Integrated Circuits

What's an IC?

1) Multiple components (transistors, diodes, etc) built into a small single package.

2) P and N type silicon encased in plastic shell with leads.

2) Analog ICs deal with varying levels of voltage.

3) Digital ICs deal with only high (1) or low (0) states.

4) ICs are labeled with part number and manufacturing info.

Identifying ICs

1) All ICs have useful datasheets which can be found by entering the part # into google or seaching through online retailers such as digikey.com, or mouser.com

2) Datasheets contain package information, electrical information, pin diagram, and hopefully application notes. Datasheets are your friend.

3) ICs come in a variety of packages.

4) Surface mount components are extra small and are not meant for prototyping. You will be sad if you buy these by mistake.

5) DIP (Dual in line package) have pins spaced .1 inches apart, just like your breadboard. DIPs are your friend.

5) The top of an IC is typically marked with a notch or dot, or both.

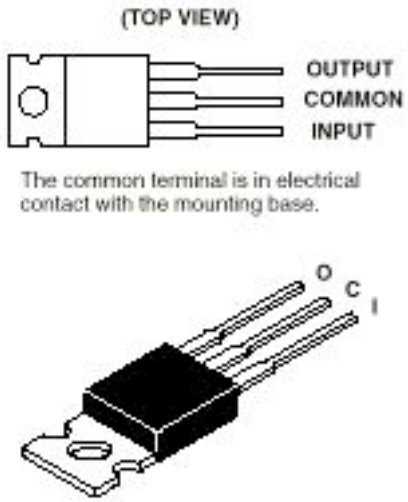
5) Pins are numbered counterclockwise, starting in the upper left.

78xx voltage regulator

1) 78xx family regulates a range of voltages.

2) 7805 regulates down to 5v. 7812 regulates down to 12v.

3) Extra voltage dissipated as heat.

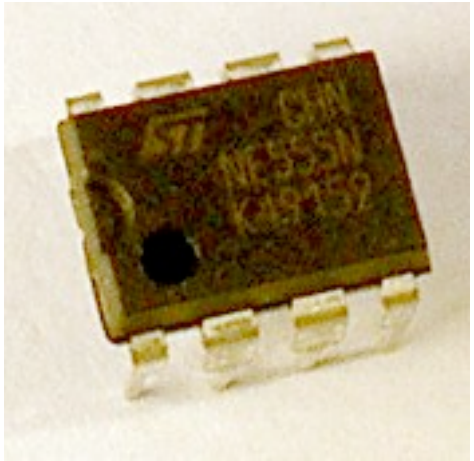


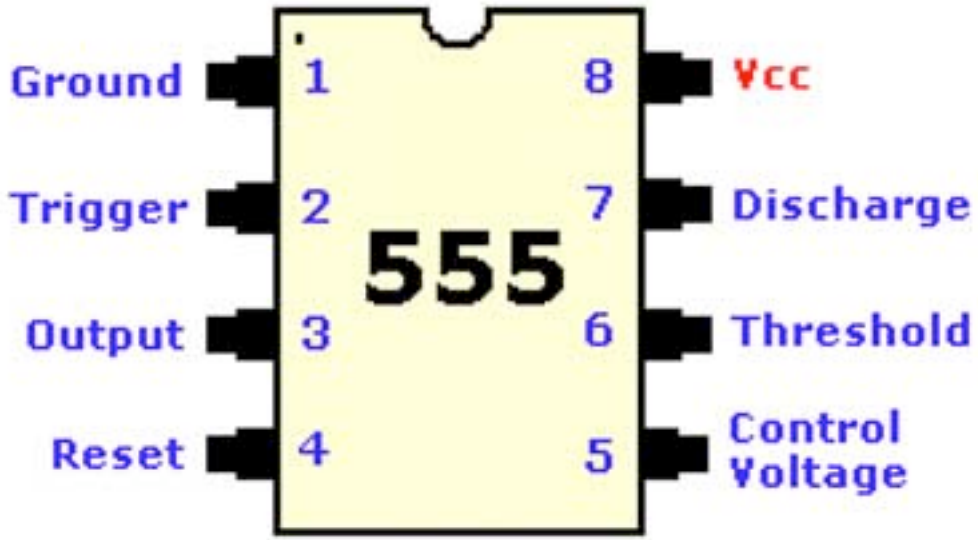
555 timer

1) 555 is a precision timer that can operate as either a single shot timer (monostable mode) or an oscillator (astable mode).

2) 555 is "programed" by wiring it with resistors and capacitors. These create RC circuits that control the timing.

3) Easy to use, cheap and has many applications such as led/light flashers, tone generators, on shot timer circuits, etc




Ground
1
Trigger
2
Output
3
Reset
4
555
8
Vcc
7
Discharge
6
Threshold
5
Control
Voltage

1) Ground. Connect this to ground. Remember to connect all grounds in a circuit together.

2) Trigger. A short low (less than 1/3 Vcc) pulse on the trigger starts the timer. By connecting this to ground we "turn on" the 555 timer.

3) Output. During a timing interval, the output stays at +VCC. Can source up to 200ma.

4) Reset. Forces pin 3 low if pulled to ground.

5) Control. Can be used to adjust threshold trigger voltage. Connect to ground with a .01uF cap to eliminate supply noise from Vcc.

6) Threshold. When threshold crosses above 2/3 Vcc timing interval ends.

7) Discharge. connects to ground when output goes low. Controls timing.

8) Vcc. Power supply. Typical range 4.5v to 16v.

monostable

1) Does nothing until a low pulse is applied to trigger (pin 2). Low pulse is usually provided by connecting to ground via a switch or transistor.

2) Output goes high for duration set by R1C time constant.

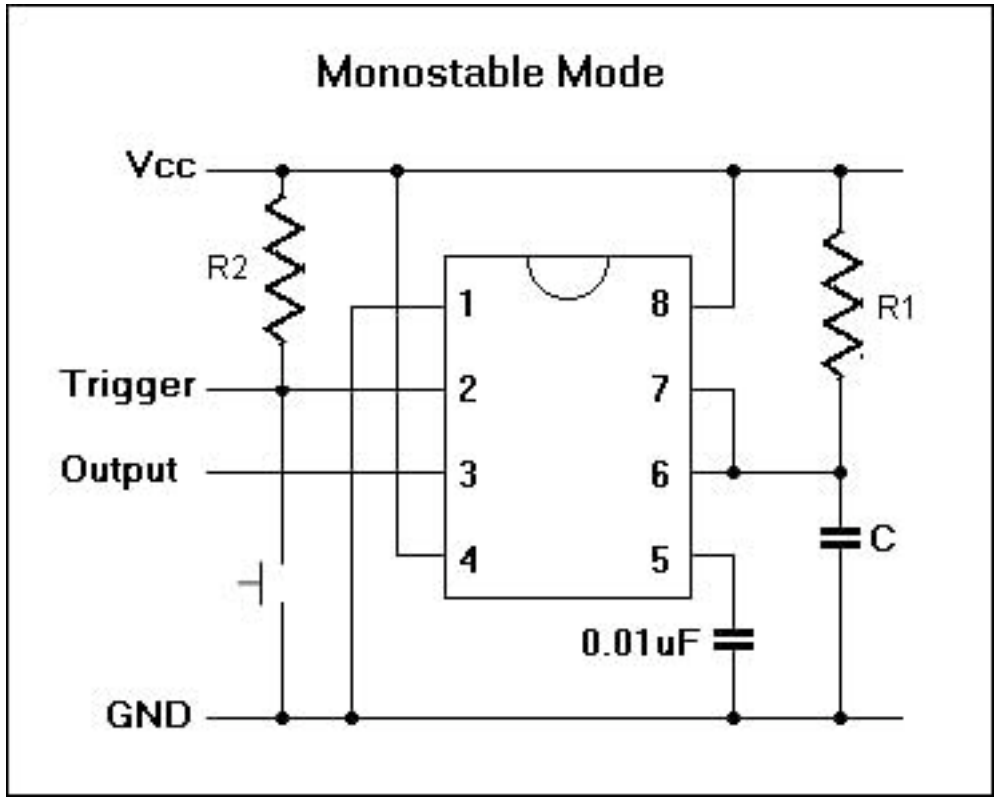
3) R1 should be between 10k and 14m.

4) Timing cap C should be between 100pF and 1000uF.

5) R2 pulls trigger high to prevent false triggering.

6) Uses - One shot timers, switch debouncing.

monostable


Monostable Mode
Vcc
R2
Trigger
Output
GND
1
2
3
4
8
7
6
5
R1
C
0.01uF

astable

1) No stable state. Output jumps between Vcc and Ground.

2) Output is a square wave with a mark period and a space period.

3) Frequency is set by R1, R2 and C

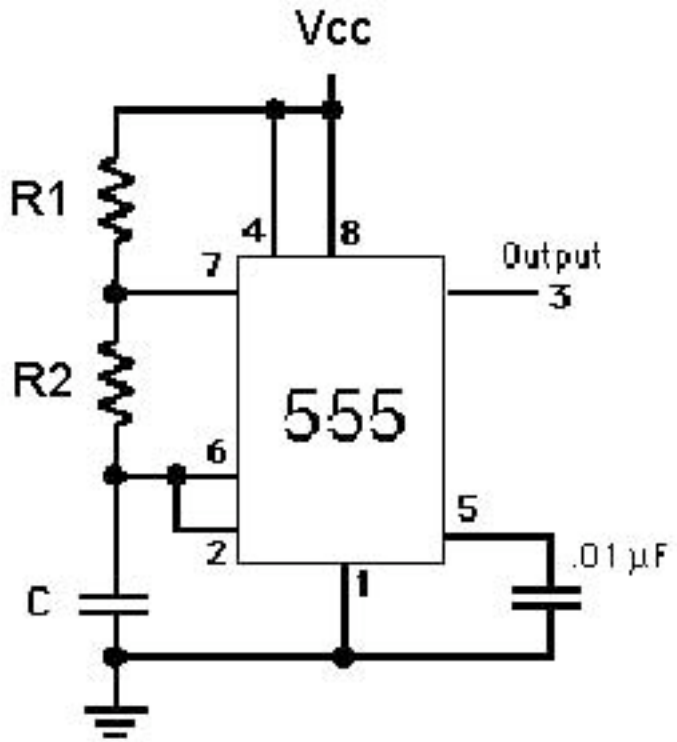
4) Uses - flashing light, tone, pulse width modulation

$$T_{mark} = 0.7(R_1 + R_2)C$$

$$T_{space} = 0.7R_2C$$

$$F = \frac{1.44}{(R_1 + 2R_2)C}$$

astable



working with ICs

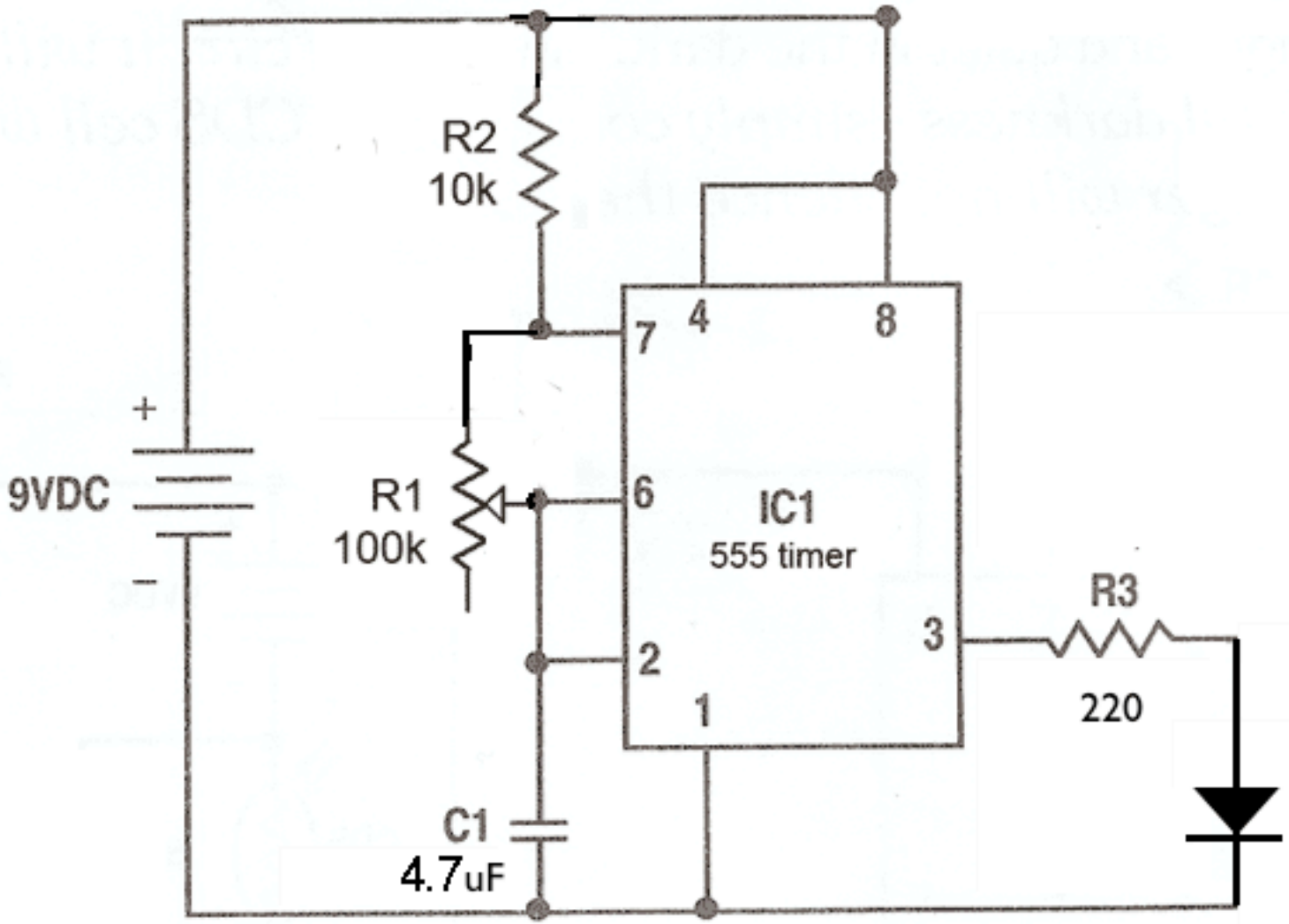
1) Some ICs are static sensitive. Treat them with care.

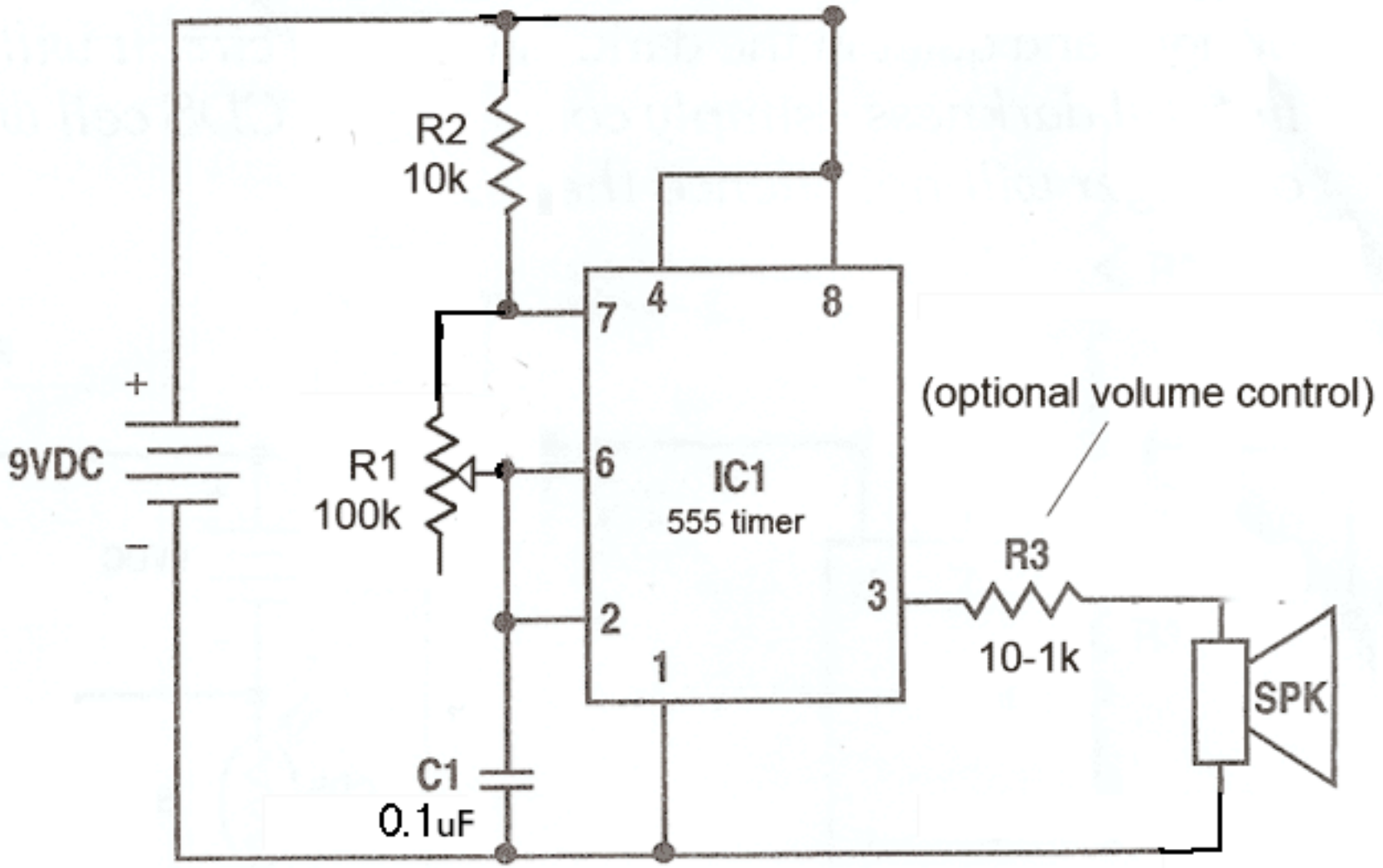
2) Work in order, pin by pin.

3) Dots on schematic mean connection. No dot means no connection.

4) If it doesn't work, check all connection in order. If it still doesn't work, pull it apart and rebuild it from scratch.

5) If components or battery get hot, or smoke, or explode, disconnect power supply.


R2
10k
7
4
8
+
9VDC
−
R1
100k
6
IC1
555 timer
R3
3
2
220
1
C1
4.7uF


R2
10k
7
4
8
+
9VDC
–
R1
100k
6
IC1
555 timer
(optional volume control)
R3
2
3
10-1k
1
SPK
C1
0.1uF