**DT021-3 Thyristors and Thyristor Controlled Rectifiers**

1. **The Thyristor also known as a Silicon Controlled Rectifer (SCR)**

**Construction:**

K



P

N

P

N

A

G

**Two Transistor Equivalent Model:**

2transistor scr

P

N

P

N

A

K

N

P

G

**Explanation of Two Transistor Model**:

If the pnp transistor is initially off and no current is provided at the gate then the pnp transistor has no base current and is off. This in turn means that the PNP transistor had no base current and also remains off. The thryistor remains in its non conducting state.

On the other hand if we introduce a small current into the gate this will turn on the NPN transistor. Providing there is external voltage applied between Anode and Cathode then current flow into the base of the PNP and through the npn. This will turn on the pnp which in turn will supply base current to the NPN **even after the external base current has been removed.** The thyristor latches on It will remain on until the external voltage is removed at which time it will revert to its non-conducting state.

In practise once the gate current is removed the device will only remain on providing the the anode current has exceeded a certain minimum value known as the **Latching current**. Once the latching current has been achieved the device will remain on until the anode current falls below a lower current level called the **holding current**.

Note that IL>IH

**Note:** Latching current and holding current scale with current rating of the thyristor so it is important to correctly size a thyristor for an application. If you use a thyristor with too generous a current rating the circuit current may not build up to the latching current during the gate pulse and the thyristor may not latch on.

Note that once a standard thyristor has started conducting it cannot be turned off via the gate. It behaves like a diode until such time as the anode current falls below the holding current and the device reverts to its blocking state.

**Applications of Thyristors**

Thyristors are extremely robust semi-conductors and a wide range of models are available up to very high levels of voltage and current. Thyristor converters have been implemented at power levels of up to 100’s MW for example in the DC link between the power grids of Ireland and Scotland. A version of the thyristor called a TRIAC is also widely used in low cost low power AC control systems (for example in dimmer switches for incandescent light bulbs.

**Thyristor Derivatives:**

**Triac**: Effectively two back to back thyristors in one package with a single gate. Widely used for AC power control.

**GTO:** A thyristor which can be forced to turn off by pulling current out of the gate.

**IGCT:** Based on an GTO with integrated gate drive circuit. Optimised for fast turn on and off.

**MCT:** A hybrid of Mosfet and Thyristor. The thyristor may be turned on or off by application of a appropriate voltage signal to the gate. Allows high speed switching.