BreadboarD GeniuS™

Congratulations on acquiring your BreadboarD GeniuS™ Project Lab! This manual is designed to guide you through setting up and maximizing the capabilities of your new electronics development environment. Ideal for students, educators, and hobbyists alike, the BreadboarD GeniuS™ is crafted to foster innovation and streamline the process of electronics prototyping.

Package Contents:

1 BreadboarD GeniuS™ Main Unit
1 USB Power Supply Unit with built in oscilloscope (USB-PD compatible)
1 Breadboard mount with the following items built in
    4 Breadboards
    LEDs (8 white, 2 red, 2 yellow, 2 green, 2 blue)
    8 Push Switches
    8 SPDT Toggle Switches
    Variable Resistors (1K, 10K, 100K Ohms)
22 Visual Logic Gates with Indicator LEDs
2 Binary and Decimal Counters (1 with Visual Decimal outputs.)
65 Jumper Wires
1 User Manual

Unpacking Your Kit:

Carefully unpack each component from the box. Verify that all items listed in the Package Contents are present. Contact our support team if any parts are missing or damaged.

Setting Up the Power Supply:

Connect the USB power supply unit to your BreadboarD GeniuS. Plug the other end into a compatible USB-PD power source. Ensure the connection is secure to provide a stable power supply to your projects.

Organizing Your Workspace:

Arrange the electronic components, switches, and resistors on the breadboard as per your project requirements. Utilize the storage drawers within the main unit to keep additional components and tools organized and within easy reach.

Beginning Your First Project:

Start by inserting the jumper wires to connect the various components as outlined in your project diagram. Remember, the layout and connectivity are crucial for ensuring your circuit functions correctly.

Safety Precautions:

Always disconnect the power supply before making changes to your circuit.

Handle all electronic components with care to avoid damage.

Keep your workspace clean and free of unnecessary materials that could cause shorts.

For indoor use only, do not leave in direct sunlight. 

Keep away from liquids. 

Do not use in environments with combustible gasses. 

Do not use while driving. 

Do not swallow, choking hazard. 

Power Supply Unit:

The BreadboarD GeniuS™ is equipped with multiple power sources, -5v (20 Watts), GND, +5v (20 Watts), and a variable 0 to 30v (35 Watts). They have overload and short circuit protection built in, care must still be taken to prevent shorts using jumper wires rated less than the supply wattage, the power supply may see resistance in jumper wires used on the breadboard and assume normal circuit operation and may cause the wire to overheat/melt/cause fire. Precautions must be taken during the assembly of circuits to prevent Fire, BreadboarD GeniuS™ cannot take responsibility for fires or burns caused by incorrect usage of the system. Adult supervision is required when used by minors.

BreadboarD GeniuS™ is best used with a USB C PD power supply capable of providing 20V at 100 Watts, although other lower rated supplies can be used you would better benefit from the full power it can provide. Other compatible voltages are 5v, 9v, 12v 15v, and 20v, the “Input V” indicator will display the voltage being supplied to the Power supply unit. The “Input A” indicator will display the current currently being drawn by the power supply unit, this includes the power used by the scope, the fan and other electronics within the power supply and is not a representation of the power drawn only on your circuit.

Use only Banana type plugs in the Power/HZ receptacles, do not insert other objects into the plugs.

The BreadboarD GeniuS™ power supply has a silent running fan at normal usage, if the internal electronics raises to 35 degrees Centigrade the Fan will begin to spin faster upto its maximum speed at 45 degrees centigrade. The Unit will automatically cut power if the temperature rises higher than 60 degrees.

Variable Power Supply 0 – 30 volts

Setting Output Voltage and Current

1. **Access the Voltage/Current Setting Interface:**
    - On the default display, briefly press the **‘V/A’** button to enter the voltage/current setting mode.
    - The screen will display **‘SET’** and a **‘CV’** symbol on the left side of the third line, with the identifier flashing. This indicates that the voltage value is ready to be modified.
2. **Adjust the Voltage:**
    - Press the **‘SW’** button or the potentiometer briefly to switch to the voltage adjustment mode.
    - Rotate the potentiometer to increase or decrease the voltage value.
3. **Adjust the Current:**
    - Press the **‘V/A’** button again to switch to current setting mode. The display will show the **‘CC’** symbol.
    - Rotate the potentiometer to adjust the current value.
4. **Save and Exit:**
    - Press the **‘V/A’** button once more to save your settings and exit the voltage/current setting interface.

Quick Voltage or Current Setting

Note: This method allows for quick adjustments but is not recommended due to the risk of accidental changes.

1. **Enable Quick Set Function:**
    - Set the **'FET'** parameter to **'CV'**, **'CC'**, or **'OFF'**:
        - **CV:** Enables quick voltage setting in Normal Display mode by rotating the potentiometer.
        - **CC:** Enables quick current setting in Normal Display mode by rotating the potentiometer.
        - **OFF:** Disables the quick set voltage or current function.
2. **Using Quick Set:**
    - When **'CV'** or **'CC'** is selected, rotating the potentiometer in Normal Display mode will adjust the respective voltage or current value.
    - If set to **'OFF'**, rotating the potentiometer will not change the output value in Normal Display mode.

Setting Parameters

1. **Enter Parameter Setting Mode:**
    - On the default display, press and hold the **'SW'** button for 2 seconds to access the parameter setting interface.
2. **Adjust Parameters:**
    - Press the **'SW'** button briefly to cycle through different parameters.
    - Press the potentiometer briefly to select the specific bit you wish to modify.
    - Rotate the potentiometer to change the parameter value.
3. **Manage Functions:**
    - Press the **'ON/OFF'** button to toggle the following functions:
        - **Max-Capacity (OAH)**
        - **Max-Energy (OPH)**
        - **Max-Running-Time (OHP)**
    - A **'----'** symbol indicates that the function is turned off.
4. **Set Parameter Units:**
    - Press and hold the **'ON/OFF'** button to set the units for **OAH** and **OPH**.
    - Adjust the decimal point position to change the unit:
        - **OAH Range:** 9.999Ah / 99.99Ah / 999.9Ah / 9999Ah
        - **OPH Range:** 9.999Wh / 99.99Wh / 999.9Wh / 9999Wh
5. **Save and Exit:**
    - Press and hold the **'SW'** button for 2 seconds to save the parameters and exit the setting interface.

Switching Display Between Input and Output Voltage

- In Normal Display mode, press the **'SW'** button briefly to toggle between displaying input voltage and output voltage on the first line.
- **Note:** When displaying input voltage, an **'IN'** symbol will appear on the left side.

Querying Parameters: Power, Capacity, Energy, and Time

- On the default display screen, press the potentiometer briefly to cycle through and display the following parameters:
    - **Power (W)**
    - **Capacity (Ah)**
    - **Energy (Wh)**
    - **Time (H)**

Locking and Unlocking Parameters

- To prevent accidental changes to the output voltage and current:

- On the default display, press and hold the potentiometer for 2 seconds to lock or unlock the parameters.
- A lock symbol will appear on the left side of the first line when parameters are locked.
- When locked, parameter values cannot be changed until unlocked.

Statistics: Capacity, Energy, and Work Time

- **Tracking Statistics:**
  - Statistics begin tracking when the output is turned on and stop when it is turned off.
- **Clearing Statistics:**
  - To clear statistical values for Power, Capacity, Energy, or Time, press and hold the **'ON/OFF'** button for 2 seconds while viewing the respective display.

Setting Maximum Output Capacity (OAH)

- **Functionality:**
  - When enabled, the device will turn off the output and display a flashing **'OAH'** symbol on the LCD if the statistical capacity exceeds the set maximum OAH value.
  - Capacity statistics are automatically cleared after the alarm is addressed.
- **Behaviour:**
  - The device will continue to track capacity whether the OAH function is enabled or not.
  - Output will remain active if the OAH function is disabled.

Setting Maximum Output Energy (OPH)

- **Functionality:**
  - When enabled, the device will turn off the output and display a flashing **'OPH'** symbol on the LCD if the statistical energy exceeds the set maximum OPH value.
  - Energy statistics are automatically cleared after the alarm is addressed.
- **Behaviour:**
  - The device will continue to track energy whether the OPH function is enabled or not.
  - Output will remain active if the OPH function is disabled.

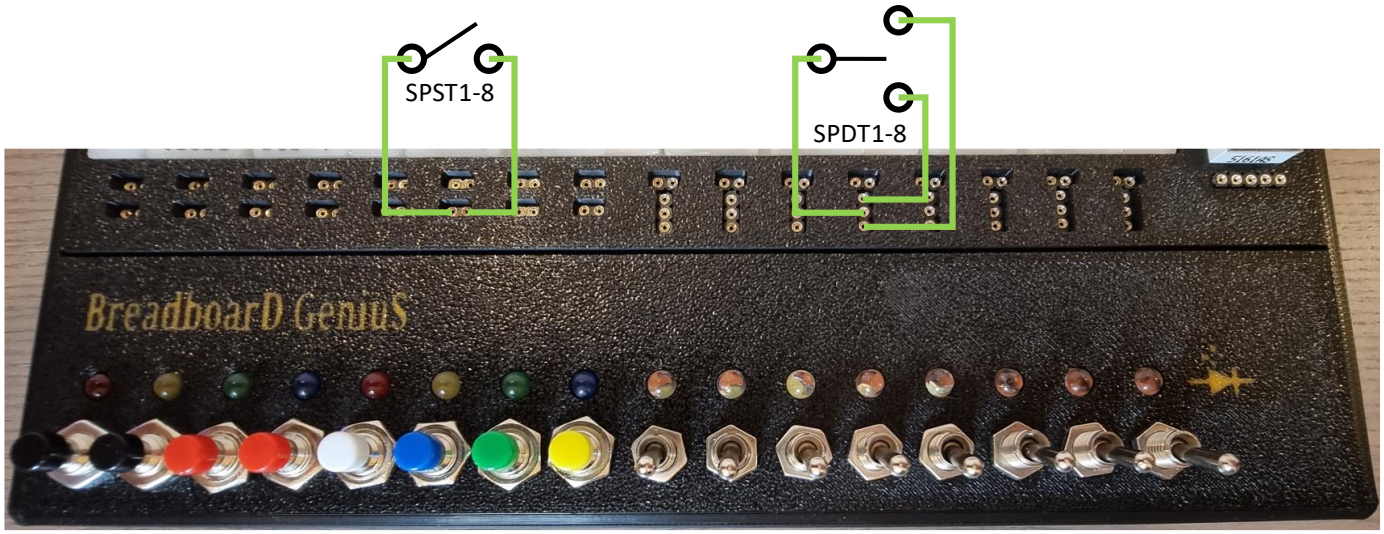
Setting Maximum Running Time (OHP)

- **Functionality:**
  - When enabled, the device will turn off the output and display a flashing **'OHP'** symbol on the LCD if the statistical work time exceeds the set maximum OHP value.
  - Work time statistics are automatically cleared after the alarm is addressed.
  - Operates in countdown mode when enabled.
- **Behaviour:**
  - The device will continue to track work time whether the OHP function is enabled or not.
  - Output will remain active if the OHP function is disabled.
- **Use Case:**
  - This function is useful for timed power supply applications.

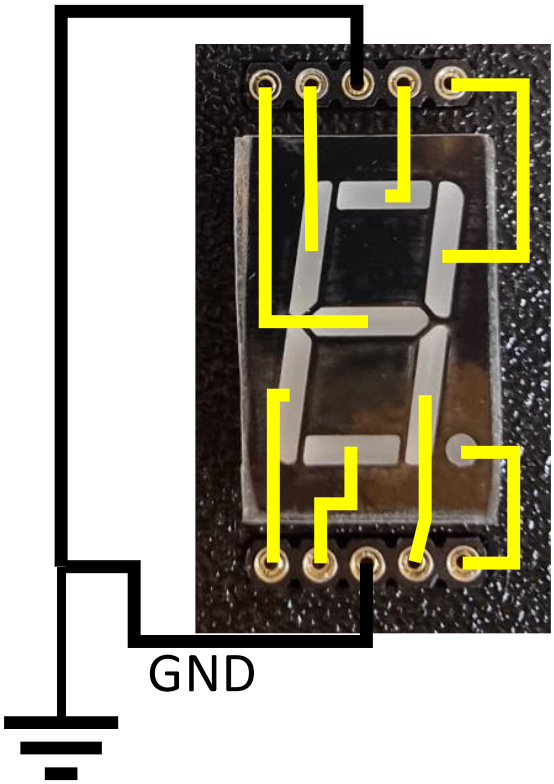
Main Breadboard Connections

On the main breadboard unit is a variety of built in components, the connections to those are as Follows:

The top line of plug-in connections on the breadboard mount board are for the LEDs, they have resistors built into the circuit to limit the current to each LED. They are designed for 5 volts, 0.06(W), Working current 20(mA).



The bottom line of plug-in connections on the breadboard mount board are for the various switches, the left hand 8 switches are Single Pole Single Throw (SPST) and are spring loaded normally open push switches. The right hand 8 switches are Single Pole Double Throw (SPDT) toggle switches.



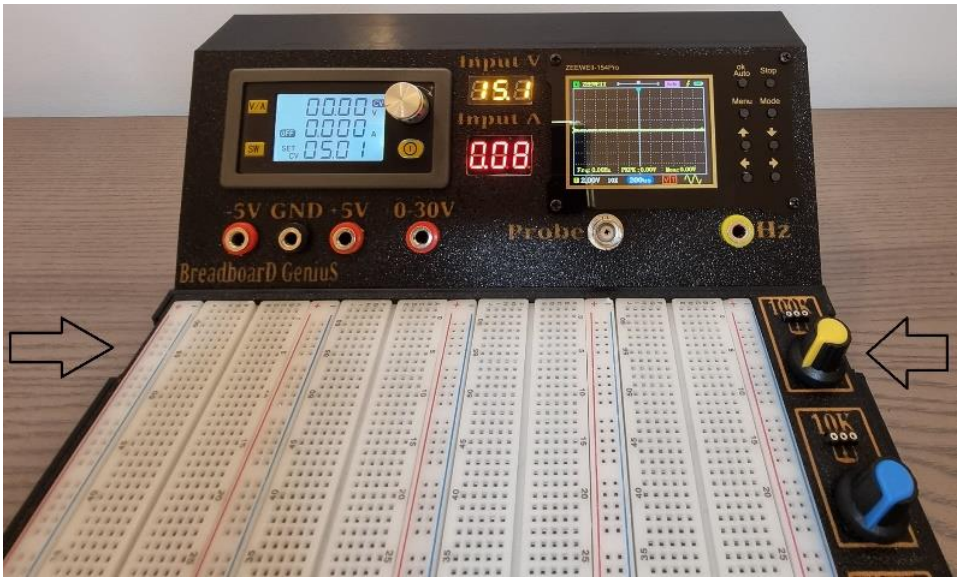
The Two LED displays are connected as shown in the above diagram and are common cathode type, the two ground pins are connected within the display. They have built in resistors and are set for a 5v circuit.

The Breadboard mount is equipped with 3 Potentiometers (Variable Resistors).

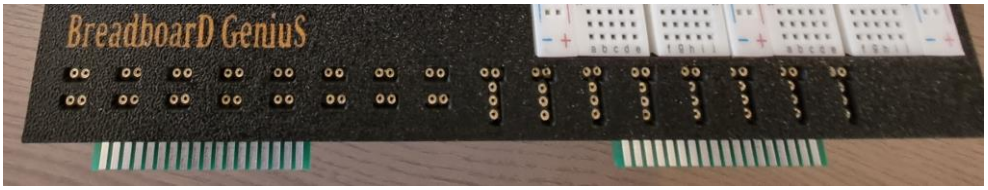
The 1K, 10K, and 100K Ohm Variable Resistors and are of the Linear type and rated at 0.125 watts.

Removal of the Breadboard mount:

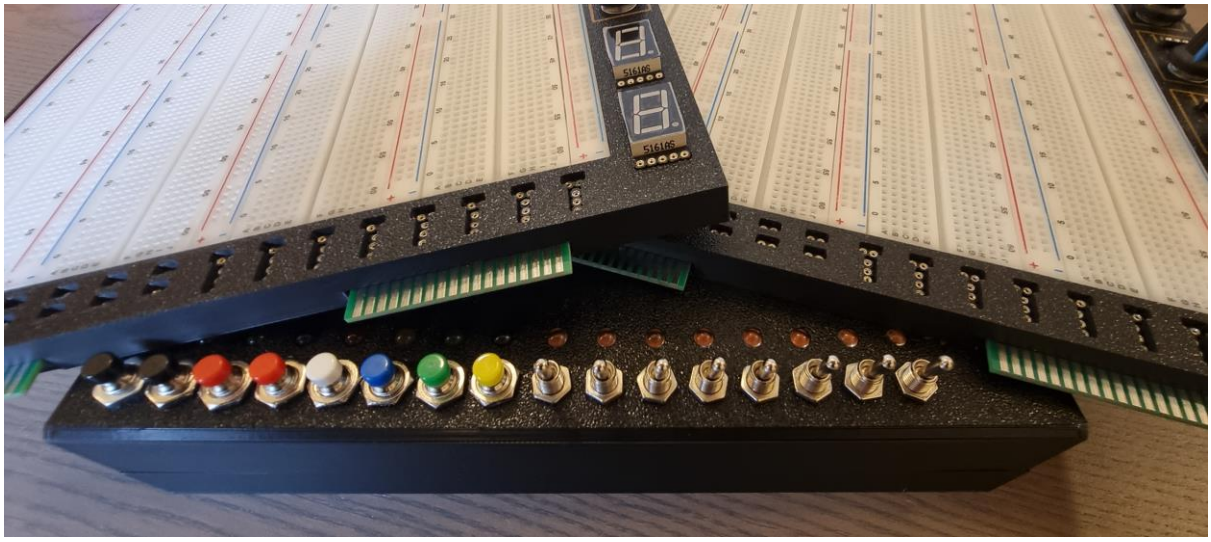
To remove the breadboard mount and swap it with another project you must lift the back of the board, do this using both hands, place your fingers in the recess as indicated in the image below and lift the board upwards about 1cm, then push the board away from you to disconnect it from the main unit. You must do this evenly and avoid pushing one side further than the other as this may twist the connection. Once the unit is lose you should push it towards the back to unplug it, then lift it up and away from the main unit.



The connectors at the bottom of the breadboard mount enable you to disconnect the board without having to unplug all your LEDs and switches, this vastly reduces the time needed when swapping projects.

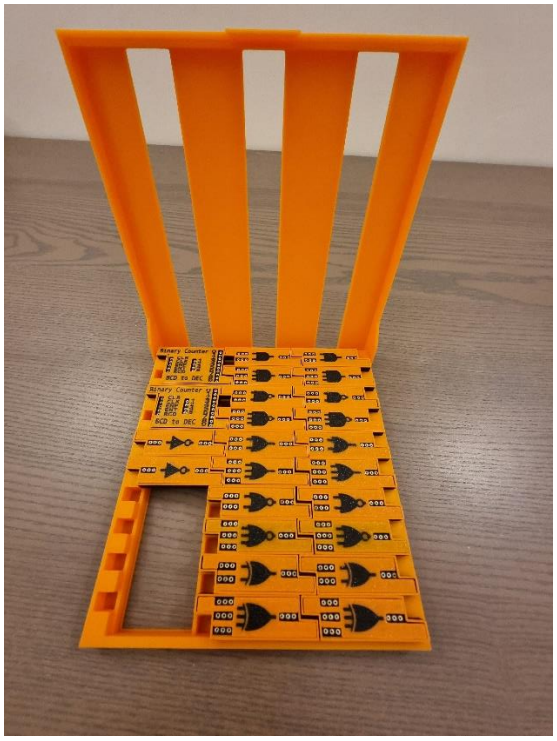


To insert a new board line up the edge connection on the breadboard with the socket on the main unit, pull into place before lowering the back of the board into the slot.

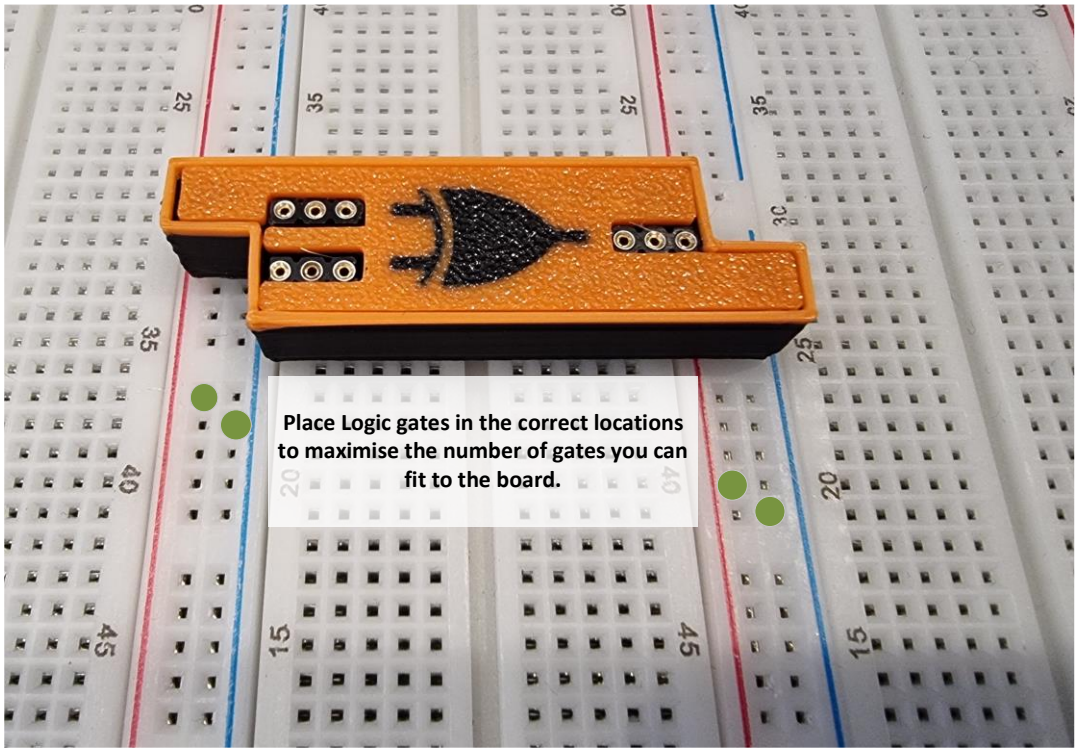


Additional boards with a handy carry case can be obtained in the online stores in Etsy and Amazon.

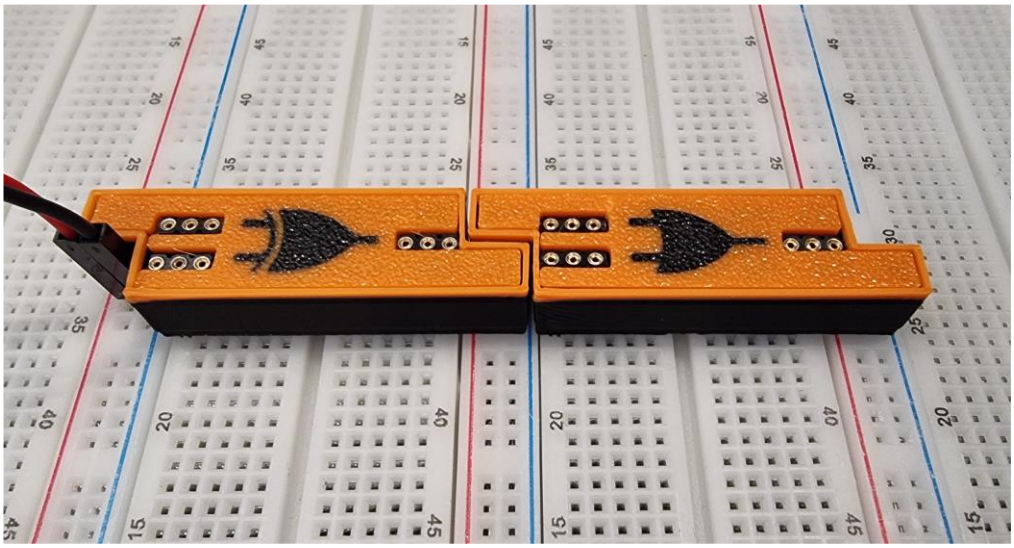
Logic Gates



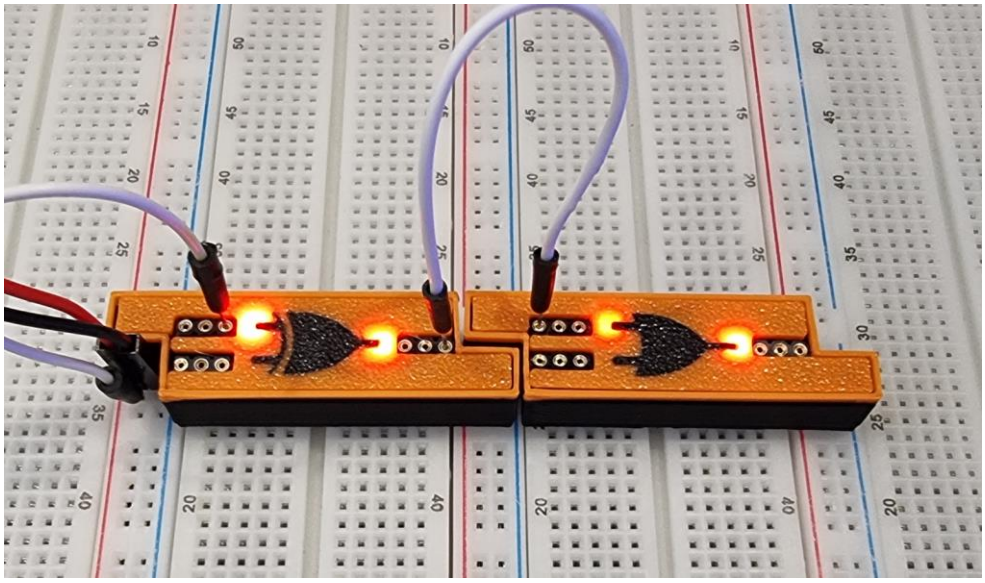
The Logic gates come in a handy box specifically designed to store them without bending the pins on the bottom, it's important not to bend the pins as they are for powering the logic gates and transferring power between each set of power rails on the breadboard. To open the box, lift from the tab at the front of the box. (Warning-have you ever stepped on a Lego Brick? it really Hurts. Stepping on logic gates hurt more.)



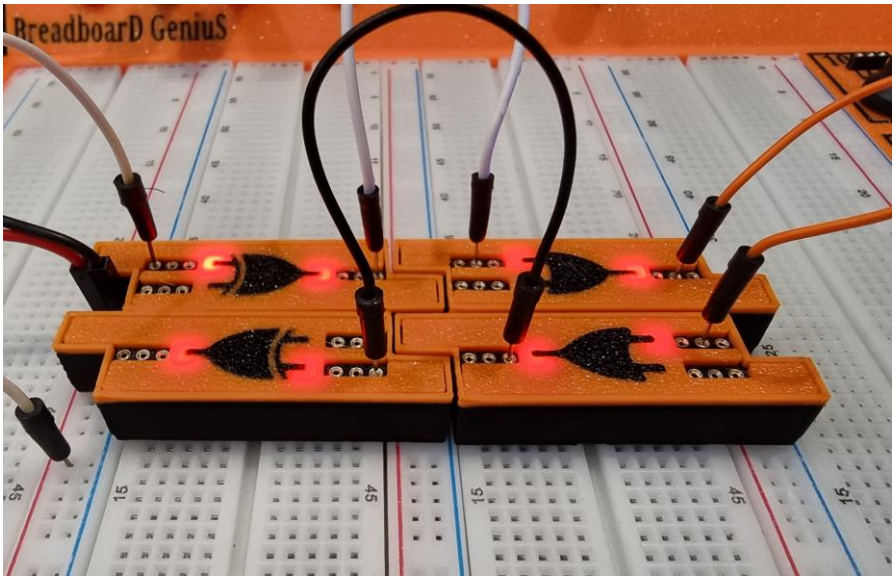
When placing the Logic gates on a breadboard its best to place them with the lower pins on the power rails to maximise the number of logic gates you can add, make sure you connect them to the top four pins in the left-hand block of 10 pins and the lower 4 pins in the right hand block of 10 pins, as shown in the image above.



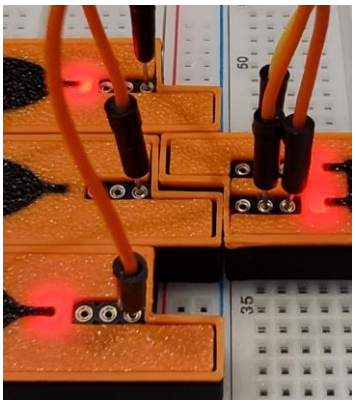
Once you have plugged in the first logic gate in the correct location you will be able to add another directly next to it.



Notice how the first power rail has power connected to it, yet the next set of power rails are now active. Normally with breadboards you are required to connect each power rail with power, the BreadboarD GeniuS™ Logic gates however carry power between the rails and thus no additional power jumpers are needed. It is vital that you don't accidently incorrectly jumper power wires between power rails or attempt to introduce another voltage level on a power rail connected to a logic gate. The BreadboarD Genius™ logic gates are designed to carry upto 7amps of power at a maximum of 5v, do not exceed this voltage. When used within the BreadboarD Genius™ lab the max delivered power is 4amps, so when used within the BreadboarD GeniuS™ project lab you won't exceed this rating. You must connect the logic gates using the GND and +5V connections on the BreadboarD GeniuS™ Power supply unit, if you are using the 0-30V connection make sure the voltage is set to 5V.



You can plug the BreadboarD GeniuS™ logic gates either way, and both ways on the same power rails, this enables more options when laying out a design, and reducing the need for long jumper wires between outputs and inputs.

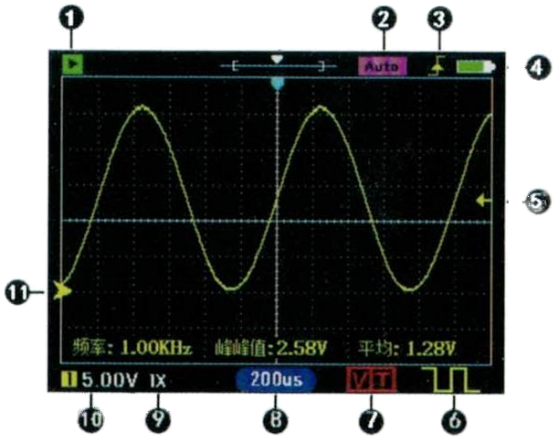


If you connect multiple gates outputs to a single input of another gate, neither gate will activate the opposing gates output indicator. The BreadboarD GeniuS™ logic gates have been designed specifically this way to show you which gate is active, in a normal logic gate if multiple gates are connected in this way then the output of all gates on the same line will become high, if we didn't add additional circuitry then all outputs will light up irrespective of the activity of the gate. The negative effect of this is that you can only drive a positive output, when the gate is low the output is floating, it will not go to ground even though it will register at 0 volts, you can't drive the cathode of an LED as the logic gate won't sink the current, you can however drive an LED to the anode. As the gates output is isolated using an additional transistor, it can drive a much higher load than a traditional gate. However, the binary/decimal counters decimal outputs only drive the cathodes, so any devices are sunk to ground when active

The connections on the Logic gates are circular, you must only insert circular jumper wires, inserting square jumpers will damage the connections.

Digital Oscilloscope.

• The maximum measuring voltage of the probe X1 is ±40V, and the maximum measuring voltage of X10 is DC ±400V. P6100 probe can switch X1/X10.



1. Run/Stop.
2. Trigger.

2.1. Auto=auto trigger.

2.2. Normal=normal trigger.

3. Trigger edge.
4. Power Level.
5. Trigger Level.
6. Signal generator: If there is no waveform here, it means the generator is off.
7. [VT] indicates that the arrow keys can adjust the voltage and time base range, and the [Mode] key can be used to switch the mode to move the waveform or the trigger level.
8. Time base: The time of a grid in the horizontal direction.
9. Probe ratio: set it in the [menu] -> [Set] to be the same as that on the probe, the purpose is to tell the oscilloscope what ratio of probe you use.
10. Sensitivity: The voltage of a grid in the vertical direction.
11. Zero baseline: The position where the voltage in the vertical direction of the screen is zero.

Button functions.

Power Button, hold to turn on/off, short press to pause. When paused use the arrow keys to scroll around the saved output, press mode then the arrow keys to increase and decrease the depth and voltage height.

OK/Auto

1. As the OK" function when the menu is open
2. When the menu is closed, as the 'Auto' button

Stop RUN/STOP

Menu Menu

Mode

1. Mode switch: adjust range or move waveform or move trigger level.
2. Menu Toggle

↑ Increase sensitivity or move the waveform up.
↓ Decrease the sensitivity or move the waveform down.
← Increase the time base or shift the waveform left.
→ Decrease the time base or shift the waveform right.

• Auto: Connect the probe first, then press the [Auto] button, the oscilloscope will automatically detect the waveform and adjust the range. Note that when the frequency is lower than 40hz, "Auto" will not work, you need to manually adjust the range.
• Probe attenuation: In the menu -> [set], set the probe to be the same as the probe, the purpose is to tell the oscilloscope what proportion of the probe you use.
• Signal Generator: Open the menu, press the [Mode] key to switch to the signal generator interface, press the [OK] key to switch the waveform, and press the [Stop] key to turn on/off the output.
• Trigger Level: Open Menu -> [Trig] and set the trigger level to 'Manual. Close the menu, press the [Mode] key to switch to the trigger level mode, then you can move the trigger level up and down.
• 50%: Long press the [Mode] key to quickly return the zero baseline and trigger to the middle of the screen.
• Rtauto: Long press the [Auto] button to enter the "real-time auto" mode. In this mode, the device is always in the "auto" adjustment state. Any key operation will terminate this mode.

Common Problems

1. How to quickly see the waveform?

A: Connect the probe to the signal first, then press the Auto button, the oscilloscope will automatically detect the waveform and adjust the range.

2. What if I can't see the waveform?

A: Generally, it is because the probe is not connected properly, or there is no signal output. Use a multimeter to check for voltage. If you suspect that the problem is the oscilloscope, you can test the output of the built-in generator. If you can measure the waveform, it means that the oscilloscope is fine.

3. Why does the waveform refresh slower when the time base is increased?

A: The reason is very simple; the time base represents the time of a grid in the horizontal direction of the screen. For example, the current time base is 100ms, and the screen has 12 grids, It takes 100ms*12=1.2 seconds to sample the waveform of one screen, so it takes 1.2 seconds to refresh one screen. Therefore, when the time base is greater than 20ms, the refresh will be significantly slower. When it is greater than 200ms, to avoid not refreshing for a long time, it will automatically enter the "roll" mode, and refresh while rolling.

5.How to measure the built-in signal generator?

A: The probe is connected to the Hz output first. Then open the menu->[Signal Generator], press the [Stop] button to turn on the generator output status as 'ON', press the [OK] button to switch the waveform you need, note that the frequency cannot be '0'. Close the menu and press Auto button and you will see the waveform.

Specifications of the Scope

Sampling rate	40MS/s
Bandwidth	18MHz
Sensitivity	20mV/Div ~ 10V/Div
Time Base	50ns ~ 10s
Max Voltage	X1: ±40V, X10: ±400V
Impedance	1MΩ
Trigger mode	Auto/Normal
Coupling	DC
Generator	Frequency: 0-500K Vol: 3.0V
Measurement	Freq/PkPk/Duty/RMS... 14 Types
Roll mode	200ms Enter roll mode.

Do Not Use the scope for objects outside of the BreadboarD GeniuS™ project lab, items must be common neutral to the power supply unit, the scope is coupled, you cannot measure other items for example direct mains frequencies.

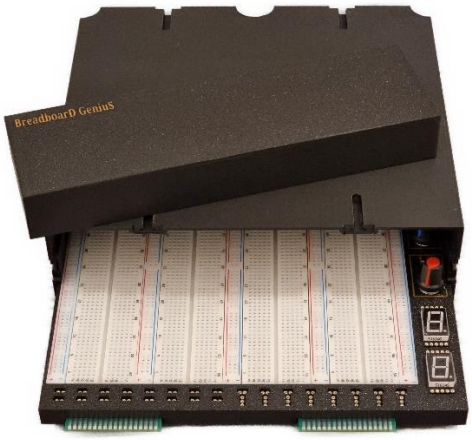
Expansion Modules.

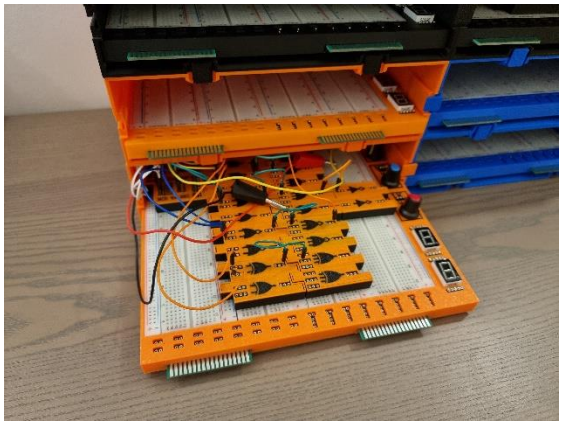
Available in the store are additional breadboard mounts, those clip together and enable you to double the space on the breadboard system, you can mix and match the breadboards. If you needed extra space for Arduino/Raspberry Pi projects, you could have both types of breadboard mounts.

You can also double up the Power supply units to get more power for your projects, once connected they form a common ground automatically.

Additional Boards.

You can also purchase additional boards, so you can put a project on hold while you build something else, they come with a sturdy storage box which can accommodate the project safely and enable you to store in your bag and travel with it, great for sharing projects with friends or education where more than one student will be working on independent projects. The storage boxes can be linked together to build storage cluster which can be desk mounted or screwed to a wall, you can add as many storage units in this manor as you require. Great for classrooms.





Support:

For assistance, troubleshooting tips, or additional resources, please email us at support@breadboardgenius.com Our team is dedicated to helping you make the most of your BreadboarD GeniuS™ experience. You can find other products in our range in our Etsy/Tindie/Amazon/eBay stores.

https://breadboardgenius.etsy.com/