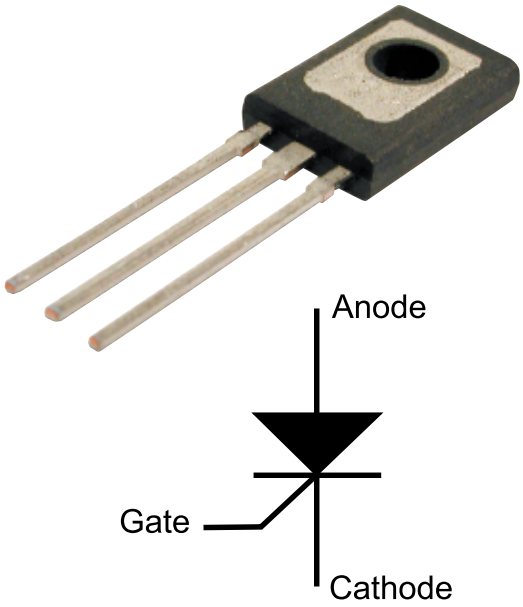
TEP PrESS Teacher Guidance UNIT

PrESS is the acronym for Practical Electronics Support for Schools

This guide will help teachers plan-in and deliver electronics activity either as a 'drop-in' activity into an existing scheme of work or as part of a wider programme. It is devised to develop skills, knowledge and understanding through a hands-on approach to electronics at a component and sub system level. This is timely for the revised National Curriculum Key Stage 3 that includes Systems and Control or as a stand alone input at any stage.

This mini series will cover worked examples and applications for:

Thyristor, FET, PIC's, IQ2, 555 Timer, Infra Red, Op Amps



Thyristor

The thyristor or S.C.R. (silicon controlled rectifier) is a three legged plastic encapsulated semiconductor device that can supply large currents, or switch large currents on or off. Thyristors are widely used in alternating current circuits. A thyristor can be used as a latching device in direct current circuits. Thyristors are specified by their reverse voltage, the gate voltage and current.

The thyristor is made up of p-type or n-type semiconductor material connected to two metal contacts called the anode A and cathode C. The third contact, gate G connects to the side.

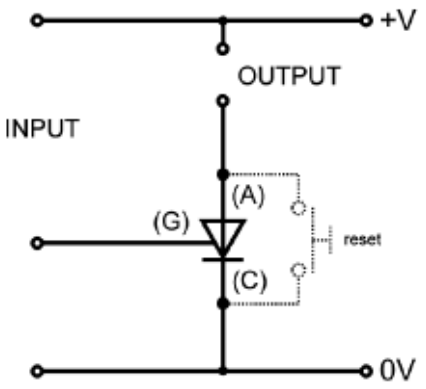


Fig. 1

The Thyristor as a latch

A Thyristor (Fig.1) is used here as an electronic switch that latches 'on' or 'off'. No current passes between the anode and cathode unless a relatively small current passes to the third leg: the gate. (Fig.2) If a momentary connection is made between the gate and +ve, then the thyristor turns on and continues to pass current anode to cathode (even after the input is removed) until either the supply is interrupted or the thyristor is momentarily bypassed – e.g., by making a direct connection from anode to cathode with a wire as shown by the shaded reset button.

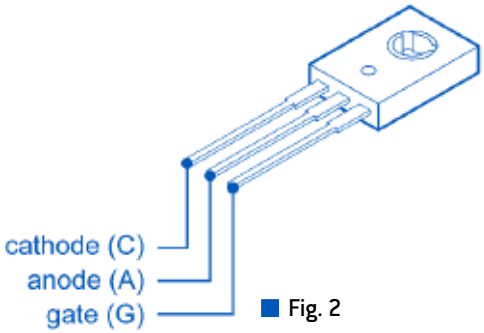


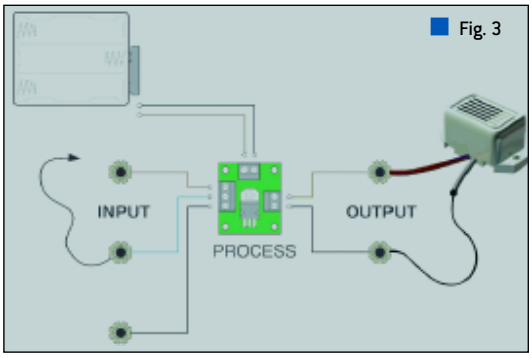
Fig. 2

Cathode

Triggering

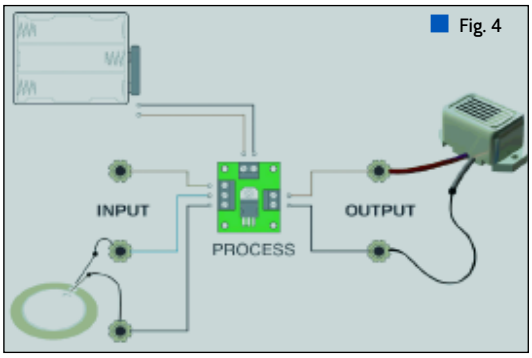
Because the thyristor latches on instantly, the term 'triggering' is often used to describe a momentary input to the gate. The thyristor can be triggered using a switch or a flying lead between the gate and +ve. (Fig.3) Alternatively, the thyristor can be triggered by bridging across from gate to +ve with relatively poor conductors such as liquid (e.g. probes in water), or a heavy graphite line on paper.

Fig. 3



It can also be triggered, for example, by connecting a piezo electric transducer (the flat speaker element in musical cards) between the gate and –ve. (Fig.4) When the transducer is tapped, it produces a momentary output sufficient to trigger the thyristor.

Fig. 4



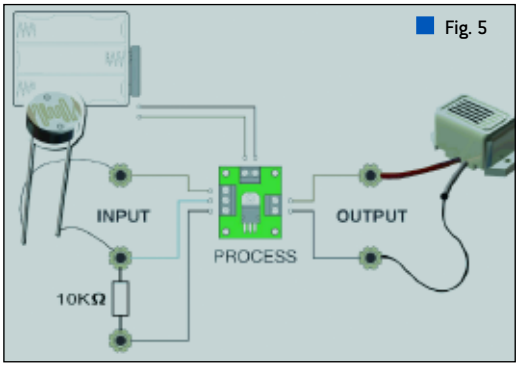
Using sensors

In fig 5 The gate of the thyristor is connected to the junction of an LDR (light dependent resistor) and variable resistor. These two components form a potential divider whose voltage at the centre varies according to light level. In subdued light, the voltage at the centre is insufficient to turn on the thyristor. As the light level increases, the voltage also increases and eventually reaches the turn-on threshold. The reverse happens if the positions of LDR and resistor are reversed. (After experiment, a fixed resistor might be substituted for the variable type.)

A heat sensor

The thyristor can be connected as above but a thermistor (heat dependent resistor) is substituted for the LDR. A higher value resistor will need to be substituted too.

Fig. 5



Applications and contexts

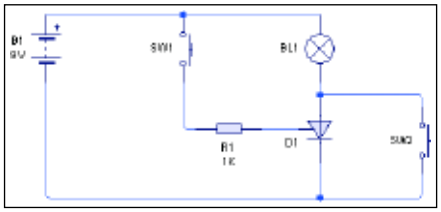
The thyristor provides a one-component electronic (processing) solution, and can be applied to a wide range of practical tasks. It can be set up easily to trigger from inputs including a wide variety of switch types, and sensors for light and heat. The circuits here can be used in alarm contexts where the audible output from a buzzer continues to sound after initial triggering. The wide variety of inputs provides endless opportunities for different systems and products. Because the thyristor can also be used for all-electronic switching, it provides a simple means of creating functional prototypes – e.g. a torch that uses a membrane switch for on and off.

Switch triggers Examples include:

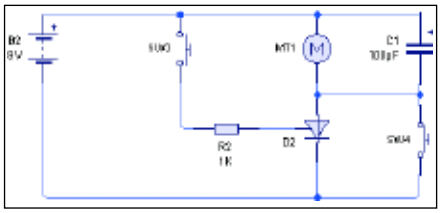
- Press switch
- Membrane panel
- Tilt switch
- Mat switch (under carpet type)

These can also be used, as appropriate, to turn off the thyristor either by momentarily interrupting the supply or by-passing anode to cathode as in Fig.2.

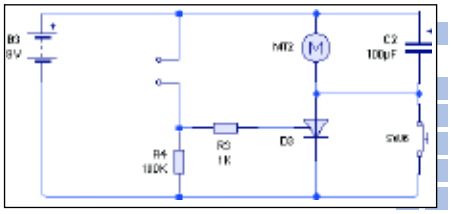
Note in diagram the use of limiting resistor



Note in diagram the use of capacitor C1 to 'smooth' current characteristic on motor to prevent thyristor turning off (the thyristor 'sees' the brushes and commutator of a motor as an on off switch. The same applies to mechanical buzzers)



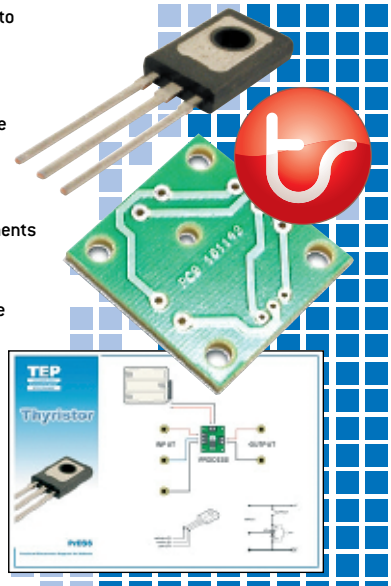
Note the use of an R4 100k resistor to 'steer' input from floating input terminals. Even very small currents will drive this device 'on' (see technical notes)



Technical Notes for TIC 106D Thyristor

With a gate trigger current of only **200 µA** required and a nominal gate voltage of around **.8Volt** it is a usefully sensitive device. Latching current is around **6mA** minimum so if it does not latch 'on' when testing it is almost certainly an open circuit somewhere on the input or load. This thyristor will handle high voltages (up to 400V) but not for school use and currents of up to 4A.

Thyristor 106D type - Code: ET2 001 for 15p each is available from TR meaning really low-cost projects of under 70p excluding batteries are possible.
A thyristor teaching and learning board is also available **TRA 009** for £5.61 and individual pupil packs with all components and batteries is available as **TRA 012** for £1.51



You can download a Thyristor animation from the TEP website under the Electronics and What's New tabs.

Due to the simplicity of the circuit it is a great 'fault free' introduction for pupils and students and can be on PCB, copper tape or breadboard.

Next Issue: we will look at
Field Effect Transistors or FET's