Sloth Byte Limited

Discrete 555 Timer Kit

Standard and EZ Version

Assembly & User Manual

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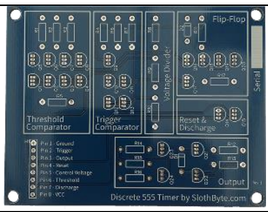
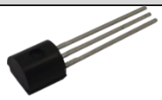
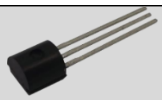
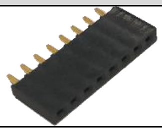
Disclaimer: This kit contains small parts which present a choking hazard to small children. Please keep this kit out of reach of small children. Children old enough to assemble the kit should be supervised, during assembly and during use of the completed kit. This is an educational hobby kit; it is not for use in life-critical systems or where failure could lead to the risk of injury or death. Switch off when leaving unattended. The technical data contained herein has been provided solely for informational purposes and is not legally binding. This manual is subject to change, technical or otherwise.

Attention: This kit is designed to work with a **5 volt dc** power supply!

Kit Contents

Before you begin, take some time to check that you have received all the components. If you ordered the PCB only and not the kit, the following list can be used as a shopping guide. The pictures are meant as a guide as the actual component design may differ slightly, for example in size or colour.

We have tried our best to ensure that your kit has everything included, if however, something is missing, please contact us at info@slothbyte.com.

Picture	Value	Component number	Description	Quantity
	PCB	-	Circuit Board	1
	1N4148	D1, D2	Small signal diode	2
	100 Ω	R16	Resistor Brown-Black-Brown	1
	220 Ω	R14	Resistor Red-Red-Brown	1
	820 Ω	R2	Resistor Grey-Red-Brown	1
	1 kΩ	R4	Resistor Brown-Black-Red	1
	3.9 kΩ	R13	Resistor Orange-White-Red	1
	4.7 kΩ	R1, R3, R15, R17	Resistor Yellow-Violet-Red	4
	5.1 kΩ	R8, R9, R10, R11	Resistor Green-Brown-Black-Brown	4
	6.8 kΩ	R12	Resistor Blue-Grey-Red	1
	10 kΩ	R5	Resistor Brown-Black-Orange	1
	100 kΩ	R6, R7	Resistor Brown-Black-Yellow	2
	2N3904	Q1, Q2, Q3, Q4, Q14, Q16, Q17, Q18, Q21, Q22, Q23, Q24	Transistor – NPN	12
	2N3906	Q5, Q6, Q7, Q8, Q9, Q10, Q11, Q12, Q13, Q15, Q19, Q20	Transistor – PNP	12
	Header	H1	Connector	1

Introduction

From its beginnings in the early 1970s, the humble 555 Timer IC has found itself at the heart of many designs and school projects. But what exactly is in that eight-legged small black plastic block aside from magic smoke?

Magic smoke? That's a little joke engineers share. We say that the manufactures went to great lengths to put the magic smoke into the component, and occasionally when things go wrong, it's let out.

The first design of 555 Timer used bipolar transistors. So with this in mind, this kit follows suit by also using bipolar transistors – 24 of them.

Once completed, you will have a version of the 555 Timer constructed from discrete components. You'll then be able to experiment with it by incorporating it into test circuits using breadboard. See the **Example Circuits** section for astable and monostable circuit examples.

Components Overview

Resistors

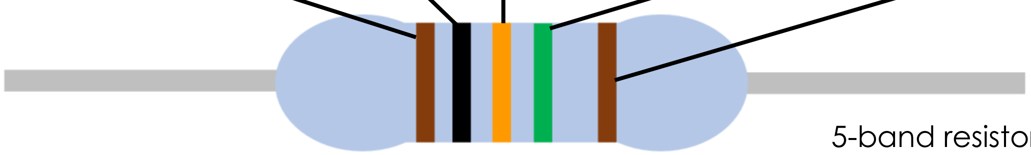
As their name suggests, resistors resist the flow of electrical current. They have two legs and can be inserted into the circuit board in either direction. However, for aesthetics, they do look better when all inserted the same way around, i.e. tolerance band to the right.

Resistor Symbol

The amount of resistance offered by the resistor is expressed in the unit ohms. The symbol used for ohms is the uppercase Greek letter Omega (Ω).

Resistors have their value printed on them using a colour code. The table below shows how to read 4-band and 5-band resistors.

Colour	Band 1	Band 2	Band 3	Multiplier		Tolerance
Black	0	0	0	x 10^{0}	(1 Ω)	
Brown	1	1	1	x 10^{1}	(10 Ω)	± 1%
Red	2	2	2	x 10^{2}	(100 Ω)	± 2%
Orange	3	3	3	x 10^{3}	(1 kΩ)	
Yellow	4	4	4	x 10^{4}	(10 kΩ)	
Green	5	5	5	x 10^{5}	(100 kΩ)	± 0.5%
Blue	6	6	6	x 10^{6}	(1 MΩ)	± 0.25%
Violet	7	7	7	x 10^{7}	(10 MΩ)	± 0.1%
Grey	8	8	8	x 10^{8}	(100M Ω)	± 0.05%
White	9	9	9	x 10^{9}	(1 GΩ)	
Gold				x 10^{-1}	(100 mΩ)	± 5%
Silver				x 10^{-2}	(10 mΩ)	± 10%



The first resistor in the example is a 4-band resistor; it has four coloured bands representing its value. The tolerance band is spaced further away from the other bands and is always placed on the right-hand side when reading the value of the resistor.

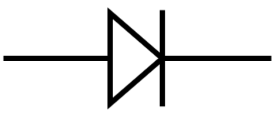
Let's look at the value; the bands are brown, black, orange and gold. From the chart, we can see that these are equal to 1, 0, x 10^3 and ±5% respectively. This gives a value of 10000 Ω with a tolerance of ±5%, although you usually see such a large number formatted as 10 kΩ, where k is short for kilo (1000).

With a tolerance of ±5% we'd expect this resistor to measure anywhere in the region of 9.5 kΩ to 10.5 kΩ.

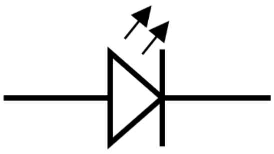
As a final note on resistors, when I was at college, my lecturer taught the class a way to remember the colour code with the phrase "Betty Brown Runs Over Your Garden But Violet Grey Walks".

Diodes and Light Emitting Diodes

Diodes only allow current to flow in one direction, so must be fitted to the circuit board the correct way around. They have two legs; one is called the Anode (+), and the other is the Cathode (-). In the symbols below, the Anode is the left side, and the Cathode is the right side.



Diode Symbol



LED Symbol

Regular diodes (symbol on the left), have a line printed on their Cathode side which corresponds to the line in the symbol (vertical line to the right of the triangle). There is also a line printed on the circuit board to help orientate the diode the correct way around when installing it.

LED is short for Light Emitting Diode; this is a diode that emits light when current is flowing through it. An LEDs Anode can be identified by a slightly longer leg, and the Cathode can be identified by a flat side of the LED.

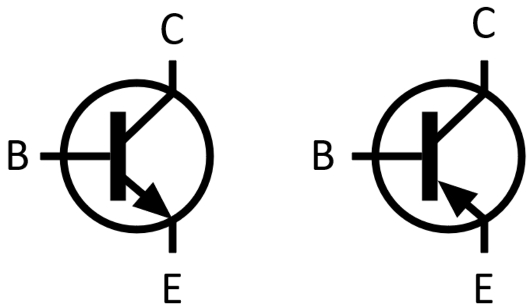
Although there are no LEDs in this kit, it is a good idea to know how to connect them as you are most likely going to want to use one to test the output of the Discrete 555 Timer Kit. An LED and resistor is a great way to do this.

LEDs typically work using a low voltage (around 1.8 V), you must, therefore, use a resistor to drop the voltage to a suitable level.

Tip: Diodes must be inserted the correct way around.

Transistors

Transistors are small electronic switches that have three connections; Base Emitter and Collector (B, E and C respectively). Transistors must be installed the correct way around; incorrect orientation can cause them to fail by letting out the magic smoke. The correct orientation is marked on the circuit board of this kit, the shape printed on the board matches that of the component.

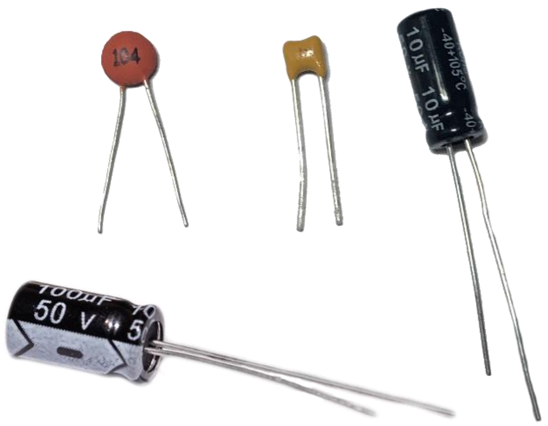


NPN Transistor Symbol PNP Transistor Symbol

When the base-emitter voltage of an NPN transistor is around +0.7V, current flow from the collector to the emitter is switched on; hence they act like tiny electronic switches. The opposite is true for a PNP transistor, in this case, current will flow from the emitter to the collector when the base-emitter voltage is around -0.7V.

Tip: Transistors must be inserted the correct way around. The two types of transistor in this kit look the same, always check the number printed on the front of them.

Capacitors



Capacitors store energy in an electric field. A capacitor has two connections, and depending on its type may need to be installed the correct way around.

The symbol below on the left is for a ceramic capacitor; these can be installed in any direction. However, the symbol on the right is for an electrolytic capacitor; these must be installed the correct way around to avoid destruction and the release of magic smoke. Electrolytic capacitors usually have the negative leg clearly marked.

Capacitor Symbol   Electrolytic Capacitor Symbol

Capacitors are made of two conductors separated by a dielectric (non-conductive material). If you look at the symbol for a capacitor, you can see this notion is graphically represented by two parallel lines separated by a gap.

Capacitance is measured using the unit farad (F). 1F is actually a pretty large value; you'll most likely come across values in the pF (x 10^{-12}), nF (x 10^{-9}) and µF (x 10^{-6}) range. For example, 100 µF expressed as farads is 0.0001 F.

There are no capacitors in this kit; however, you will want to use at least one when using the Discrete 555 Timer Kit as part of a circuit. See the **Example Circuits** section for more information.

Tip: Electrolytic capacitors must be inserted the correct way around; their negative leg is usually marked with a stripe containing the minus symbol (-) down one side of the capacitor as per the image at the top of the page.

Tools

Required Tools

You will need some basic tools to complete this kit.

- Soldering Iron & solder
- Small wire cutters

Optional tools

- Small needle-nose pliers
- Multimeter for measuring resistor values, fault finding and testing
- Magnifying glass for checking solder joints if fault-finding
- Solder sucker/wick
- Soldering matt to protect your desk

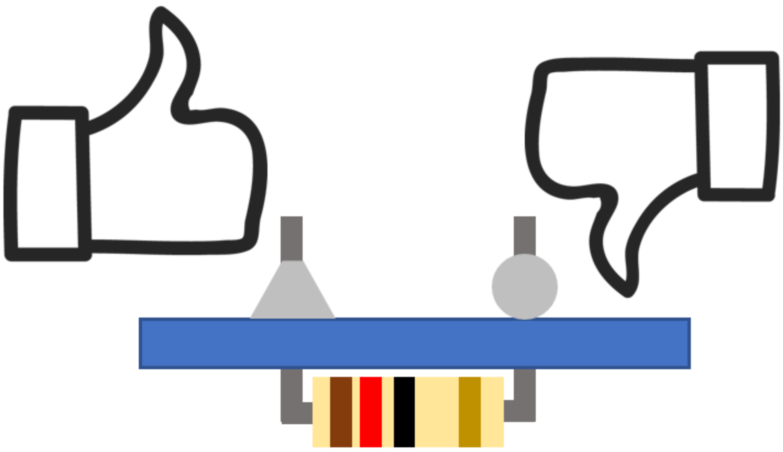
Soldering

As with all things, the more you practice, the better your soldering will become.

The order to construct this kit is covered in the next section, but before you read that, here is a little overview of soldering.

When the soldering iron is hot, start by applying a small amount of solder to the tip. Then hold the iron to the pad of the circuit board and leg of the component to be soldered to heat them both up. Finally, apply some solder to the joint. Remove the iron, and that's your first joint done.

The image below shows what a good joint should look like, along with a bad joint.



Tip: Different types of solder have different melting temperatures, and some are easier to work with. The wattage of your soldering iron and size of tip affect the ease of soldering.

Important: Ensure that you solder in a well-ventilated area and avoid breathing the fumes. Always wash your hands after handling solder.

Assembly

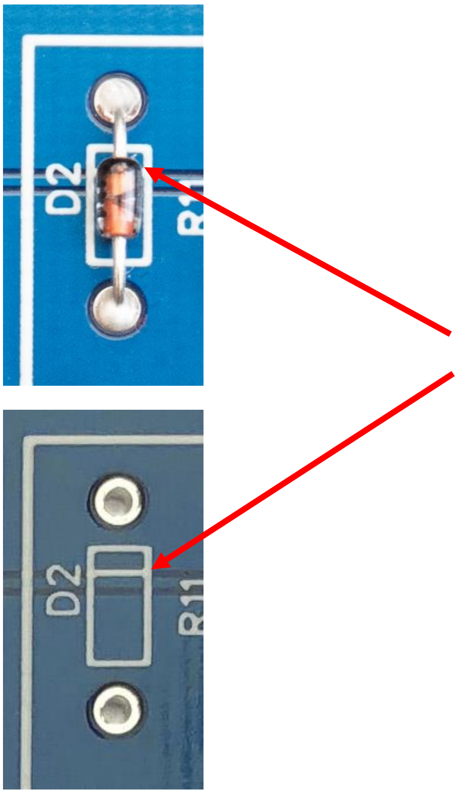
Diodes

Start with the two diodes. Both diodes are the same value, and the positions on the circuit board are labelled as D1 and D2. Pay attention to the line printed on the diode, it matches the position of the line printed on the circuit board.

When bending the leg of the diode, take care not to bend it too close to the glass tube as this may cause it to break.

After soldering each diode into place, cut the excess legs off.

That's all the diodes done so move on to the resistors.



Black line on diode (cathode) aligned with line on the circuit board.

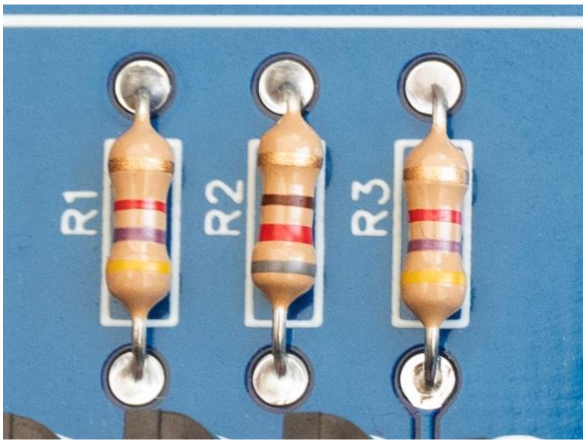
Resistors

There are ten different resistor values used in this kit. It's essential that the correct value is inserted into the correct position, or the kit will not work as intended.

The easiest way to identify the resistor values is by checking their coloured bands against the **Kit Contents** section. Or you could use a multimeter set to the ohms range to identify them. If you want to practice reading and decoding the colour code yourself, then you can refer to the **Resistors** section and the colour code table contained within.

Work in whatever order you prefer, e.g. R1, R2, R3, R4 etc. or by resistor value, e.g. all of the 5.1 KΩ resistors and then the next value and so on. Just be sure to take your time and not mix up the values.

Resistors can be installed either way around. However, the finished kit will look nicer if they are all inserted the same way, i.e. the tolerance band on the same side of each resistor.



Transistors

There are two types of transistor used in this kit.

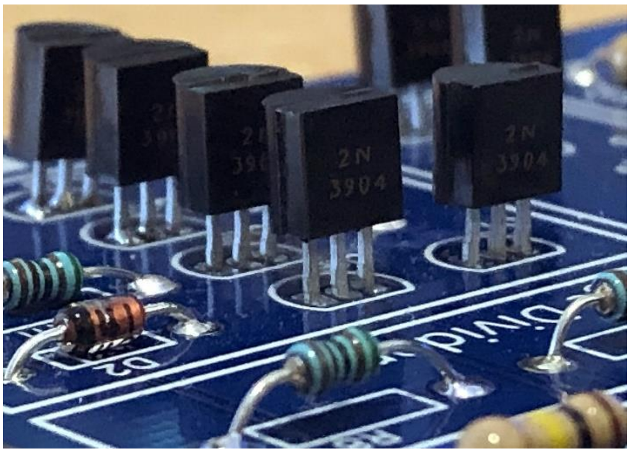
- 12 x 2N3904 (NPN)
- 12 x 2N9306 (PNP)

The two different types of transistor have been packed in different bags to make them easy to identify. The value is also printed onto the flat side of the transistor. It is essential that the two types of transistor are not mixed up, although they look the same, they operate in the opposite way to each other.

Start by soldering all the 2N3904 transistors in place, then repeat for the 2N3906 transistors. Ideally, the transistors look best if raised slightly off the circuit board and all at the same height. If you have the EZ version of the kit, positioning the transistors in this way will be straightforward, just push them down and they naturally sit around 3 to 4 mm off the PCB. However, if you have the standard kit, this can be a little tricky to achieve, so If you prefer, just push them all the way down before soldering in place.

2N9304 transistors: Q1, Q2, Q3, Q4, Q14, Q16, Q17, Q18, Q21, Q22, Q23, Q24

2N9306 transistors: Q5, Q6, Q7, Q8, Q9, Q10, Q11, Q12, Q13, Q15, Q19, Q20



Tip: The pads for the transistors are small and close together making them the most challenging component in the kit to solder into place. If you find that the solder keeps bridging the pads, try trimming the legs down a bit and with the soldering iron heat the joint, and suck the excess solder away using a solder sucker. Some people get on better with solder wick, so you could also give that a go.

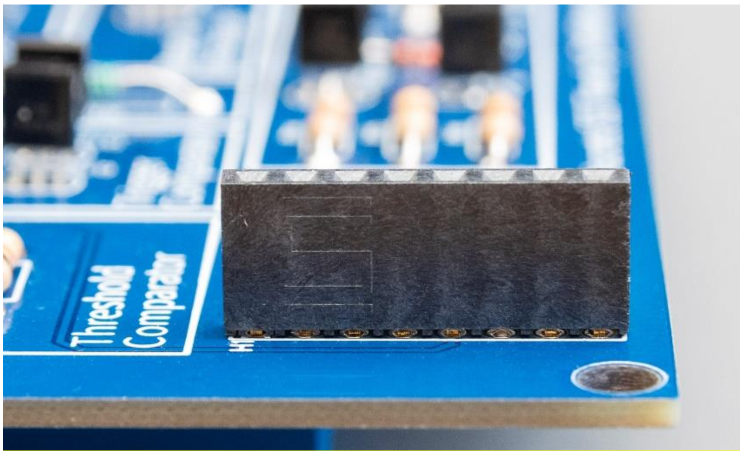
Use a magnifying glass and/or multimeter to check for shorts. If there are any shorts between the transistor pads, then the kit will not work.

Tip: Three of the transistors (Q5, Q8 and Q19) will read a short between their base and collector, this is by design and shown on the schematic.

Connection Header

The last component to solder in place is the connection header. This connector is the same style as used on the popular Arduino microcontroller boards. After it is soldered in place, a connection is made by inserting a solid core wire into the hole. The recommended gauge of wire is 22 awg.

The orientation of the header doesn't matter. To solder in place, start by soldering just one of the outer pins. Check if the header is level, if not heat the joint and move the header so that it is. Once correctly positioned, solder the remaining seven pins.



Congratulations your Discrete 555 Timer Kit is now complete!

You can test the completed Discrete 555 Timer kit by building it into one of the circuits in the **Example Circuits** section. My favourite is the astable circuit; this will repeatedly pulse the output (pin 3) on and off in a square wave. You can use the output to drive an LED but remember to protect the LED using a resistor.

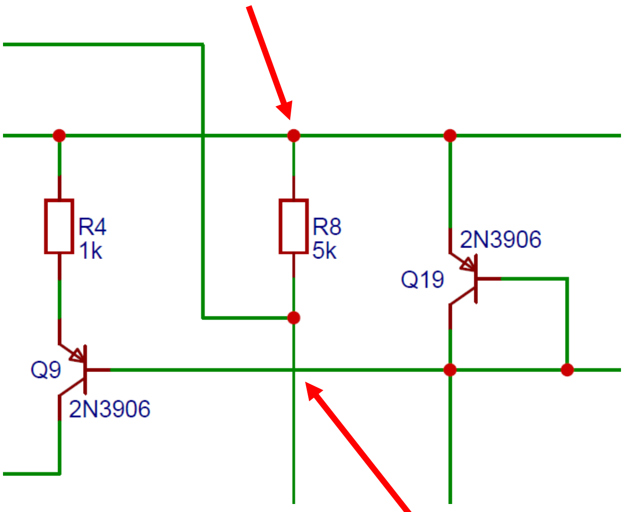
Reading Circuit Diagrams

Connections

Circuit diagrams are a way of representing a circuit in pictorial form using pre-agreed upon symbols, some of which we've already covered. Circuit diagrams are usually laid out in such a way as to minimise the clutter of lines. This means that components that are often next to each other on the diagram may not actually be physically located next to each other on the circuit board.

Where there is an electrical connection between two components, this is represented in the diagram by a line connecting the two components.

Where multiple lines are connected, they are shown with a small dot at the point of the connection.



Extract from Discrete 555 Timer Circuit Diagram

Large circuit diagrams can get quite busy with lines crossing over each other. If there is no dot where they cross, then there is no electrical connection between the two lines. They merely cross over like this as there is no other practical route to draw the line.

Components

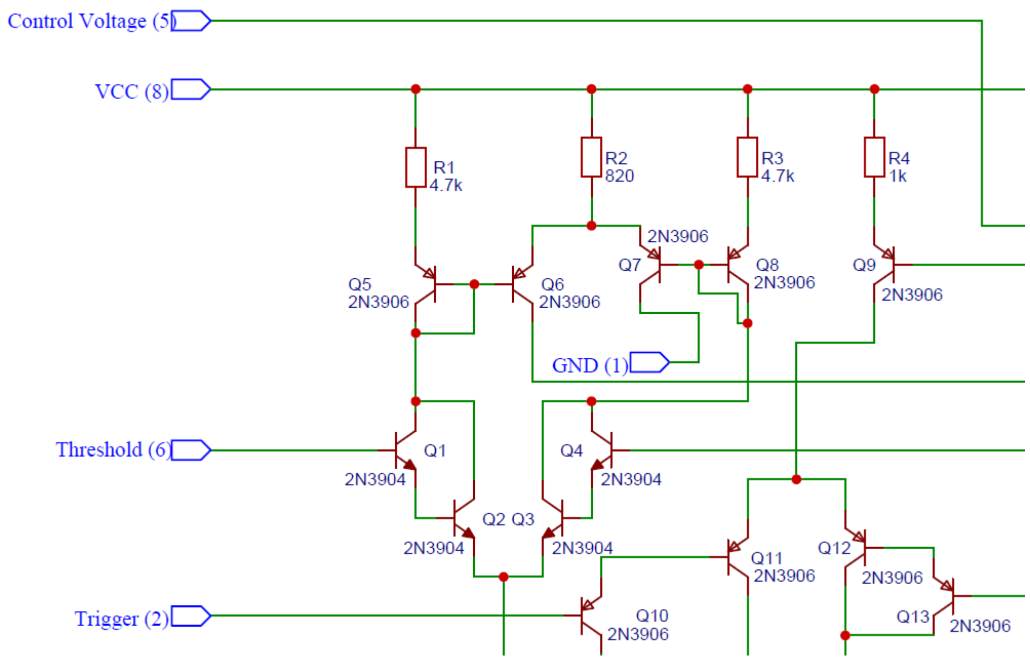
Each component in the circuit diagram has a unique identifier, typically a letter followed by a number, for example, R1. But the drawing may not always follow this pattern.

The following letters are typically used to identify components, although not everyone follows this convention.

- C = Capacitor
- D = Diode
- Q = Transistor
- R = Resistor
- S = Switch
- U = Integrated Circuit (IC/Chip)

Shortcuts When Drawing Lines

Often on large circuit diagrams, you'll find lines that terminate at a label. You'll find a label with the same name elsewhere on the circuit diagram. Labels sharing the same name are electrically connected. Drawing the lines like this is just a way to cut down on the need to cover the page in long lines.



Extract from Discrete 555 Timer Circuit Diagram

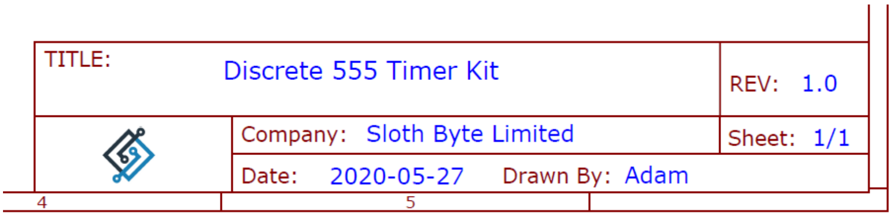
Power

Throughout this kit, all circuit diagrams will refer to the supply + volts dc as "VCC" and the supply 0V as "GND". Any number shown in brackets after the label VCC or GND simply refers to the pin number of the connection header on the circuit board.

Important: This kit is designed to work with a **5 volt dc** power supply! That means +5V connects to VCC and 0V connects to GND.

Technical Drawings

Technical drawings such as circuit diagrams generally have some important information in the lower right-hand corner. Below is an extract from the circuit diagram for this kit. Information that you'll find here can often tell you what the drawing is for, which company drew it along with revision number, date, and how many pages there are.



Extract from Discrete 555 Timer Circuit Diagram

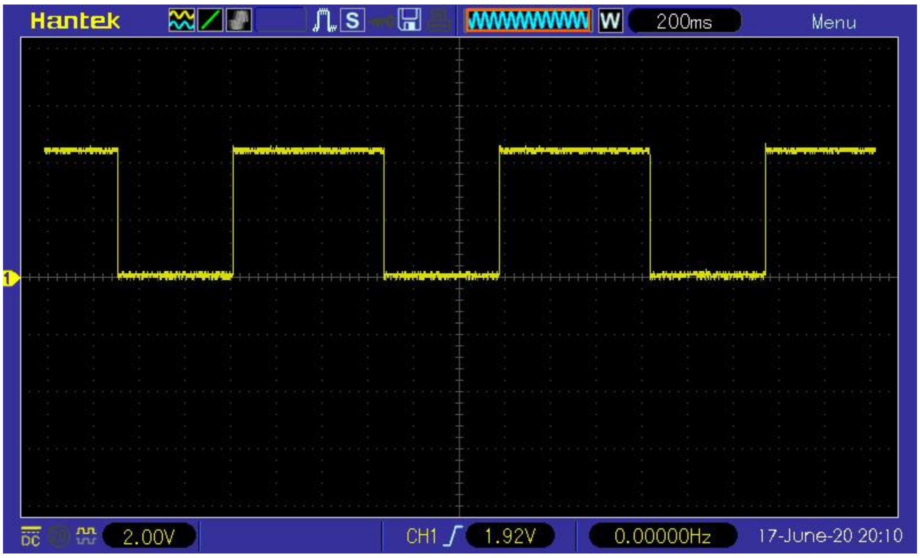
When I was at University, one of my lecturers told us about the importance of this information. He explained how he'd used it at a job interview when presented with a diagram and asked what the circuit's function was.

After graduating from University and attending some job interviews, I found myself in the same situation. A complex circuit diagram was placed in front of me, and I was asked what its function was. Its function was clearly written in the bottom right-hand corner; I got the job.

Example Circuits

Astable

When the 555 Timer is used in an astable configuration, its output is a square wave that switches between on (≈5 volts) and off (0 volts).



The number of on/off cycles that occur in one second is known as the frequency and is measured using the unit Hertz (Hz). The output frequency of the 555 can be changed by selecting different external component values.

The image above is a screenshot from an oscilloscope showing the output voltage of the Discrete 555 Timer Kit plotted against time. The vertical axis measures voltage, 0 volts being the centre line. Each vertical division is equal to 2 volts, so we can see that when the output is on (top of the square wave) it is around 4.5 volts.

The horizontal axis plots time and each division is equal to 200 ms (0.2 seconds). If we count the horizontal divisions for one complete cycle (on/off) we can see that one cycle is 5.8 divisions.

So, the time (T) taken for one cycle is;

T = 5.8 x 200 ms

T = 1160 ms (1.160 seconds)

The formula to calculate frequency is as follows, where the frequency is in Hertz and time is in seconds.

$$f = \frac{1}{T}$$

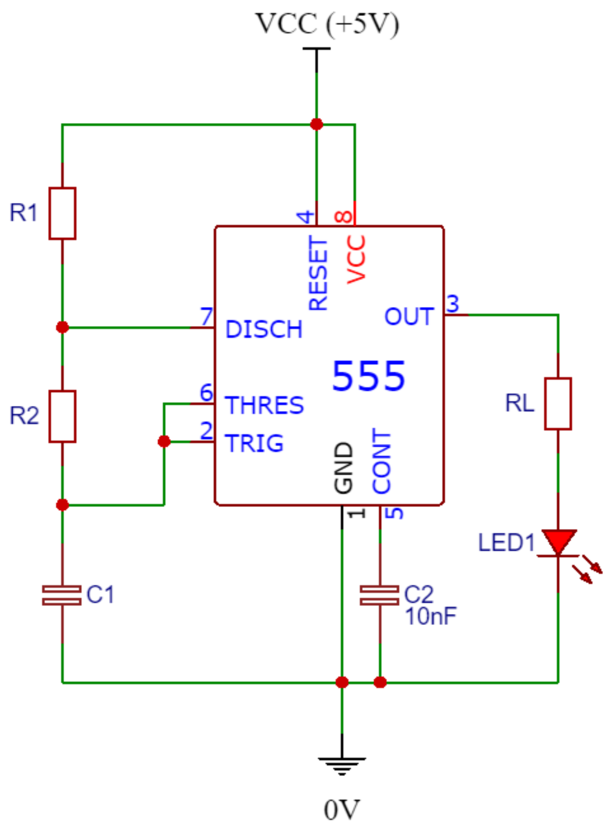
$$f = \frac{1}{1.160}$$

$$\boldsymbol{f = 0.862\ Hz}$$

Build Your Own Astable Circuit

In the circuit below, the Discrete 555 Timer Kit is represented by the rectangle labelled "555". Its pins are labelled with text and numbers that correspond to the connection header labels on the circuit board. All other components shown in this circuit are external to the Discrete 555 Timer Kit. You can probably get away without including C2.

By changing the values of R1, R2 and C1, it is possible to change the output frequency. A suitable value for RL must also be selected in order to protect the LED selecting this value will be covered later.



The formula for calculating the frequency in Hertz is below.

$$f = \frac{1.44}{(R_1 + 2R_2)C_1} Hz$$

R1 and R2 are in ohms, C1 is in farads. So, let's see what the frequency would be if we used the following values;

- R1 = 10 kΩ
- R2 = 100 kΩ
- C1 = 10 µF

$$f = \frac{1.44}{(10000 + 2 \times 100000)0.00001} Hz$$

$$f = \frac{1.44}{210000 \times 0.00001} Hz$$

$$f = \frac{1.44}{2.1} Hz$$

$$\boldsymbol{f = 0.686\ Hz}$$

Therefore, by using these values; R1 = 10 kΩ, R2 = 100 kΩ and C1 = 10 µF, we can make the output have a frequency of 0.686 Hz. But what does that look like in time?

Since we know that the time of one cycle is equal to 1 divided by the frequency, we can substitute in the frequency that we just calculated to give;

$$T = \frac{1}{f}\ seconds$$

$$T = \frac{1}{0.686}\ seconds$$

$$\boldsymbol{T = 1.46\ seconds}$$

This means that if we use the values for R1, R2 and C1 as defined above, then the time for one on/off cycle of the output will be 1.46 seconds. This time can be decreased by or increased by adjusting the values chosen for R1, R2 and C1.

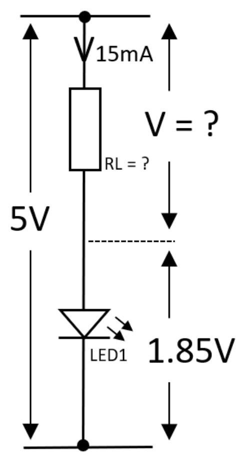
Tip: Increase C1 to reduce the frequency (increase the period).

Tip: There are two an online 555 calculators at https://www.slothbyte.com/555-calculator The first calculator shows the time and frequency for specified component values. The second calculator gives component values for a specified frequency.

Using an LED for the Output

If you plan to flash an LED from the output, then you must use a resistor to protect the LED. We can use ohms law to calculate the value of resistor that should be used.

Let's assume that the output of the 555 Timer is at 5 volts. Let's also assume that the LED has a forward voltage of around 1.85 volts and a forward current of 15 mA (check the manufacturer datasheet of your LED for this information). Then we can calculate the resistance of RL as follows.



Ohms law tells us the following, where R is resistance in ohms, V is volts, and I is current in Amps.

$$R = \frac{V}{I}$$

Since we need to know two out of three values to solve the above formula, we must approach this by first calculating the voltage drop across the resistor.

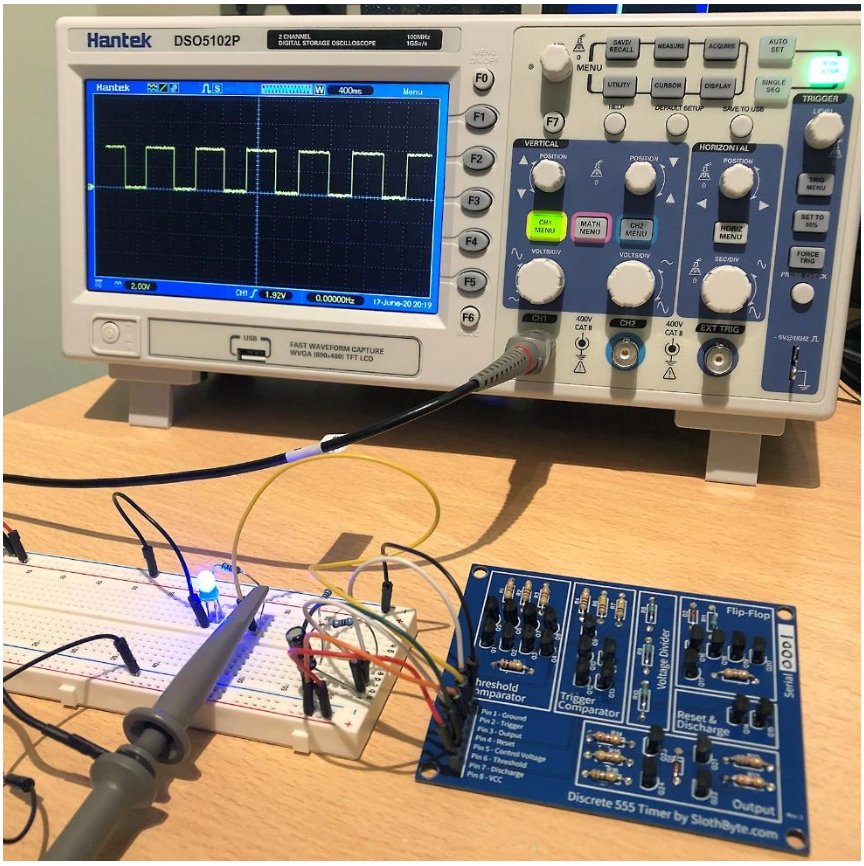
We know the supply voltage is 5 volts and that the LED will drop 1.85 volts, this means that the voltage drop across RL must be 5 volts minus 1.85 volts. We know that the current through the LED should be 15 mA, so substituting in these values gives us the following.

$$\boldsymbol{RL} = \frac{5 - 1.85}{0.015} = \frac{3.15}{0.015} = \mathbf{210\Omega}$$

You may find that the exact resistance that you calculate isn't available, this is because manufactures only make resistors in specific values. If this is the case, just choose the closest available value. In some circumstances, it may be that you need to combine resistors to obtain a suitable value.

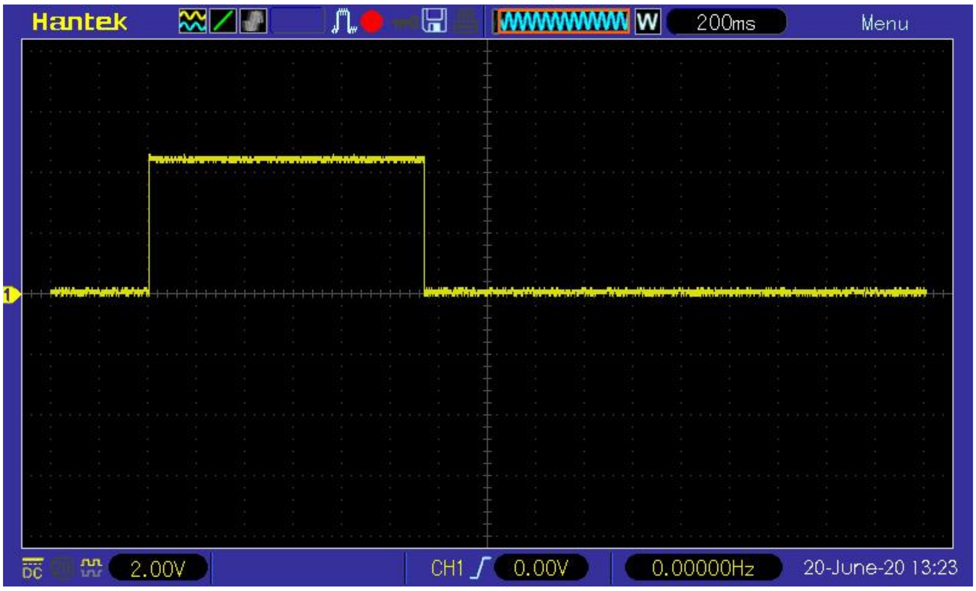
Important: Only connect the output of this kit to low current devices such as an LED (using a resistor) or the input of other TTL logic devices that operate at 5 volts. If you wish to drive something that will draw a lot of current, then you must switch this by using a transistor that is capable of switching the required current. Remember that this kit is powered using 5 volts dc and not designed to switch anything that uses more voltage than this.

The photograph below shows the Discrete 555 Timer Kit connected in an astable configuration using components on a breadboard. The output is connected to an LED through a resistor. The output is also being monitored on an oscilloscope. Oscilloscopes are expensive but worth the investment if you are serious about pursuing electronics.



Monostable

When the 555 Timer Kit is used in a monostable configuration, its output remains off until the trigger pin is pulsed low. The output then goes high (on) for a defined time period before going low (off) again. The output will remain off until the trigger pin is pulsed low again.



The image above is a screenshot from an oscilloscope showing the output voltage of the Discrete 555 Timer Kit configured in monostable mode plotted against time. The vertical axis measures voltage, 0 volts being the centre line. Each vertical division is equal to 2 volts, so we can see that when the output is on (top of the pulse) it is around 4.5 volts.

The horizontal axis plots time and each division is equal to 200 ms (0.2 seconds). If we count the horizontal divisions for the pulse, we can see that it is about 5.7 divisions.

So, the time (T) taken for the pulse is;

T = 5.7 x 200 ms

T = 1140 ms (1.140 seconds)

It is possible to adjust the time pulse by selecting different external component values, which is covered in the next section.

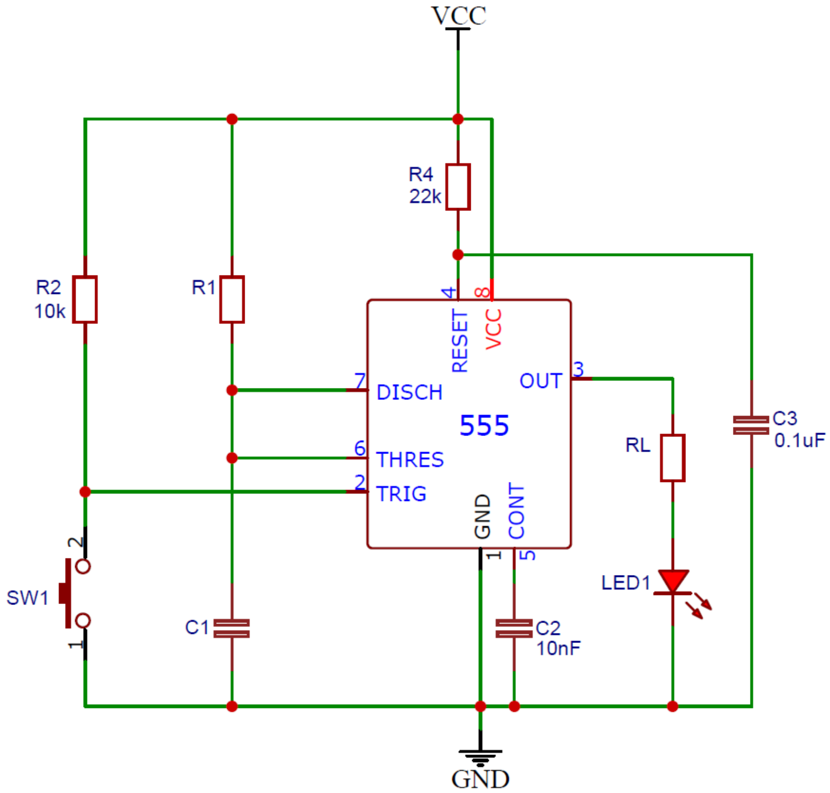
Build Your Own Monostable Circuit

The circuit below shows how to connect the Discrete 555 Timer Kit to operate in monostable mode. Note that you can most likely get away without the need for C2.

R4 and C3 are included to give a "delayed start" to the circuit. They will hold pin 4 of the 555 momentarily low at first power on. Pin 4 turns on/off the 555, when pin 4 is held high, the 555 is on, when pin 4 is held low, the 555 is off.

The delayed start is necessary as upon first power on, some states internally are unknown/invalid and cause the 555 to trigger its monostable output right away. We can easily implement the delayed start using a resistor (R4) and a capacitor (C3).

How does this "delayed start" work? Electricity is like water in that it wants to take the path of least resistance. In this case, it is easier for the electricity to flow into C3 than it is pin 4 of the 555. As C3 begins to charge the voltage at pin 4 begins to rise until it is high enough to turn on the 555.



The formula to calculate the time pulse output on pin 3 is as follow.

$$T = 1.1R_1 \times C_1$$

So, let's use 100 kΩ for R1 and 10 μF for C1 to get a feel for what sort of time pulse these values will give.

$$T = 1.1 \times 100000 \times 0.00001$$

$$\boldsymbol{T = 1.1\ seconds}$$

Or if you have a specific time in mind, for example, 10 seconds, then pick a suitable value for C1, again let's say 10 µF and rearrange the formula to solve for R1.

$$R_1 = \frac{T}{1.1C_1}$$

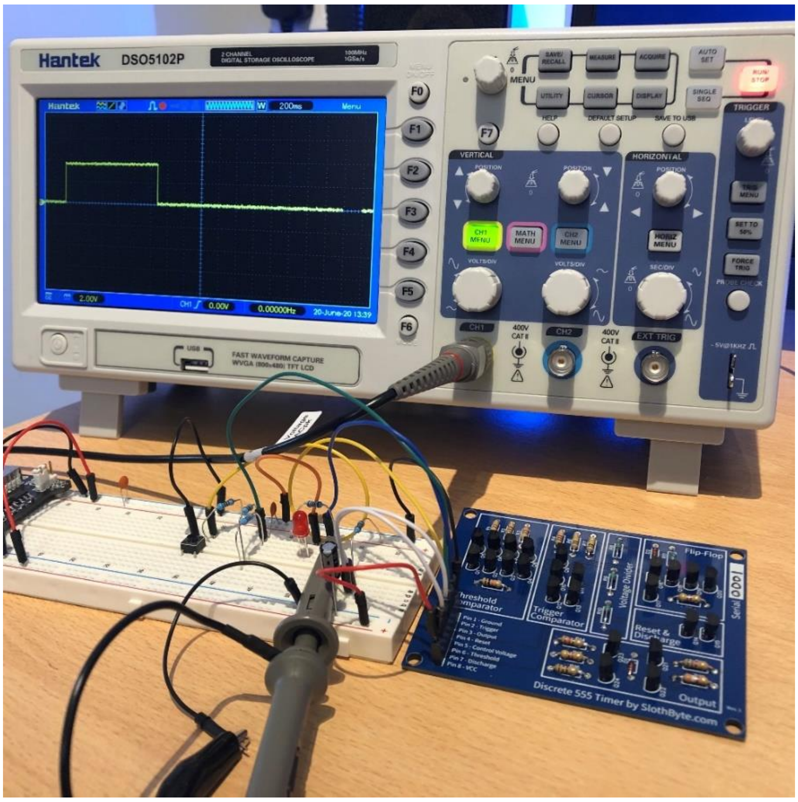
$$R_1 = \frac{10}{1.1 \times 0.00001}$$

$$\boldsymbol{R_1 = 909\ k\Omega}$$

If the resistor value calculated for your desired time is not a standard value, then you can either choose the nearest standard value or combine several resistors to form your calculated resistance.

Finally, if you wish to test the output with an LED, then you must select a suitable value resistor to limit the current flow through the LED. See the section **Using an LED for the Output** for how to do this.

The photograph below shows the Discrete 555 Timer Kit connected in a monostable configuration using components on a breadboard. The output is connected to an LED through a resistor. The output is also being monitored on an oscilloscope. Oscilloscopes are expensive but worth the investment if you are serious about pursuing electronics.

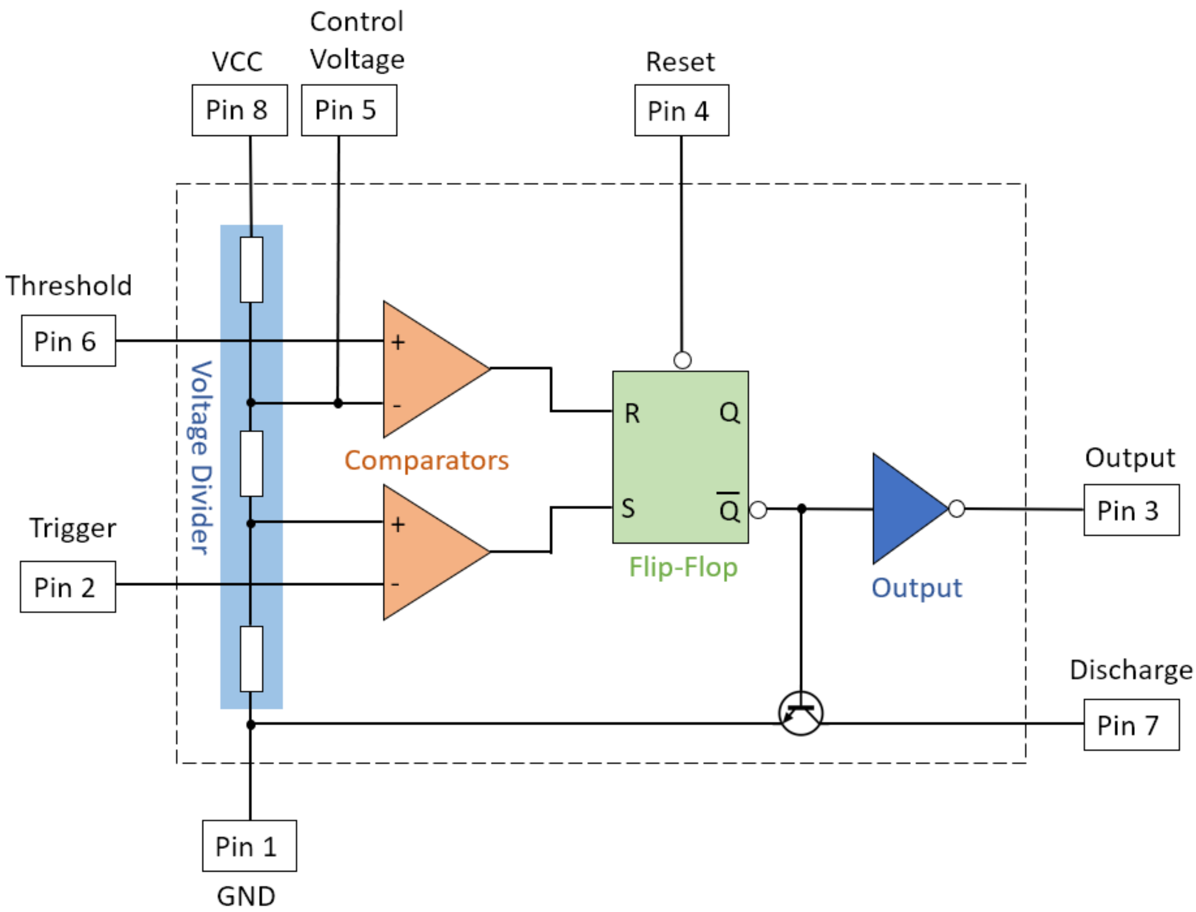


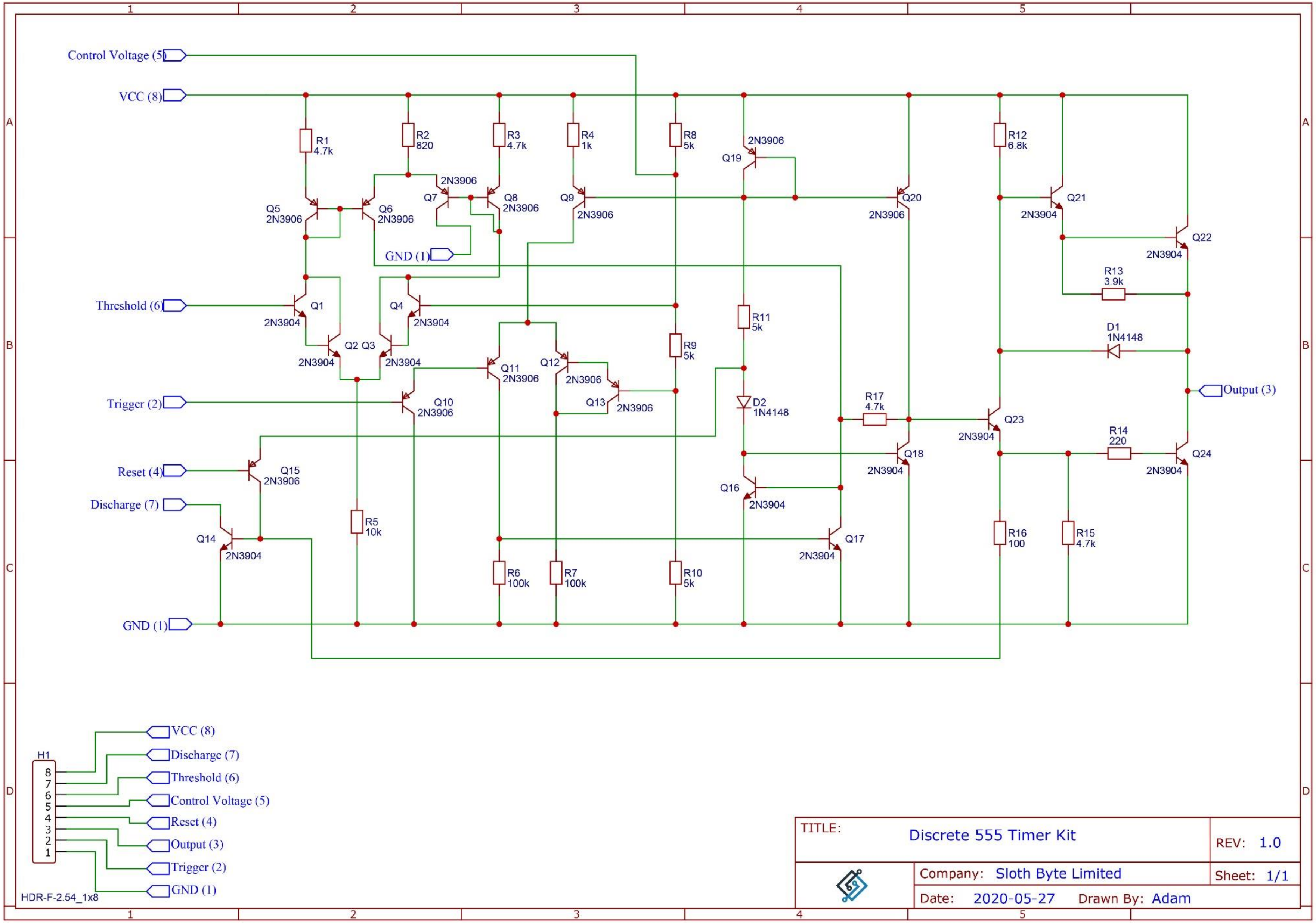
Appendix

Schematics

When dealing with complex circuits, it can be easier to get an overview of what's going on by concentrating on the bigger picture. Instead of worrying about each individual component, the function of several components can be grouped together into a block that describes how that group of components function.

In the case of this kit the entire circuit can be represented by the block diagram below. The circuit board in this kit has these areas marked out on the circuit board so you can see which components belong to each block. Now it just becomes a case of understanding how the following parts work; voltage divider, comparator, flip-flop, the output and the discharge pin.




Control Voltage (5)
VCC (8)
Threshold (6)
Trigger (2)
Reset (4)
Discharge (7)
GND (1)
Output (3)
R1 4.7k
R2 820
R3 4.7k
R4 1k
R5 10k
R6 100k
R7 100k
R8 5k
R9 5k
R10 5k
R11 5k
R12 6.8k
R13 3.9k
R14 220
R15 4.7k
R16 100
R17 4.7k
D1 1N4148
D2 1N4148
Q1 2N3904
Q2 Q3 2N3904
Q4 2N3904
Q5 2N3906
Q6 2N3906
Q7 2N3906
Q8 2N3906
Q9 2N3906
Q10 2N3906
Q11 2N3906
Q12 2N3906
Q13 2N3906
Q14 2N3904
Q15 2N3906
Q16 2N3904
Q17 2N3904
Q18 2N3904
Q19 2N3906
Q20 2N3906
Q21 2N3904
Q22 2N3904
Q23 2N3904
Q24 2N3904
H1
HDR-F-2.54_1x8
TITLE: Discrete 555 Timer Kit
REV: 1.0
Company: Sloth Byte Limited
Sheet: 1/1
Date: 2020-05-27
Drawn By: Adam