Thyristors (npnp devices)

- The general information
- Structure and principles of operation
- Types of thyristors

Objectives:
Knowledge of types, structure, operation and properties of npnp devices
General information

1. A thyristor is a pnpn semiconductor device that can be switched from the OFF state to the ON state or vice versa.

2. Types of pnpn devices:
   - pnpn devices with two terminals – pnpn diodes (= four layer diodes, = Schokley diodes). Diodiniai tiristoriai – dinistoriai
   - pnpn devices with three terminals – triode thyristors (= silicon controlled rectifiers (SCRs)). Triodiniai tiristoriai – trinistoriai
   - pnpn devices with four terminals (silicon controlled switches). Tetrodiniai tiristoriai – binistoriai
   - Bydirectional thyristors (sidac, diac, triac). Simetriniai tiristoriai – simistoriai
The Silicon Controlled Rectifier (SCR) or Thyristor proposed by William Shockley in 1950 and championed by Moll and others at Bell Labs was developed first by power engineers at General Electric (G.E.) led by Gordon Hall and commercialised by G.E.'s Frank W. "Bill" Gutzwiller.
http://www.answers.com/topic/thyristor

Types of thyristors

**SCR** — Silicon controlled rectifier
**ASCR** — asymmetrical SCR
**RCT** — reverse conducting thyristor
**LASCR** — light activated SCR, or **LTT** — light triggered thyristor
**DIAC** & **SIDAC** — both forms of trigger devices
**BOD** — breakover diode — a gateless thyristor triggered by avalanche current, used in protection applications
**TRIAC** — a bidirectional switching device containing two thyristor structures
**GTO** — gate turn-off thyristor
**MA-GTO** — Modified anode gate turn-off thyristor
**DB-GTO** — Distributed buffer gate turn-off thyristor
**MCT** — MOSFET controlled thyristor containing two additional **FET** structures for on/off control.
**BRT** — Base Resistance Controlled Thyristor
**SITH** — Static induction thyristor, or **FCTh** — Field controlled thyristor containing a gate structure that can shut down anode current flow.
The structure, operation and properties of the pnpn diode

\[ I_2 = \alpha_1 I_1 + \alpha_2 I_3 + I_R \]

\[ I_1 = I_2 = I_3 = I \]

\[ I = \frac{I_R}{1 - (\alpha_1 + \alpha_2)} \]

- \( U_0 \) – break-over voltage,
- \( I_H \) – holding current
The structure, operation and properties of the pnpn diode
The structure, operation and properties of the pnpn diode

\[ U = f(I) \]

\[ U = E - IR \]
Switching of the pnpn diode

(a)  

(b)  

(c)
Silicon controlled rectifiers

SCRs were first introduced in 1956 by Bell Telephone Laboratories.

A current pulse is enough for switching ON. To switch the device back the anode current must be reduced.
Symmetrical (bidirectional) thyristors

Two terminal symmetrical thyristor – diac.
Three terminal device – triac.
Structures and parameters of thyristors

Structures made using (a) thermal impurity diffusion and alloy technology and (b) epitaxial-diffusional technology

The most important parameters:
- Break over voltage (įjungimo įtampa)
- Holding current (išjungimo srovė)
- Turn ON time (įjungimo trukmė)
- Turn OFF time (išjungimo trukmė)
- Maximal forward current (leidžiamoji tiesioginė srovė)
- Maximal reverse voltage (leidžiamoji atvirkštinė įtampa)
- Maximal frequency (didžiausias darbo dažnis)
Thyristor 100 Ampere/800 Volt
SCR rated about 100 amperes, 1200 volts
Paragon has a range of thyristor power controllers to suit every need. Whether the load is constant or variable resistance, inductive or transformer coupled, single or three phase, we have thyristors to meet your exact requirements.

You can view our product range by choosing the required load type below

- single phase
- 2 leg switching of 3 phase
- 3 leg switching of 3 phase
A bank of six, 2000A Thyristors (white pucks). The clear tubes are for cooling water
HVDC Thyristor valves

The HVDC technology (High Voltage Direct Current) is used to transmit electricity over long distances by overhead transmission lines or submarine cables. It is also used to interconnect separate power systems, where traditional alternating current (AC) connections can not be used. ABB pioneered the HVDC technology and is the undisputed world leader in the HVDC field.