EEE163
System Design Analysis

Lecture 5

The fruits of your labours last Friday…

… 17 trashed printers

Inkjet print head

Vaporisation actuation

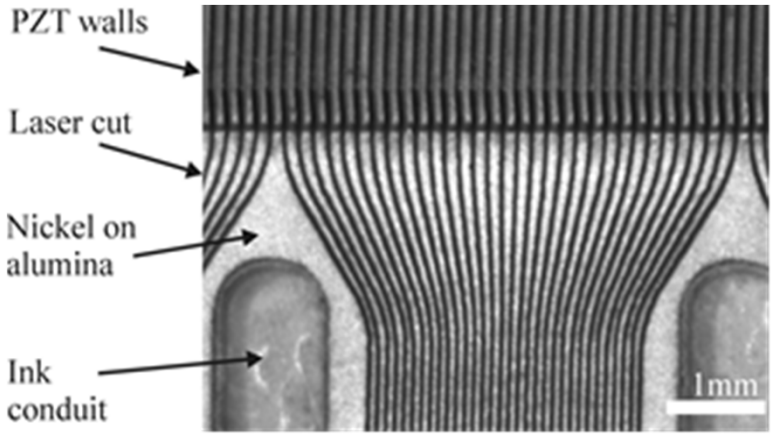
Piezo-electric actuation

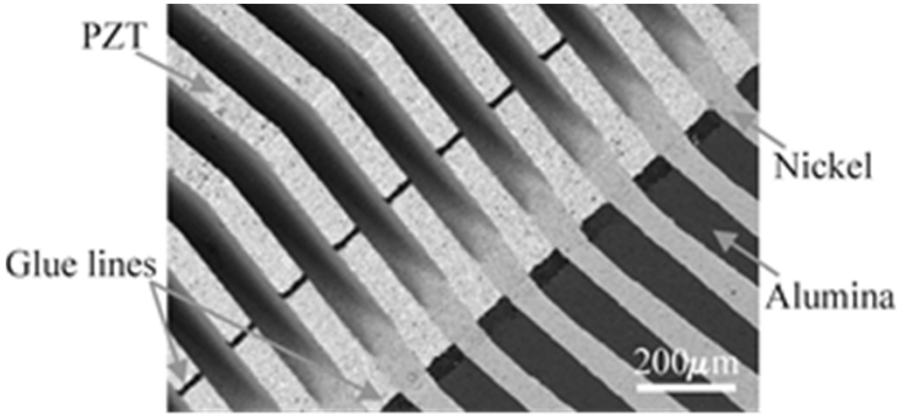
One line at a time

Page width

300 dot per inch = 1 dot per 84 µm

Section of PZT actuator





Micron scale resolution required

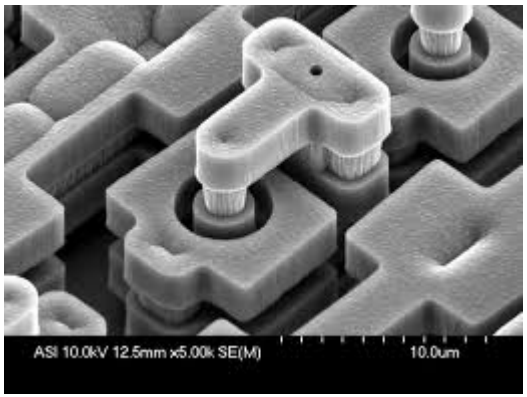
XAAR®

Use the techniques of the electronics industry (plating/etching/lithography,…)
But in *3d*

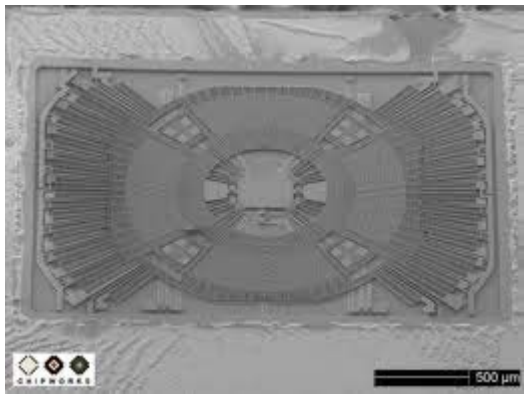
memjet® think fast.™

As an example, see video here:
http://www.memjet.com/technology/

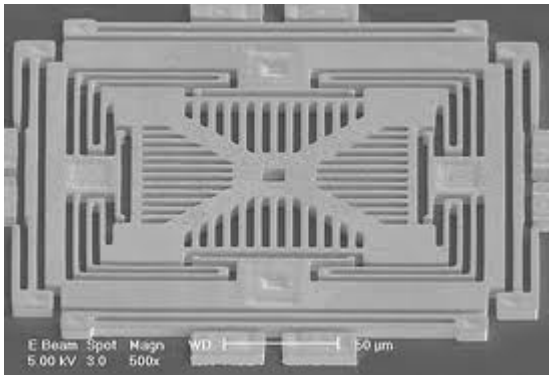
Microelectromechanical Sysytems (MEMS)



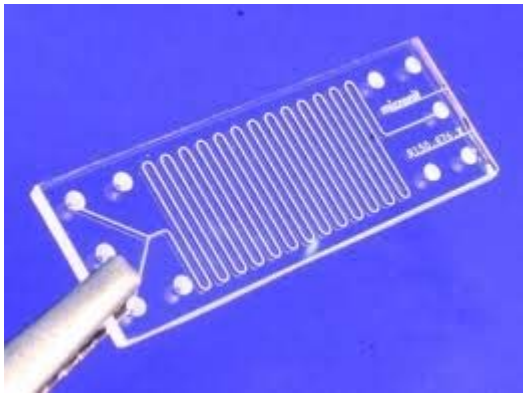
Actuator



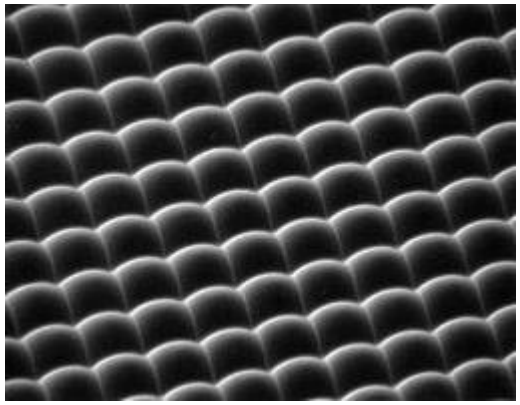
Gyroscope



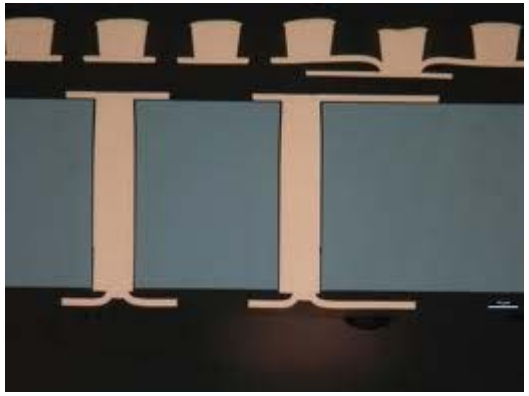
Accelerometer



Micro-fluid reactor



Micro-optics



Through silicon via

Final Presentations

Tuesday 8 May 2-5 pm

Venues:	Portobello B51	Prof Tozer	Groups 1-6
	Hadfield K13	Dr Seed	Groups 7-12
	Hicks F41	Dr Williams	Groups 13-17

Allocation of groups to venues to be advised at later date

- Group presentation
- All students to contribute equally
- 20 minutes presentation
- 5 minutes questions
- Presentation to be based on product analysed in final lab class
- 20 March - Make sure you attend!

Content #1

Presentation to include all you have been doing so far:

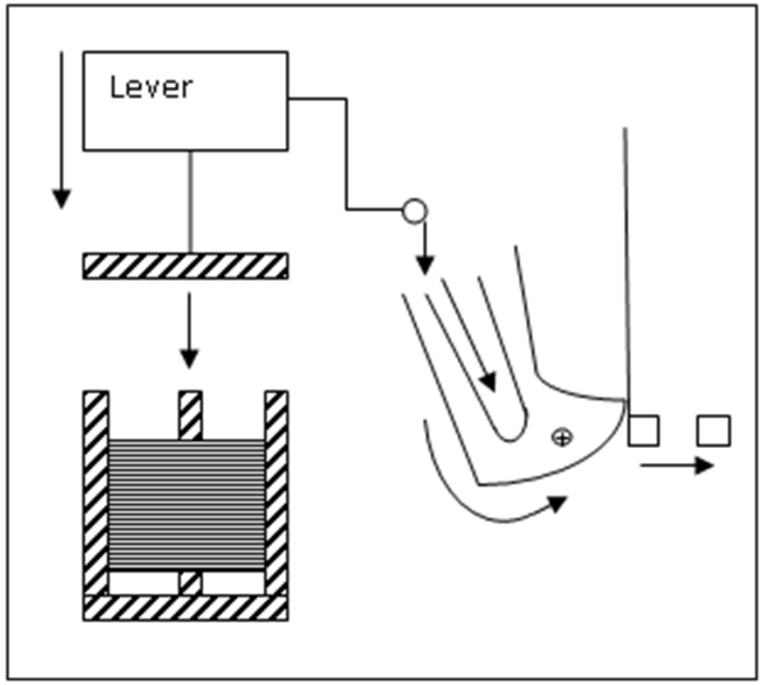
A	Product *name* / part number / manufacturer?
B	*Function(s)* of the product?
C	What *physical principles* allow the product to achieve this/these function(s)?
D	Construct a *diagram* describing the function of the system.
E	Devise the method(s) by which the product was *assembled*.
F	Describe the electrical *power* source(s) and their distribution. AC/DC? Voltage? Transformers?
G	Describe the signal *inputs and outputs* from the system. Data bus?
H	Produce a *parts list* for the product.
I	Produce a breakdown of the *materials* used in the product.
J	Suggest likely *failure mechanisms* for the product.
K	Identify any components that can be *replaced or repaired*.
L	How should the product be *recycled*?
M	Characterise any *printed circuit boards* (PCB) in the product (line width, line pitch, metal thickness, board thickness, number of layers. To help with this, you should ask a demonstrator to help you section one of the PCBs, then examine it using the digital microscope.
N	Characterize the *assembly* of components onto the PCBs. Surface mount? Through hole? Flip chip?
O	Characterize the printer *actuators.* How does it achieve its designated print quality (dots per inch - dpi), contrast (greyscale) and colour?
P	Identify all the *motors* in the product and explain their purpose.
Q	Comment on the *safety* features of the product.
R	Comment on the aesthetic *design*, ergonomics, packaging and appearance of the product.
S	Identify three '*good' and 'bad'* features of the product.
T	How might the product be *manufactured* a) more cheaply and b) more reliable?

Content #2

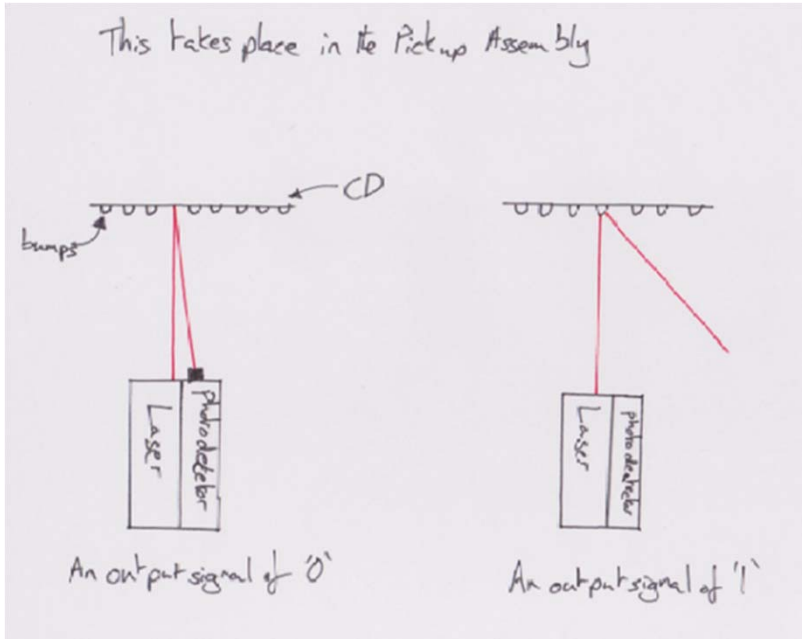
… plus some extras, possibly including:

- Date of manufacture
  - is it the current model?
  - is it obsolete?
- Comparison with similar ‘state of the art’ products
  - do these use the same physics?
- Energy audit
  - use
  - manufacture
  - disposal
- Assembly/disassembly instructions
- Etc…

Function examples



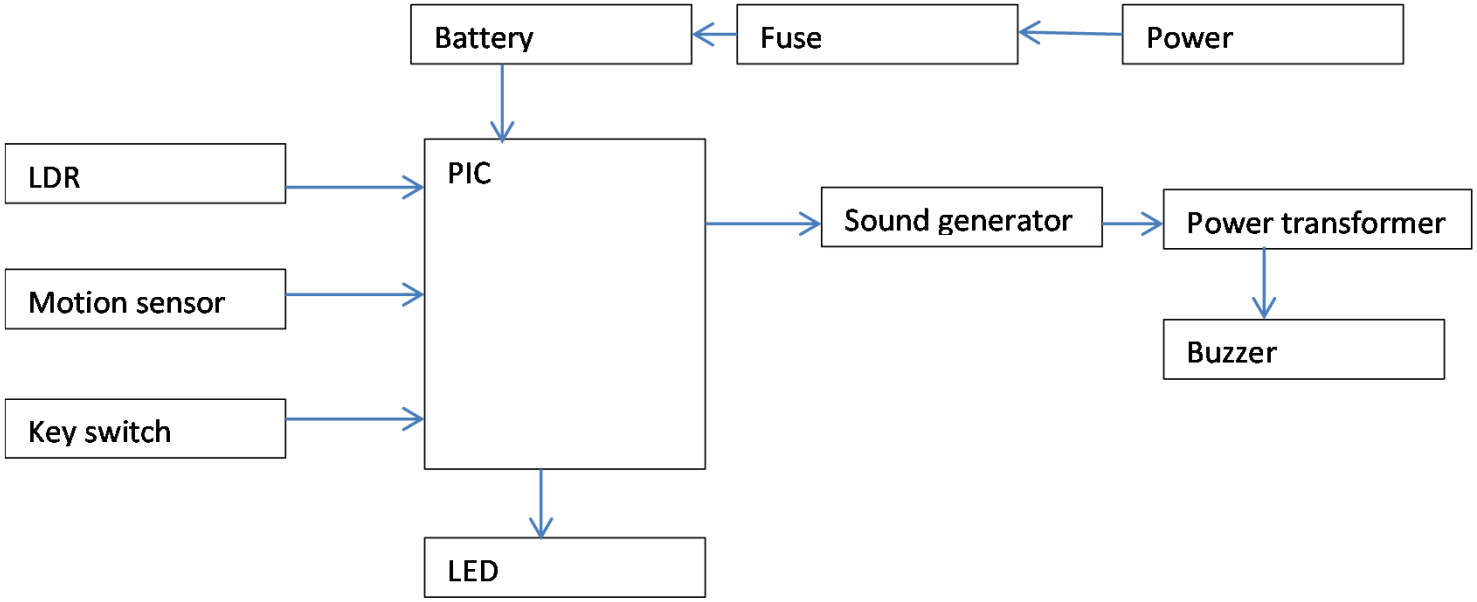
Toaster release mechanism



CD pickup assembly

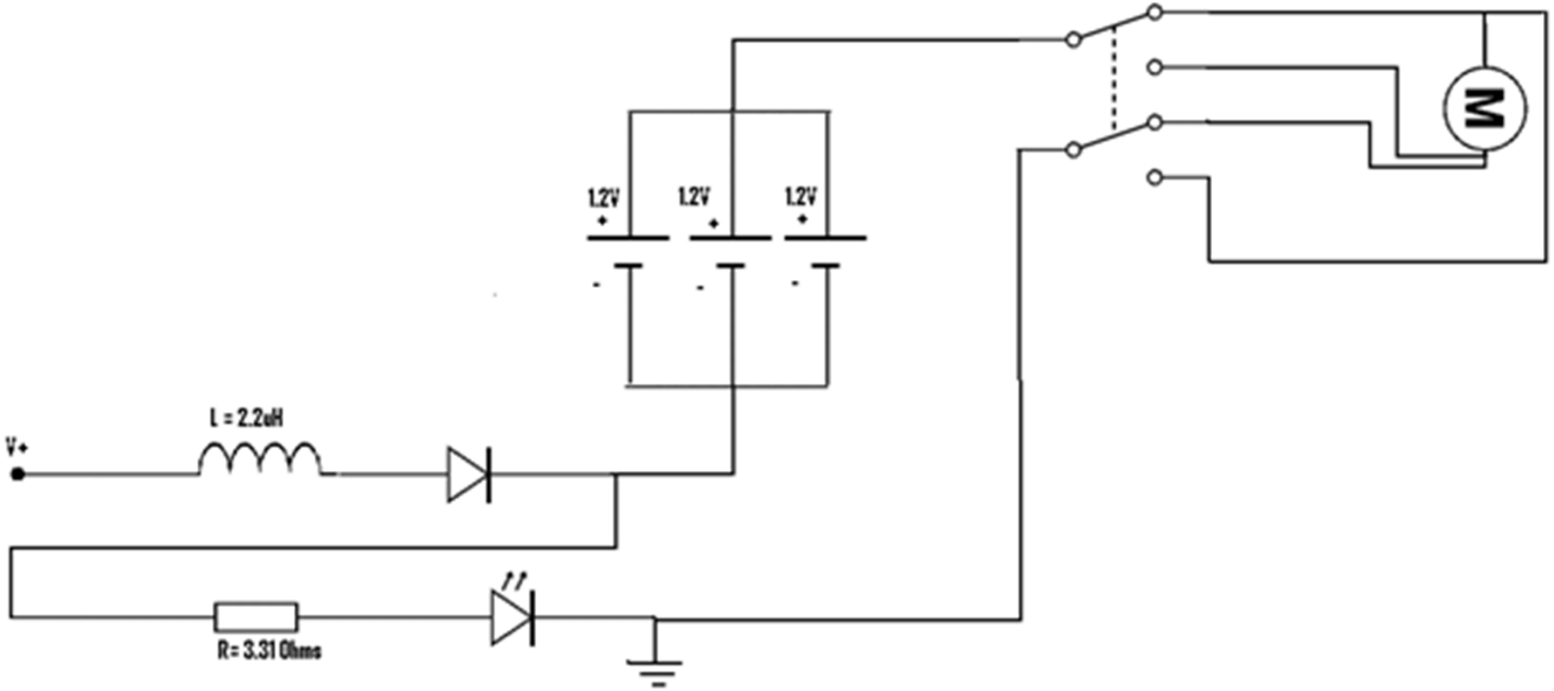
System Design Example – PC Alarm

A diagram showing the function of the system is shown below.



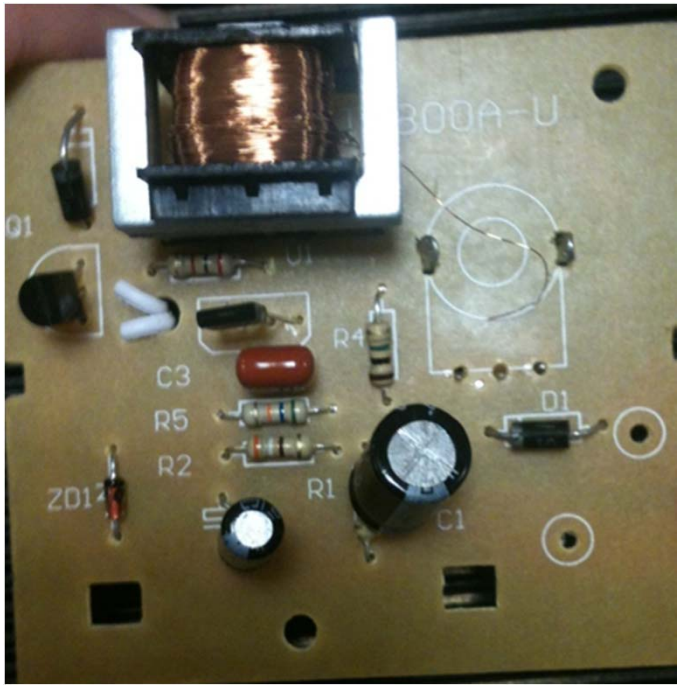
Block diagram for complex systems

System Design Example – Electric screwdriver

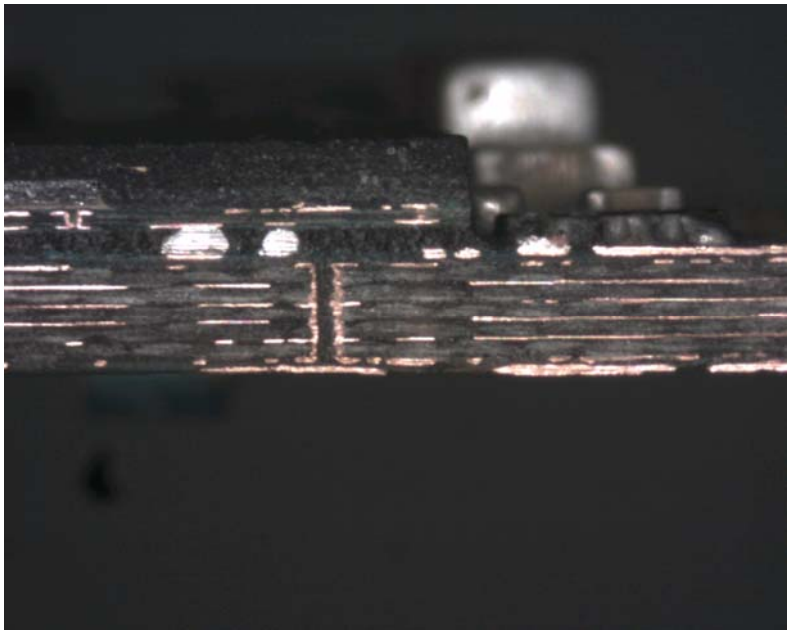


Complete circuit diagram for simple systems

Use photographs



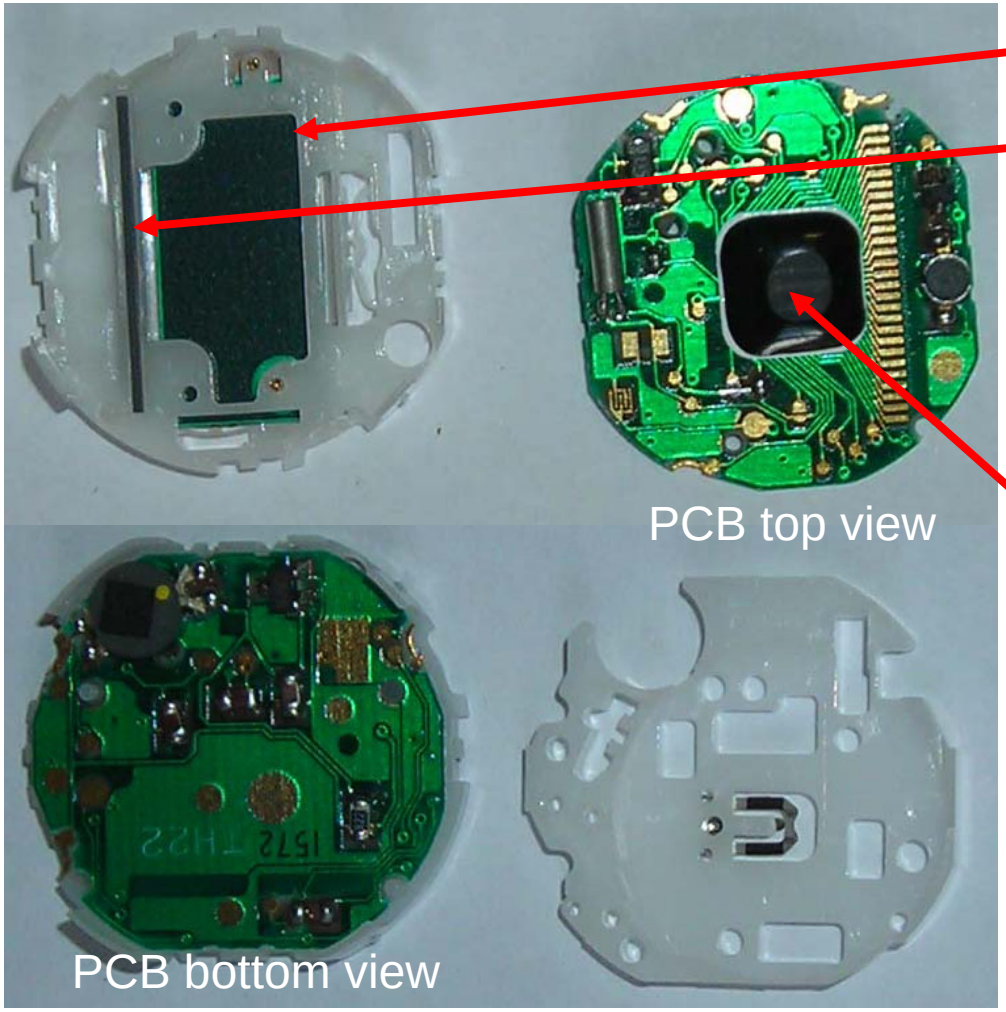
Toaster circuit board



Multilayer PCB cross section

Before and after…

Photographs example



- Display screen
- Electrical connector
- Printed circuit board
- - electrical tracks and pads
- - blob of epoxy (hiding the chip)
- - various other discrete electrical components

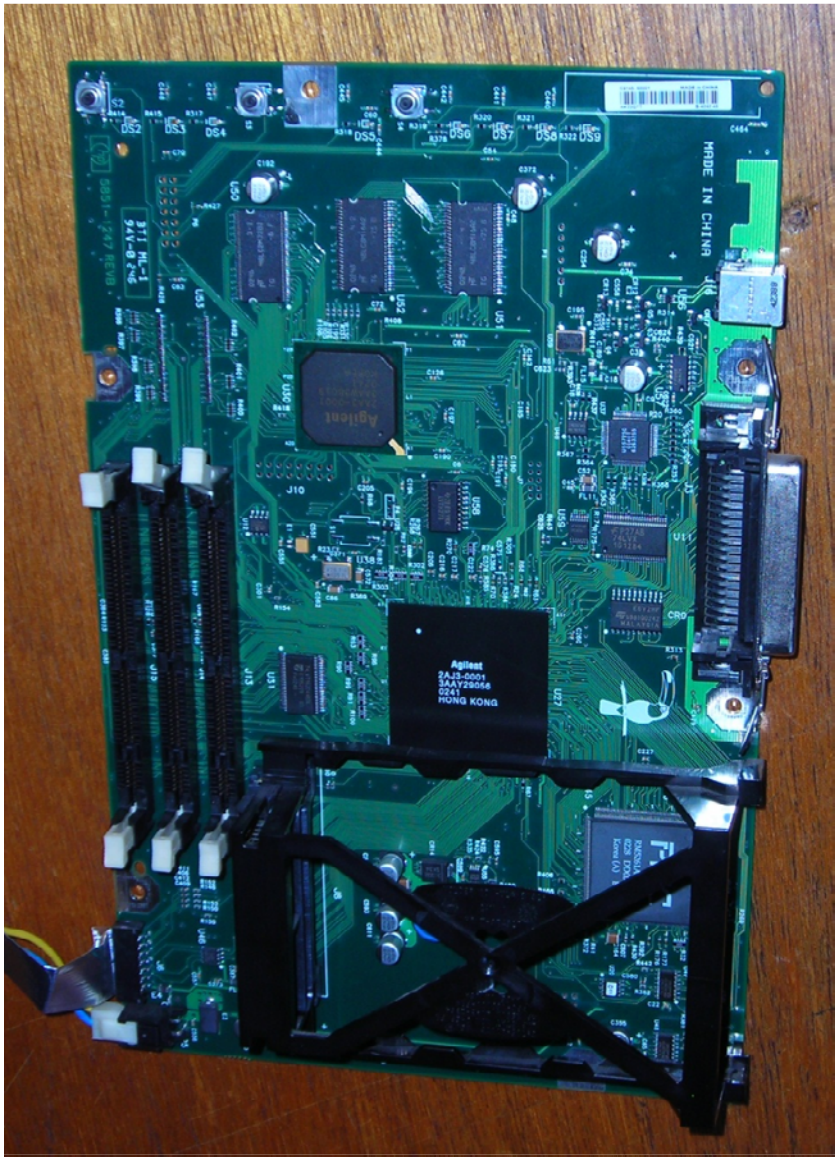
Parts list example – CD ROM

- Two halves of a plastic outer casing,
- A metal shell
- Plastic cogs
- Motors
- Small metal poles
- Runners, (to allow the components to slide along the poles smoothly)
- Plastic disc drive, (which contained metal balls to stop vibrations when spinning)
- Component boards
- Capacitors
- Inductors
- Resistors
- Switch
- Plastic ejector button
- Specific grouped wiring
- Microcontrollers
- Lens
- Metal lens cover
- A laser
- Wires
- Screws
- Plastic disc tray
- MT1199E chip
- YYS7W chip
- UT51C16JC – 35 chip
- Pins
- Plastic clips

Materials example – PC alarm

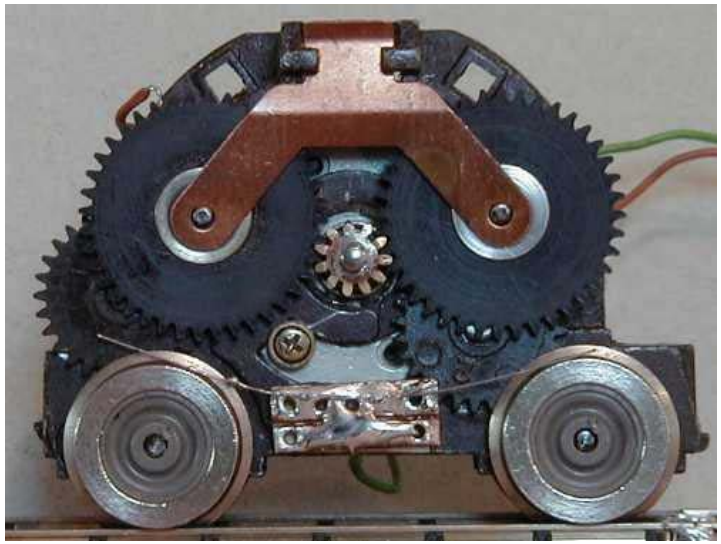
- Metals:
- - Copper: main conductive material connecting an electronic circuit
- - Carbon: part of the resistive element within a resistor
- - Iron: laminated iron-core of transformer
- - Steel/Aluminium: screw, override key/switch, 16-bit expansion slot fastening
- - Solder: fusible metal alloy used to electrically connect metal conductors
- - Plastics: circuit board, device/component enclosures and wire insulator
- - Glass: fuse enclosure
- - Silicon: semiconductor material used in IC, transistors and diodes
- - Dielectric (Paper, Mica or Ceramic): used in non-electrolytic capacitor
- - Electrolyte: required in the function of electrolytic capacitors
- - Electrochemical (Nickel-Metal Hydride/Lithium-Ion): rechargeable battery pack
- - Adhesive: glue used to set component parts in a fixed place

Components, PCB, Assembly



- ICs: identify using data sheets on the web
- Passives
- Clock generator (metal can)
- Assembly
  - Through hole?
  - Surface mount?
  - Flip chip?
- Connectors
- Cables
- Printed circuit board
  - Routing pitch?
  - Layers?

Motors and drives



Many products will contain motors and drive mechanisms

AC?

DC?

Brushless?

Number of poles?

Stepper?

Power Supplies

Products all run from mains
240 V, 50 Hz

ICs need ~ 5 V DC
Motors need ?
Displays need >400 V DC

Hence transformers and
voltage regulators required.

WEEE
Waste Electrical and Electronic Equipment

Junk from last week's lab class – 17 printers

Next lecture:

12-1 27 March
Portobello B59

Charlotte Winnert
Environment Officer
University of Sheffield