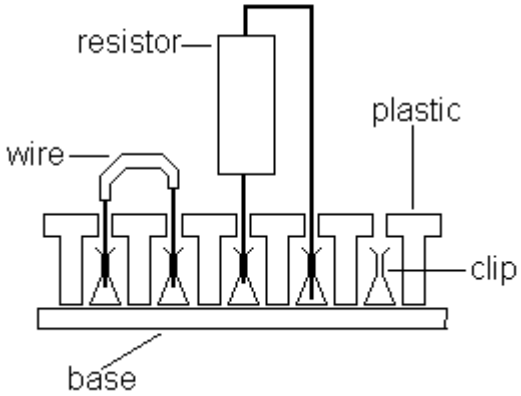
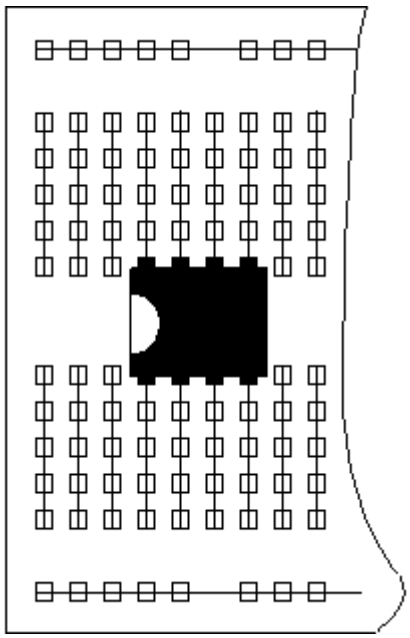
Hardware required

All the practicals assume the use of breadboard (prototype board) to assemble the circuits. This is a flat slab of plastic with an array of holes in it. Underneath the holes are strips of metal which can grip the bared ends of wires thrust through them.





You will need the following items of hardware:

1. Stabilised power supply capable of supplying +5 V and 0 V for digital circuits and +5 V, 0 V and –5 V for analogue ones.

2. Digital multimeter.

3. Double beam oscilloscope (at least 10 mV cm^{-1}, 1 μs cm^{-1}).

4. Signal generator (sine wave of up to 1 V between 100 Hz and 100 kHz).

5 Variable mains transformer with floating outputs (up to 9 V r.m.s.).

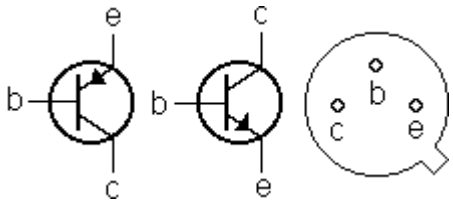
6. Computer capable of running Excel spreadsheet.

7. Analogue and digital integrated circuits and discrete components listed in the data sheets.

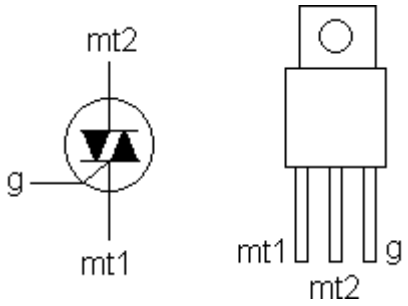
8. Various input/output devices, including thermistors, LDRs, relays, loudspeakers and electret microphones.

9. Lots of reels of solid 0.6 mm core wire with different colours of insulation.

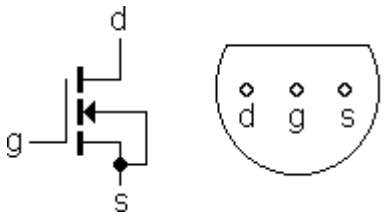
Bipolar transistors: Transistors are viewed from the top. The tag is always nearest to the emitter. It helps if you paint the PNP transistors purple.
Use BC108/BC477 signal transistors and BC441/BC461 power transistors.

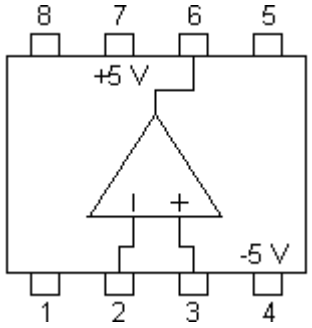
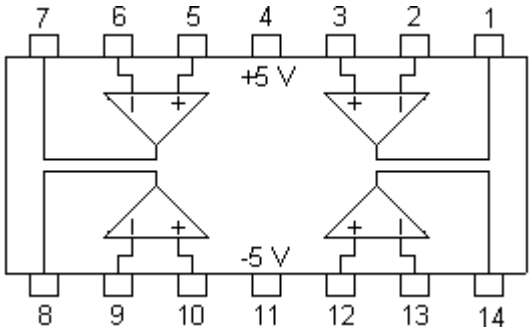
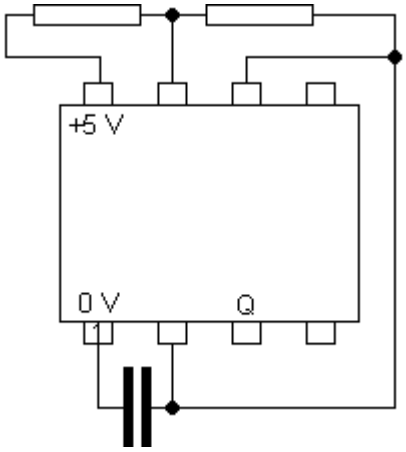
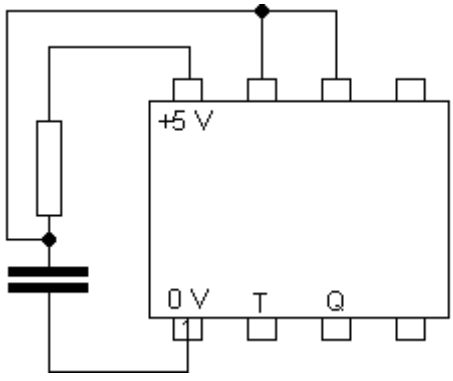


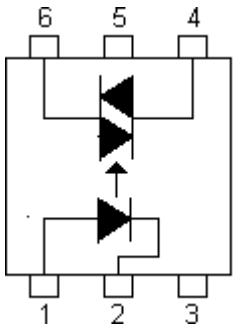
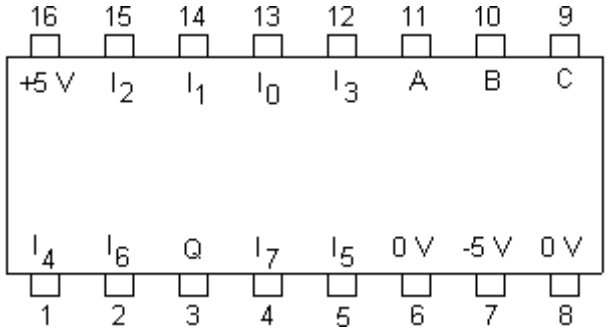
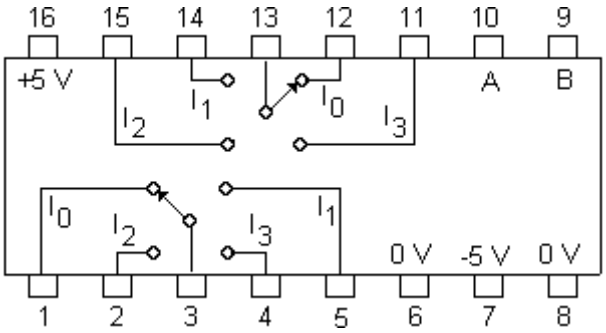
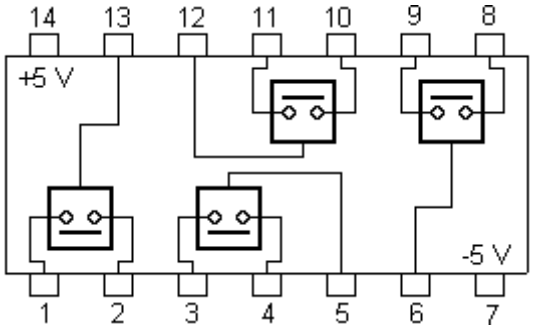
Triac: T206 viewed from the front.

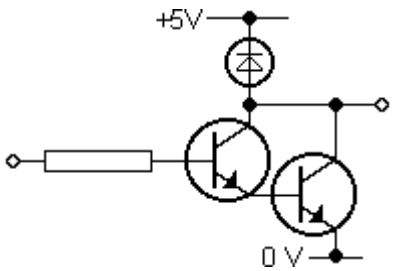
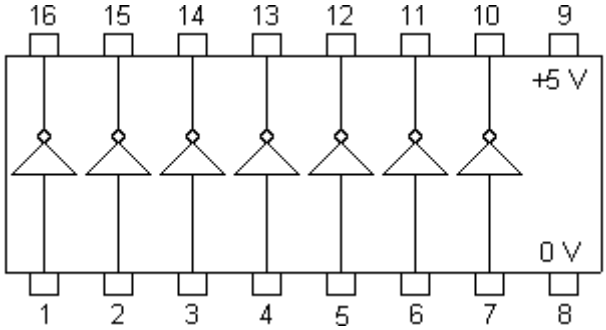
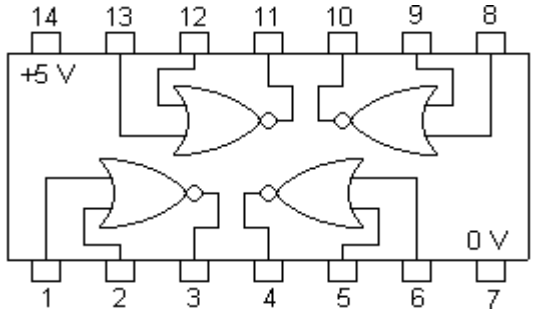
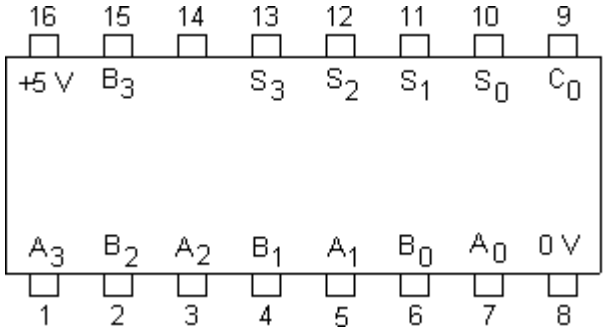
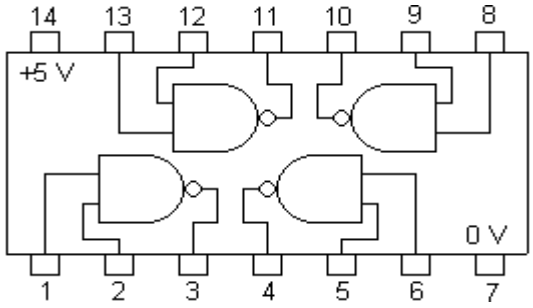
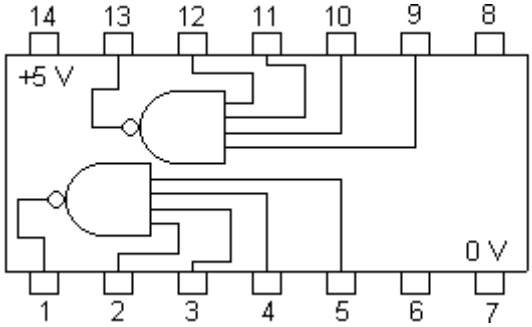


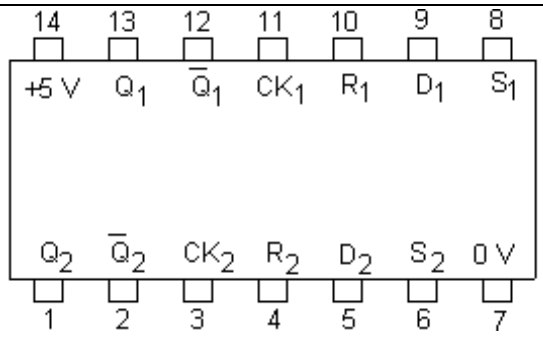
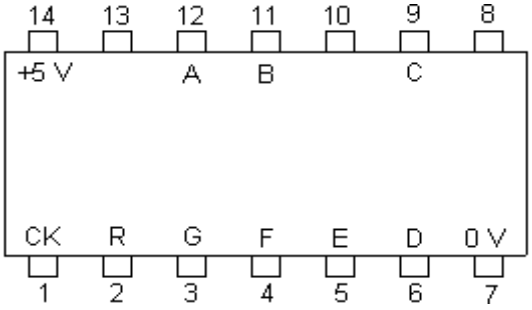
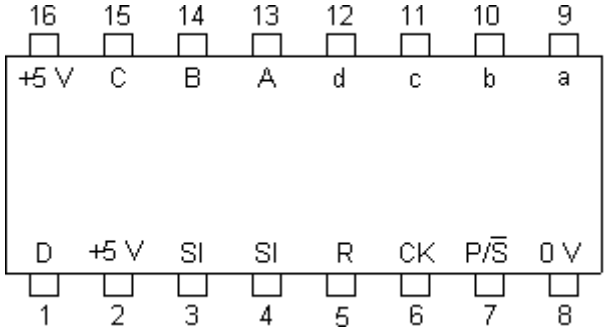
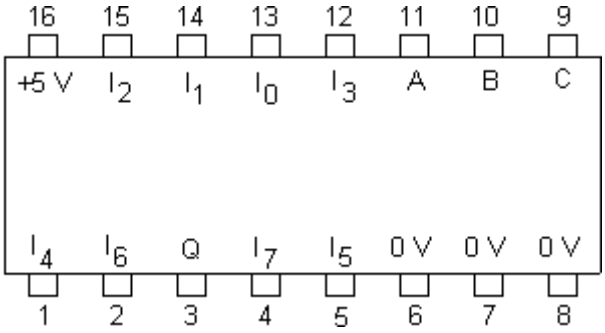
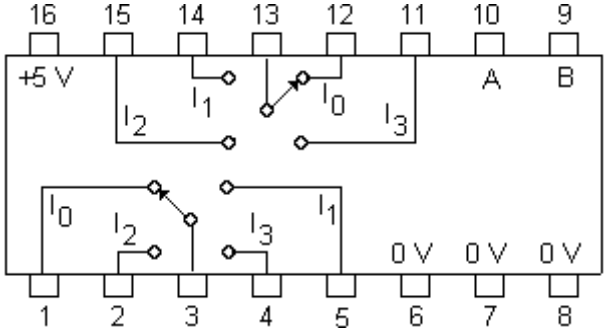
MOSFETs: 2N7000 viewed from the top.

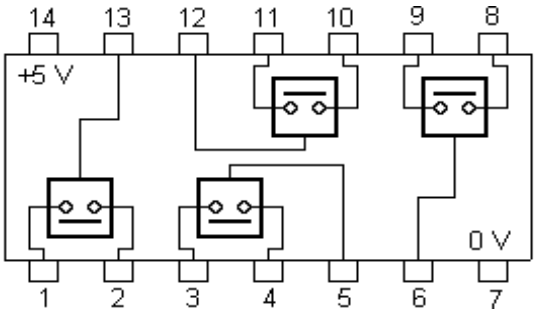
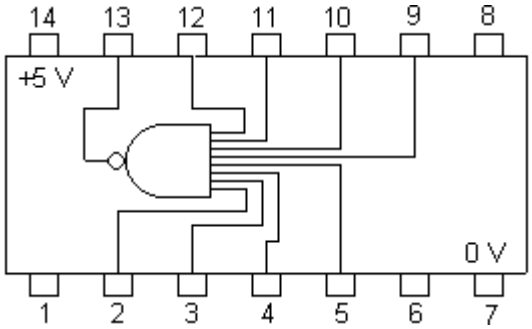
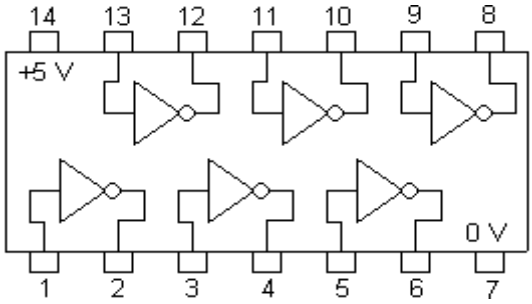
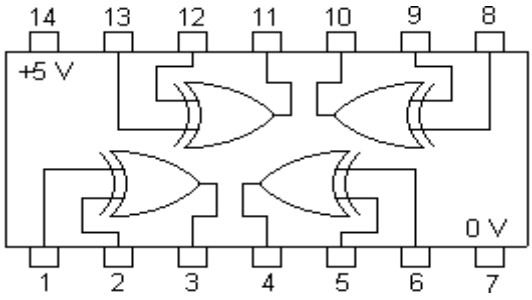
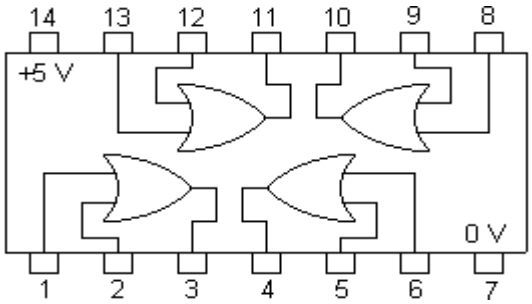


Analogue integrated circuits	
081 op amp	
084 op amps	
555 astable	
555 monostable	

3010 optotriac	
4051 multiplexer	
4052 multiplexers	
4066 analogue switches	

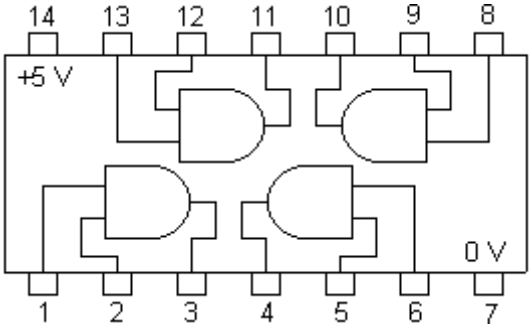
Digital integrated circuits	
2004 drivers 	
4001 dual input NOR $Q = \overline{A + B}$	
4008 four-bit adder $S_3S_2S_1S_0 = A_3A_2A_1A_0 + B_3B_2B_1B_0 + C_0$	
4011 two-input NAND $Q = \overline{A.B}$	
4012 four-input NAND $Q = \overline{A.B.C.D}$	

4013 dual D-type flip-flop $Q = D,\ \overline{Q} = \overline{D}$ when CK rises $Q = 1,\ \overline{Q} = 0$ if $S = 1$ $Q = 0,\ \overline{Q} = 1$ if $R = 1$	
4024 seven bit counter $GFEDCBA = 0000000$ when $R = 1$ counts rising edges at CK	
4035 shift register join the SI inputs together $DCBA = dcba$ when $P/\overline{S}$ is high and CK rises from 0 to 1 When $P/\overline{S}$ is low, D → C etc. on rising edges at CK	
4051 eight-bit multiplexer $Q = I_n$ where $n = 4C + 2B + A$	
4052 dual four-bit multiplexer $Q = I_n$ where $n = 2B + A$	

4066 quad two-input multiplexer switch closes when control is high	
4068 eight-input NAND $Q = \overline{A.B.C.D.E.F.G.H}$	
4069 hex inverters $Q = \overline{A}$	
4070 Exclusive-OR gates $Q = \overline{A}.B + A.\overline{B}$	
4071 two-input OR gates $Q = A + B$	

4081 two-input AND gates

$Q = A.B$



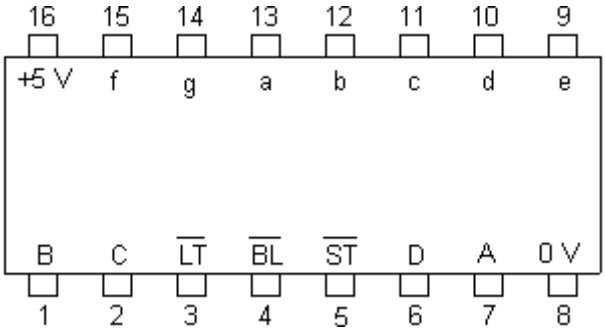
4511 BCD-to-LED decoder

g fedcba frozen when $\overline{ST} = 1$

gfedcba = 1 when $\overline{LT} = 0$

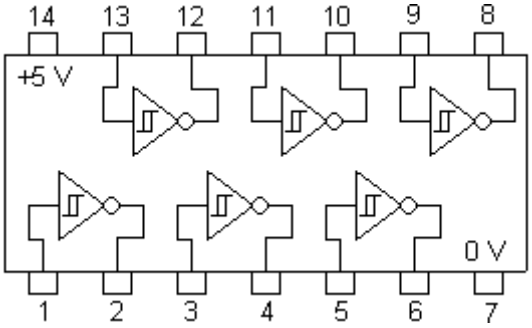
gfedcba = 0 when $\overline{BL} = 0$

a
f b
g gfedcba ≡ DCBA
e c
d



40106 Schmitt triggers

Q = 1 when A ≤ 2.2V
Q = 0 when A ≥ 2.8V



6116 RAM