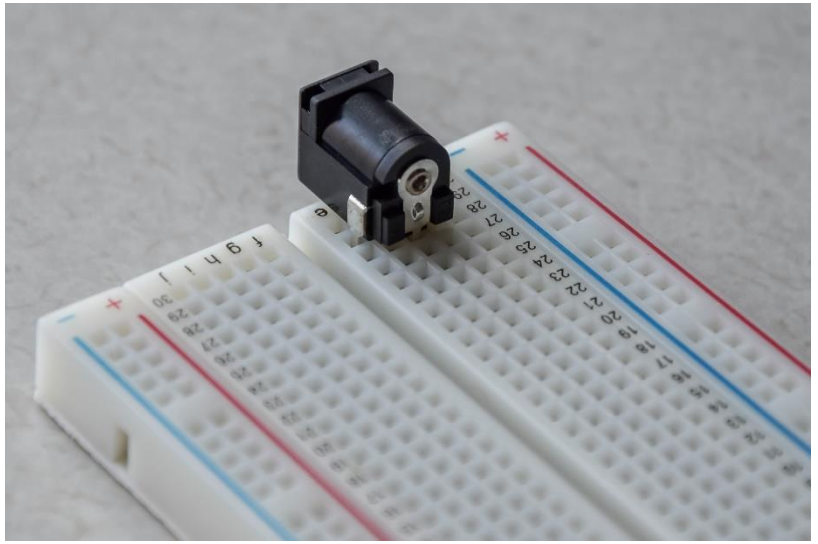
- Insert a 14-pin male header in LCD pads from the bottom and solder from the top.



Wiring the Breadboard (1)

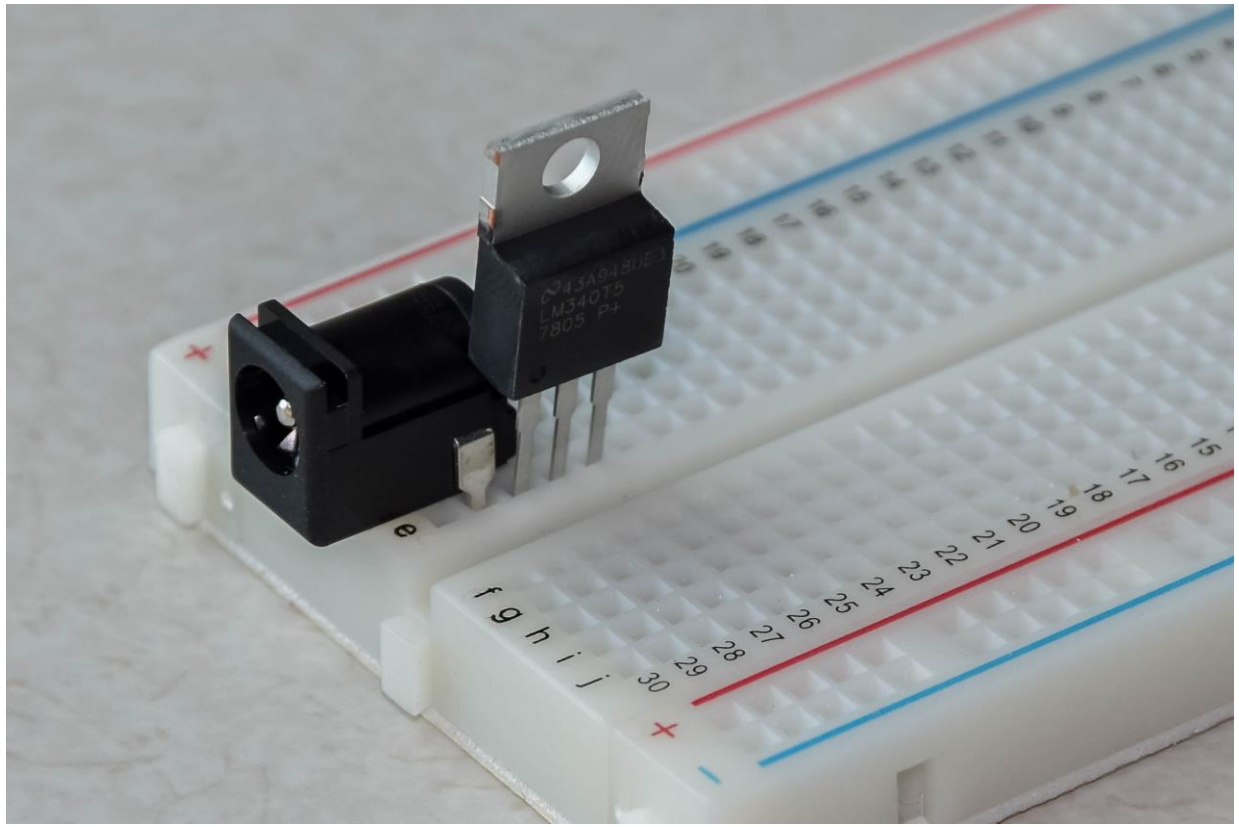
- Start with inserting the DC Power Jack pins into rows 28, 29, 30 and columns ‘c’ and ‘e’.





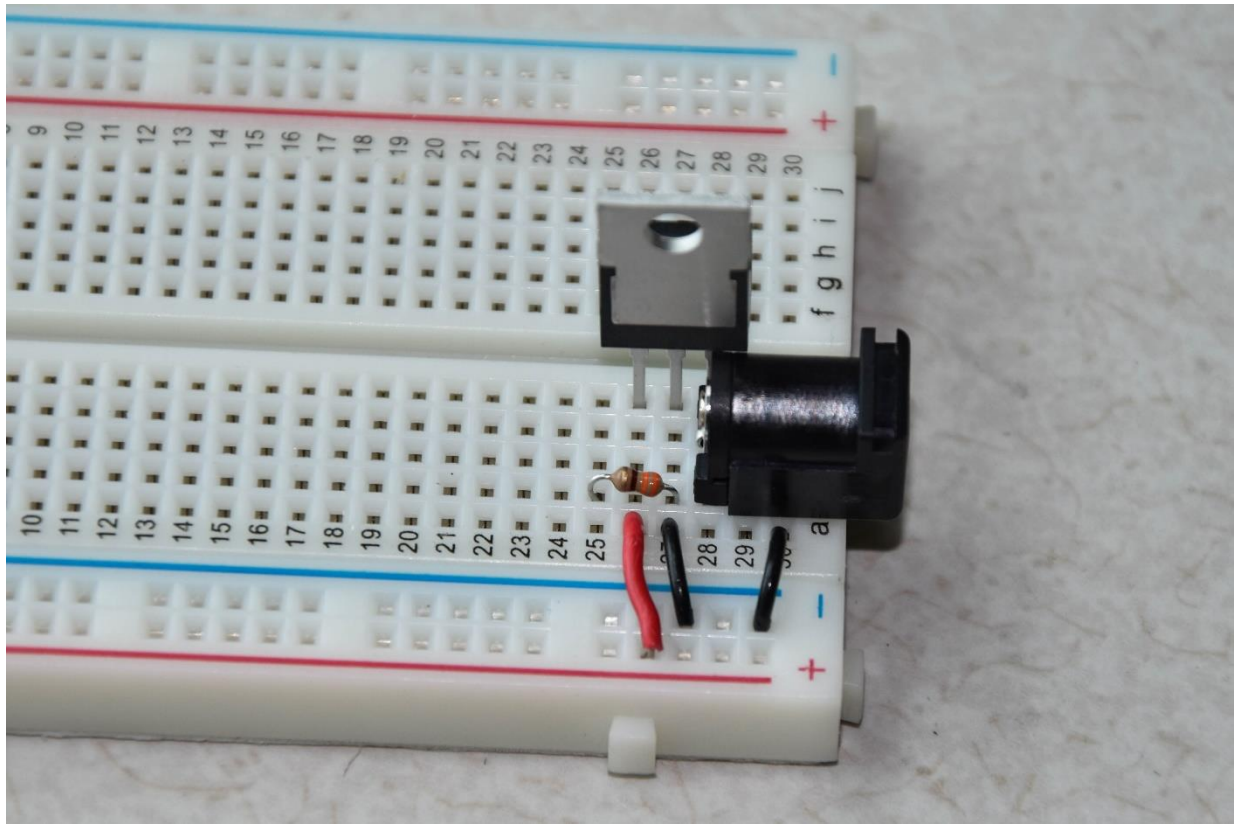
Wiring the Breadboard (2)

- Insert the 5V Regulator (7805) into rows 26, 27, 28 and column ‘e’ EXACTLY as shown in the figure.



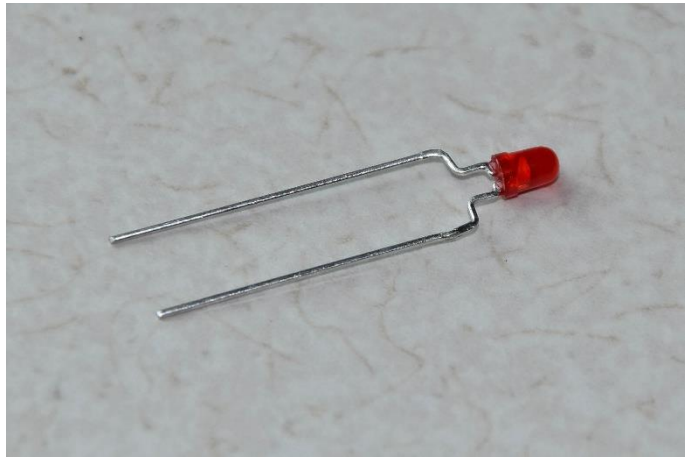
Wiring the Breadboard (3)

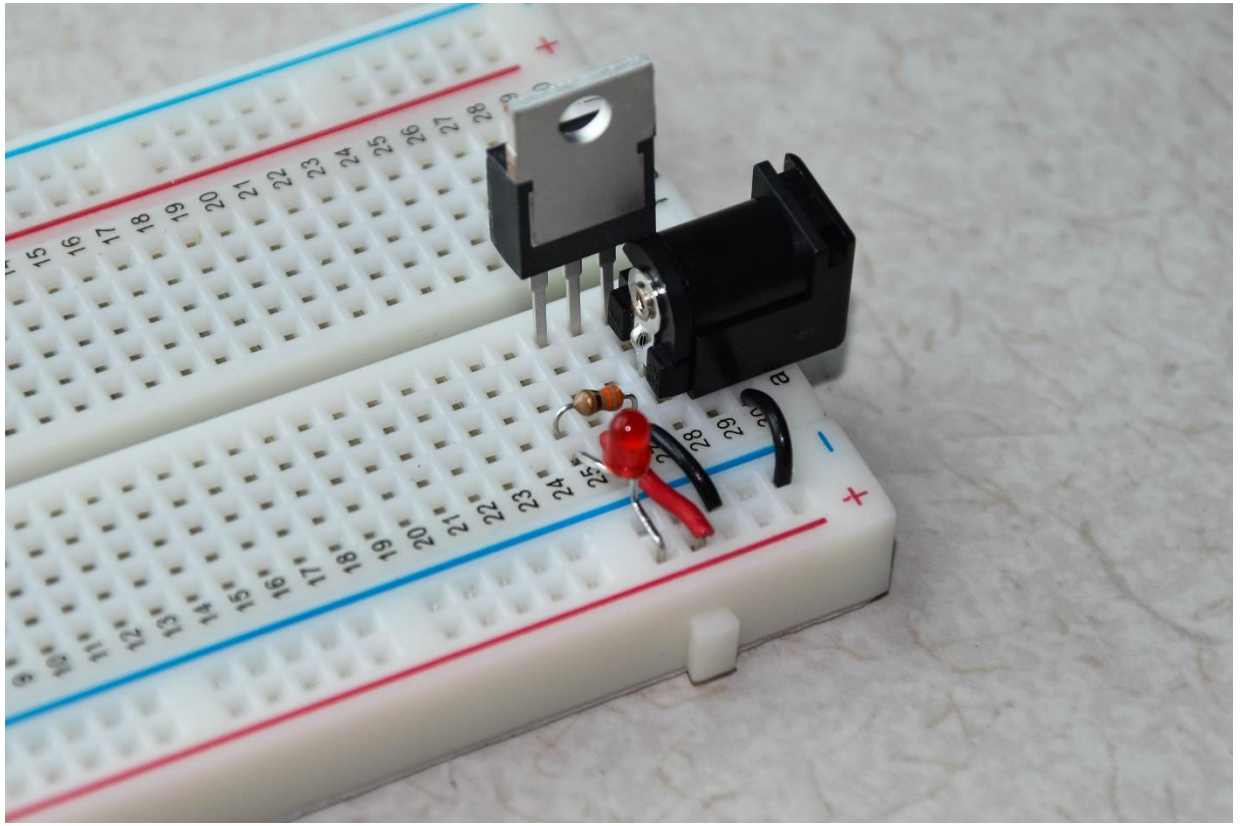
- Connect a 330 Ohm resistance and VCC (+) and GND (-) wires as shown in the figure.



Wiring the Breadboard (4)

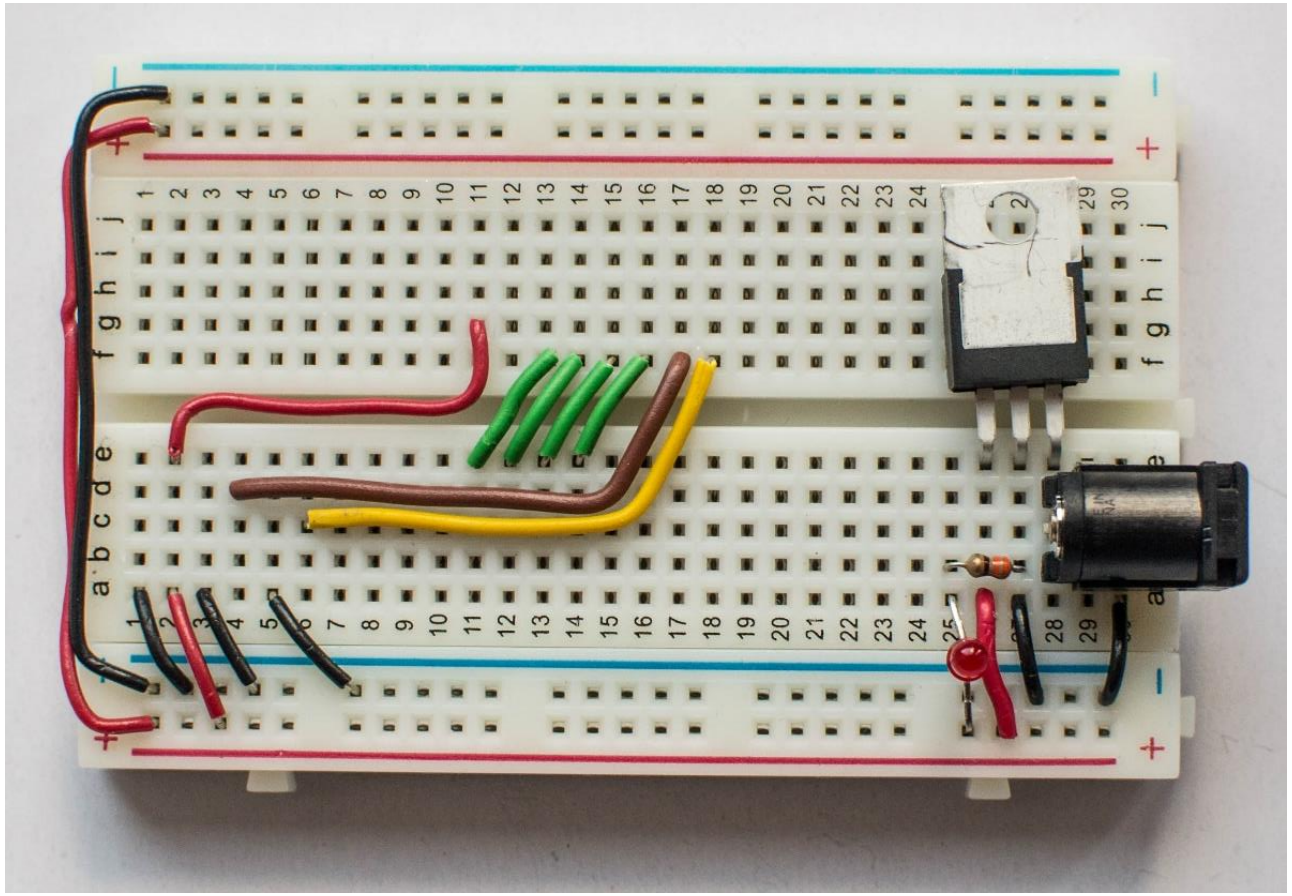
- Insert long end of a LED in VCC (+) and short end in row 25.
- This LED is lit up whenever power is supplied to the board.





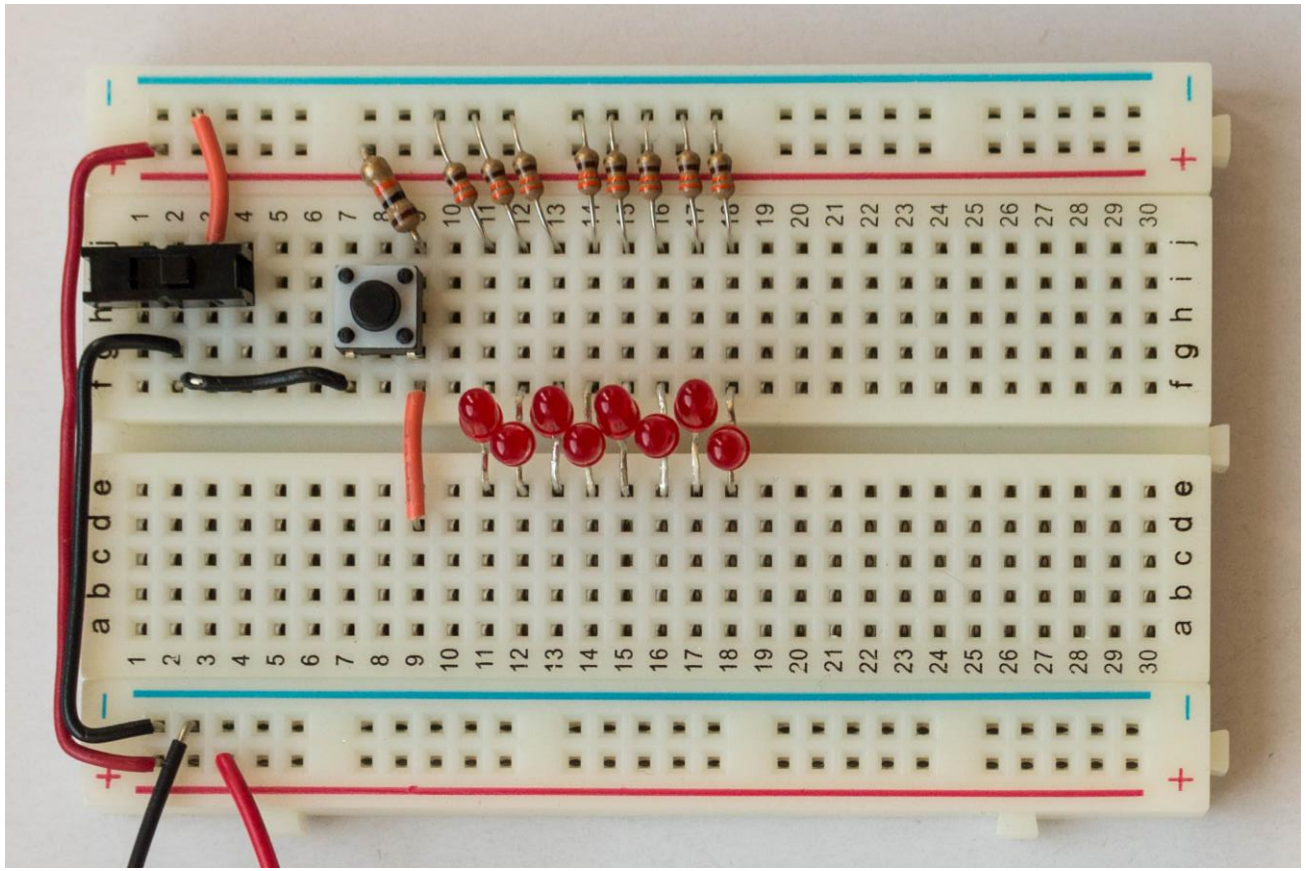
Wiring the Breadboard (5)

- Connect the rest of the wires as shown in the figure.



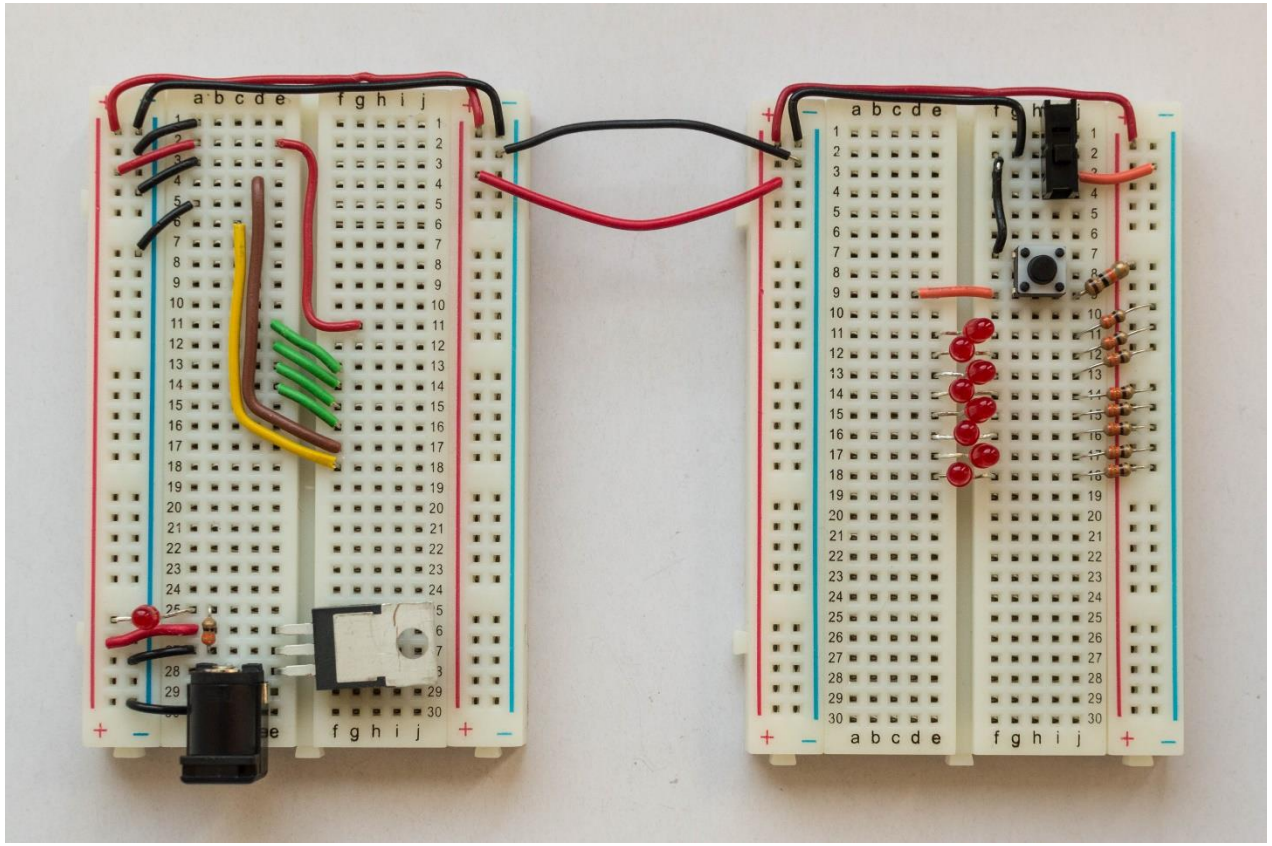
Wiring the Breadboard (6)

- On the second breadboard, connect eight LEDs, eight 330 Ohm resistors, 10 kOhm resistor, push switch, slider switch and other wires as shown in the figure.

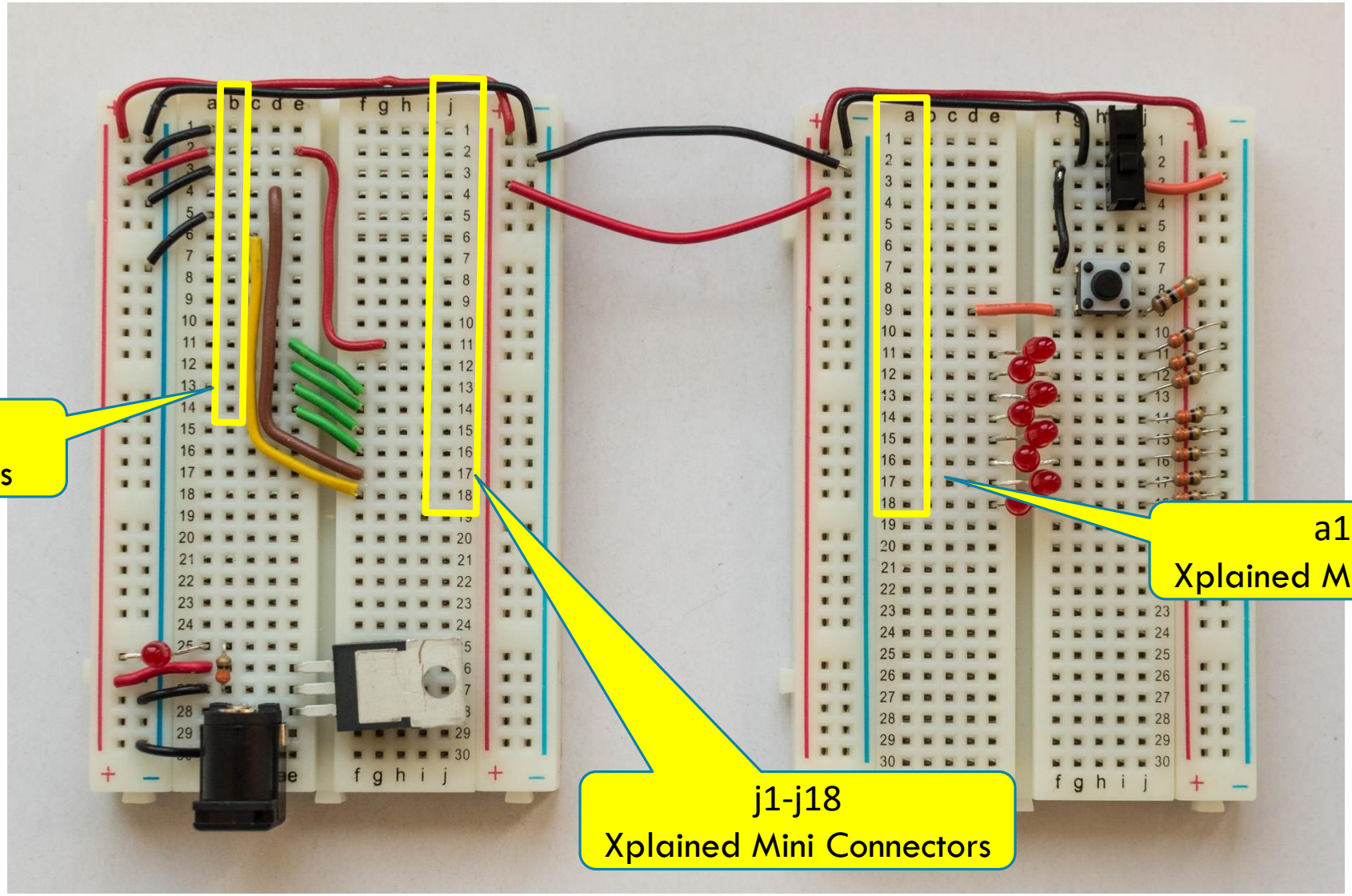


Wiring the Breadboard (7)

- Connect the two breadboards together by supplying VCC and GND from the left board to the right one.

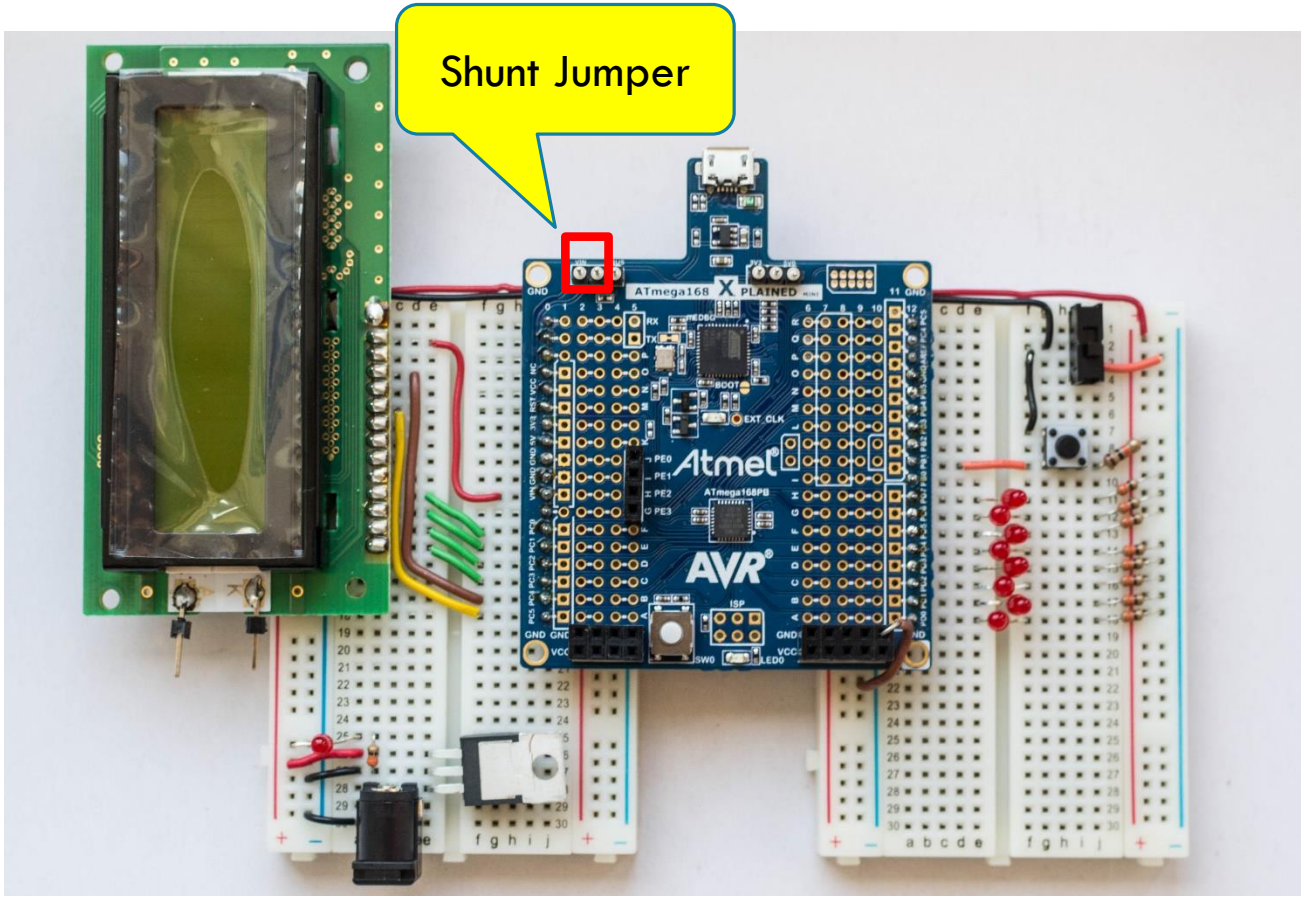


Wiring the Breadboard (8)



Putting everything together…

- Insert the left headers of Xplained Mini into column ‘j’ & rows 1-18 of left breadboard.
- Insert the right headers of Xplained Mini into column ‘a’ & rows 1-18 of right breadboard.
- Position the LCD outward and Insert its headers into column ‘b’ & rows 1-14 of left breadboard.
- Connect the right female GND header of Xplained Mini with the right breadboard’s ground (-).
- Put a Shunt-Jumper to short the two pins indicated in order to power up the board using external adapter.



Test Code

```
// ------- Preamble -------- //
#define F_CPU 16000000UL /* Tells the Clock Freq to the Compiler. */
#include <avr/io.h>            /* Defines pins, ports etc. */
#include <util/delay.h>        /* Functions to waste time */
int main(void) {
    // -------- Inits --------- //
    /* Data Direction Register D: Setting Port D as output. */
            DDRD = 0b11111111;
    // ------ Event loop ------ //
    while (1) {
        PORTD = 0b01010101;  /* Turn on alternate LEDs in PORTD */
        _delay_ms(1000);          /* wait for 1 second */
        PORTD = 0b10101010;  /* Toggle the LEDs */
        _delay_ms(1000);          /* wait for 1 second */
    } /* End event loop */
    return (0); /* This line is never reached */
}
```

Task 1: Blinking a single LED

- Blink a single LED at two different rates based on a push switch.
  - When the switch is not pressed, LED should blink at 2Hz frequency.
  - As long as the switch is pressed, LED should blink at 8Hz frequency.
- The blinking duty cycle should be 50%
  - E.g. for 2Hz frequency, the LED should be on for $1/4^{th}$ of a second, then off for next $1/4^{th}$ of a second and so on.
- You may use the on-board LED and push switch for this task.

Task 2: Blinking 8 LEDs one after another

Extend the Task1 with another switch which activates the blinking to loop through all 8 LEDs one after another.

- When the system starts, LED 0 is active and blinks at 2Hz.
- As long as switch 1 is pressed, the currently active LED blinks at 8Hz. Otherwise it blinks at 2Hz.
- As long as switch 2 is pressed, the currently active LED keeps shifting towards left at the frequency depending upon the position of switch 1, and starts from 0 again.
  - E.g. if LED 0 is active currently, pressing switch 2 shifts the blinking to LED 1, 2, 3, … , 7 and then again LED 0 and so on.
- When switch 2 is released, the last active LED should keep blinking without anymore shifting.