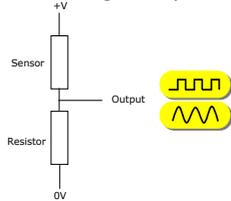


Programmable Components overview for KS3 and GCSE Design and Technology

INPUT

Most electronic systems use one or more inputs, so the electronics can respond to user inputs, environmental conditions, mechanical and/or electronic events.

Virtually all input devices are a sensor of some type, basic sensors all have the same arrangement of a sensing component and a resistor:



Some sensors produce a **Digital (on/off)** signal, other produce an **Analogue (variable)** signal.

- | | |
|--|--|
| | |
| Digital sensors | Analogue sensors |
| <ul style="list-style-type: none"> PTM switch PTB switch Tilt switch Moisture probe Magnetic switch Photodiode | <ul style="list-style-type: none"> LDR Thermistor Piezo transducer Potentiometer |
| Off = 0V, On = +V | The signal can vary between 0V and +V |

Some sensors are chip based and need additional electronics and/or coding to make them function, such as temperature, humidity, PIR, rotary position, GPS, accelerometers etc.

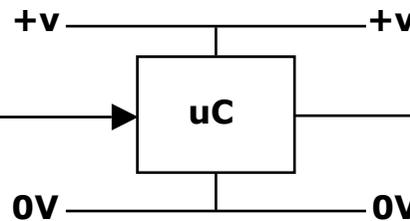
PROCESS

The key process block for all modern electronics is the **Microcontroller (uC)**.



This electronics is known as **Embedded Electronics**, since the microcontroller is 'embedded' into a product.

In school's the most common microcontroller systems are **PICAXE, Genie, Micro:bit, Crumble, and Arduino**.



The other useful component is the **transistor**, 2 types are useful for us:

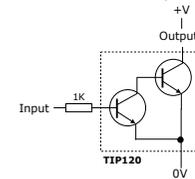
NPN		MOSFET	
<p>Transistor: Off < 0.7V On > 0.7V</p>		<p>Transistor: Off < 3.0V On > 3.0V</p>	
Both act as electronic switches			

INTERFACE

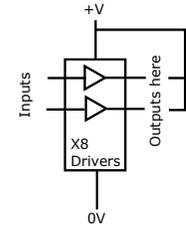
The output from a microcontroller can only supply about **10mA at maximum**, if more current is needed an **Interface driver** will be needed.

Single transistor drivers using either an **NPN** or **MOSFET** version, usually for a **current <250mA**.

For **currents >250mA** a Darlington Driver is required.



Sometimes using a microcontroller more drivers might be needed, the best solution here is to use a driver chip that contains 7 or 8 drivers.



OUTPUT

Output devices all fall into one of the following groups:

- Light:**
- Single LED
 - Bi coloured LED
 - Tri coloured LED
 - LED Bars
 - 7 segment LED
 - RGB LED
 - NeoPixels - needs coding to operate

- Audio:**
- Piezo Transducer
 - Buzzer
 - Speaker - needs a transistor driver

- Motors:**
- DC motor - needs a transistor driver (on/off)
 - DC motor - motor driver (CW, CCW, off)
 - Servo motor - 180° - needs coding but no driver
 - Servo motor - 360° - needs coding but no driver
 - Stepper motor - 360° - needs coding & driver chip
 - Solenoid - linear movement - needs a transistor driver

For further information see the full set of individual eCards covering Inputs, Processes, Interfaces, Outputs and Power

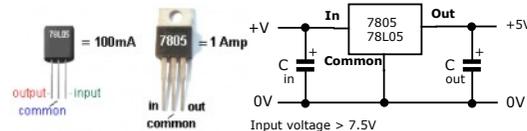
POWER

All electronic systems require a power supply, the most common solutions are:

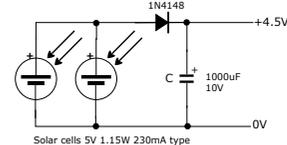
- Batteries - check voltage, capacity & size
- Solar Cells - check voltage & current
- Super capacitors - check voltage & size
- USB power - +5V

You will need to select the most appropriate for you solution taking into account it's **use and it's voltage & current requirements**.

For microcontrollers you may need to use a **voltage regulator** to ensure the correct voltage is used, normally +5V, if you are using a 9V battery for example



Solar cells can provide a reasonable supply, but you often have to use more than 1 cell to get a higher enough voltage & current.



Super Capacitors can be charged up via another battery, solar cells or a USB connection. They can power a low current circuit for up to 15 mins. They make good power sources for portable lighting solutions.



