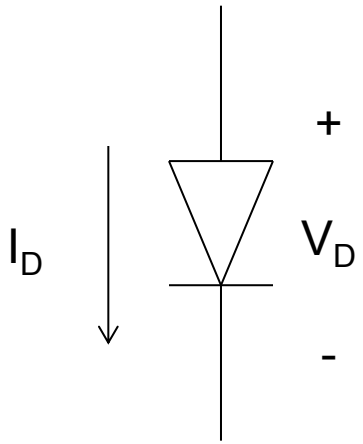
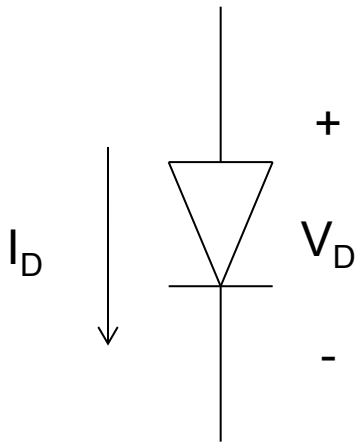
# DIODO

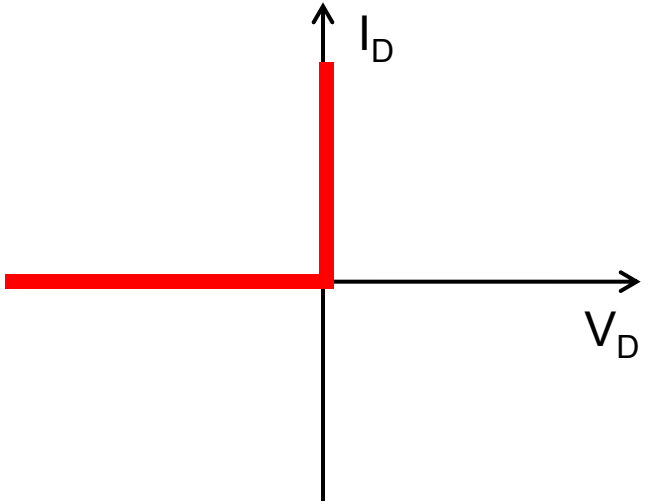
Definición: Dispositivo de dos terminales que permite la Circulación de corriente en un solo sentido

Símbolo:

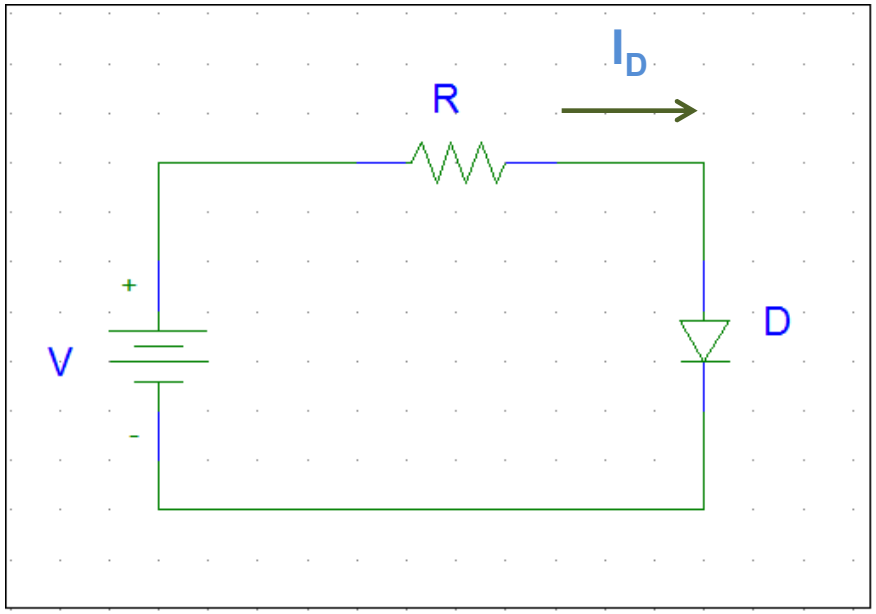


# Modelo Ideal

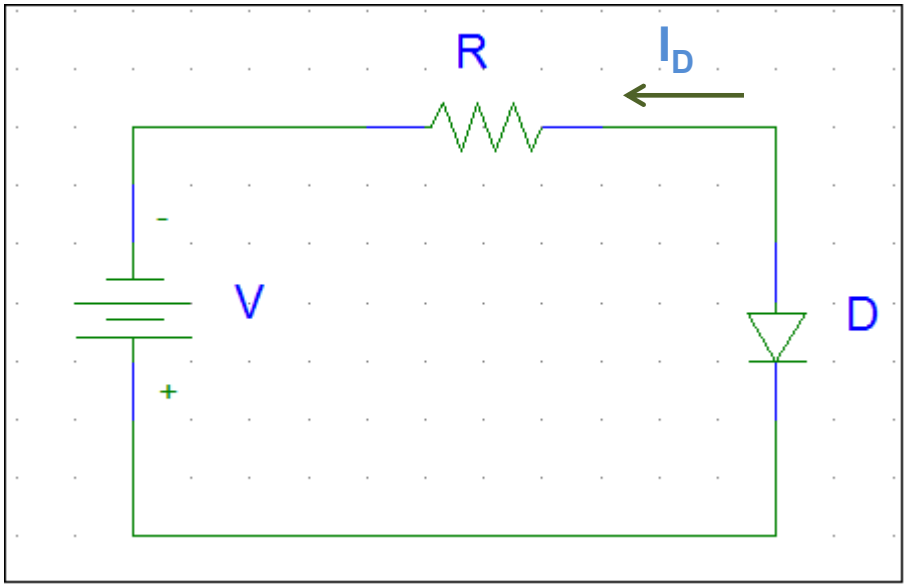



- Apenas $V_D > 0$ el diodo conduce
- El valor de $I_D$ no esta controlada por $V_D$
- No hay caída directa
- La resistencia serie es cero



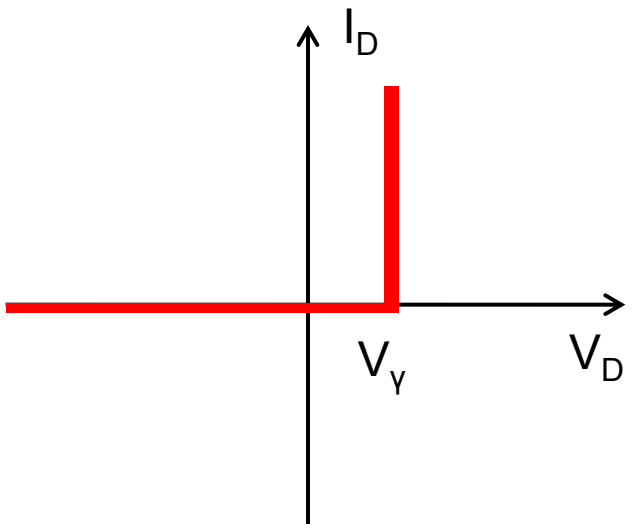

$$I_D = \frac{V}{R}$$

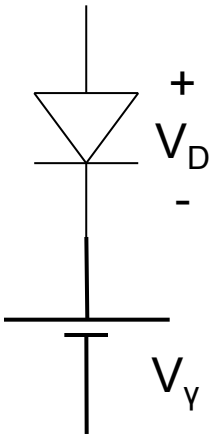


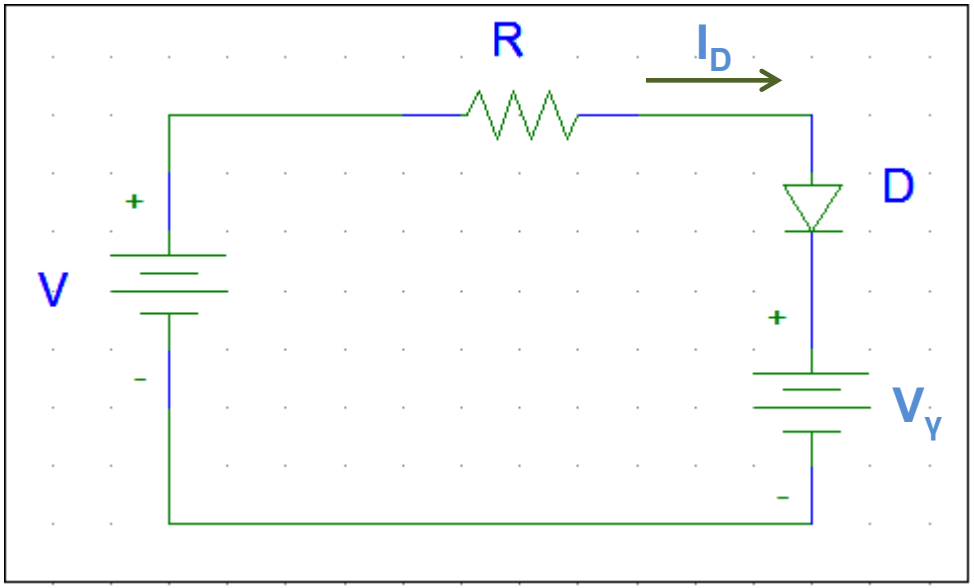

$$I_D = 0$$

# Modelo Real (1)

- Caída Directa



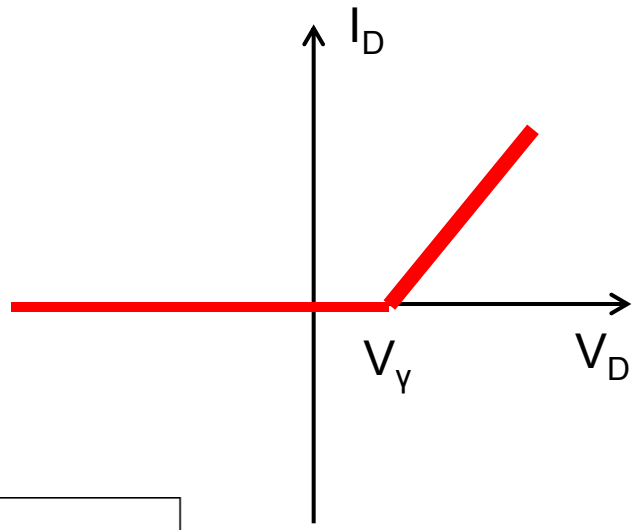



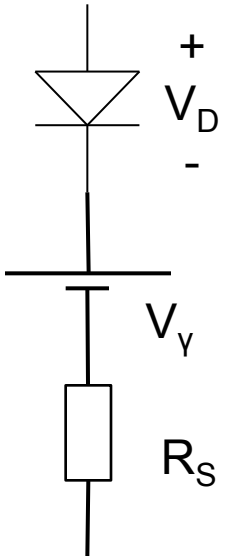



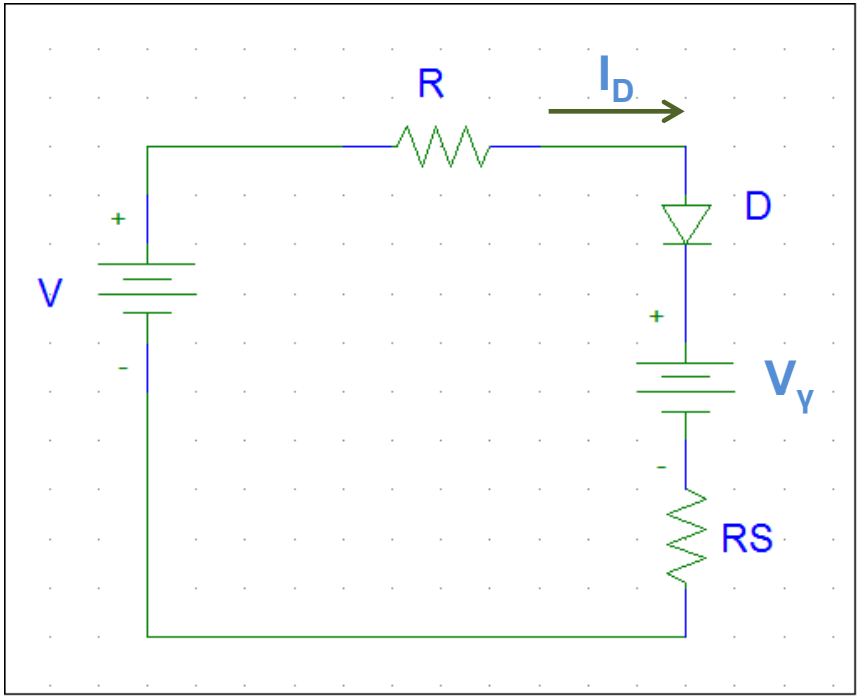

$$I_D = \frac{V - V_\gamma}{R}$$

# Modelo Real (2)

- Resistencia Serie



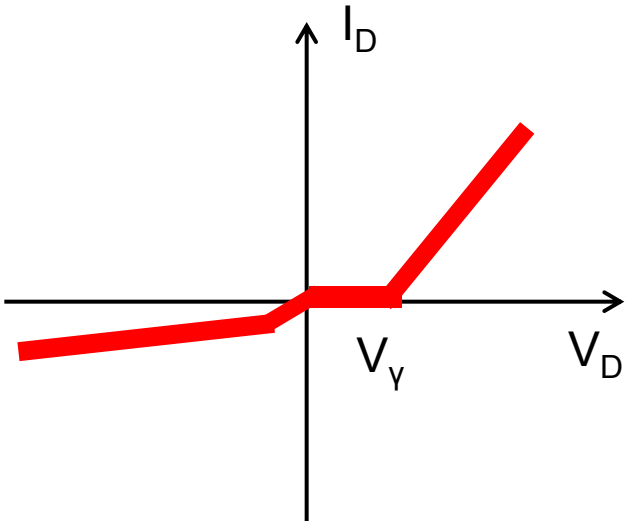



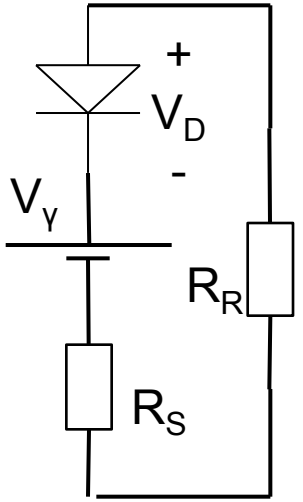



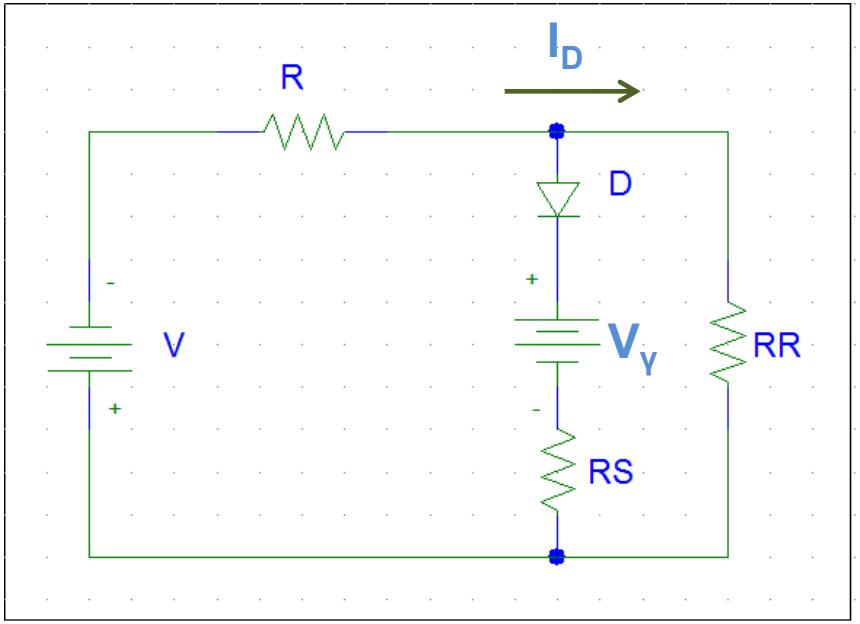

$$I_D = \frac{V - V_\gamma}{R + R_S}$$

# Modelo Real (3)

- Corriente Inversa



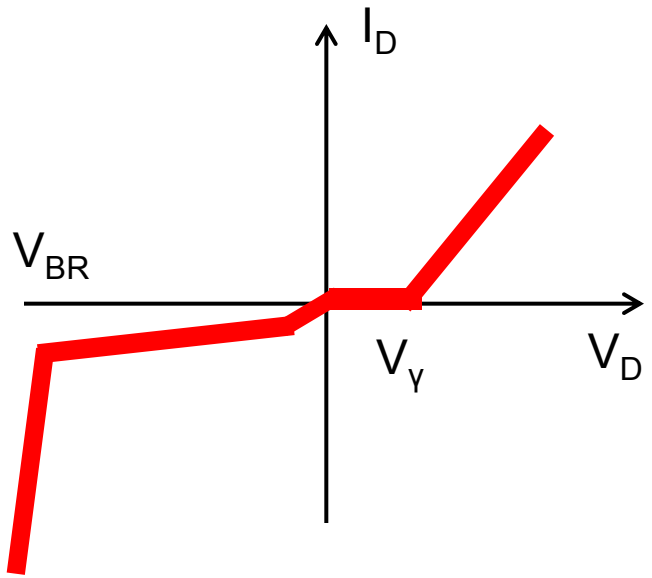



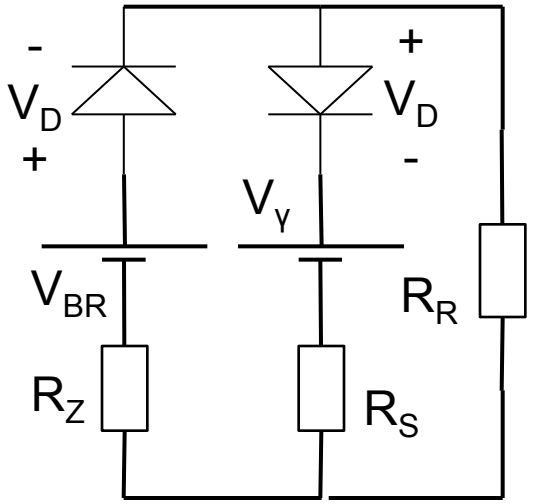



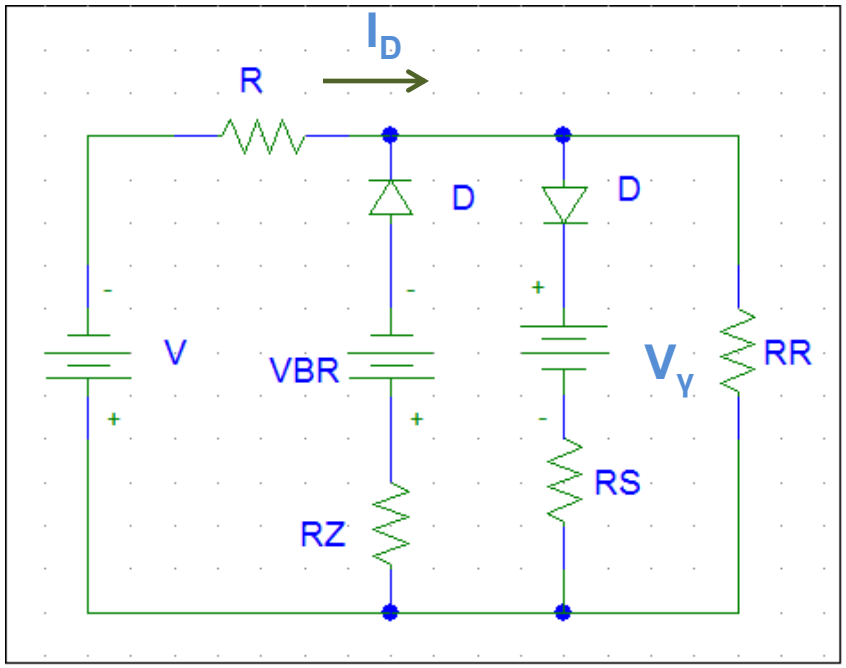

$$I_D = -\frac{V}{R + R_R}$$

# Modelo Real (4)

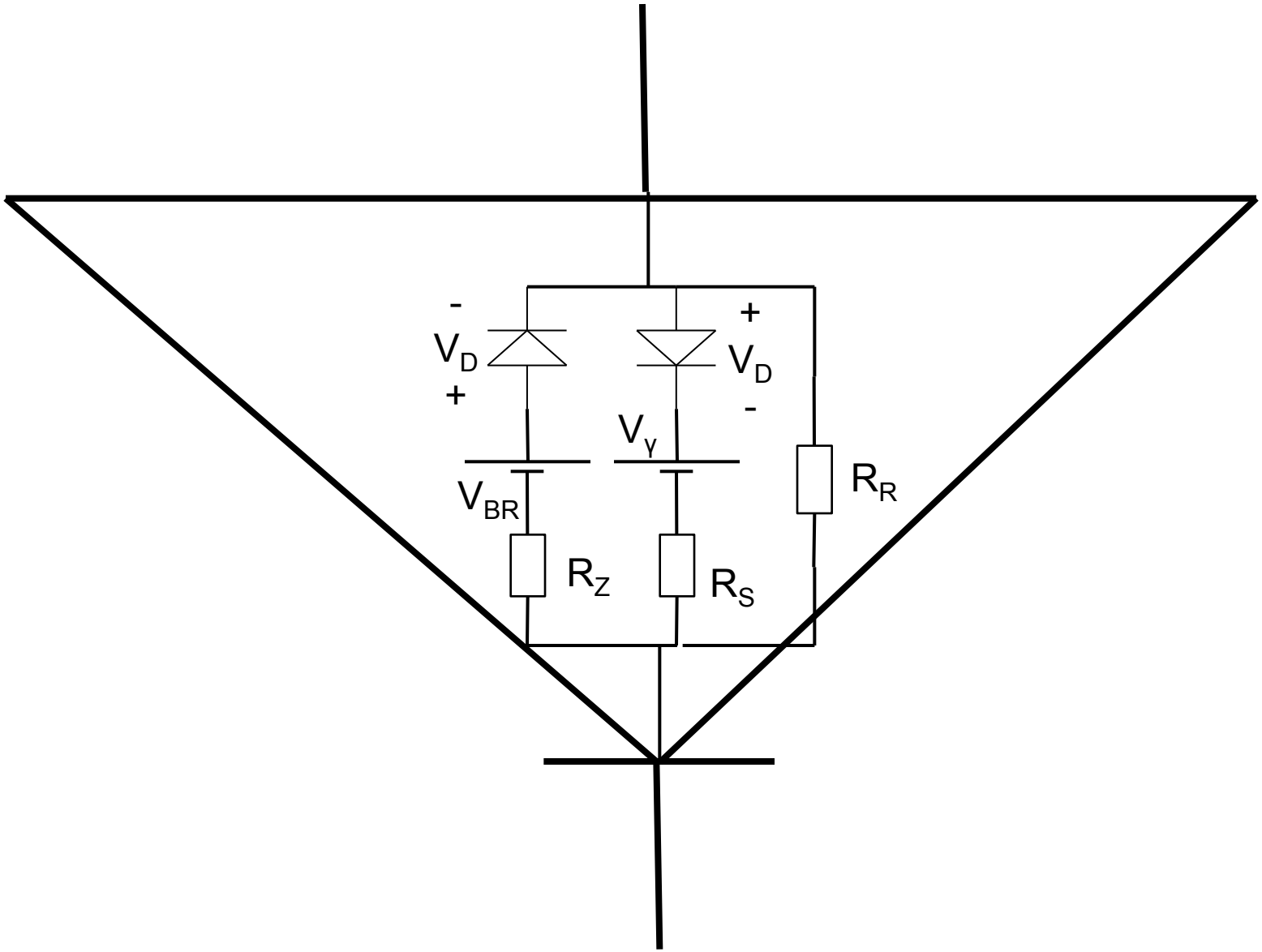
- Máxima Tensión Inversa



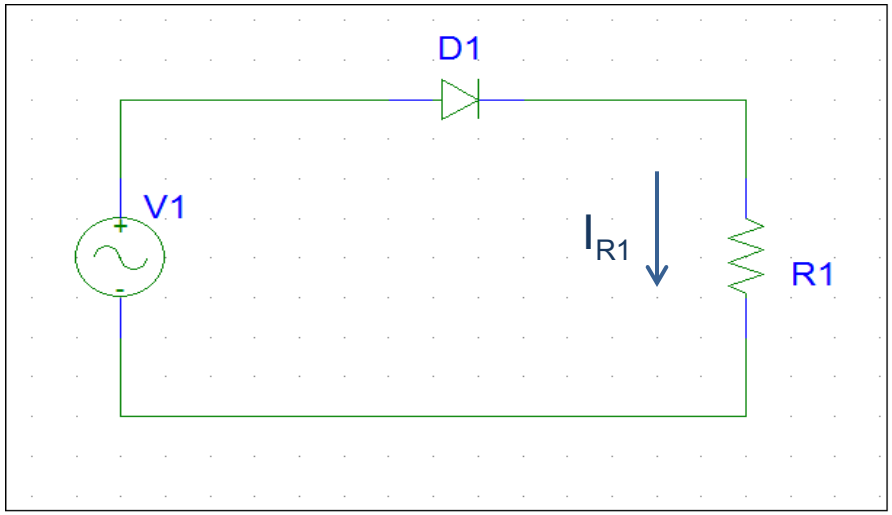



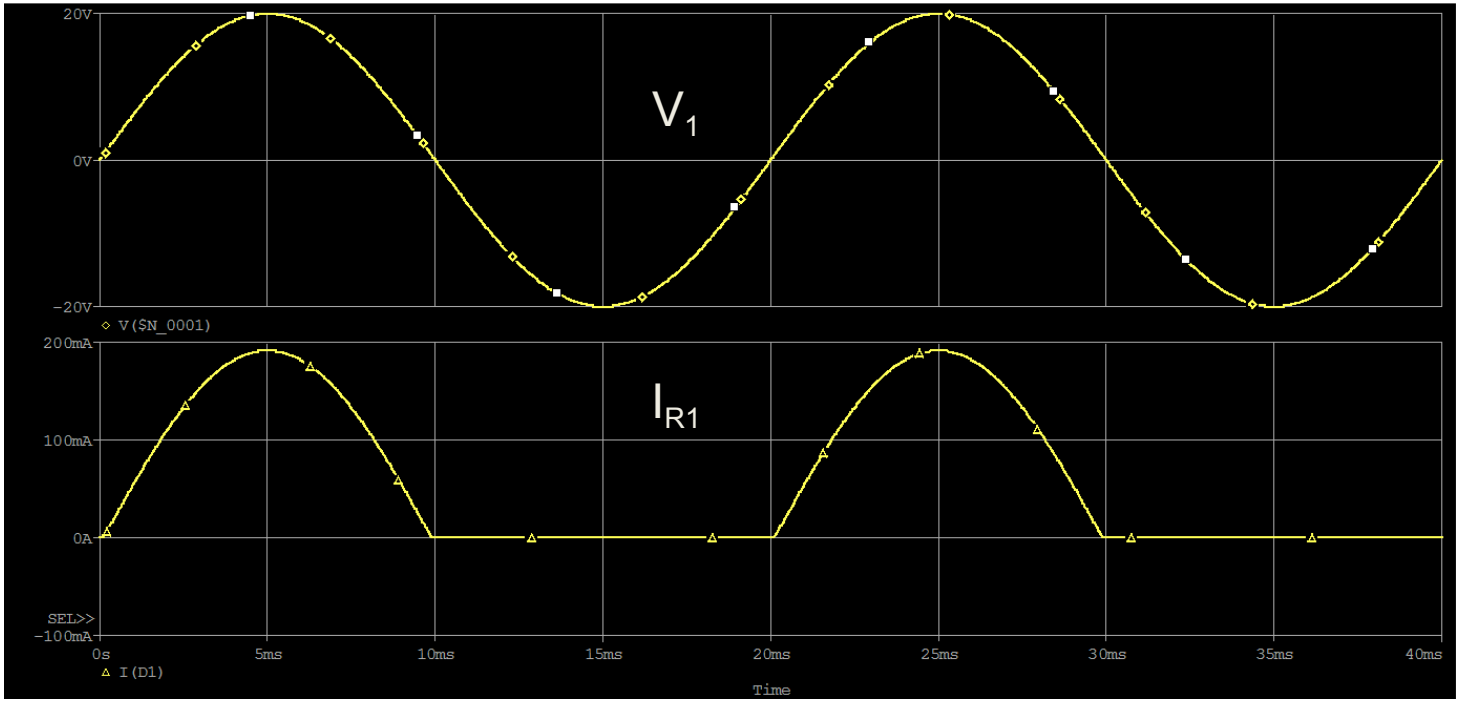




# Modelo Real (5)

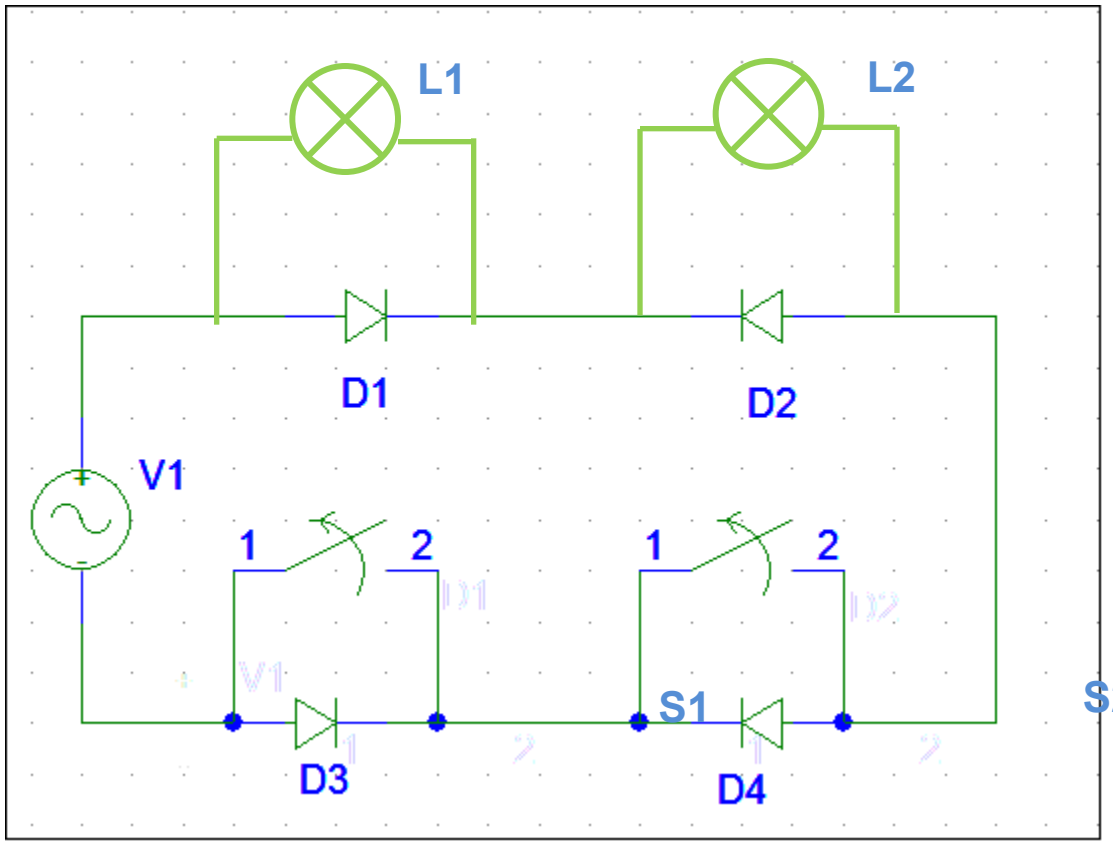


# Diodo como rectificador



# Ejercicio




- L1 y L2 son lámparas incandescentes
- V1 es una fuente de 220 V 50 Hz
- S1 y S2 son llaves

Explicar como funciona el circuito

1. Cuando las llaves están abiertas
2. Cuando las llaves están cerradas
3. Cuando cierro S1 o S2

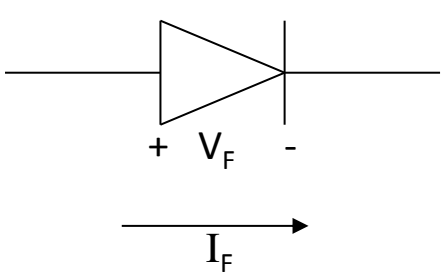
Proponer una aplicación practica para el circuito

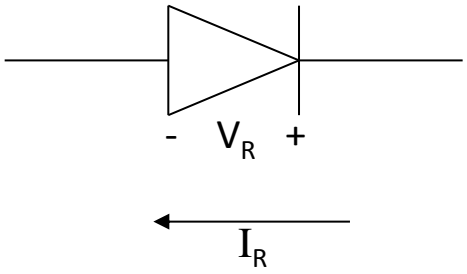
# DIODO SEMICONDUCTOR

## Definición:

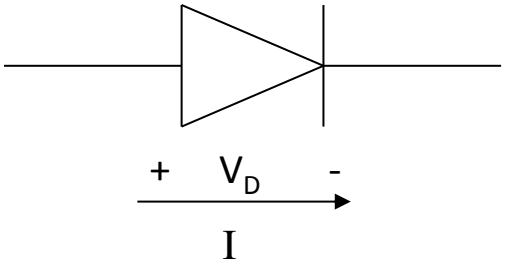
- Dispositivo Semiconductor
- Dos terminales
- Permite la Circulación de corriente ( I ) en un solo sentido

## Símbolo y convenciones V - I:



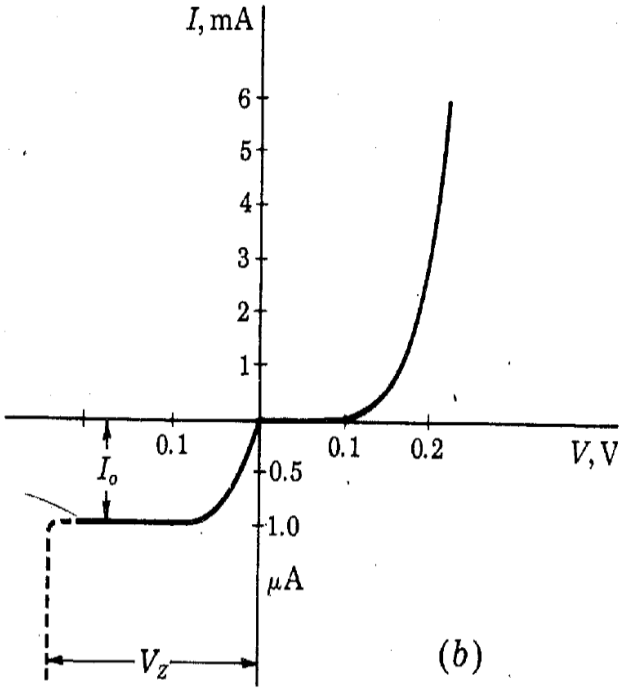
# Relación V – I (Modelo Diodo Semiconductor)

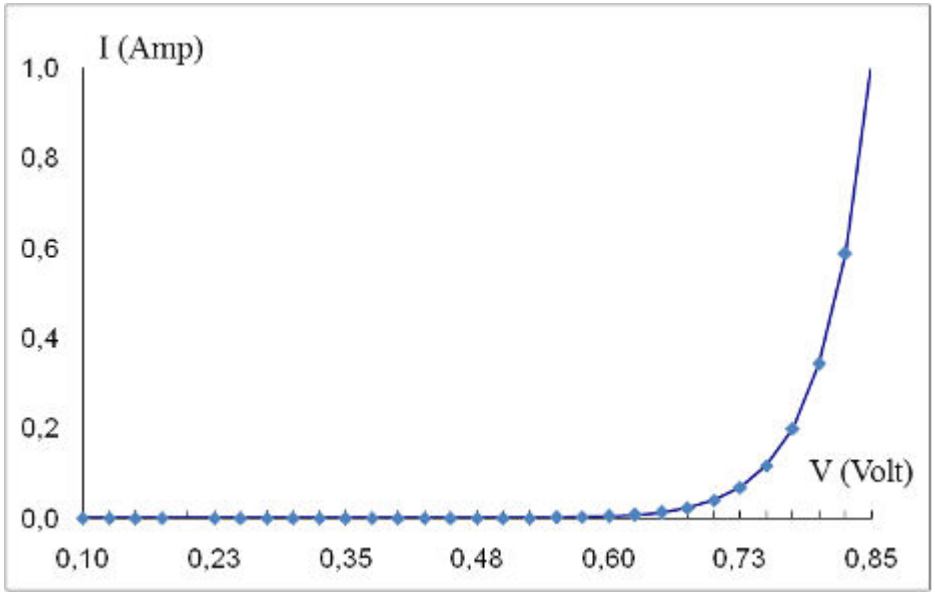



$$I = Is\ [\ \exp\ (V_D/U_T) - 1]$$

$$Is \longrightarrow \text{Fabricación}$$

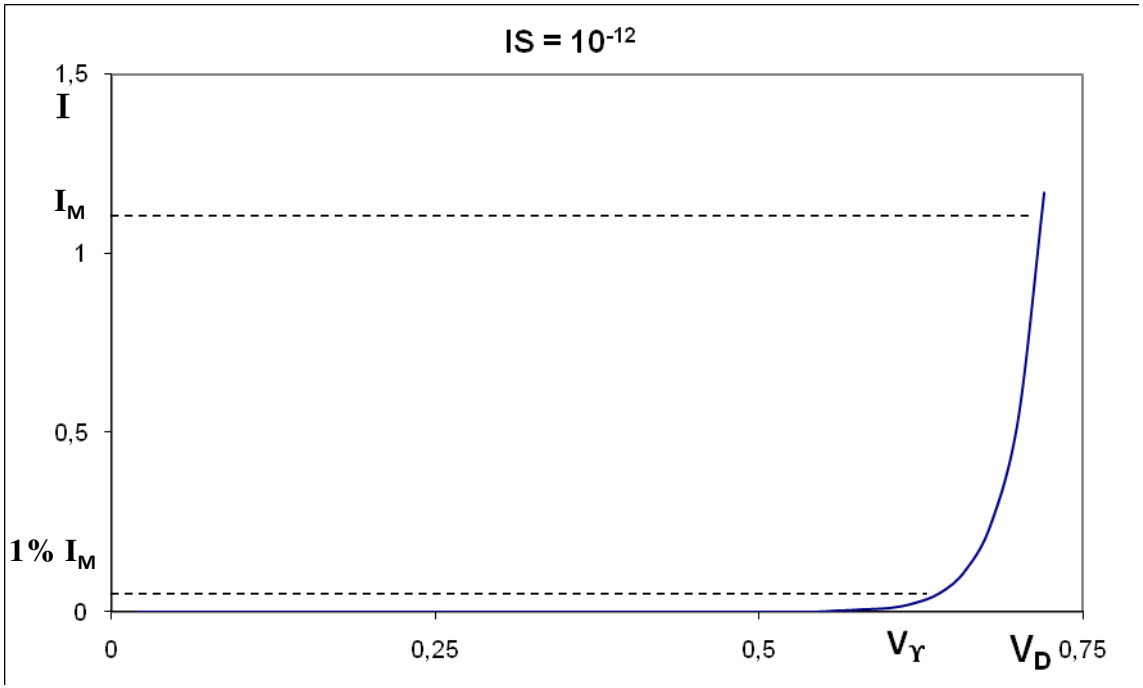
$$U_T = k\ T\ /\ q$$



$$I = Is\ [\ \exp\ (V_D/U_T) - 1]$$

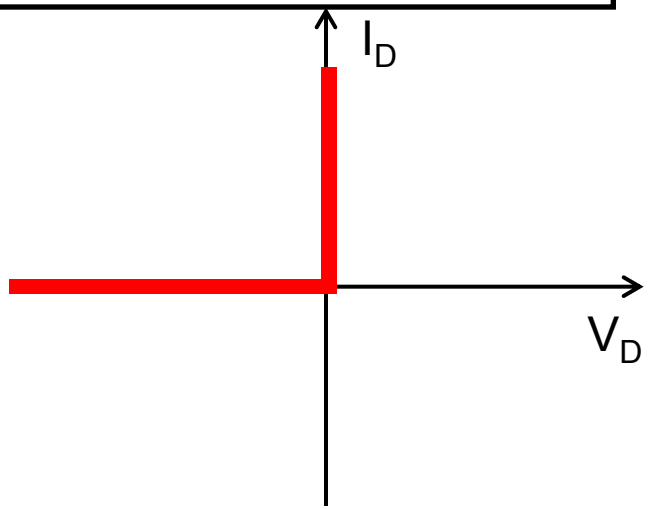
- Dos diodos se diferencian entre si a través del valor de Is
- Is refleja el proceso de fabricación (material, concentraciones, dimensiones)
- Is depende de la temperatura.
- La $V_\gamma$ (Tensión umbral) se define como la tensión que produce el 1% del valor de corriente máxima que puede conducir el Diodo

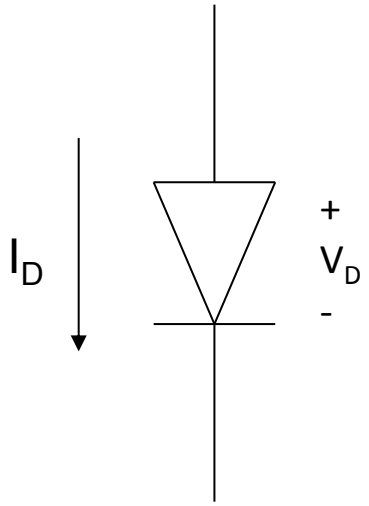


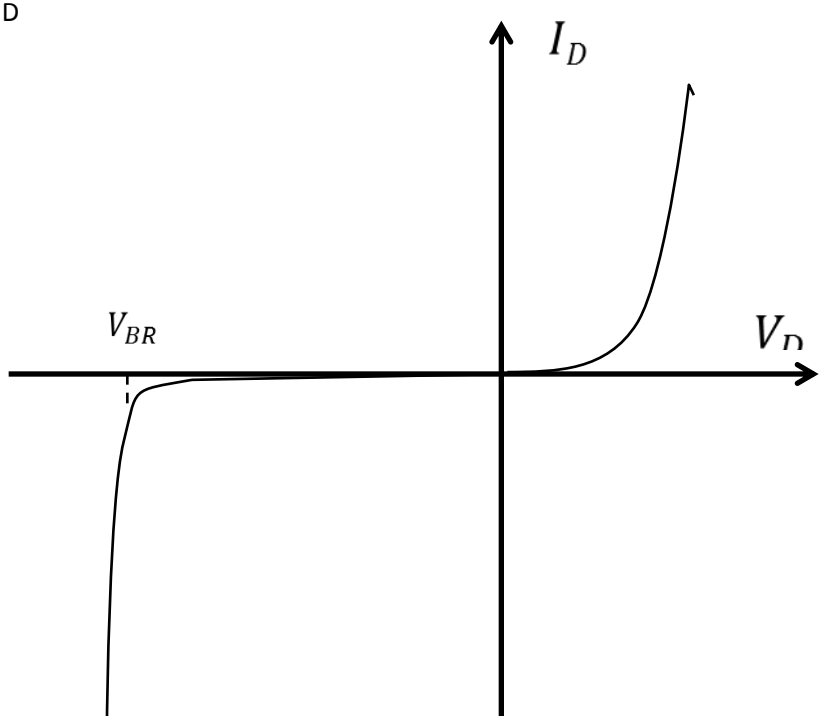
# DIODO
## Ideal vs. Semiconductor

DIODO IDEAL

$VD > 0 \Leftrightarrow ID \rightarrow \infty$



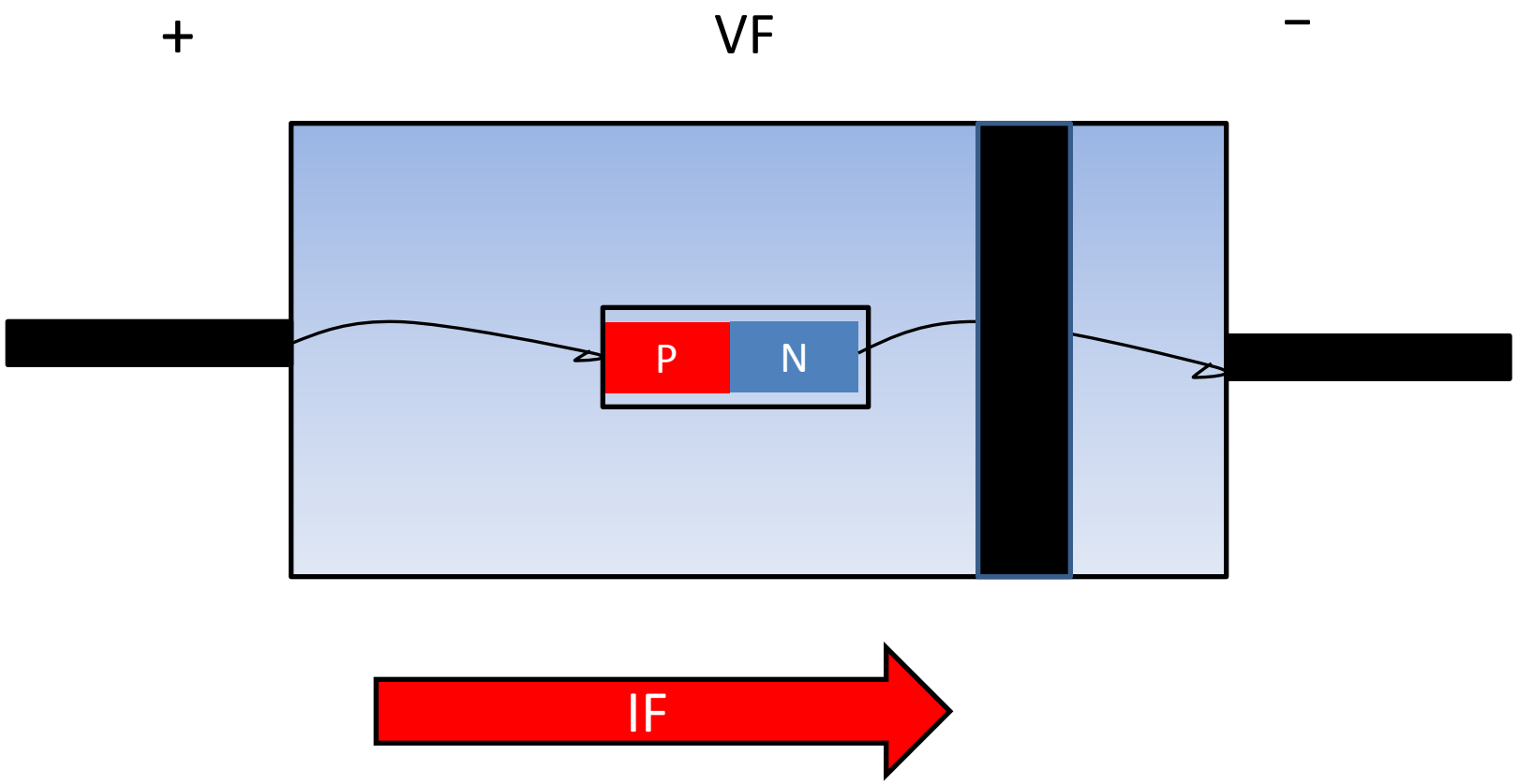




DIODO Semiconductor

$I_D = Is\ [\ exp\ (V_D/U_T) - 1]$

# Máxima Corriente Directa ( $I_{FM}$ )



# CLASIFICACION DE LOS DIODOS

- MATERIAL

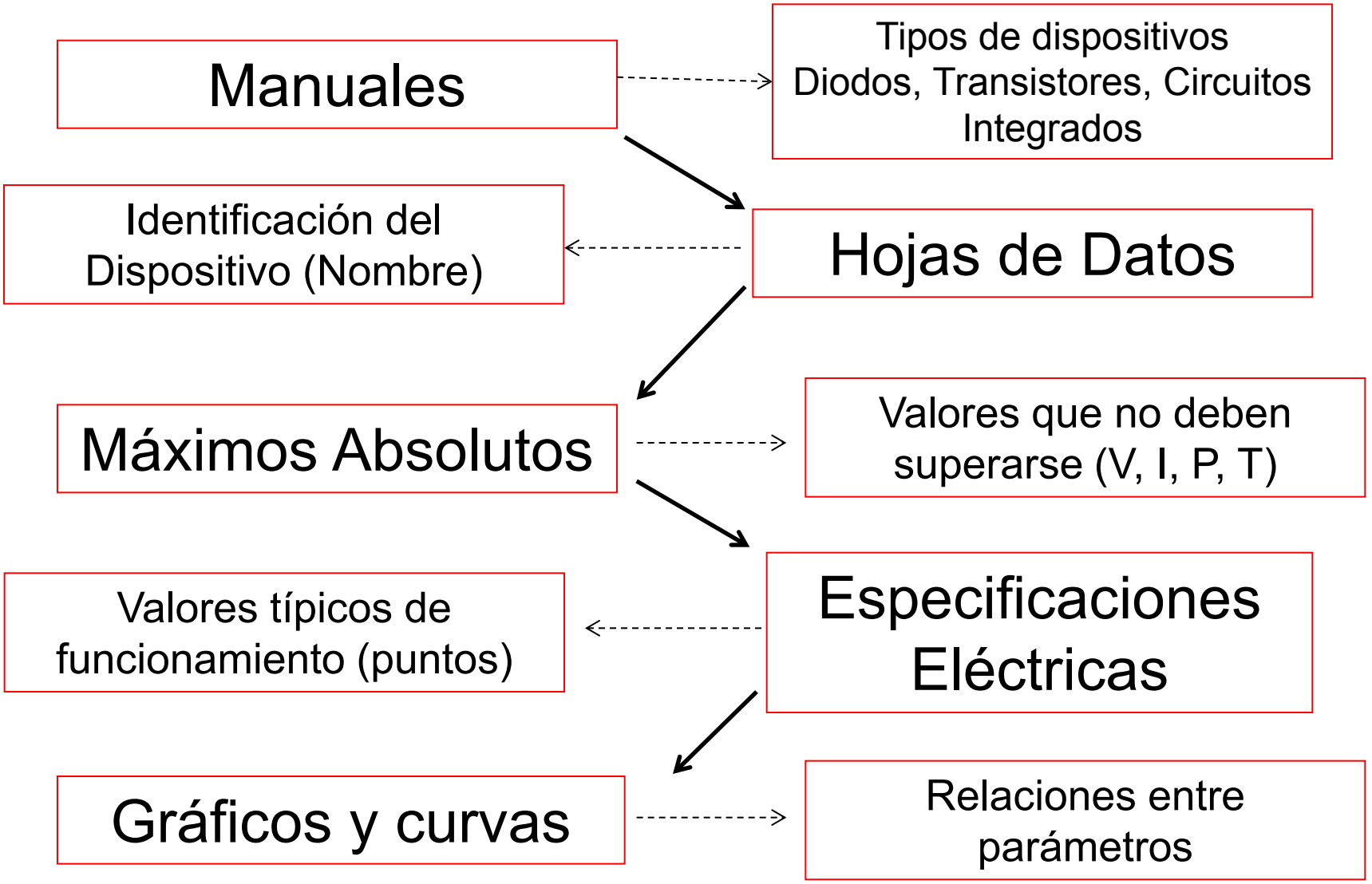
Material
- Ge
- Si
- As Ga

- POTENCIA

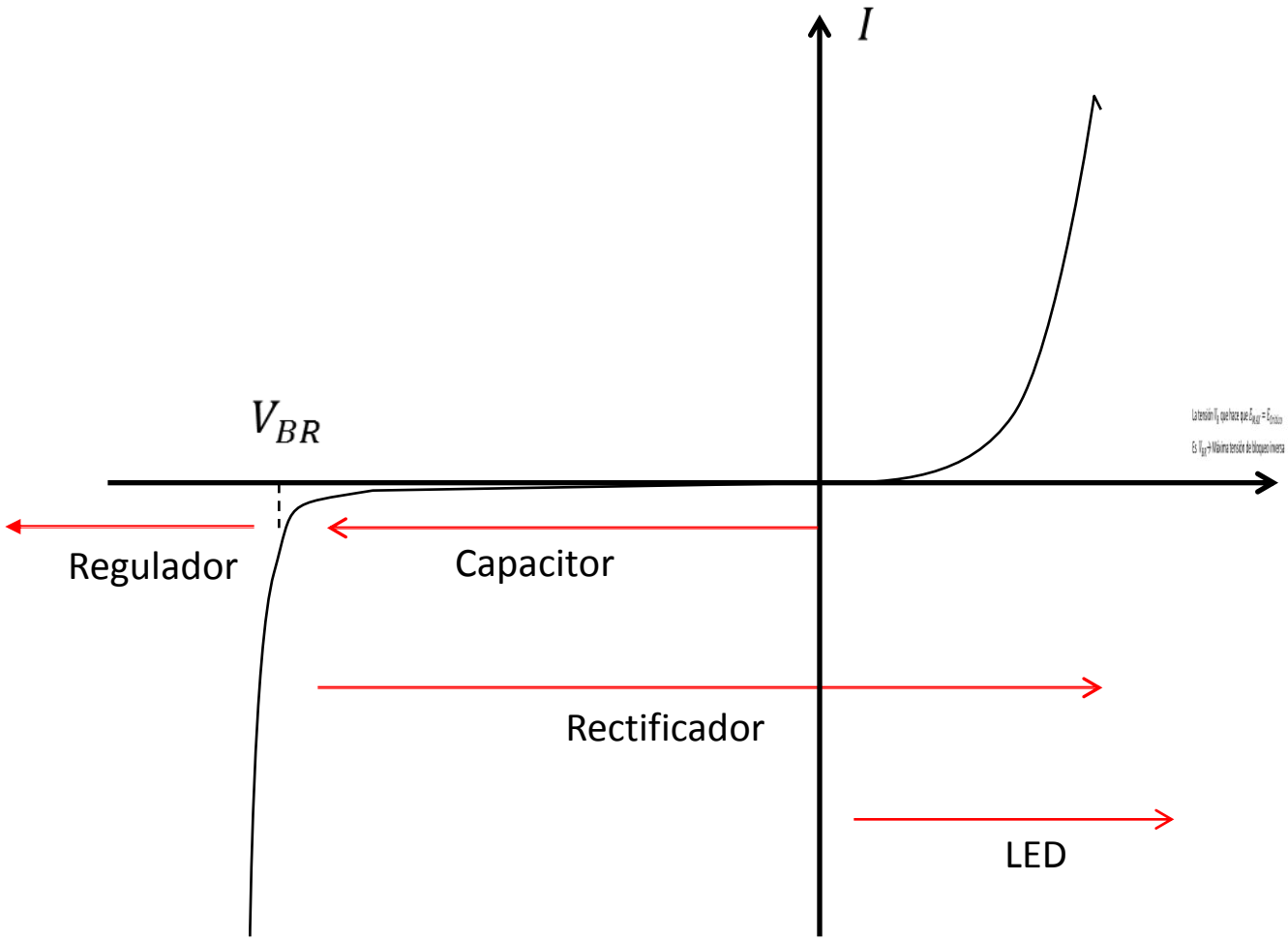
Potencia
- Señal ( P < 1 watt)
- Potencia ( P > 1 watt)

Función en los circuitos
- Rectificador → Velocidad de conmutación
  - Normal
  - Rápido
  - Ultrarrápido
  - Schottky
- Regulador (Zener)
- Capacitor (Varicap)
- Emisor de luz (LED)
- Fotodetector

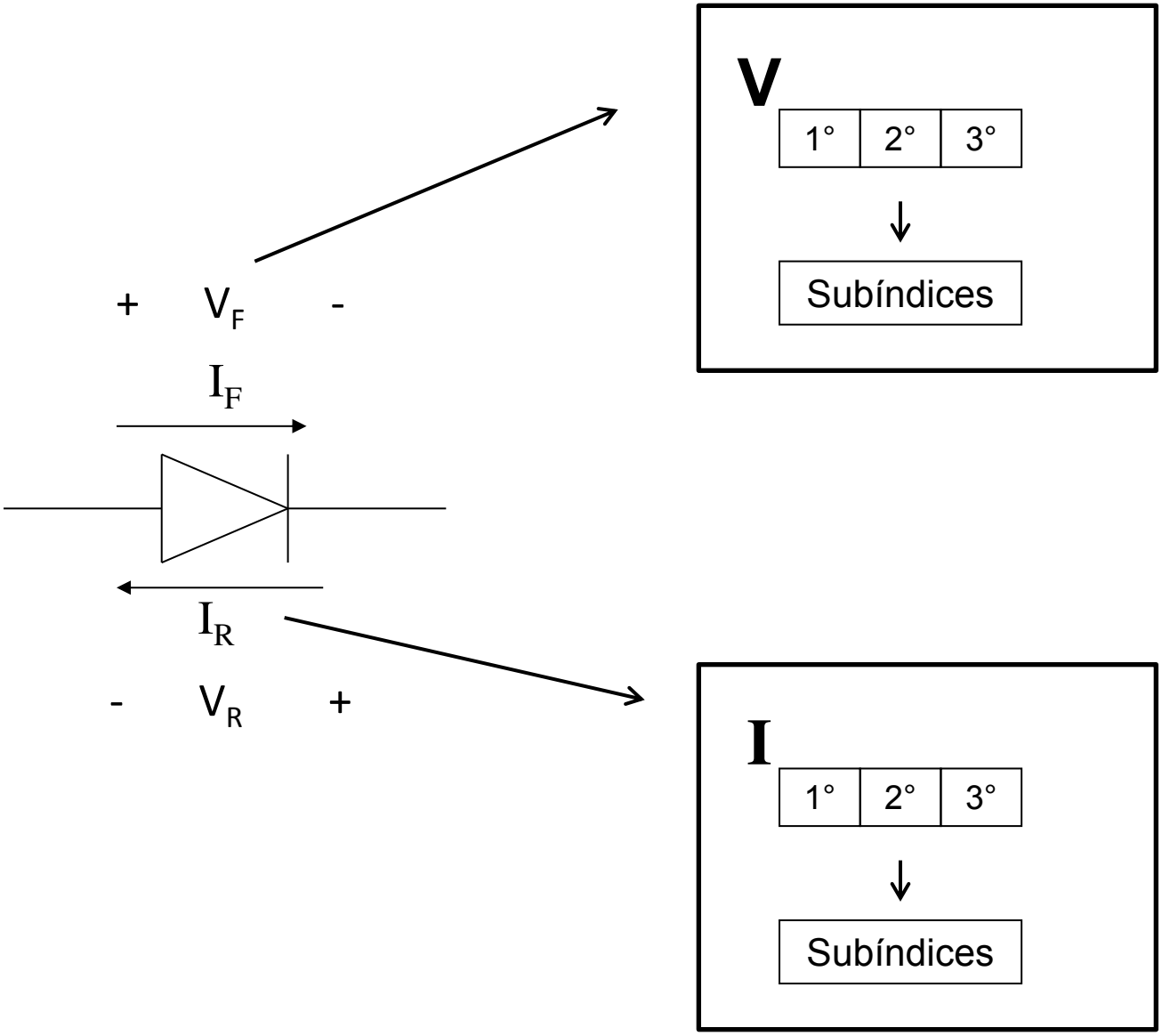
# ESPECIFICACION DE DISPOSITIVOS SEMICONDUCTORES

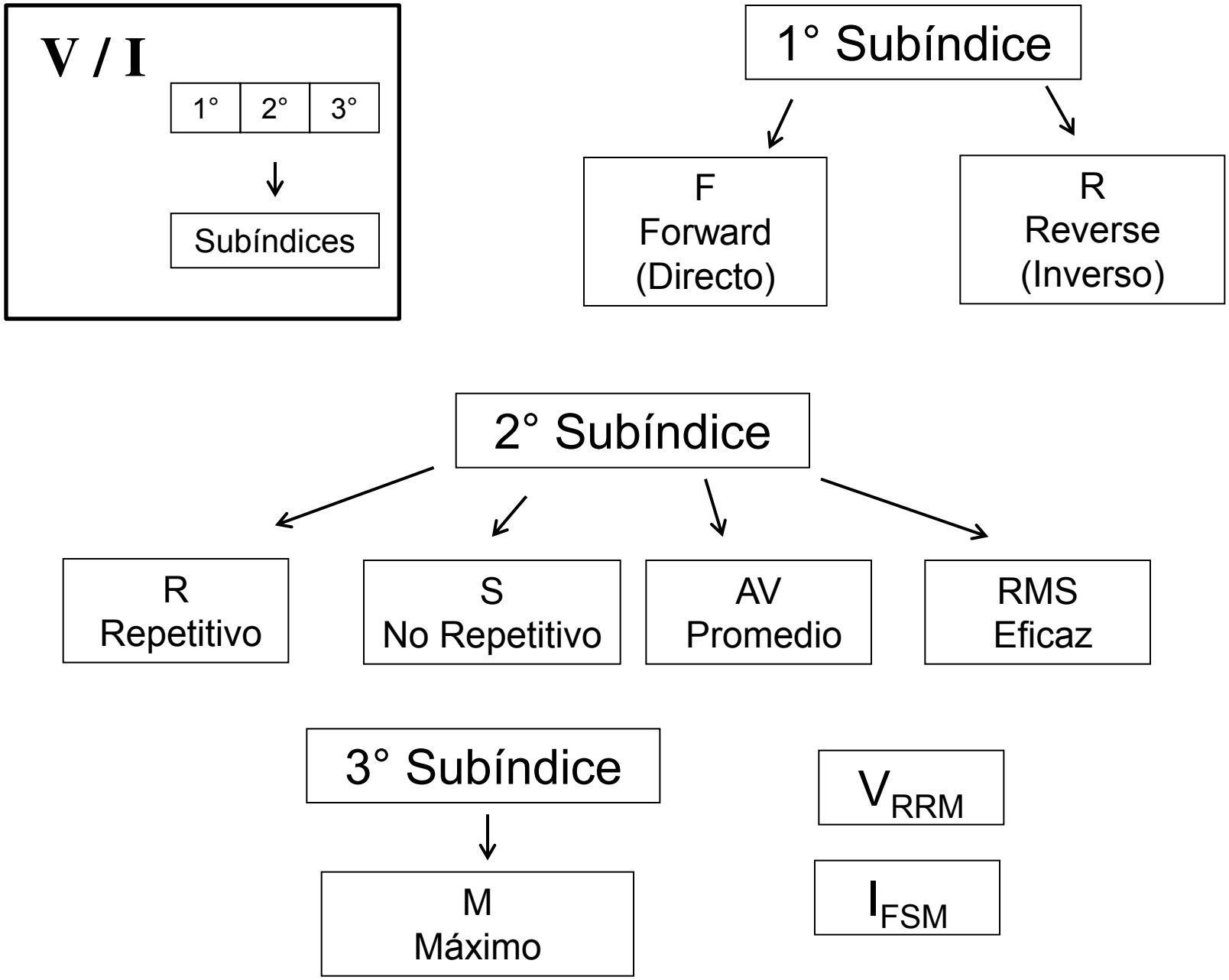


# ZONA DE FUNCIONAMIENTO DE CADA TIPO DE DIODO



# Convenciones de tensiones y corrientes




V / I
1°
2°
3°
Subíndices
1° Subíndice
F
Forward
(Directo)
R
Reverse
(Inverso)
2° Subíndice
R
Repetitivo
S
No Repetitivo
AV
Promedio
RMS
Eficaz
3° Subíndice
M
Máximo
$V_{RRM}$
$I_{FSM}$

FAIRCHILD
SEMICONDUCTOR®

# 1N4001 - 1N4007

## Features

- Low forward voltage drop.
- High surge current capability.

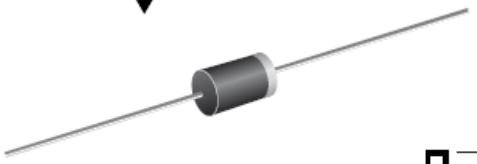
**DO-41**
COLOR BAND DENOTES CATHODE

# General Purpose Rectifiers (Glass Passivated)

# 1N4001 thru 1N4007

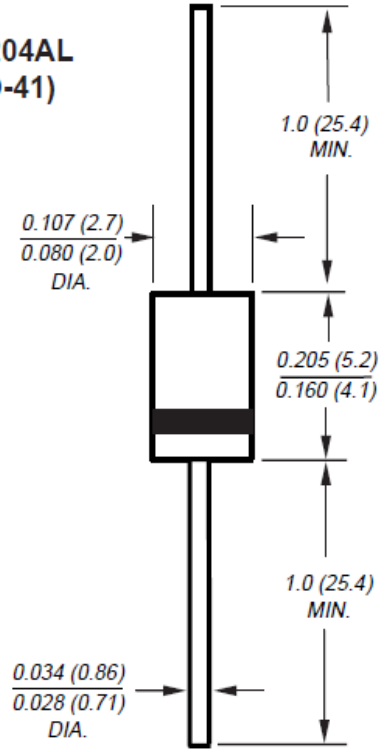
Vishay Semiconductors
formerly General Semiconductor

## General Purpose Plastic Rectifier



**Reverse Voltage**
50 to 1000V
**Forward Current** 1.0A

**DO-204AL**
**(DO-41)**




NOTE: *Lead diameter is* 0.026 (0.66) / 0.023 (0.58) *for suffix "E" part numbers*

## Features

- Plastic package has Underwriters Laboratories Flammability Classification 94V-0
- Construction utilizes void-free molded plastic technique
- Low reverse leakage
- High forward surge capability
- High temperature soldering guaranteed: 350°C/10 seconds, 0.375" (9.5mm) lead length, 5 lbs. (2.3kg) tension

## Mechanical Data

**Case:** JEDEC DO-204AL, molded plastic body
**Terminals:** Plated axial leads, solderable per MIL-STD-750, Method 2026
**Polarity:** Color band denotes cathode end
**Mounting Position:** Any
**Weight:** 0.012 oz., 0.3 g

## Absolute Maximum Ratings*

$T_A$ = 25°C unless otherwise noted

| Symbol | Parameter | Value | | | | | | | Units |
|---|---|---|---|---|---|---|---|---|---|
| | | 4001 | 4002 | 4003 | 4004 | 4005 | 4006 | 4007 | |
| $V_{RRM}$ | Peak Repetitive Reverse Voltage | 50 | 100 | 200 | 400 | 600 | 800 | 1000 | V |
| $I_{F(AV)}$ | Average Rectified Forward Current, .375 " lead length @ $T_A$ = 75°C | 1.0 | | | | | | | A |
| $I_{FSM}$ | Non-repetitive Peak Forward Surge Current 8.3 ms Single Half-Sine-Wave | 30 | | | | | | | A |
| $T_{stg}$ | Storage Temperature Range | -55 to +175 | | | | | | | °C |
| $T_J$ | Operating Junction Temperature | -55 to +175 | | | | | | | °C |

*These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

## Electrical Characteristics

$T_A$ = 25°C unless otherwise noted

| Symbol | Parameter | Device | | | | | | | Units |
|---|---|---|---|---|---|---|---|---|---|
| | | 4001 | 4002 | 4003 | 4004 | 4005 | 4006 | 4007 | |
| $V_F$ | Forward Voltage @ 1.0 A | 1.1 | | | | | | | V |
| $I_{rr}$ | Maximum Full Load Reverse Current, Full Cycle $T_A$ = 75°C | 30 | | | | | | | µA |
| $I_R$ | Reverse Current @ rated $V_R$ $T_A$ = 25°C<br>$T_A$ = 100°C | 5.0<br>500 | | | | | | | µA<br>µA |
| $C_T$ | Total Capacitance $V_R$ = 4.0 V, f = 1.0 MHz | 15 | | | | | | | pF |

## Thermal Characteristics

| Symbol | Parameter | Value | Units |
|---|---|---|---|
| $P_D$ | Power Dissipation | 3.0 | W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 50 | °C/W |

## Typical Characteristics

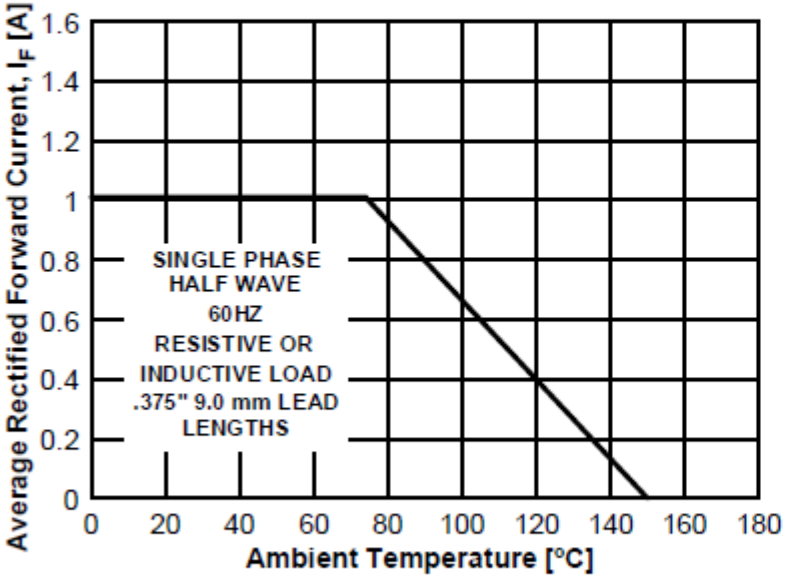



Figure 1. Forward Current Derating Curve

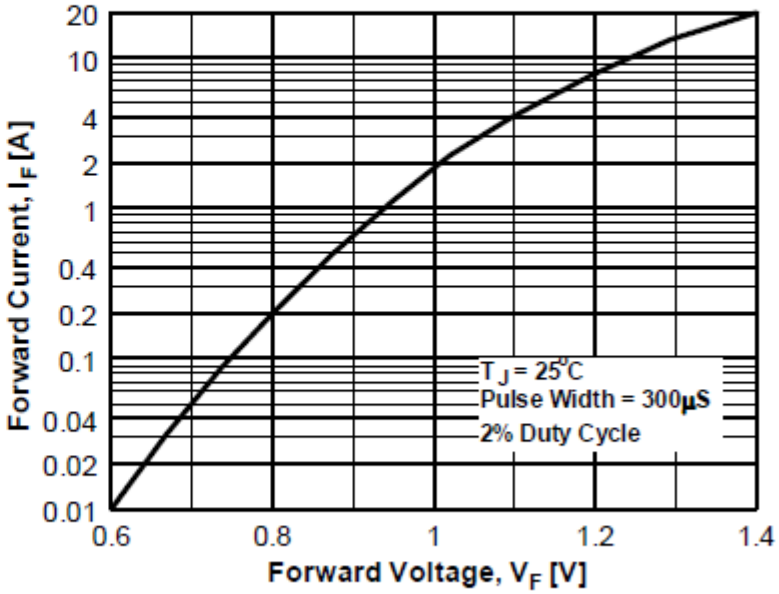



Figure 2. Forward Voltage Characteristics

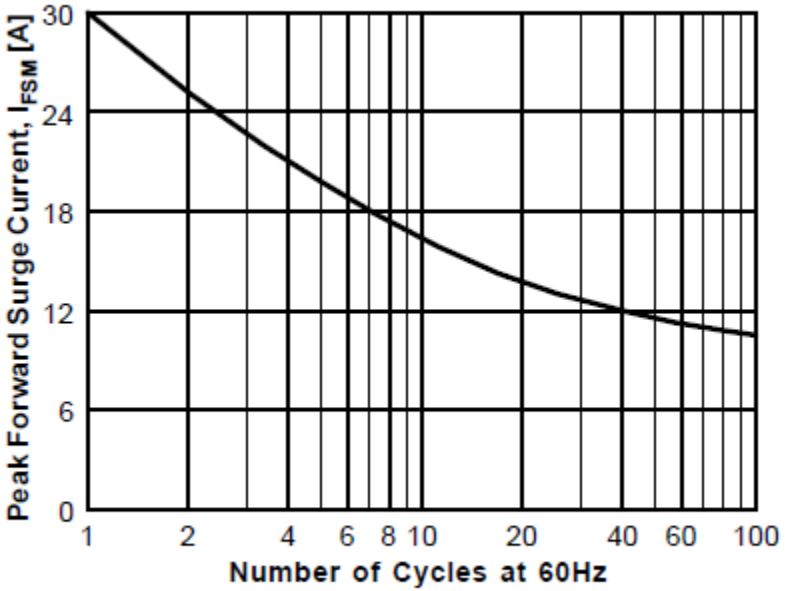



**Figure 3. Non-Repetitive Surge Current**

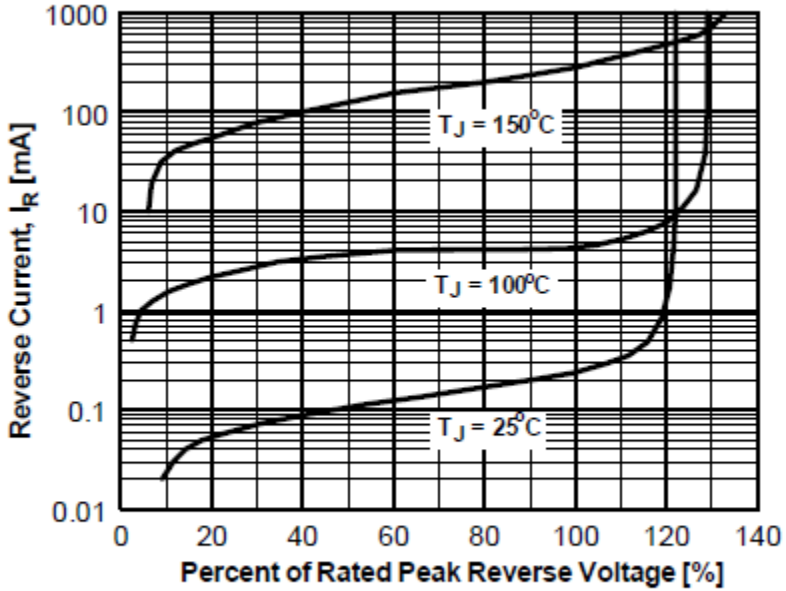



**Figure 4. Reverse Current vs Reverse Voltage**

## Maximum Ratings & Thermal Characteristics

Ratings at 25°C ambient temperature unless otherwise specified.

| Parameter | Symb. | 1N 4001 | 1N 4002 | 1N 4003 | 1N 4004 | 1N 4005 | 1N 4006 | 1N 4007 | Unit |
|---|---|---|---|---|---|---|---|---|---|
| Maximum repetitive peak reverse voltage | $V_{RRM}$ | 50 | 100 | 200 | 400 | 600 | 800 | 1000 | V |
| * Maximum RMS voltage | $V_{RMS}$ | 35 | 70 | 140 | 280 | 420 | 560 | 700 | V |
| * Maximum DC blocking voltage | $V_{DC}$ | 50 | 100 | 200 | 400 | 600 | 800 | 1000 | V |
| * Maximum average forward rectified current 0.375" (9.5mm) lead length at $T_A$ = 75°C | $I_{F(AV)}$ | 1.0 | | | | | | | A |
| * Peak forward surge current 8.3ms single half sine-wave superimposed on rated load (JEDEC Method) $T_A$ = 75°C | $I_{FSM}$ | 30 | | | | | | | A |
| * Maximum full load reverse current, full cycle average 0.375" (9.5mm) lead length $T_L$ = 75°C | $I_{R(AV)}$ | 30 | | | | | | | µA |
| Typical thermal resistance[1] | $R_{\theta JA}$<br>$R_{\theta JL}$ | 50<br>25 | | | | | | | °C/W |
| * Maximum DC blocking voltage temperature | $T_A$ | +150 | | | | | | | V |
| * Operating junction and storage temperature range | $T_J$, $T_{STG}$ | –50 to +175 | | | | | | | °C |

## Electrical Characteristics

Ratings at 25°C ambient temperature unless otherwise specified.

| | | | | |
|---|---|---|---|---|
| Maximum instantaneous forward voltage at 1.0A | | $V_F$ | 1.1 | V |
| * Maximum DC reverse current at rated DC blocking voltage | $T_A$ = 25°C<br>$T_A$ = 125°C | $I_R$ | 5.0<br>50 | µA |
| Typical junction capacitance at 4.0V, 1MHz | | $C_J$ | 15 | pF |

**Note:** (1) Thermal resistance from junction to ambient at 0.375" (9.5mm) lead length, P.C.B. mounted *JEDEC registered values

## Ratings and Characteristic Curves ($T_A$ = 25°C unless otherwise noted)

**Fig. 1 – Forward Current Derating Curve**

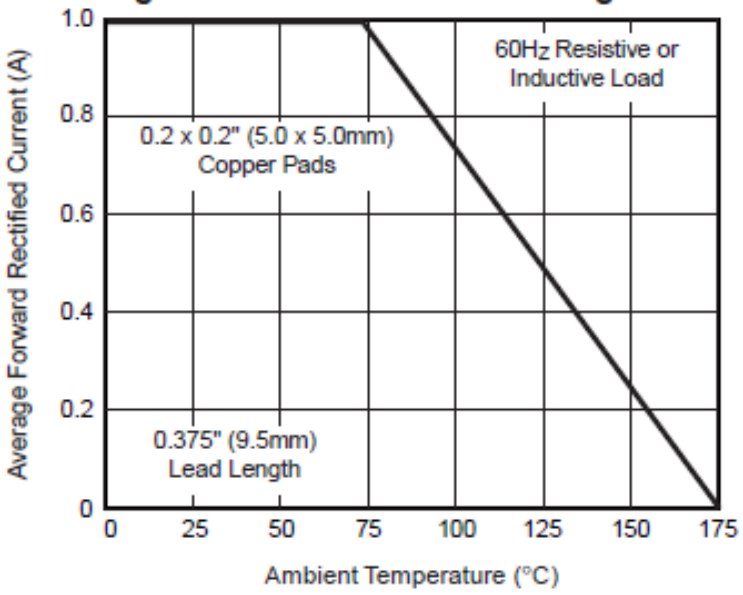
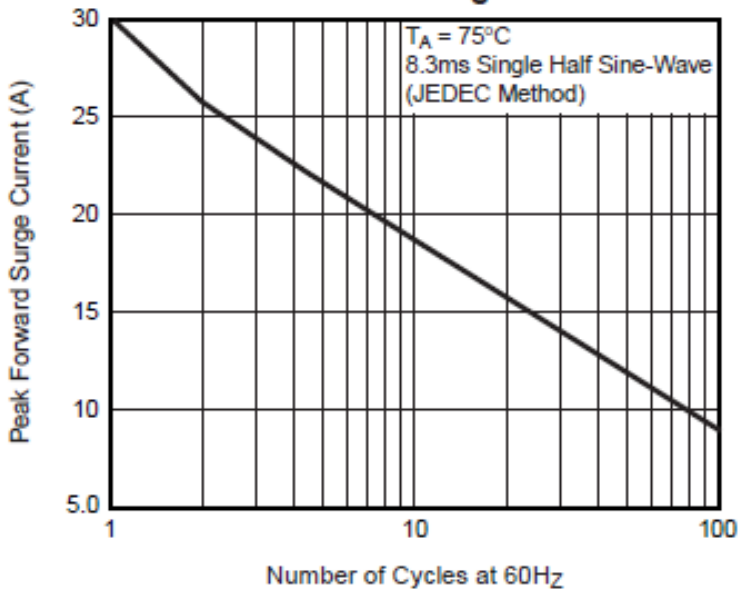
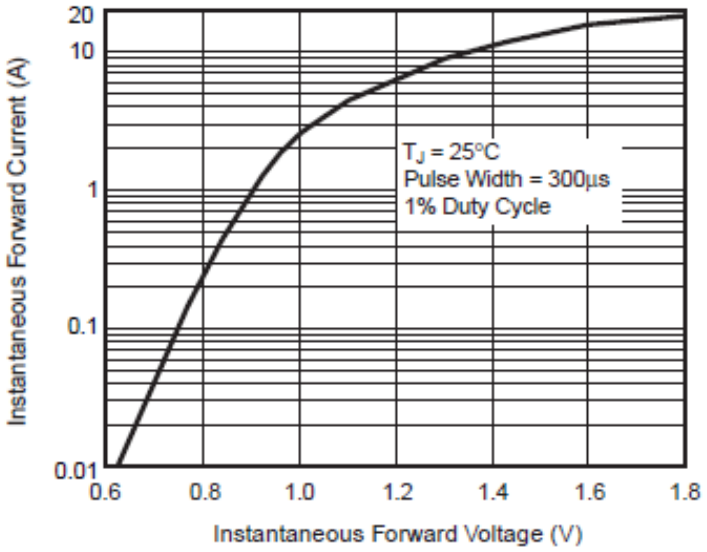


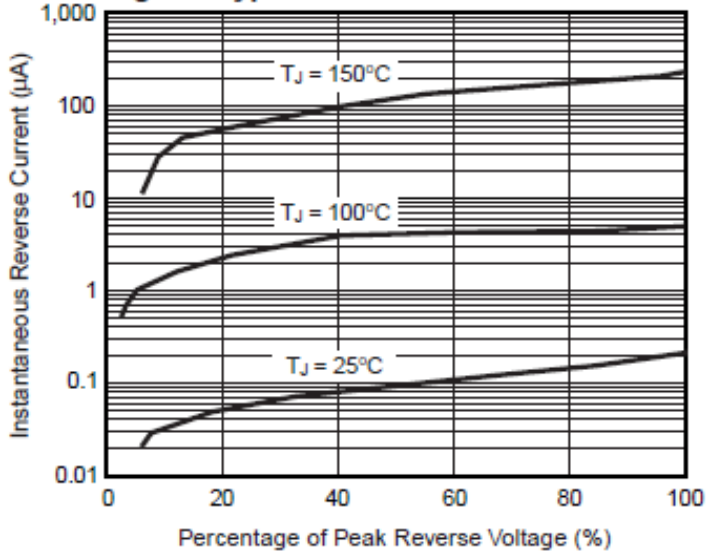

**Fig. 2 – Maximum Non-Repetitive Peak Forward Surge Current**



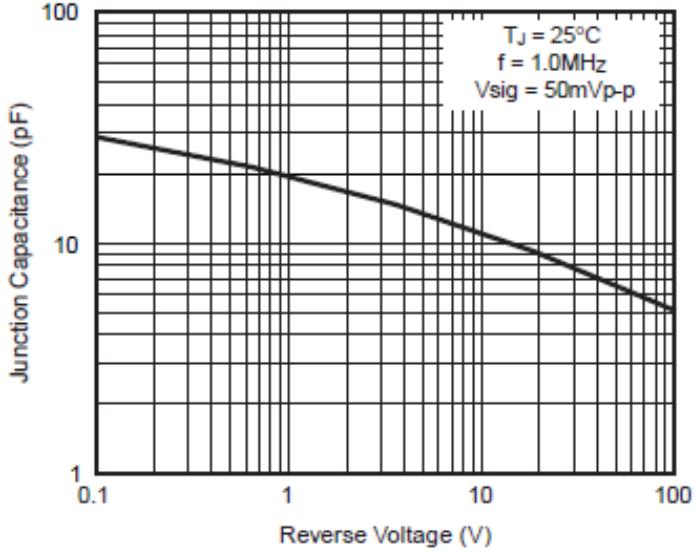
## Fig. 3 – Typical Instantaneous Forward Characteristics



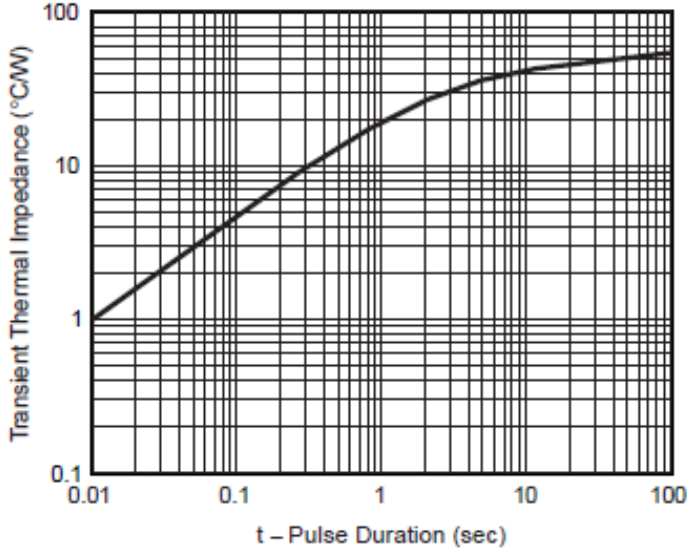

## Fig. 4 – Typical Reverse Characteristics



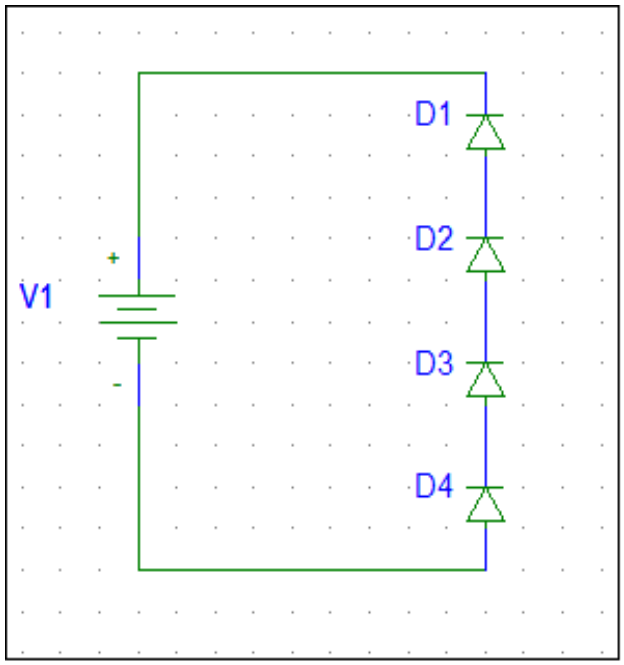

## Fig. 5 – Typical Junction Capacitance

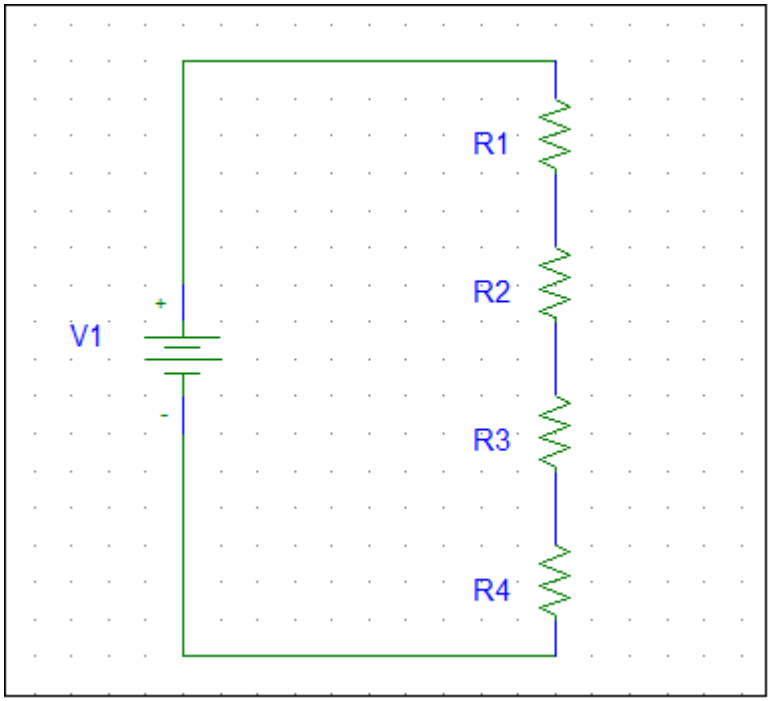



## Fig. 6 – Typical Transient Thermal Impedance



# DIODOS SERIE



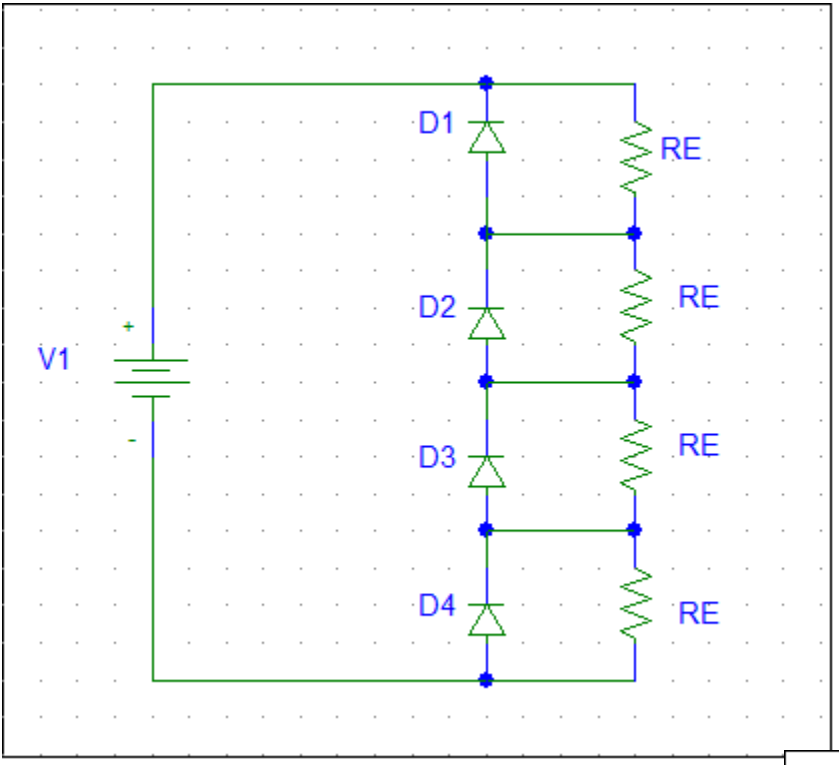



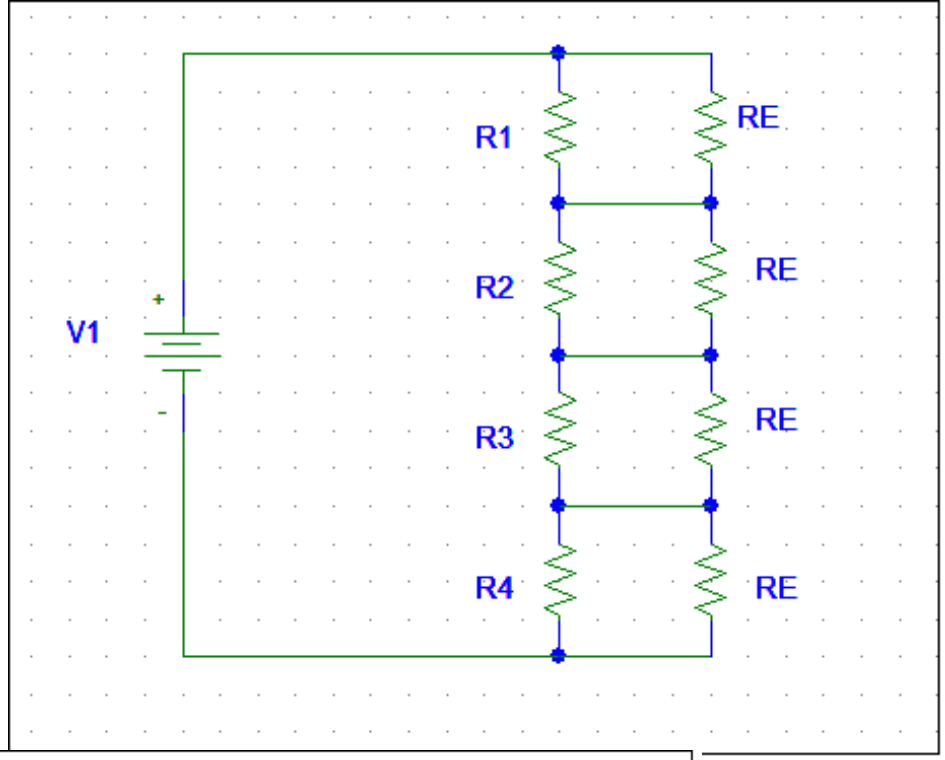

R1- R4 representan la resistencia equivalente de los diodo D1 - D4 en inversa

Si las resistencia no son iguales las tensiones en cada diodo no será igual

Ejemplo: Diodos de 1000 V de tensión inversa – Fuente 4000 V

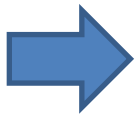
La caída en alguno de los diodos será mayor que 1000 V

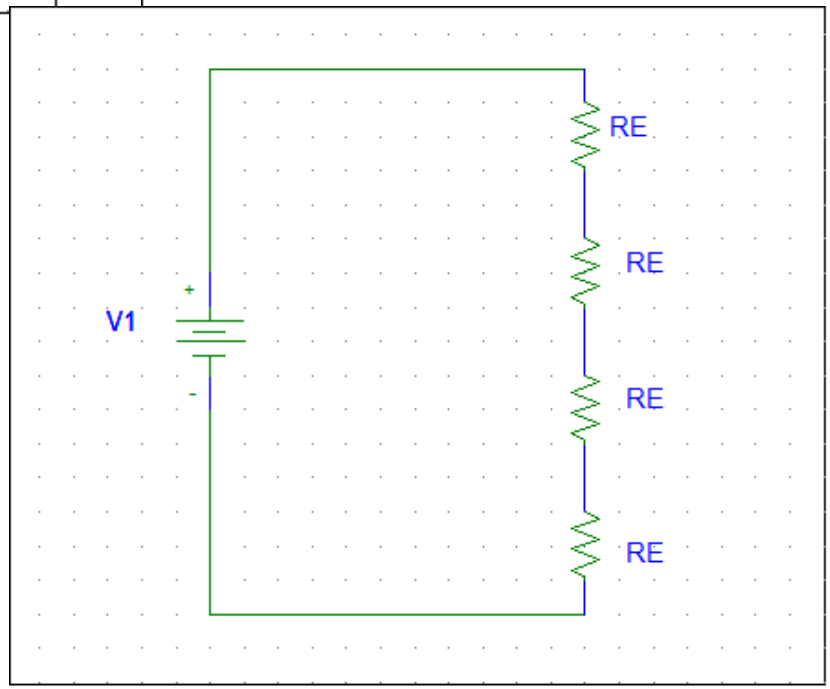



SI

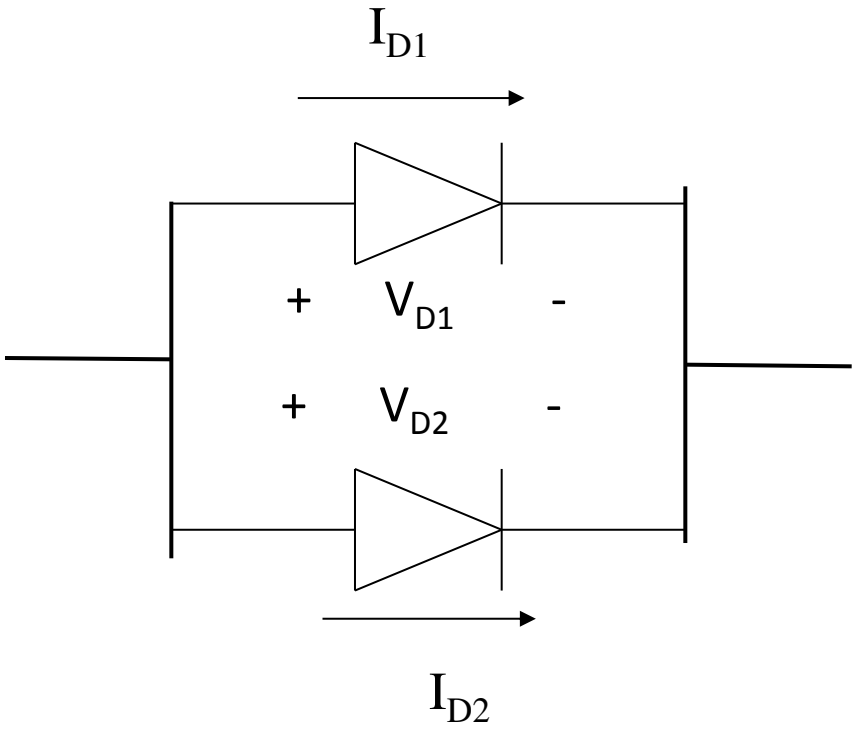
$RE << (R1\text{-}R4)_{MIN}$

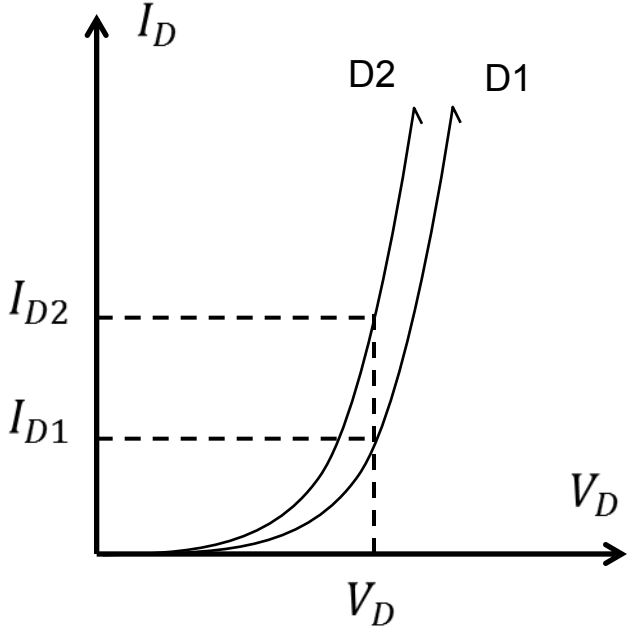





**RE ⇨ Resistencia de ecualización**

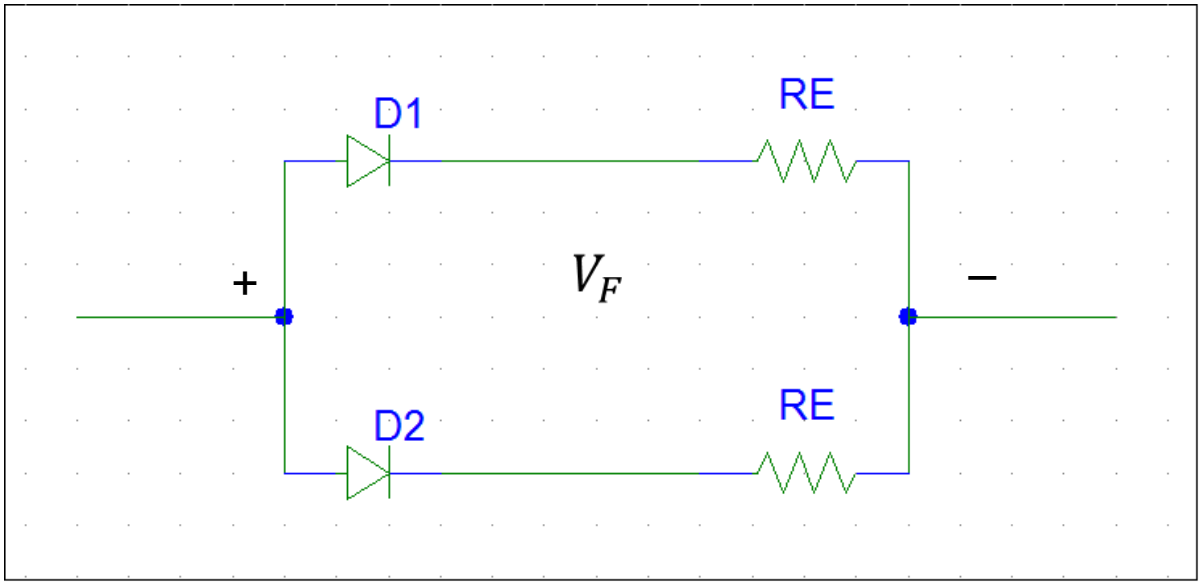
# DIODOS Paralelo

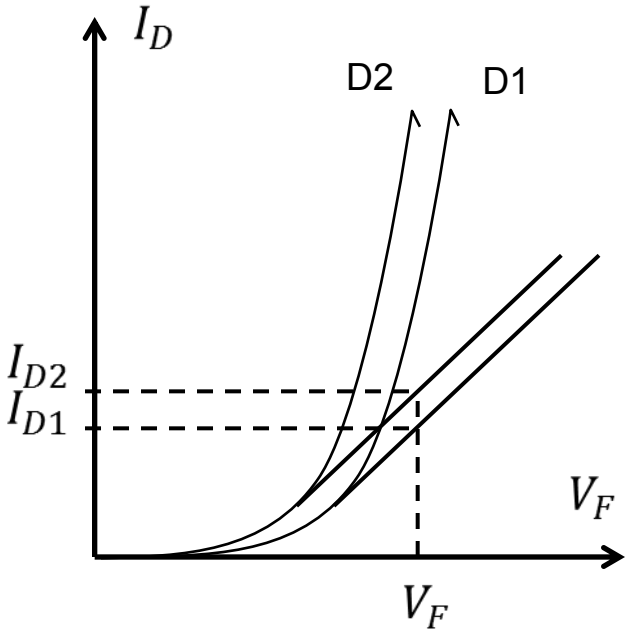



- Por la conexión VD1 = VD2
- Si las características no son idénticas uno de los diodos conducirá mas corriente

# DIODOS Paralelo




$RE >> (Rd1\text{-}Rd2)_{MAX}$