**LAYADCIRCUITS**
ANALOG · DIGITAL · ENGINEERING

OVERVIEW

The Saleng Build-Your-Own-Arduino (BYOA) is a complete, Open Source Hardware, locally made kit to build your own Arduino Uno. The kit includes the microcontroller ATmega328P-PU which comes pre-installed with the same bootloader used in the Arduino Uno. It also follows the Arduino Uno pin assignments and is hence programmed using the same Arduino IDE. Also included is a pre-fabricated PCB and all the other components required to complete the board. The schematic and example PCB layout has been provided should the user decide to self-fabricate the PCB.

Figure 1: The Saleng BYOA Kit
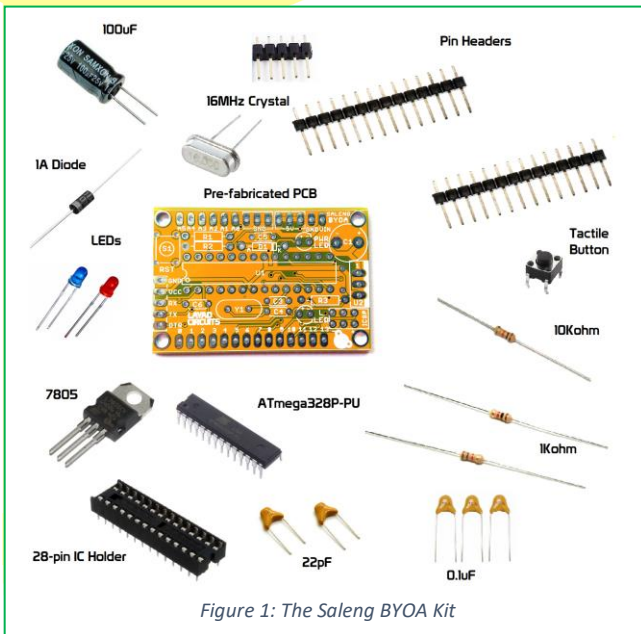
This kit requires the user to solder the components. All components have been selected as leaded through-hole devices to facilitate ease of soldering.

Programming the completed board will require a separate Serial-USB converter module or another Arduino Uno/Nano/Mega board to serve as programmer.

NOTE: Before you continue, do note that this kit is meant to be built by the user. Soldering is required and a separate Serial-USB programmer (or Arduino) is needed for programming the board.

This kit is designed as a learning tool and also as an alternative to the Arduino Uno in projects where space or cost is a priority.

CONTENTS

The kit contains the following components. See figure 1 and table 1.

Label	Item Description	Quantity
U1	ATmega328P-PU with Bootloader Installed	1
U2	7805 5V/1A Regulator, TO-220	1
D1	1N4001/1N4004/1N4007	1
LED1	3mm LED, Red	1
LED2	3mm LED, Blue/Green or Yellow	1
Y1	16MHz Crystal	1
C1	100uF, >=16V Electrolytic Capacitor	1
C2,C5,C6	0.1uF(104) Multilayer Ceramic Capacitor	3
C3,C4	22pF(22 or 220) Multilayer Ceramic Capacitor	2
R1	10 Kilo ohms, 1/4w resistor	1
R2,R3	1 Kilo ohm, 1/4w resistor	2
H1,H2	14-pins Male Pin Headers	2
H4/Prog Port	5-pins Male Pin Headers	1
S1	Tactile Push Button, NO	1
-	28-pin IC holder for U1	1
-	Pre-fabricated PCB Note:User may decide to custom build the PCB. See Appendix for example designs	1

CIRCUIT

The circuit revolves around the ATmega328P-PU microcontroller, the same IC used in the Arduino Uno. The whole design was implemented in the included PCB following the schematic. For optimum cost, the circuit does not include a Serial-to-USB converter for programming, rather, an external converter (or Arduino) can be used. See the Programming section for details.

www.layadcircuits.com
Layad Circuits Electronics Engineering Supplies & Services, B314 Lopez Bldg., Session Rd. cor. Assumption Rd., Baguio City, Philippines
General inquiries: info@layadcircuits.com   Sales: sales@layadcircuits.com   FB: facebook.com/layadcircuits   Mobile: +639164428565

An IMPORTANT NOTICE: at the end of this guide addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers.

The circuit is powered by the 7805 (U2) 5V regulator IC preceded by the reverse-polarity protection diode D1. The red LED1 indicates if the 5V power is present. Y1 and the 22pF capacitors C3 and C4 form the 16MHz oscillator clock source of the microcontroller. The reset pin of the ATmega328P-PU is active low, hence, R1 is included to pull this line to Vcc during normal operations. Pressing the tactile button S1 will cause the reset line to go low and thereby resetting the microcontroller. C6 is included to allow auto-reset via the DTR of the programmer/converter. LED2 is connected to pin D13 following the design of the Arduino Uno. When using D13, consider the effect of the LED in designing the external circuit.

Figure 3: Saleng BYOA Schematic Diagram

TOOLS/MATERIALS FOR ASSEMBLY

To assemble the board, the following are required:

- Soldering Iron

- Soldering Wire (flux/rosin core)
- Side/Diagonal/Wire cutter for cutting extra leads of the components
- We also recommend Safety/Personal Protective Equipment: Safety Goggles, Gloves, Fume Extractor, Ground Strap/Mat, etc.

SUGGESTED ASSEMBLY PROCEDURE

1. Identify the component side of the PCB, this is where you will insert the components. Refer to the figures below:
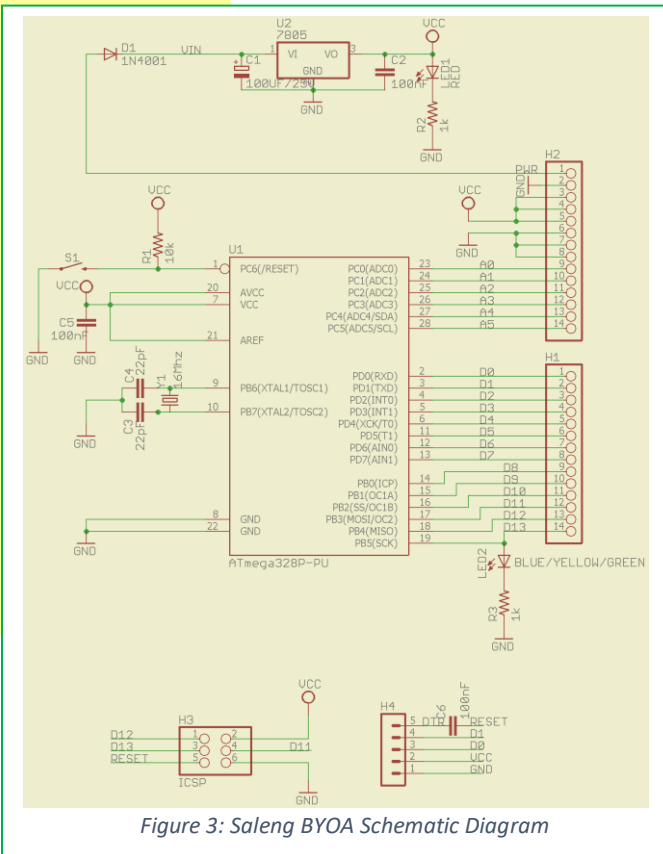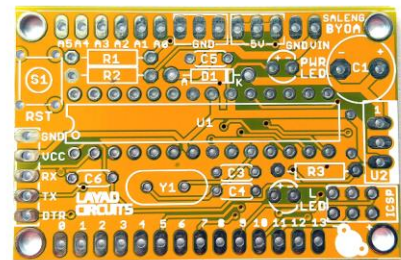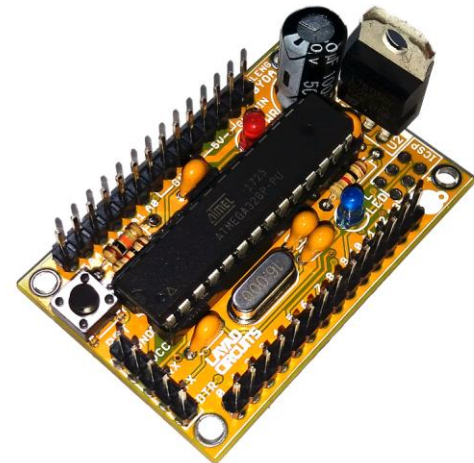

Component Side (Top Layer) of the PCB

An Assembled Saleng BYOA

Figure 2: Component Side of the PCB

2. Start soldering the smaller/shorter components: R1,R2,R3 and D1. Note the correct orientation of

D1, the cathode (stripped side) goes to the pad labeled 'K'. Bend the leads at the bottom side to keep the components in place or use tape at the component side. Flip over the PCB and solder all these 4 components.

3. Solder Y1, C2,C3,C4,C5,C6 in any order following the previous procedure.
4. Install the 28-pin IC holder in the slot labeled U1. Follow the orientation of the notch with that in the PCB. The notch should face S1 side.
5. Solder U2, C1 and S1.
6. Solder the headers. You may decide to have the 14-pin headers at the component or bottom side. Having them at the bottom allows direction insertion in a breadboard while installation on the component side allows ease of inserting wire-connectors. The 5-pin programming header should be installed on the component side.
7. Clean the circuit board of excess flux.

PROGRAMMING/USAGE

As previously mentioned, this board does not include a Serial-USB conversion circuit and must therefore use an external converter, either a module or using another Arduino. This is the same arrangement in the Arduino Pro-Mini and other Arduino compatible boards with minimalistic features.
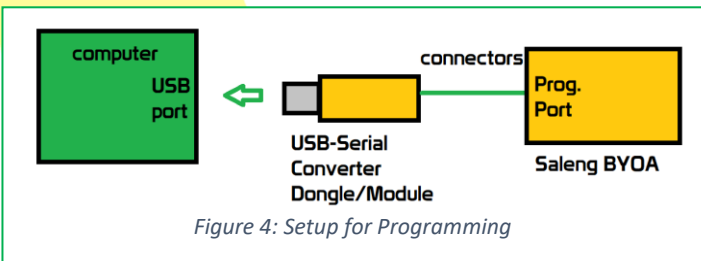

Figure 4: Setup for Programming

The converter is necessary for programming the board via the serial/bootloader approach. This is also necessary to use the Serial Monitor or Plotter tool of the Arduino IDE.

Serial USB Converter

Serial-USB converter modules come in several brands, features and configurations that selection may not be as straightforward. There is also the option to use another Arduino as the converter circuit. Below is a simple guide to help the user decide on what converter to get.

- Converter chip: FTDI xxxx, Prolific xxxx, CH340G, Silicon Labs CP2xxxx or the ATmega16U2 internal to some Arduino boards among others may be used. There is no preference in this aspect. Make sure the USB drivers of the converter chip are installed in your working computer. The drivers should be found online and some computers may install them automatically.
- Signals: At a minimum, the RXD and TXD pins should be exposed. Ideally though, the DTR signal is also broken out to allow auto-reset function during programming. Without the DTR signal, the converter will still work but you will need to manually press the reset button just before the upload sequence starts. If the DTR signal of the converter is available, connect it to the DTR pin of the Saleng BYOA and the setup should automatically perform the reset.
- Power: Common USB-serial dongles should have the 5V power pins exposed. You can use these to power the Saleng BYOA during programming.
- Dongles with an option to switch between 5V and 3.3V logic is an extra added feature to look out for for use in 3.3V systems. This is technically not required in the BYOA as it is fixed at 5V, but is a good addition when looking for a converter.
- We recommend using the Layad Circuits' Kimat USB-UART dongle as this device was designed specifically for programming the Saleng BYOA or Arduino Pro Mini and has all the desired features discussed herein.
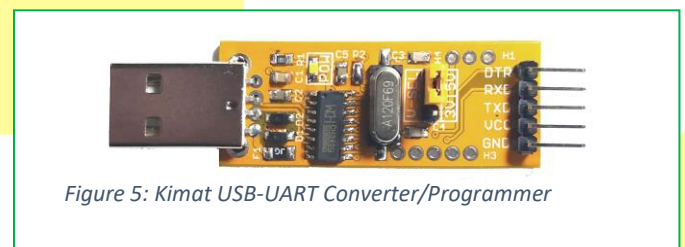

Figure 5: Kimat USB-UART Converter/Programmer

LAYADCIRCUITS
ANALOG · DIGITAL · ENGINEERING

Programming Using Another Arduino Board

This procedure follows how the Arduino Pro Mini is programmed using another Arduino Board.

The procedure described herein uses an Uno/Nano/Mega/Leonardo SMD or DIP version. Manual press of the reset button of the Saleng BYOA is required. This method does not require removal of the microcontroller IC on the Arduino board.

To program follow the steps below:

1) Prepare your Arduino board by uploading a "blank" code. The blank code is an empty setup() and loop() or simply generate one by going to File>New. Upload this to the Arduino board. Let us call this board the "programmer". To upload the code:
   - connect the Arduino to the computer using a USB cable
   - Tools>Ports and select the appropriate COM port
   - Tools>Board and select the appropriate COM port. Select Arduino Uno if you are using a Saleng Uno as programmer
   - Hit the Upload Button (arrow icon)

```
sketch_aug23a
1  void setup() {
2    // put your setup code here, to run once:
3
4  }
5
6  void loop() {
7    // put your main code here, to run repeatedly:
8
9  }
```

Figure 6 A "blank" code

2) Connect the programmer board to the target board following the diagram or table below. The "target" board is the Saleng BYOA.
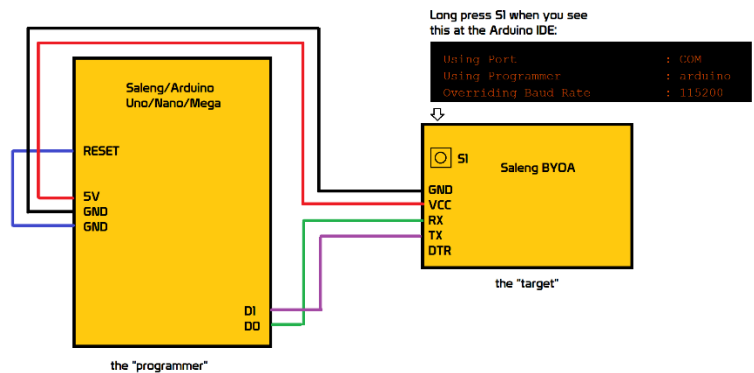

Figure 7: Programming the Saleng BYOA with an Arduino

PROGRAMMER: Arduino/Saleng Uno/ Nano/ Mega	TARGET: Saleng BYOA
5V	VCC
GND	GND
D1	TX
D0	RX
	DTR – not connected
Note: RESET is connected to GND	

Note that in this case, the programmer Arduino board acts only as a USB-Serial converter bridge and that the microcontroller is disabled with the reset line pulled to GND.

3) Next, open or write your code.
4) Tools>Boards>Arduino Uno
5) Tools>Ports> and select the correct port of the programmer
6) Hit the Upload Button (arrow icon)
7) Wait for compilation to complete
8) As the upload proper starts you should see "Using Port…" and "Using Programmer…" at the console. At this time , long press the reset button of the Saleng BYOA for around 1 second and then release.
9) Wait until upload is completed.

www.layadcircuits.com
Layad Circuits Electronics Engineering Supplies & Services, B314 Lopez Bldg., Session Rd. cor. Assumption Rd., Baguio City, Philippines
General inquiries: info@layadcircuits.com   Sales: sales@layadcircuits.com   FB: facebook.com/layadcircuits   Mobile: +639164428565
An IMPORTANT NOTICE: at the end of this guide addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers.

Programming Using a USB-Serial Converter without DTR

If your USB-Serial dongle/module does not have the DTR pin exposed then follow this procedure. This will require manually pressing the reset button of the Saleng BYOA at the right moment. Make sure your dongle/module is at 5V logic.

1) Connect as per the table below:

PROGRAMMER: USB-serial converter without DTR	TARGET: Saleng BYOA
5V	VCC
GND	GND
RXD	TX
TXD	RX
	DTR – not connected

2) Connect the converter to the computer via the USB port
3) Next, open or write your code.
4) Tools>Boards>Arduino Uno
5) Tools>Ports> and select the correct port of the programmer
6) Hit the Upload Button (arrow icon)
7) Wait for compilation to complete
8) As the upload proper starts you should see "Using Port…" and "Using Programmer…" at the console. At this time , long press the reset button of the Saleng BYOA for around 1 second and then release.

```
Using Port                : COM
Using Programmer          : arduino
Overriding Baud Rate      : 115200
```
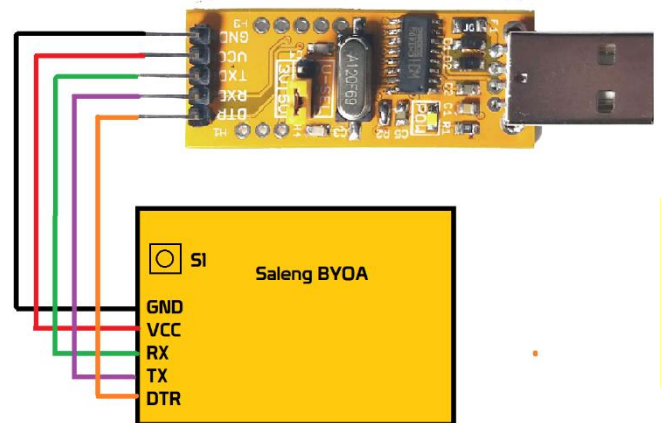
9) Wait until upload is completed.

Programming Using a USB-Serial Converter with DTR

If you are using a USB-Serial dongle/module with the DTR pin exposed such as in the Kimat USB-UART Converter, there is no need to press the reset button. This makes this method the recommended way to program the Saleng BYOA. Make sure your dongle/module is at 5V logic.

1) Connect as per the table below:

PROGRAMMER: USB-serial converter with DTR	TARGET: Saleng BYOA
5V	VCC
GND	GND
RXD	TX
TXD	RX
DTR	DTR

Below is the connection diagram using the Kimat USB-UART converter:

Layad Circuits Electronics Engineering Supplies & Services, B314 Lopez Bldg., Session Rd. cor. Assumption Rd., Baguio City, Philippines
General inquiries: info@layadcircuits.com   Sales: sales@layadcircuits.com   FB: facebook.com/layadcircuits   Mobile: +639164428565
An IMPORTANT NOTICE: at the end of this guide addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers.
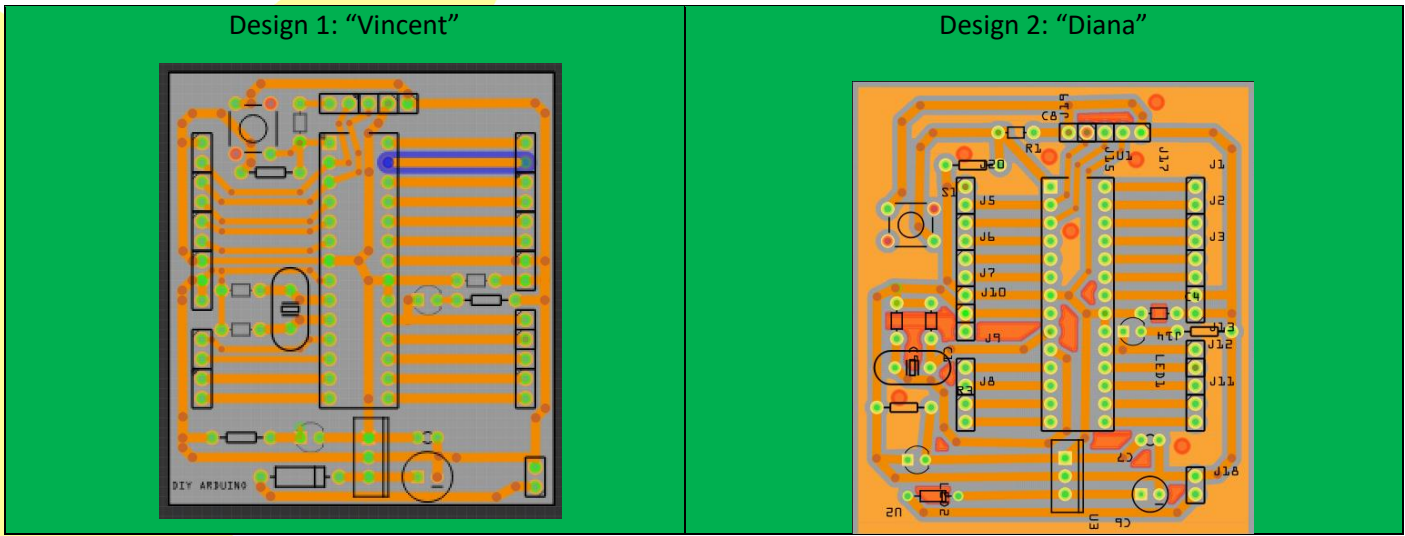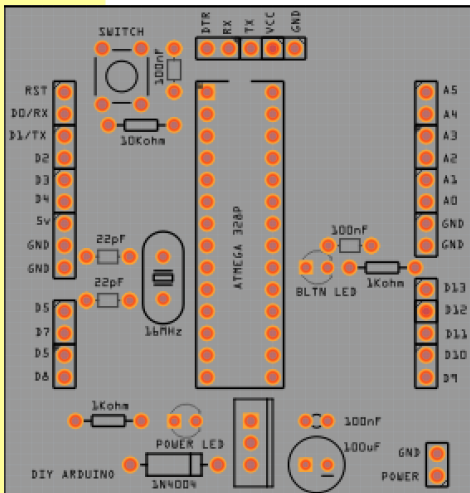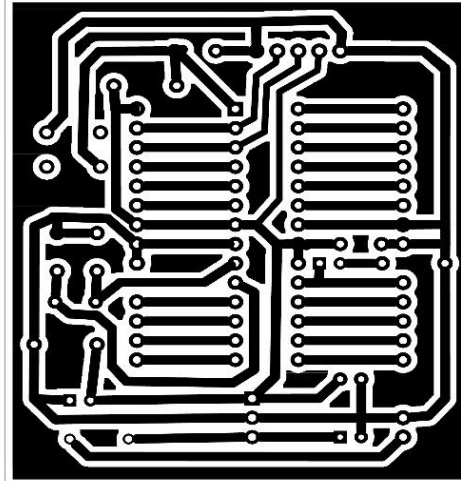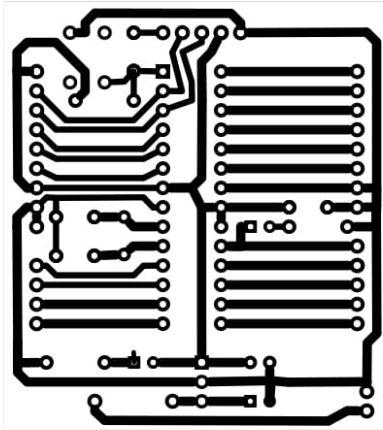
APPENDIX

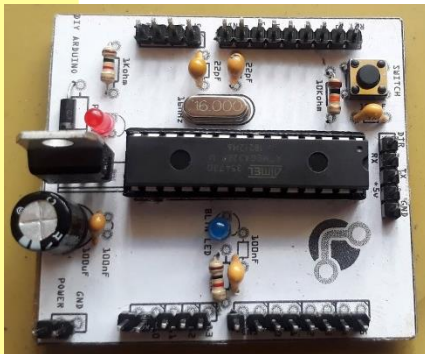**Example Custom-PCB designs and Etching Instructions**
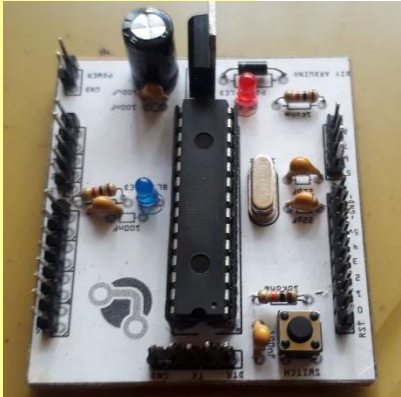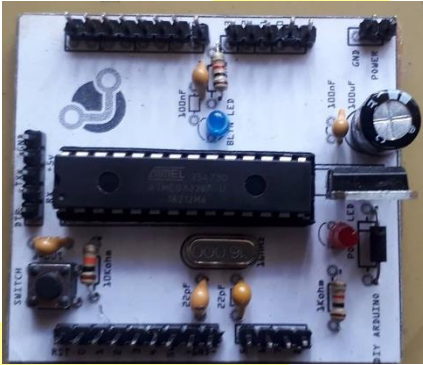
There are 2 example PCB layouts designed in Fritzing described below. Both follow the schematic diagram specified in the Saleng BYOA User Guide document. Also in this section are the suggested instructions in etching the custom PCB using a single sided pre-sensitized, positive acting, PCB.
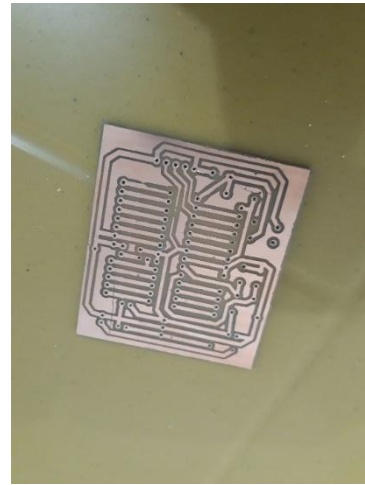
Example PCB Layouts:

Design 1: "Vincent"	Design 2: "Diana"

Part Placement Guide for the Vincent Design. Top View.

Revision: v1.0 / 09 August 2019/ V.Mendoza/D.R.Gatto/ C.D.Malecdan

www.layadcircuits.com

Copyright 2019 © Layad Circuits All Rights Reserved

Layad Circuits Electronics Engineering Supplies & Services, B314 Lopez Bldg., Session Rd. cor. Assumption Rd., Baguio City, Philippines

General inquiries: info@layadcircuits.com   Sales: sales@layadcircuits.com   FB: facebook.com/layadcircuits   Mobile: +639164428565

An IMPORTANT NOTICE: at the end of this guide addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers.

7

Etched PCB of the Diana Design

Final Product of the Vincent Design

Final Product of the Vincent Design

Suggested Instructions

1. Cut the presynthesized pcb and the acetate into a desired shape. Remove the white protective film of the presynthesized pcb and overlap it on the acetate. Work in subdued light. Do not touch its surface and keep it safe from contaminants.

Tip: Overlapping two or more acetate layouts create a darker pattern thus creating a better result.
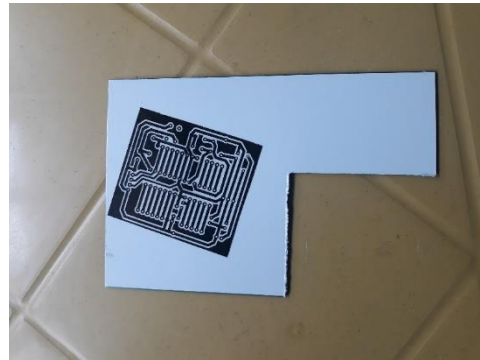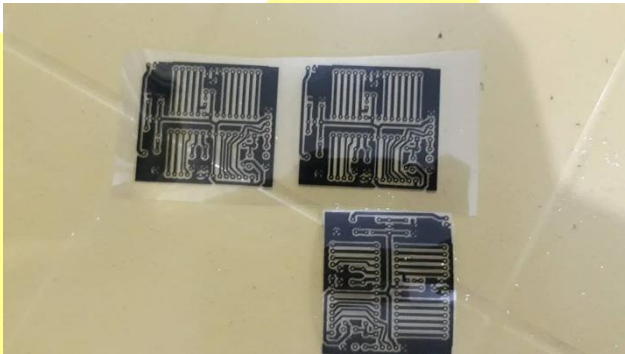
2. Expose the PCB on a 25watt CFL light bulb. Make sure that the acetate is laid firmly flat on the PCB.

Exposure time varies with UV intensity, distance to light source, PCB quality etc. The PCB examples in this document were exposed for 50 minutes.

3. After exposure, fill a plastic container with water and dissolve the developer. Agitate the PCB in the container until all pattern becomes visibly clean. Do not dissolve all the developer solution, dispense slowly until desired strength of solution is acquired.

Revision: v1.0 / 09 August 2019/ V.Mendoza/D.R.Gatto/ C.D.Malecdan

www.layadcircuits.com
Layad Circuits Electronics Engineering Supplies & Services, B314 Lopez Bldg., Session Rd. cor. Assumption Rd., Baguio City, Philippines
General inquiries: info@layadcircuits.com   Sales: sales@layadcircuits.com   FB: facebook.com/layadcircuits   Mobile: +639164428565
An IMPORTANT NOTICE: at the end of this guide addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers.

Copyright 2019 © Layad Circuits All Rights Reserved

9

4. When patterns are visibly clear, rinse the PCB in water. Pour ferric chloride (or other etching solution) into another container and etch. Rinse in water when the unwanted copper is removed.


5. Drill all the necessary holes on the PCB

www.layadcircuits.com
Layad Circuits Electronics Engineering Supplies & Services, B314 Lopez Bldg., Session Rd. cor. Assumption Rd., Baguio City, Philippines
General inquiries: info@layadcircuits.com   Sales: sales@layadcircuits.com   FB: facebook.com/layadcircuits   Mobile: +639164428565
An IMPORTANT NOTICE: at the end of this guide addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers.

6. Test the PCB for shorts and open tracks. Scrape off short circuits using a cutter knife of sharp tool. Fix open/cut tracks with solder wire.

Tip: If you want to remove the green coating, you can remove it with acetone or alcohol.
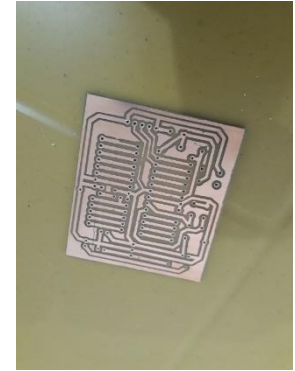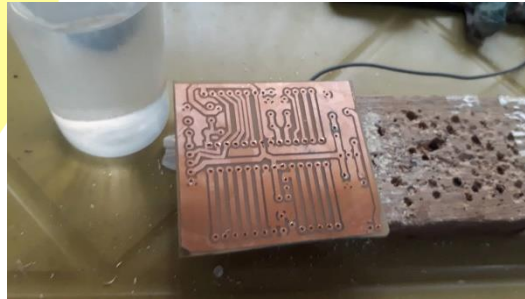
7. Mount all devices at the component side. Watch out for the orientation of the diode, LED's, IC's and polarized capacitor. Use tape to temporarily hold the components if necessary. Flip over and solder the leads.
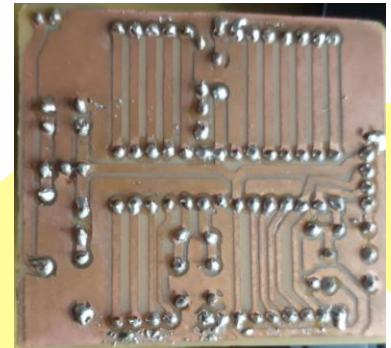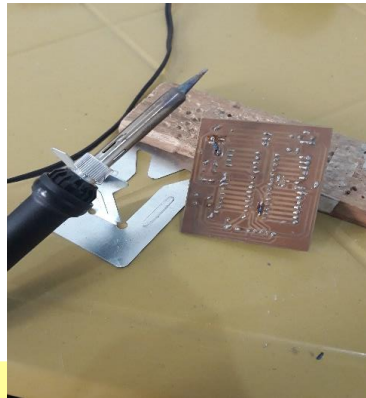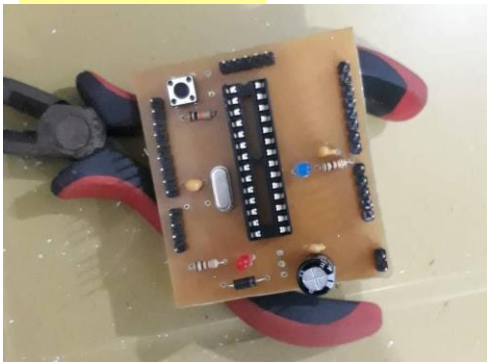
8. Test the assembled board. Happy Building!

IMPORTANT NOTICE

Layad Circuits Electronics Engineering Supplies & Services (Layad Circuits) reserves the right to make corrections, enhancements, improvements and other changes to its products, services and documentations, and to discontinue any product or service. Buyers or clients should obtain the latest relevant information before placing orders and should verify that such information is current and complete. Additional terms may apply to the use or sale of Layad Circuits products and services.

Reproduction of significant portions of Layad Circuits information in Layad Circuits datasheets or user guides is permissible only if reproduction is without alteration, displays the Layad Circuits logo and is accompanied by all associated warranties, conditions, limitations, and notices. Layad Circuits is not responsible or liable for such reproduced documentation. Information of third parties may be subject to additional restrictions. Resale of Layad Circuits products or services with statements different from or beyond the parameters stated by Layad Circuits for that product or service voids all express and any implied warranties for the associated Layad Circuits product or service. Layad Circuits is not responsible or liable for any such statements.

Buyers and others who are developing systems that incorporate Layad Circuits products (collectively, "Designers") understand and agree that Designers remain responsible for using their independent analysis, evaluation and judgment in designing their applications and that Designers have full and exclusive responsibility to assure the safety of Designers' applications and compliance of their applications (and of all Layad Circuits products used in or for Designers' applications) with all applicable regulations, laws and other applicable requirements. Designer represents that, with respect to their applications, Designer has all the necessary expertise to create and implement safeguards that (1) anticipate dangerous consequences of failures, (2) monitor failures and their consequences, and (3) lessen the likelihood of failures that might cause harm and take appropriate actions. Designer agrees that prior to using or distributing any applications that include Layad Circuits products, Designer will thoroughly test such applications and the functionality of such Layad Circuits products as used in such applications. Layad Circuits' provision of technical, application or other design advice, quality characterization, reliability data or other services or information, including, but not limited to, reference designs and materials relating to evaluation modules, (collectively, "Layad Circuits Resources") are intended to assist designers who are developing applications that incorporate Layad Circuits products; by downloading, accessing or using Layad Circuits Resources in any way, Designer (individually or, if Designer is acting on behalf of a company, Designer's company) agrees to use any particular Layad Circuits Resource solely for this purpose and subject to the terms of this Notice.

Layad Circuits' provision of Layad Circuits Resources does not expand or otherwise alter Layad Circuits' applicable published warranties or warranty disclaimers for Layad Circuits products, and no additional obligations or liabilities arise from Layad Circuits providing such Layad Circuits Resources.

Layad Circuits reserves the right to make corrections, enhancements, improvements and other changes to its Layad Circuits Resources. Layad Circuits has not conducted any testing other than that specifically described in the published documentation for a particular Layad Circuits Resource.

NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER LAYAD CIRCUITS INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT OF LAYAD CIRCUITS OR ANY THIRD PARTY IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which Layad Circuits products or services are used. Information regarding or referencing third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of Layad Circuits Resources may require a license from a third party under the patents or other intellectual property of the third party, or a license from Layad Circuits under the patents or other intellectual property of Layad Circuits. Layad Circuits RESOURCES ARE PROVIDED "AS IS" AND WITH ALL FAULTS. LAYAD CIRCUITS DISCLAIMS ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING RESOURCES OR USE THEREOF, INCLUDING BUT NOT LIMITED TO ACCURACY OR COMPLETENESS, TITLE, ANY EPIDEMIC FAILURE WARRANTY AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS. LAYAD CIRCUITS SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY DESIGNER AGAINST ANY CLAIM, INCLUDING BUT NOT LIMITED TO ANY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON ANY COMBINATION OF PRODUCTS EVEN IF DESCRIBED IN LAYAD CIRCUITS RESOURCES OR OTHERWISE. IN NO EVENT SHALL LAYAD CIRCUITS BE LIABLE FOR ANY ACTUAL, DIRECT, SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF LAYAD CIRCUITS RESOURCES OR USE THEREOF, AND REGARDLESS OF WHETHER LAYAD CIRCUITS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. Unless Layad Circuits has explicitly designated an individual product as meeting the requirements of a particular industry standard, Layad Circuits is not responsible for any failure to meet such industry standard requirements. Where Layad Circuits specifically promotes products as facilitating functional safety or as compliant with industry functional safety standards, such products are intended to help enable customers to design and create their own applications that meet applicable functional safety standards and requirements. Using products in an application does not by itself establish any safety features in the application. Designers must ensure compliance with safety-related requirements and standards applicable to their applications. Designer may NOT use any Layad Circuits products in life-critical applications. Life-critical medical equipment is medical equipment where failure of such equipment would cause serious bodily injury or death (e.g., life support, pacemakers, defibrillators, heart pumps, neurostimulators, and implantables). Designers agree that it has the necessary expertise to select the product with the appropriate qualification designation for their applications and that proper product selection is at Designers' own risk. Designers are solely responsible for compliance with all legal and regulatory requirements in connection with such selection. Designer will fully indemnify Layad Circuits and its representatives against any damages, costs, losses, and/or liabilities arising out of Designer's noncompliance with the terms and provisions of this Notice.