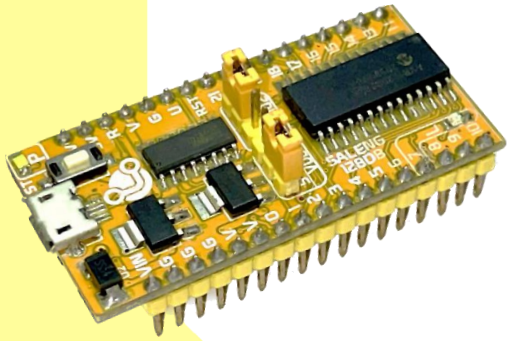
OVERVIEW

The Saleng 128DB is an Arduino compatible board based on the new generation AVR128DB microcontroller under the modern AVR® family. The CPU runs at a maximum of 24MHz. It has a flash memory size of 128KB, 16KB SRAM, 512B EEPROM and 32B User row. The microcontroller features four 16-bit timers plus a 12-bit timer, 3 hardware serial ports (UART), 12-bit ADCs or Analog pins, a DAC capable pin, internal zero cross detectors and op-amps, configurable custom logic and several other improvements from the "classic" chips such as those used in the Arduino Uno/Nano and Mega.

The Board comes with a total of 21 GPIO's on board with standard 2.54mm-pitched pin headers. 9 of the 21 pins may be used as analog input pins (ADC) with one DAC pin. 9 may be used for simultaneous PWM and all but two GPIOs are external interrupt capable.

Programming may be done via the onboard micro-USB pin. Advance users may also access the exposed UPDI programming pin at the pin headers. The board comes with the usual reset button and the Arduino-Built-In-LED on pin D7.

The Saleng 128DB has a selectable operating voltage of 5V or 3.3V via the on-board micro jumper. Another jumper is included to allow user selection of the Multi-Voltage I/O operating voltage (VDDIO2) between 5V or 3.3V which may act as built-in level-shifters.



FEATURES

- AVR128DB28 Microcontroller
- Modern AVR architecture
- CPU Clock Frequency of up to 24MHz
- 16KB of SRAM Size
- 128KB of Flash Size
- 512 Bytes of EEPROM Memory
- Total of 21 GPIO pins
- 11 pins are capable of generating PWM signals
- 9 Analog Pins with 12bit ADC
- Mixed operating voltage of 3.3- and 5-volts via the MVIOs
- Compatible with the Arduino IDE
- Alternate UART and I2C Interface
- Small form factor of 25mmx50mm PCB size
- Power indicator LED, "L" LED
- Affordable price

TECHNICAL SPECIFICATIONS SUMMARY

SALENG 128DB SPECIFICATION	
Clock Frequency	24MHz
Flash Memory	128KB
SRAM	16KB
EEPROM	512B
User Row Memory	32B
Total GPIOs	21
Max simultaneous PWM outputs	9
External Interrupt Pins	19
Language/IDE	C/C++ / Arduino IDE
DC Input Voltage Range via Vin header	6.5 - 12V Recommended
Direct Breadboard Compatibility (bottom male headers)	Yes
5V regulator current rating	1A
3.3V regulator current rating	1A
Selectable operating voltage	Yes via microjumper, 5V or 3.3V
500mA PTC fuse on USB port	Available
Timers	4x 16-bit + 1x 12bit
Hardware Serial (UART)	3
Alternate UART Pins	Available
SPI port	Available
I2C port	Available
Alternate I2C pins	Available
10-bit DAC	1
Analog Comparator	3
Multi-Voltage IO pins (5V/3.3V)	4
Zero-Cross Detectors	2
On-chip Op amp	2
Custom Logic Blocks	4
Event System channels	8 channels
Breadboard Compatible	Yes
Bootloaded	Yes (Serial 0)
On Board LEDs	Power and "L"

BASIC PIN FUNCTIONS

POWER
GROUND
PORT PIN
ARDUINO PIN
ANALOG
PWM OUTPUT
MULTIVOLTAGE IO PIN
DEFAULT SERIES INTERFACE
ALT. 1 SERIAL INTERFACE

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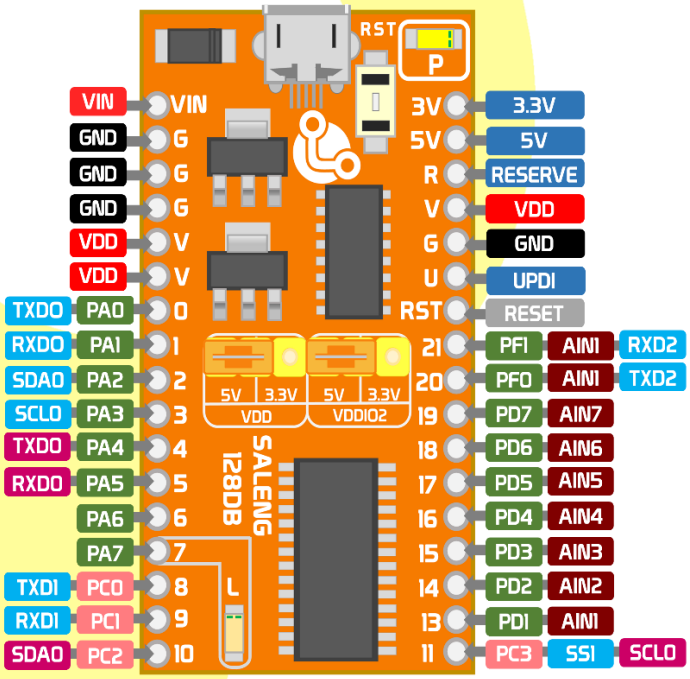


Note: A more elaborate pinout diagram can be seen on the section "DETAILED PINOUTS"

PIN FUNCTION SUMMARY

The table below describes the function of all of the pins on the main header.

Board Label	Pin Function
VIN	DC power input. 6-12V. Minimum 6.5V recommended.
G	Ground
V	VDD pin. This will follow the setting of the microjumper on the VDD pin header.
5V	Output of the 5.0V regulator. This is independent of the microjumper on the VDD pin header.
3V	Output of the 3.3V regulator. This is independent of the micro jumper on the VDD pin header.
RST	Reset Pin.
U	Unified Program and Debug Interface (UPDI)
R	Reserved. Do not use.
0 to 21	GPIO pins - all of which are digital-only I/Os except for pins 13 – 21 which may be used as analog or digital I/O's. Note: There is no pin 12 due to hardware limitations.

See the "Hardware Peripherals" section for a detailed description of of the GPIO pins.

OPERATING VOLTAGE ORIENTATION

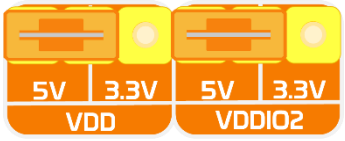
The user may change the operating voltage of the Saleng 128DB board by adjusting the orientation of microjumper at the **VDD** header located at the center of the board. This will affect all V pins and GPIO's except the 4 MVIO pins whose operating voltage will depend on the microjumper orientation at the **VDDIO2** pins header. These four pins are as follows:

MODE	PINS
VDDIO2	8, 9, 10, 12

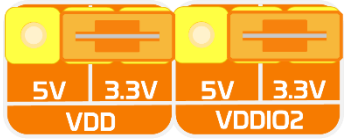
***Note:** The two jumper wires must always be installed.*

There are 4 possible arrangements that can be used:

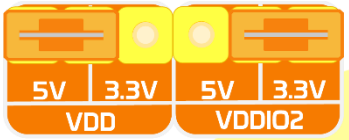
1. VDD and VDDIO2 both uses 5 volts.



2. VDD and VDDIO2 both uses 3.3 volts.



3. VDD uses 5 volts while VDDIO2 uses 3.3 volts.



4. VDD uses 3.3 volts while VDDIO2 uses 5 volts.

POWER REQUIREMENTS AND OPTIONS

The board may be powered from the following options.

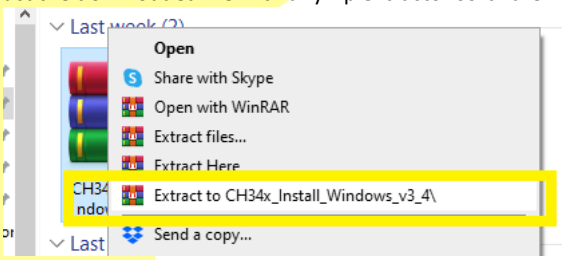
- **MicroUSB port –** the board is powered when plugged into the USB port of a computer or any power supply. Please ensure you are using a 5V power supply / charger / power bank. The port is designed for a maximum of 500mA only. A resettable fuse is installed in this port.

USB DRIVER INSTALLATION

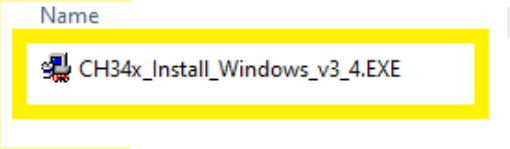
Saleng 128DB requires installation of the CH340 driver which is widely available for download online. This is required by the computer to recognize the board as a COM port (in Windows). Below is a step-by-step guide to install the driver:

1. Download the latest version of the driver from the following:
   Windows:
   https://layadcircuits.com/ds/SalengUno/drivers/CH341SER.ZIP
   Mac:
   https://layadcircuits.com/ds/SalengUno/drivers/CH341SER_MAC.ZIP
   Linux: built-in

2. Extract the downloaded file with any zip extractor software



3. Run the installer.

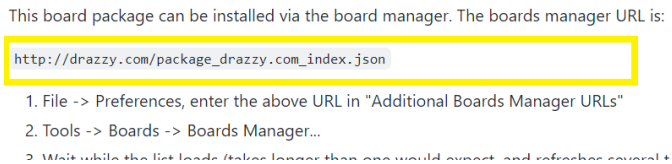


4. On the window that pops up, click on the Install Button.
5. Wait until installation is complete. Note that if you previously installed the driver, the installation may report a "failed" installation. If there is a need to reinstall, please uninstall first then reinstall.
6. Reboot the computer.
7. After reboot, insert the Saleng 128DB into one of the USB ports of the computer. The computer should now recognize the board. In Windows, the board will appear as a COM port under Ports in the Device Manager window.

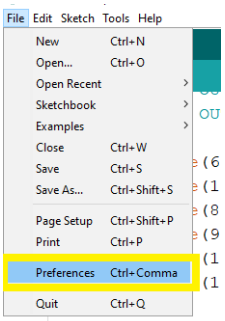
ADDING THE SALENG 128DBS BOARD IN THE ARDUINO IDE

The Saleng 128DB requires installation of the core files to allow usage with the Arduino IDE. If interested, the core files are maintained in this repository:
https://github.com/SpenceKonde/DxCore.

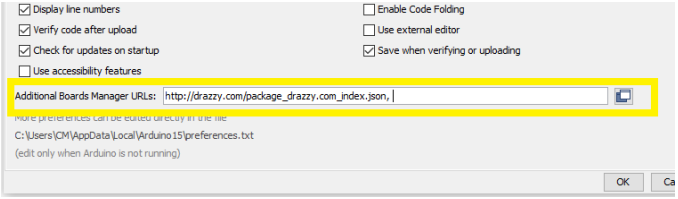
Below is a step-by-step instruction on how to install the board:
Step 1: Copy the Link below or that from the repository:
http://drazzy.com/package_drazzy.com_index.json



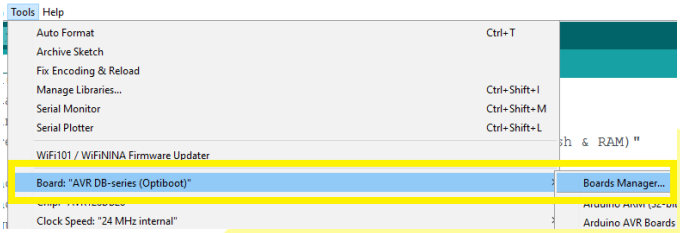
Step 2: After copying the link, Open Arduino IDE. Go to File > Preferences.



Step 3: Paste the link inside the Box beside "Additional Boards Manager URLs:" then Click "OK". Separate with commas if there are other board links.

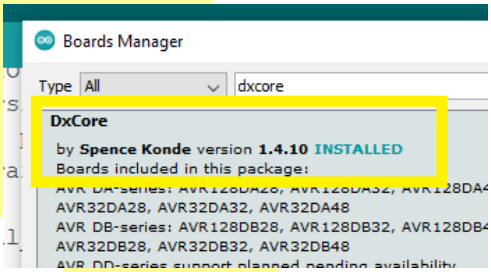


Step 4: Go to Tools > Board > Boards Manager



Step 5: Wait for the Platforms index to finish downloading.

Step 6: Look for DxCore (You can search it on "filter your search", just type 'DxCore') then click "Install". Wait until the core is successfully installed.



FIRST UPLOAD / TEST UPLOAD

To confirm successful installation of the core and to test the board, follow the steps below to upload the "blink" sketch.

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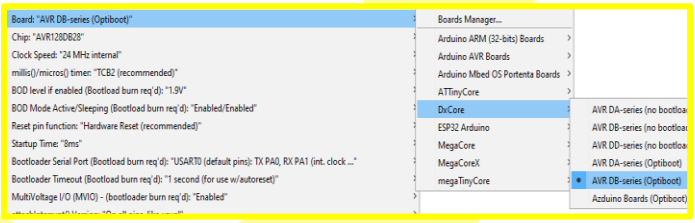
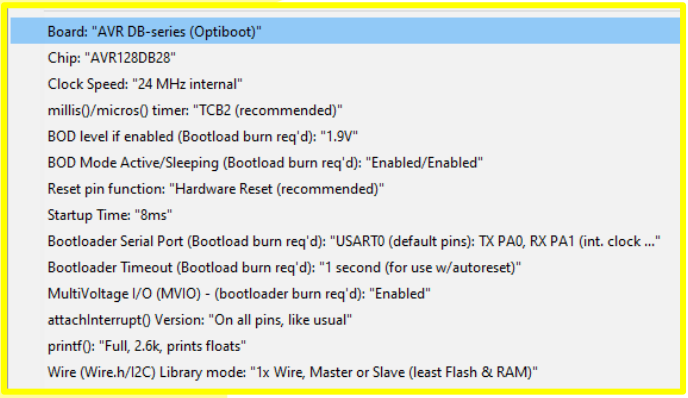
Step 1: Go to Tools > Board > DxCore and choose "AVR DB – series (optiboot)"



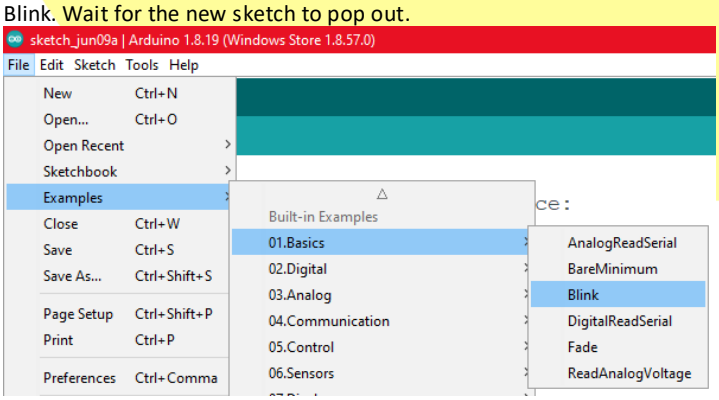
Step 2: Follow the board settings below. The options and arrangement of these settings may vary in the future but as a general rule, set the Bootloader Serial Port to "USART0" and the printf() to "Full…" and keep the rest in default position.



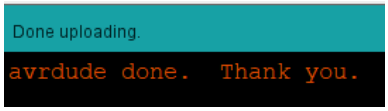
Step 3: Check your Port, make sure that your board is connected. Go to tools > Port > Serial Port and select the port number associated to your board. Note that the port number is assigned by your computer's OS and may change between USB ports.

Note: Install CH340 driver if the port associated with the board does not appear on the dropdown list under Tools>Ports

Step 4: After choosing your port, Go to File > Examples > 01. Basics > Blink. Wait for the new sketch to pop out.



Step 3: Run the code and wait for the code to finish uploading.



Step 4: Check your Saleng 128DB if its blinking based on the code.

Congratulations! You have successfully programmed your Saleng 128DB.

PERIPHERALS

The following section discusses the different peripherals available in the Saleng 128DB with emphasis on the hardware/software features not available in the "classic" boards such as the Arduino Uno/Nano/Mega.

GENERAL PURPOSE I/Os (GPIOs)

There is a total of 21 GPIOs on the board following the classic labelling style from "0" to "21". There is no pin 12. Below is a summary of the important details. Rows in **blue** are digital I/Os capable pins while those in **orange** are digital and analog capable I/Os. See also the "Detailed Pinout" section.

Board Label	Typical Function/s	Notes
0	Digital I/O, TXD0. This is the transmit pin of the "Serial" port connected to the microUSB port and used for uploading sketches and for printing output into the Serial Monitor	Serial / Serial0 / HardwareSerial 0 / USART0. It is recommended not to use HardwareSerial 0 pins unless absolutely required. If used for other purposes, it is recommended to momentarily disconnect the circuit/components attached to it while uploading.
1	Digital I/O, RXD0. This is the receive pin of the "Serial" (Serial0 / HardwareSerial 0/USART0) connected to the microUSB port and used for uploading sketches and for printing output into the Serial Monitor	
2	Digital I/O, SDA, PWM capable	I2C port
3	Digital I/O, SCL, PWM capable	
4	Digital I/O, MOSI, PWM capable, alternate pin for TXD0	SPI port
5	Digital I/O, MISO, PWM capable, alternate pin for RXD0	
6	Digital I/O, PWM capable, SCK	
7	Digital I/O, PWM capable, SS. Hardwired to the **"L" LED**	
8	Digital I/O, TXD1, MVIO. This is the transmit pin of the "Serial1" port	Serial1 / HardwareSerial 1 / USART1 port

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9	Digital I/O, RXD1, MVIO. This is the receive pin of the "Serial1" port	
10	Digital I/O, alternate pin for SDA, MVIO	
11	Digital I/O, alternate pin for SCL, MVIO	
13	Analog input, PWM capable, Digital I/O	
14	Analog input, PWM capable, Digital I/O	
15	Analog input, PWM capable, Digital I/O	
16	Analog input, PWM capable, Digital I/O	
17	Analog input, PWM capable, Digital I/O	
18	DAC output, Analog input, Digital I/O	DAC pin
19	Analog input, Digital I/O	
20	TXD2, Analog input, Digital I/O. This is the transmit pin of the "Serial2" port	Serial2 / HardwareSerial 2 / USART2 port
21	RXD2, Analog input, Digital I/O. This is the receive pin of the "Serial2" port	

ADC

Saleng 128DB has a default resolution of 10-bits (0-1023) for compatibility with other boards but the maximum is 12-bits (0-4095). To change the size into 12-bits, call the following function:

analogReadResolution( );

An example code can be seen here:

```
void setup()
{
  Serial.begin(9600);
  //display pin 21's input at default -
  //resolution (10 bit)
  analogReadResolution (10 );
  Serial.print ("ADC in 10bits - ");
  Serial.println (analogRead(21) );

  // change the resolution to 12bits
  analogReadResolution (12);
  Serial.print ("ADC in 12bits - ");
  Serial.println (analogRead(21) );

  delay(1000);

}
void loop()
{
}
```

PWM

Refer to the GPIO table for PWM capable pins. The pins 4 & 6, and pins 5 & 7 are linked, thus, each pair can only output one duty cycle at a time on one pin or on both pins. Both pairs cannot be used with the same duty cycle.

Pin 8 is used as the default millis() timer, as a result it loses its capabilities to output PWM.

ALTERNATE PINS FOR SERIAL INTERFACES

Saleng 128DB have an alternate pin-mapping alternatives that can be swap with the default pins using the *swap()* command before initializing any of the interface(*begin()*).

I2C Alternate Interface

	SDA	SCL
Default	2	3
Alternate	10	11

An example code can be seen here:

```
/*For this code, we connected an LCD with
an I2C module to the saleng 128DB. Connect
sda to pin 10 and scl to pin 11*/

#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,20,4);

void setup()
{
  Wire.swap(2); // swap default i2c pins
to 10 and 11
  lcd.init();
  lcd.backlight();// initialize the lcd
  lcd.setCursor(1,0);
  lcd.print("Testing...");
  lcd.setCursor(1,0);
  lcd.print("Swap command");
}

void loop(){
}
```


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UART Alternate Interface

	TX	RX
Default	0	1
Alternate	4	5

An example code can be seen here:

```
/*In this code, you must connect pins 4 and 5 to a uart dongle and upload code. If code is successfull, the text "Serial Changed" will appear in the port your uart dongle.
*/
void setup()
{
  Serial.swap(1);//swaps pin 0&1 to 4&5
  Serial.begin(9600);
  Serial.print("Serial Changed");
}
void loop() {
}
```

SPI

There are two default SPI pins included in the Saleng 128DB board, their pins are:

	SPI0	SPI1
MOSI	4	8
MISO	5	9
SCK	6	10
SS	7	11
Level_name	SPI0_SWAP_DEFAULT	SPI1_SWAP_DEFAULT

SPI0 is set as the default pins, but you can interchange them by using the code *SPI.swap(level_name)* before *SPI.begin()*.

For more information concerning SPI, please refer to this website.

On-Chip Opamps (OPAMP)

Saleng 128DB have 2 on-chip Opamps.

OPAMP	+ Pin	- Pin	OUT
Opamp0	13	15	14
Opamp1	16	19	17

An example code can be seen here:

```
/* Opamp.h library is for interfacing with the built-in AVR-DB Opamp developed in 2021 by MCUdude

In this code, we used opamp0 as a voltage follower. Meaning that the output is equal to the input voltage.
*/
#include <Opamp.h>

void setup()
{
//Connect pin 13 to external input
  Opamp0.input_p = in_p::pin;
//Connect N-input to output internally
  Opamp0.input_n = in_n::output;
  Opamp0.output = out::enable;   //pin 14
  Opamp0.init();  // Initialize Opamp0
  Opamp::start(); // Start the Opamp hardware
}

void loop() {
}
```

For more information concerning OPAMP, please refer to this website.

Servo Support

The core discussed in this document provides a version of the Servo library tailored for the Saleng 128DB. You can assess this by going to Sketch> Include Libraries> *Servo_DxCore.h*. Please Use this instead of *Servo.h*

USEROW

For more information concerning USEROW, please refer to this website.

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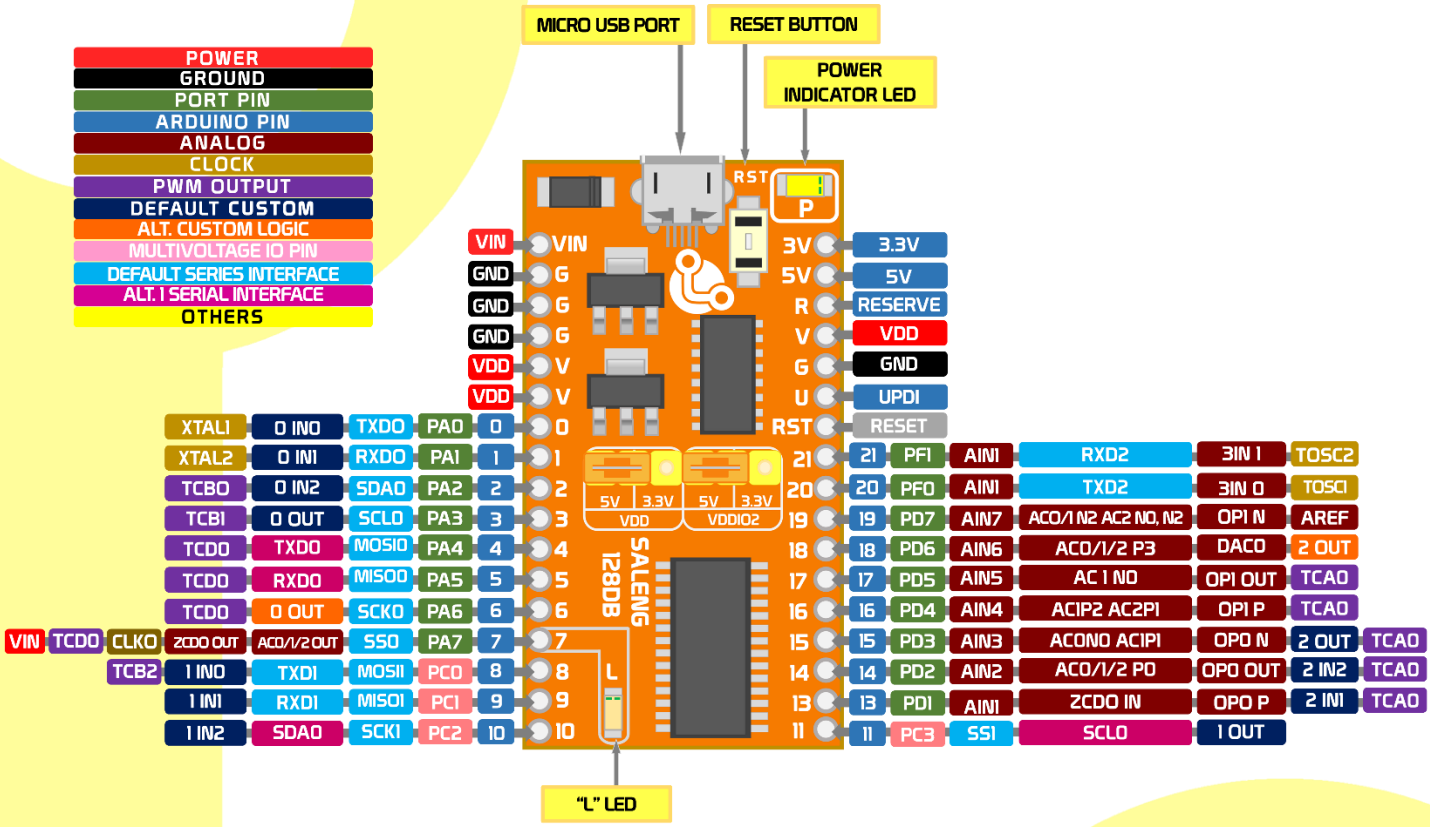
DETAILED PINOUTS



COMPARISSON WITH ARDUINO, UNO, AND MEGA

SPECIFICATION	SALENG 128DB	UNO	MEGA
Microcontroller	AVR128DB28	ATmega328P	ATmega2560
Clock Frequency	24MHz	16MHz	16MHz
SRAM Size	16KB	2KB	8KB
Flash Size	128KB	32KB	256KB
EEPROM Size	512B	1KB	4KB
User Row Memory	32	None	None
Price Range	Mid	Mid	High
MCU Architecture / Release Year	Modern AVR / 2020s	Classic AVR / 1990s	Classic AVR / 1990s
Number of I/O Pins	21	20	54
Board Size	25mmx50mm	53mmx69mm	53mmx101.5mm
PWM capable pins	11	6	15
Max simultaneous PWM outputs	9	6	15
Number of Analog Pins	9 x 12bits	6 x 10bits	16 x 10bits

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ADC Resolution	12 bits	10 bits	10 bits
External Interrupt Pins	19	2	6
Language/IDE	C/C++ / Arduino IDE	C/C++ / Arduino IDE	C/C++ / Arduino IDE
DC Input Voltage Range via DC jack or Vin header	7-12V Recommended	7-12V Recommended	7-12V Recommended
Direct Breadboard Compatibility (bottom male headers)	Yes	Uno = No / Nano = Yes	No
5V regulator current rating	1A	1A	1A
3.3V regulator current rating	800mA	50mA	50mA
Microcontroller operating voltage	5V or 3.3V	5V only	5V only
Multi-Voltage I/O (5V/3.3V selectable)	4	None	None
500mA PTC fuse on USB power	Available	Available	Available
Timers	4x 16-bit + 1x 12bit	1x 16 bit + 2x 8bit	4x 16bit + 2x 8bit
Hardware Serial (UART)	3	1	4
Alternate UART Pins	Available	None	None
SPI port	2 channels	1 channel	1 channel
I2C port	1 channel	1 channel	1 channel
Alternate I2C pins	Available	None	None
10-bit DAC	1	None	None
Analog Comparator	3	1	1
Zero-Cross Detectors	2	None	None
On-chip Op amp	2	None	None
Custom Logic Blocks	4	None	None
Event System channels	8 channels	None	None

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