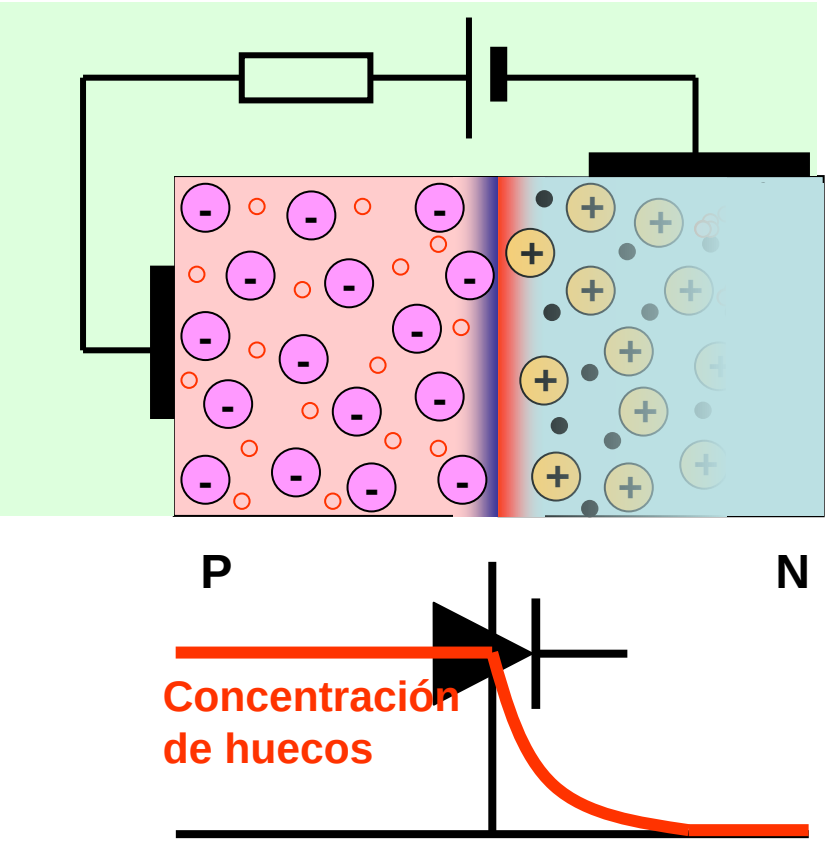
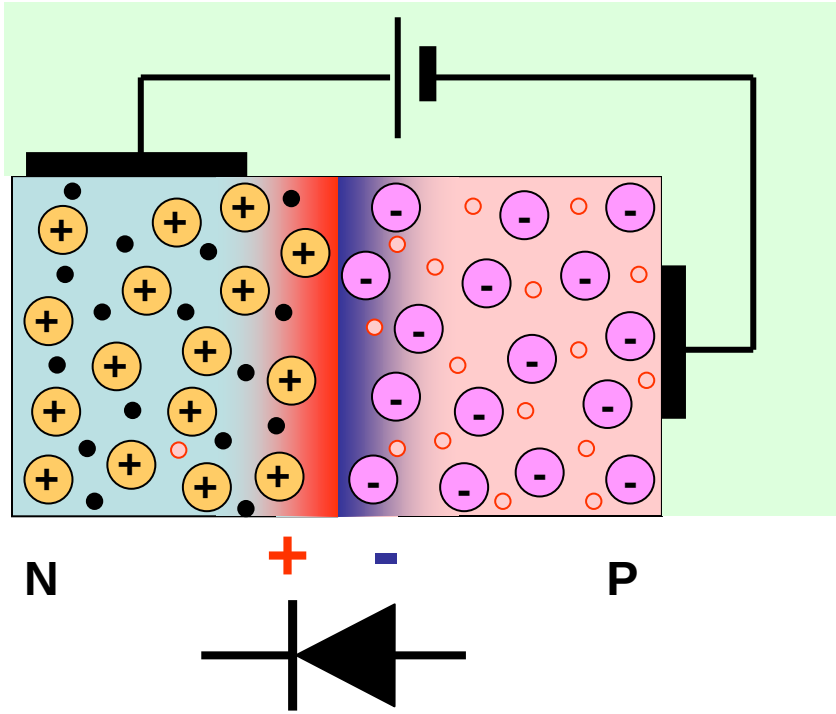
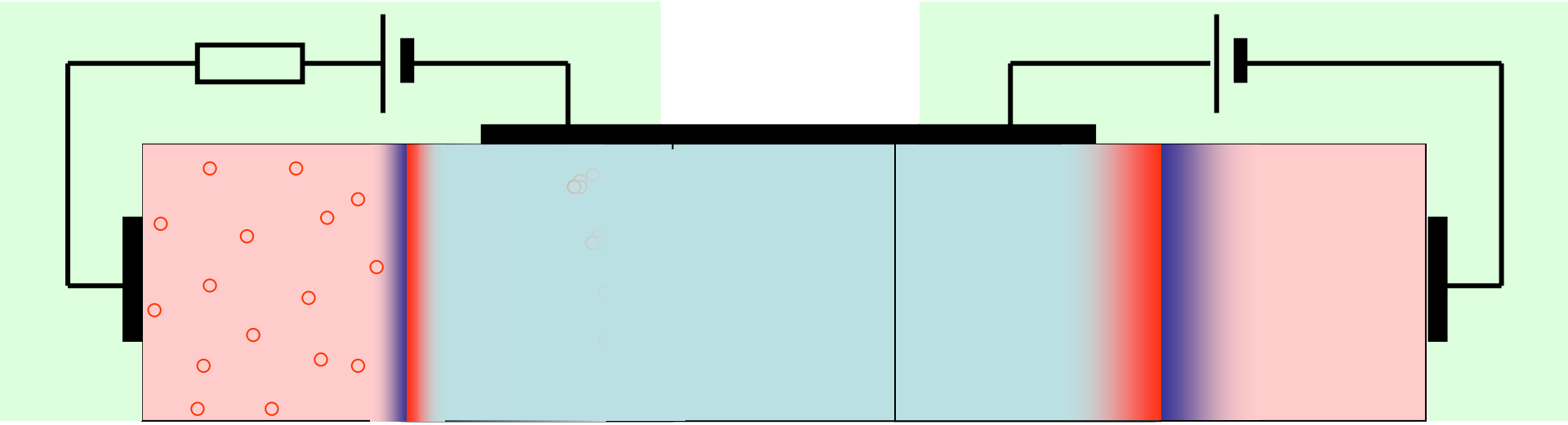
EL TRANSISTOR BIPOLAR BJT

Principio de funcionamiento del transistor bipolar





Principio de funcionamiento del transistor bipolar



Si la zona central es muy ancha, el comportamiento es similar a dos diodos en oposición. El funcionamiento de la primera unión no afecta a la segunda.

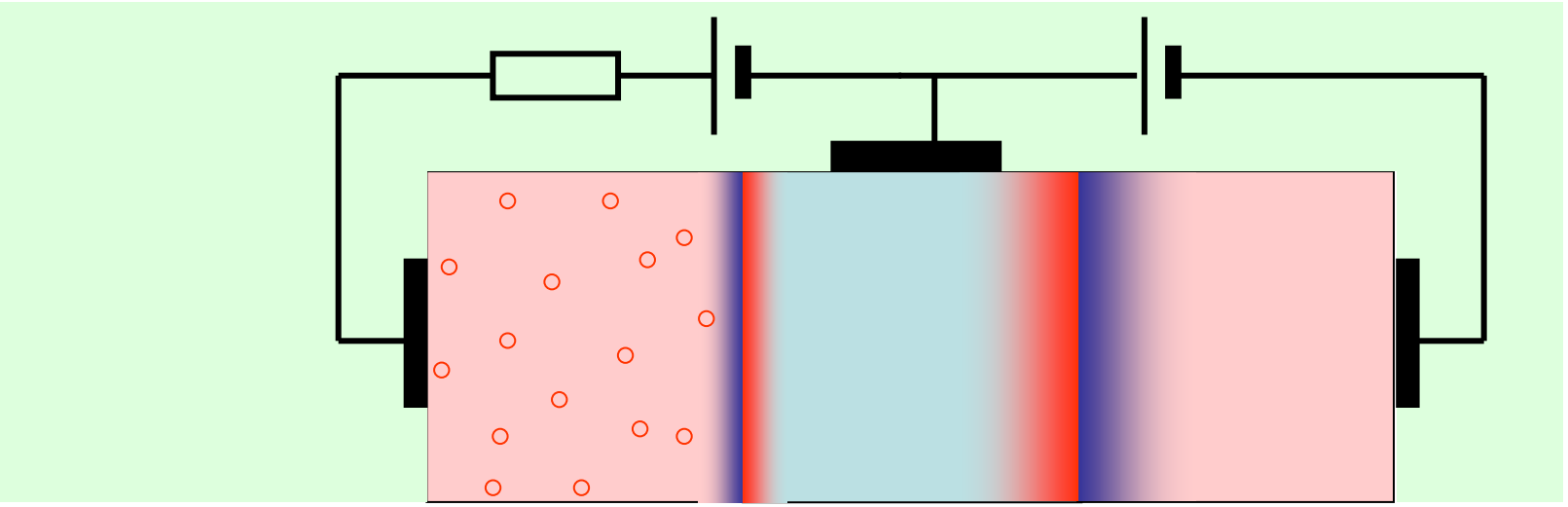
>

Principio de funcionamiento del transistor bipolar

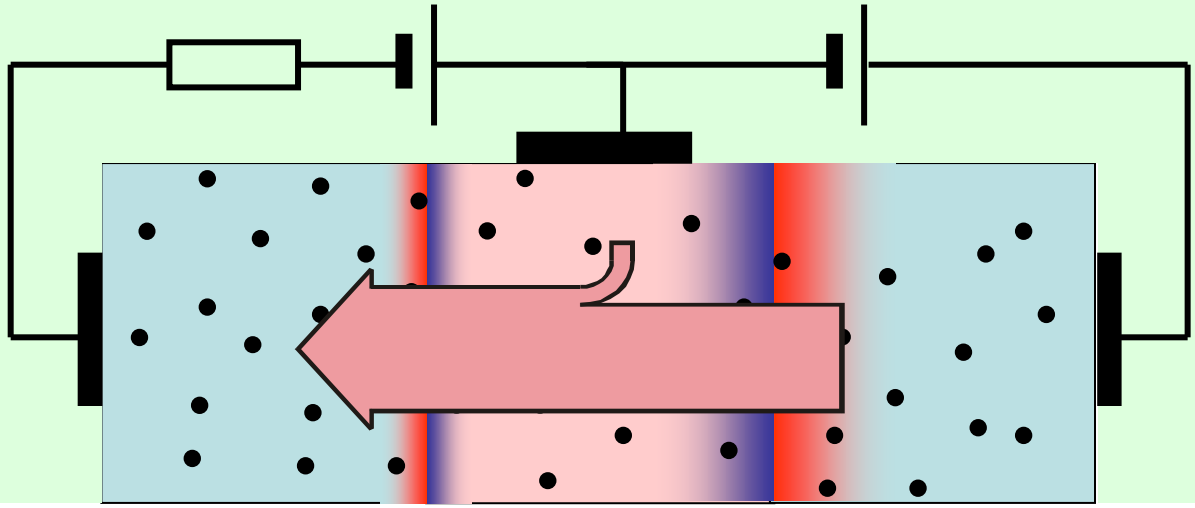
Unión o Juntura en común

>

Principio de funcionamiento del transistor bipolar

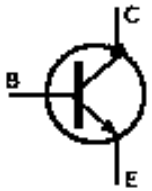


Principio de funcionamiento del transistor bipolar

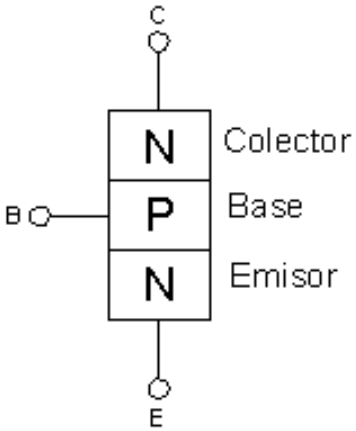


Transistor NPN

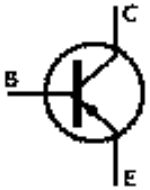
TRANSISTORES BPOLARES



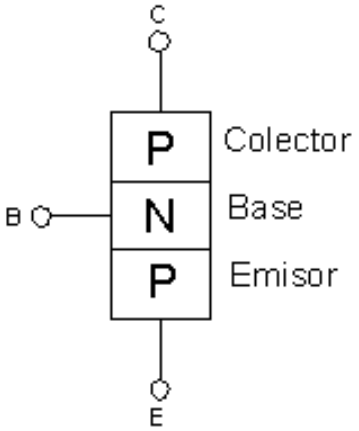
Transistor NPN



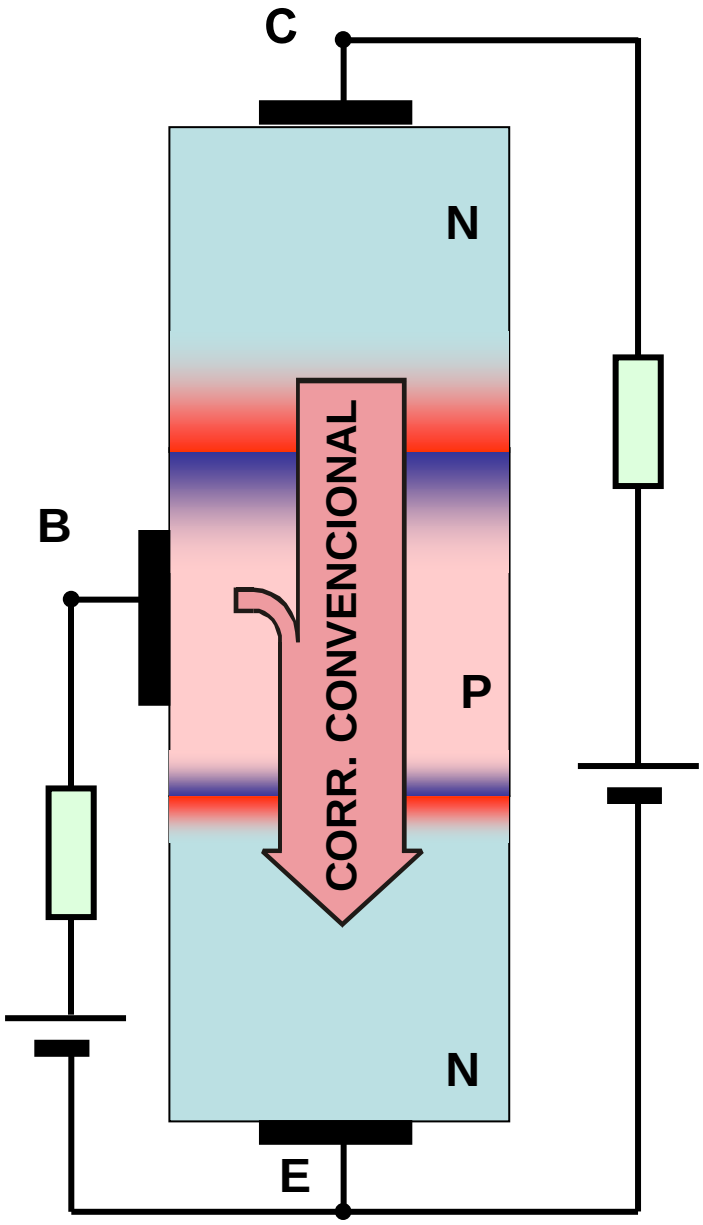
Estructura de un transistor NPN

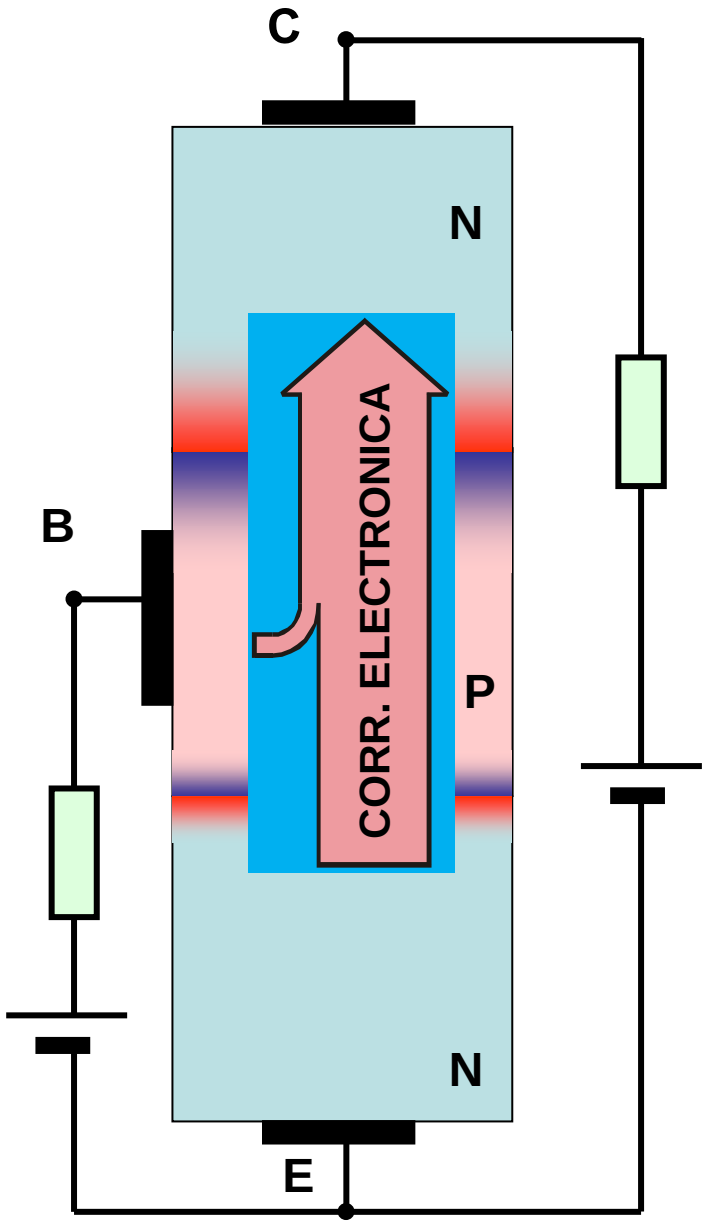


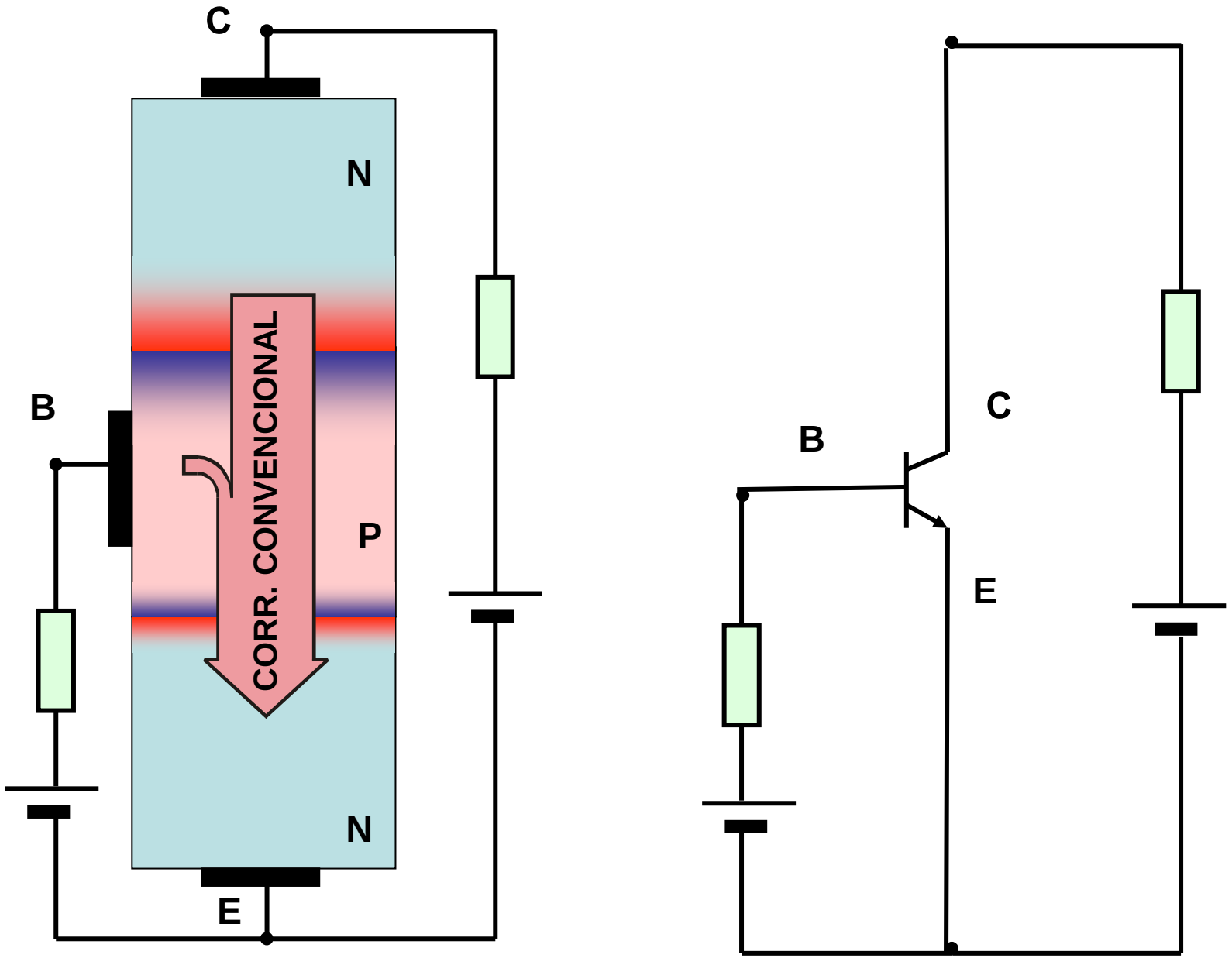
Transistor PNP



Estructura de un transistor PNP

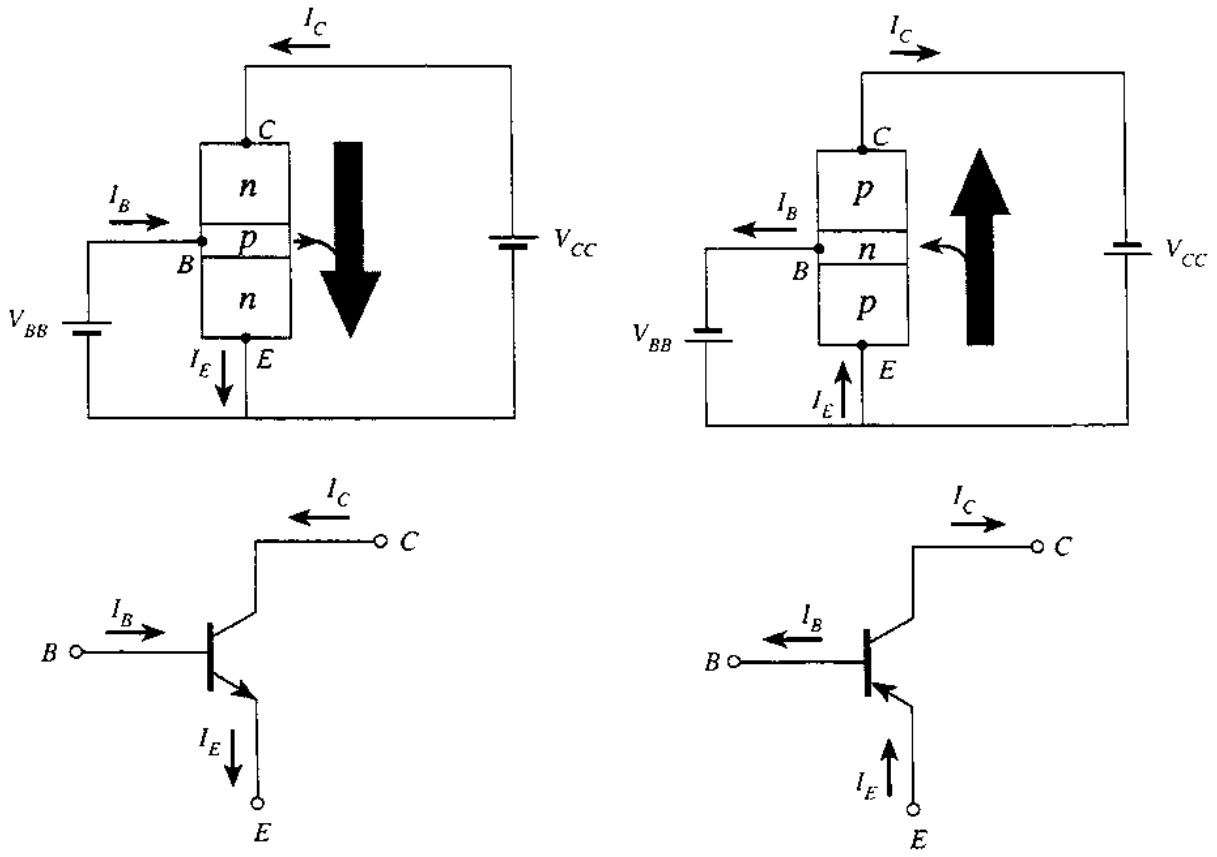

C
N
B
CORR. CONVENCIONAL
P
N
E


C
N
B
CORR. ELECTRONICA
P
N
E

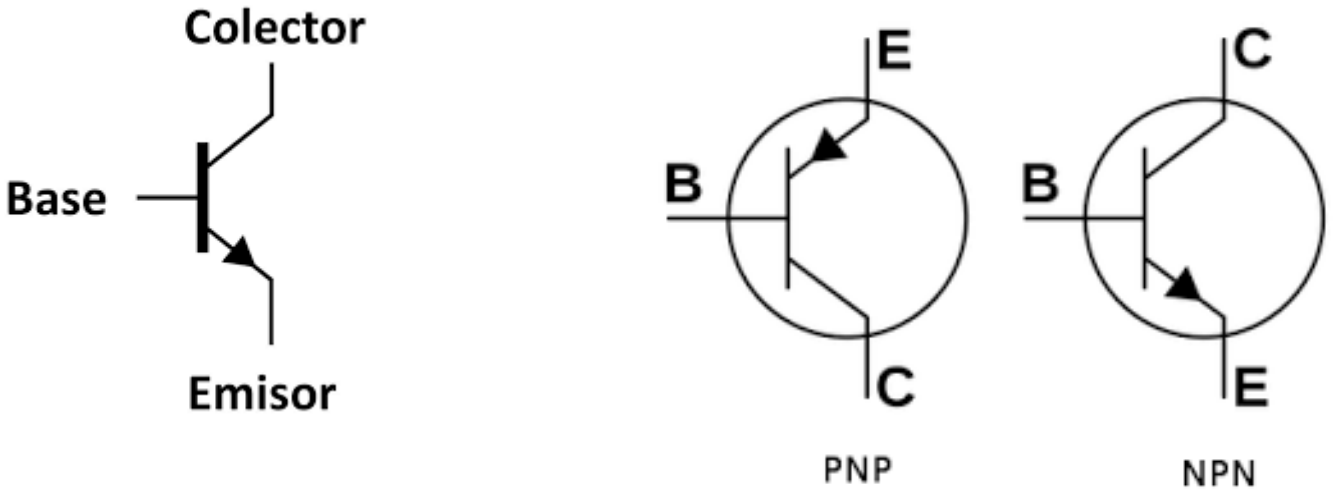

C
N
B
P
CORR. CONVENCIONAL
N
E
B
C
E

Configuración Emisor Común

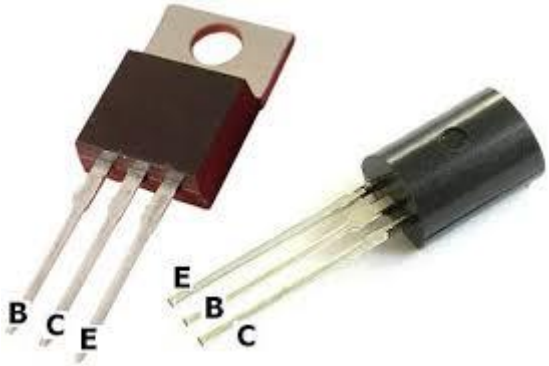
Configuración de emisor común para transistores *npn* y *pnp*.

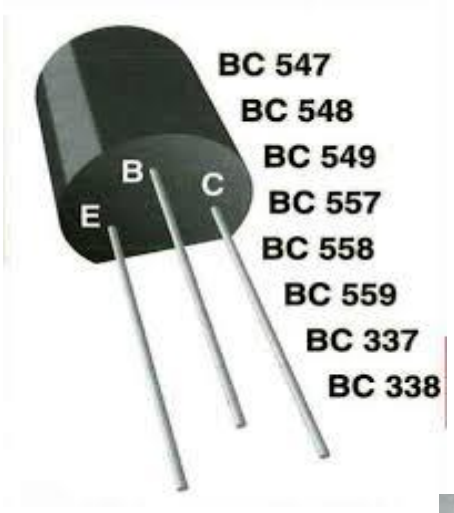


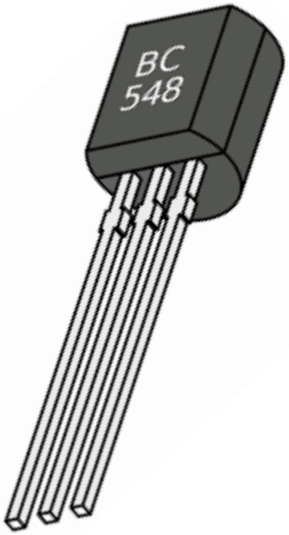
SIMBOLO DEL TRANSISTOR

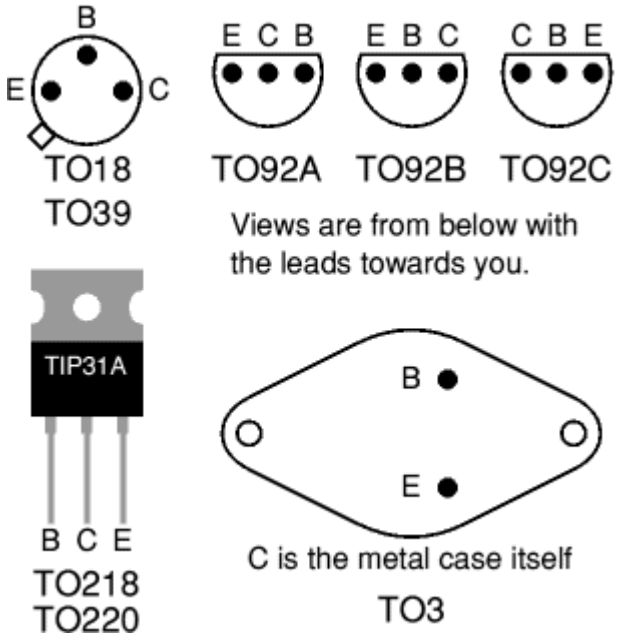


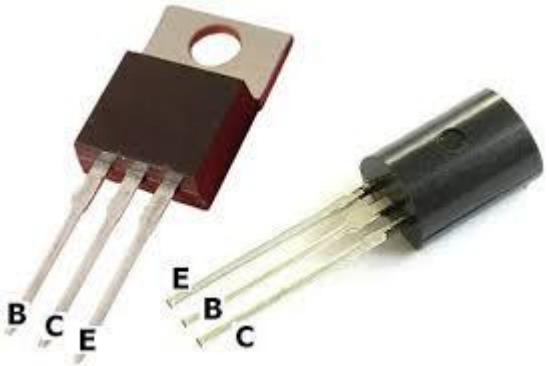
ENCAPSULADOS





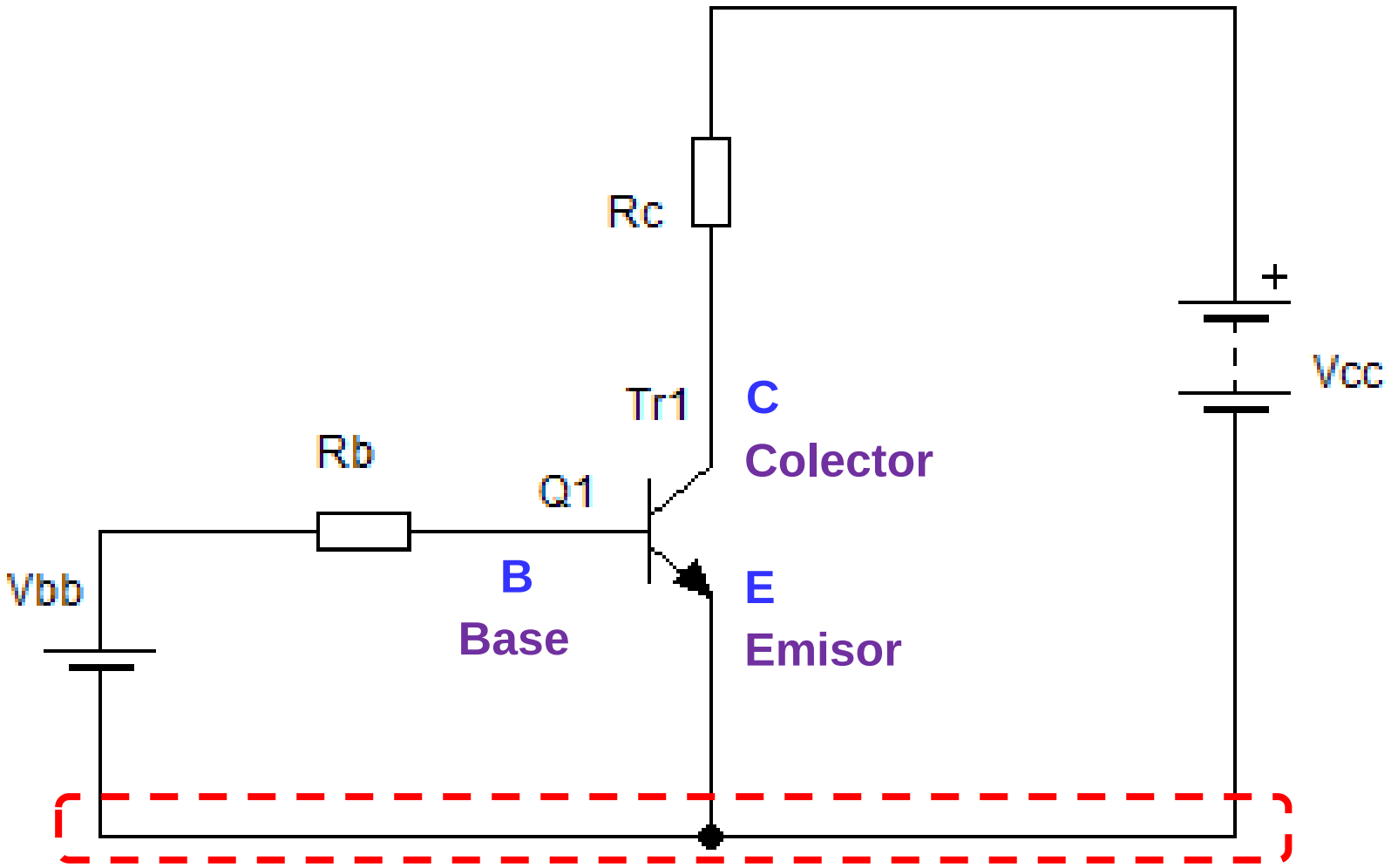




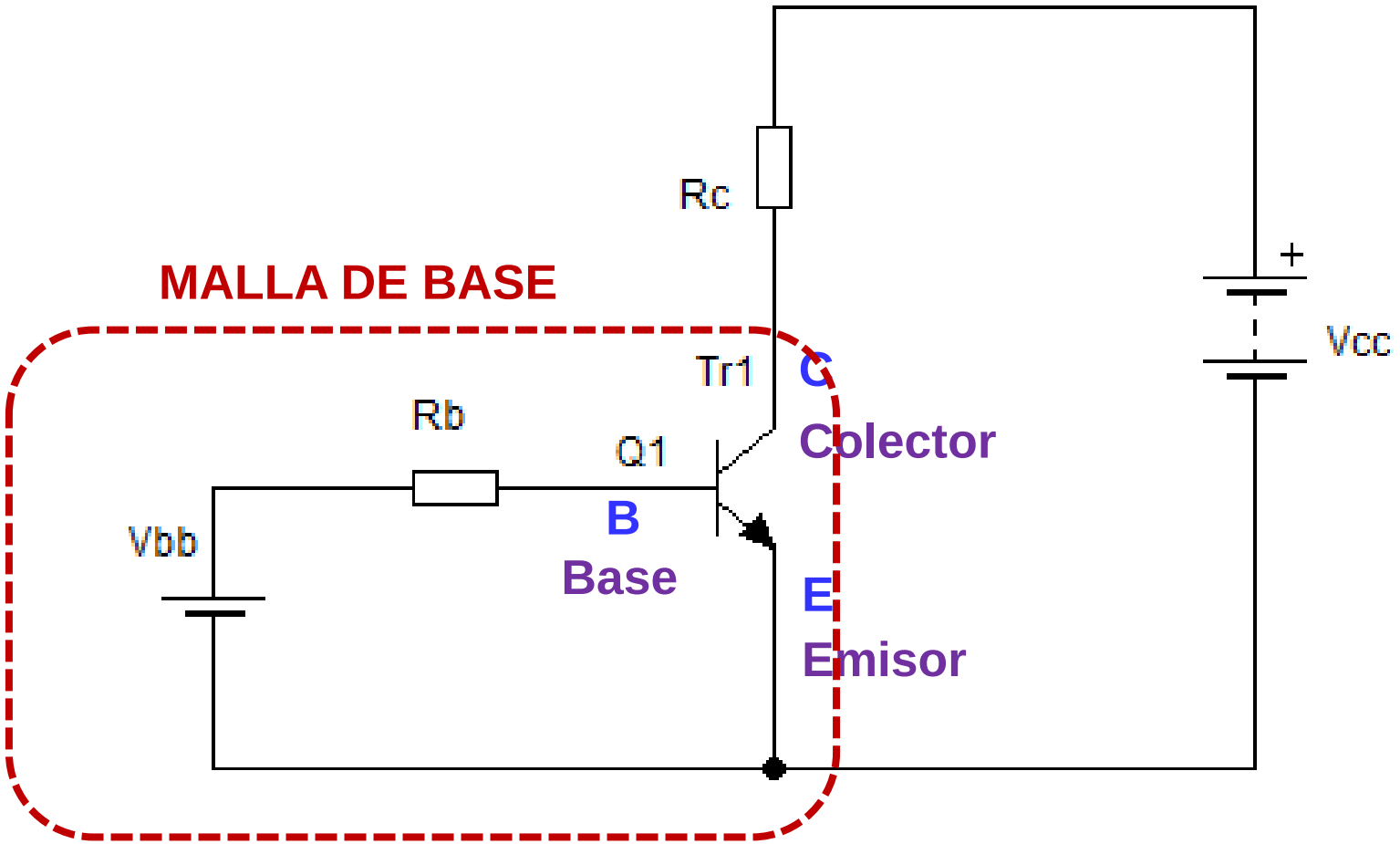


Corrientes en un Transistor

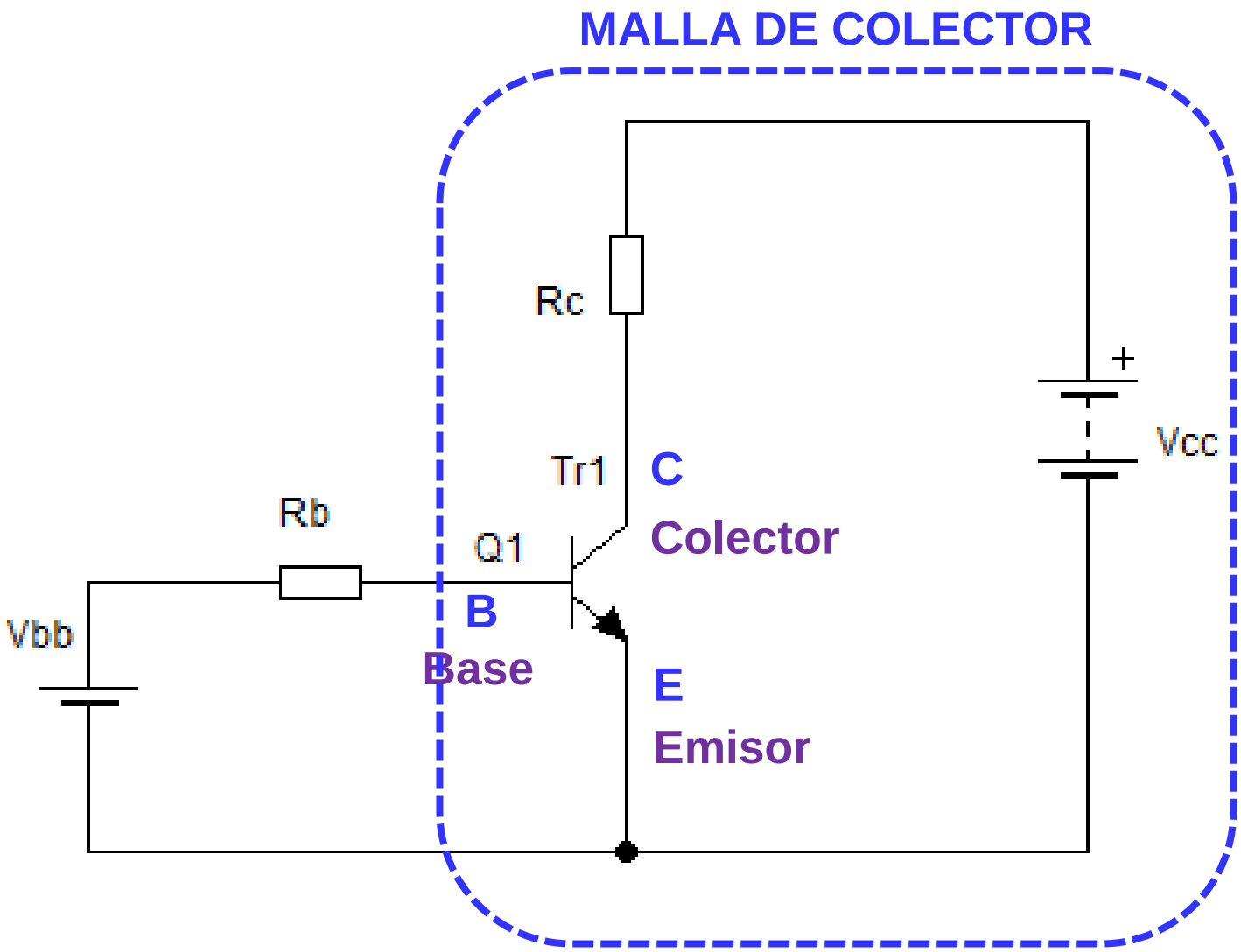
Configuración Emisor Común



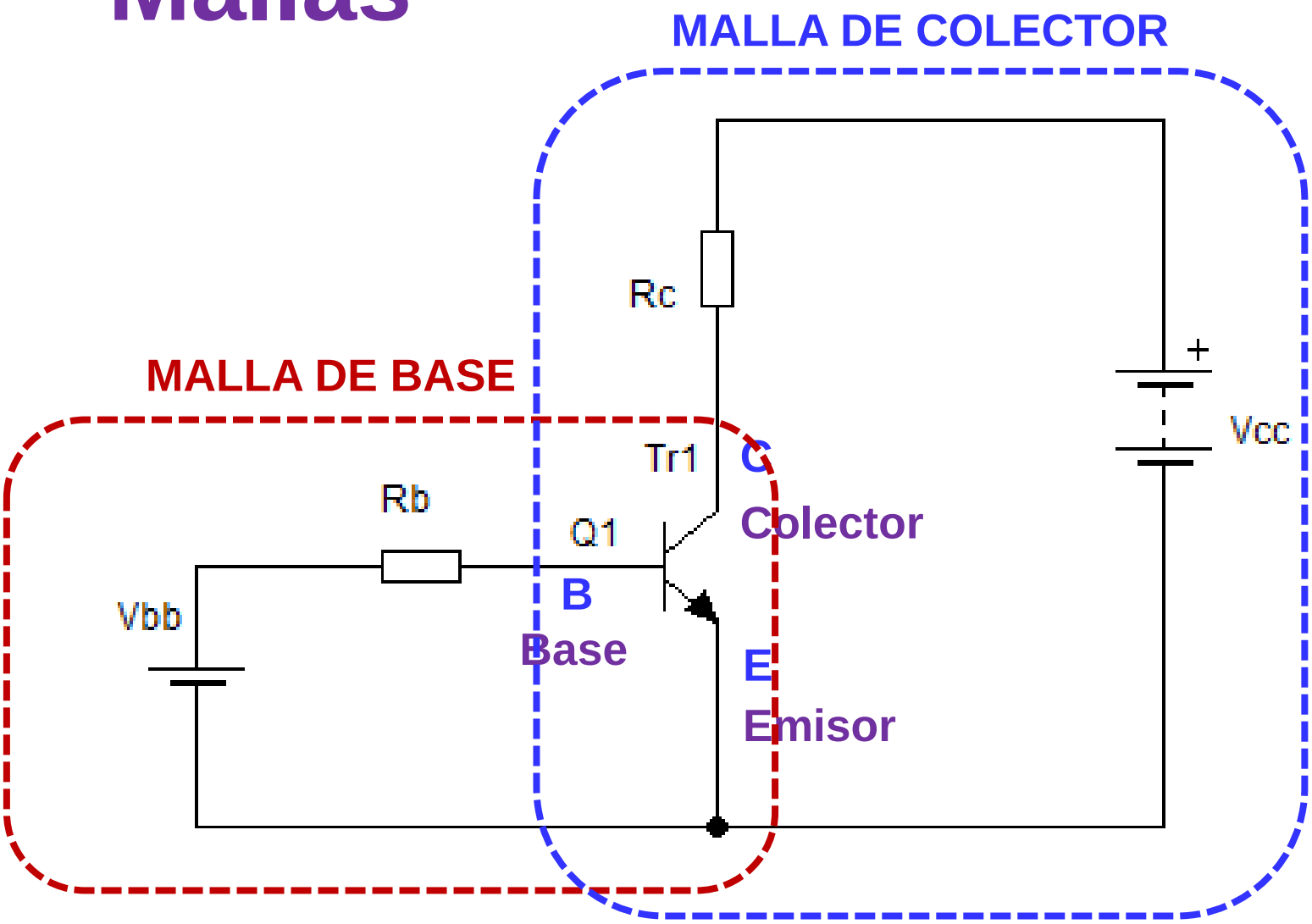
Malla de BASE



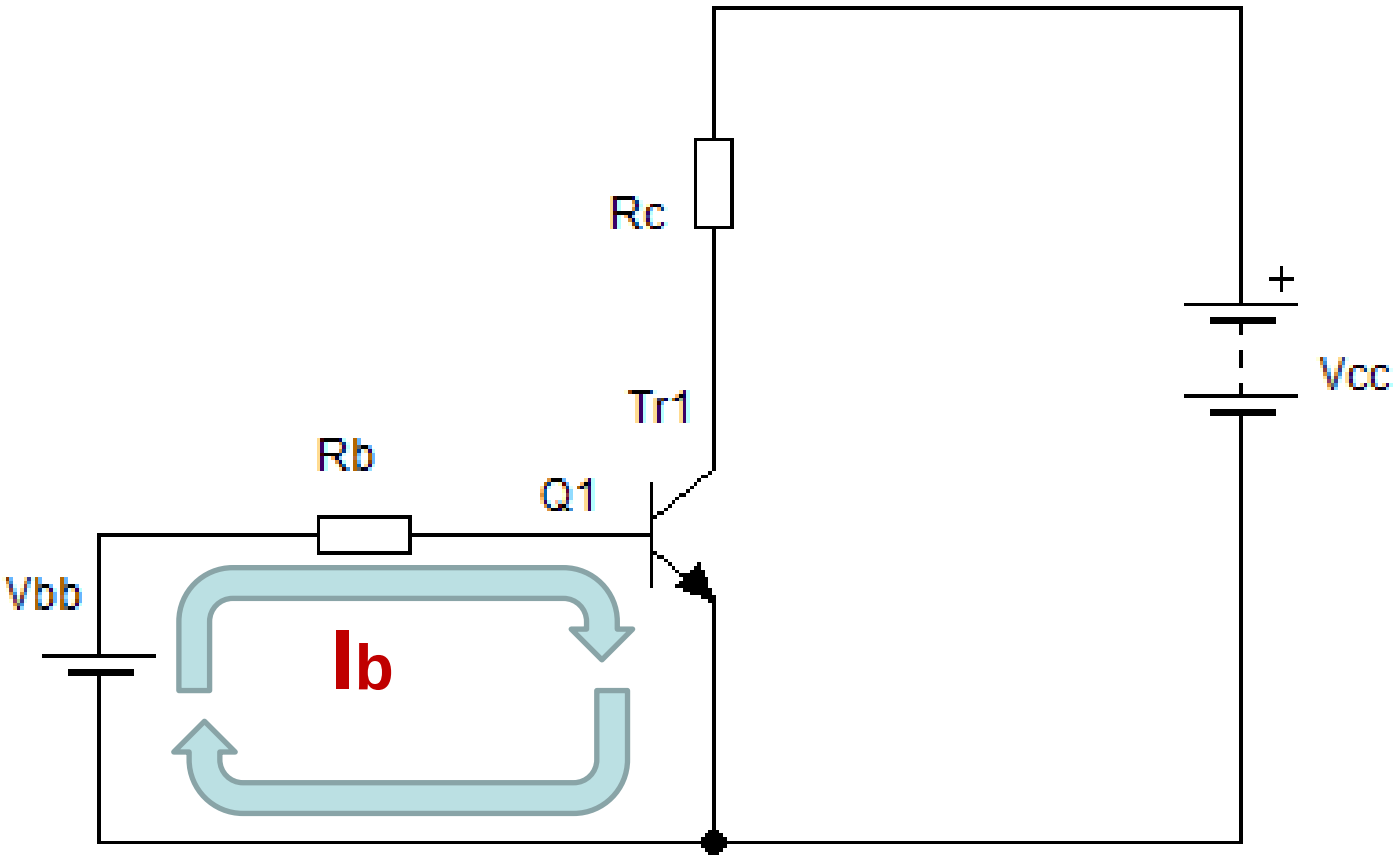
Malla de COLECTOR



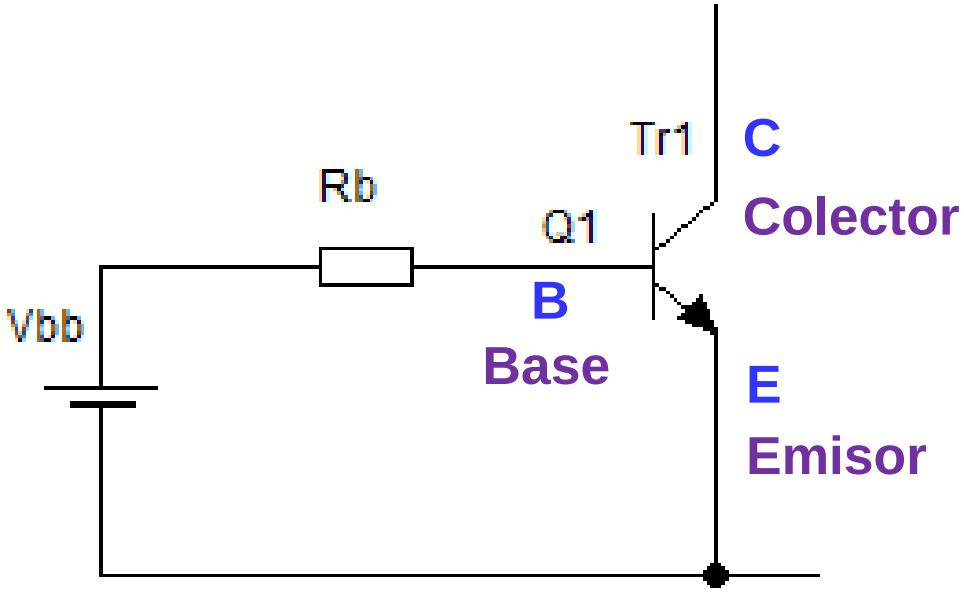
Mallas


MALLA DE COLECTOR
MALLA DE BASE
Rc
Rb
Vbb
Tr1
Q1
C
Colector
B
Base
E
Emisor
+
Vcc

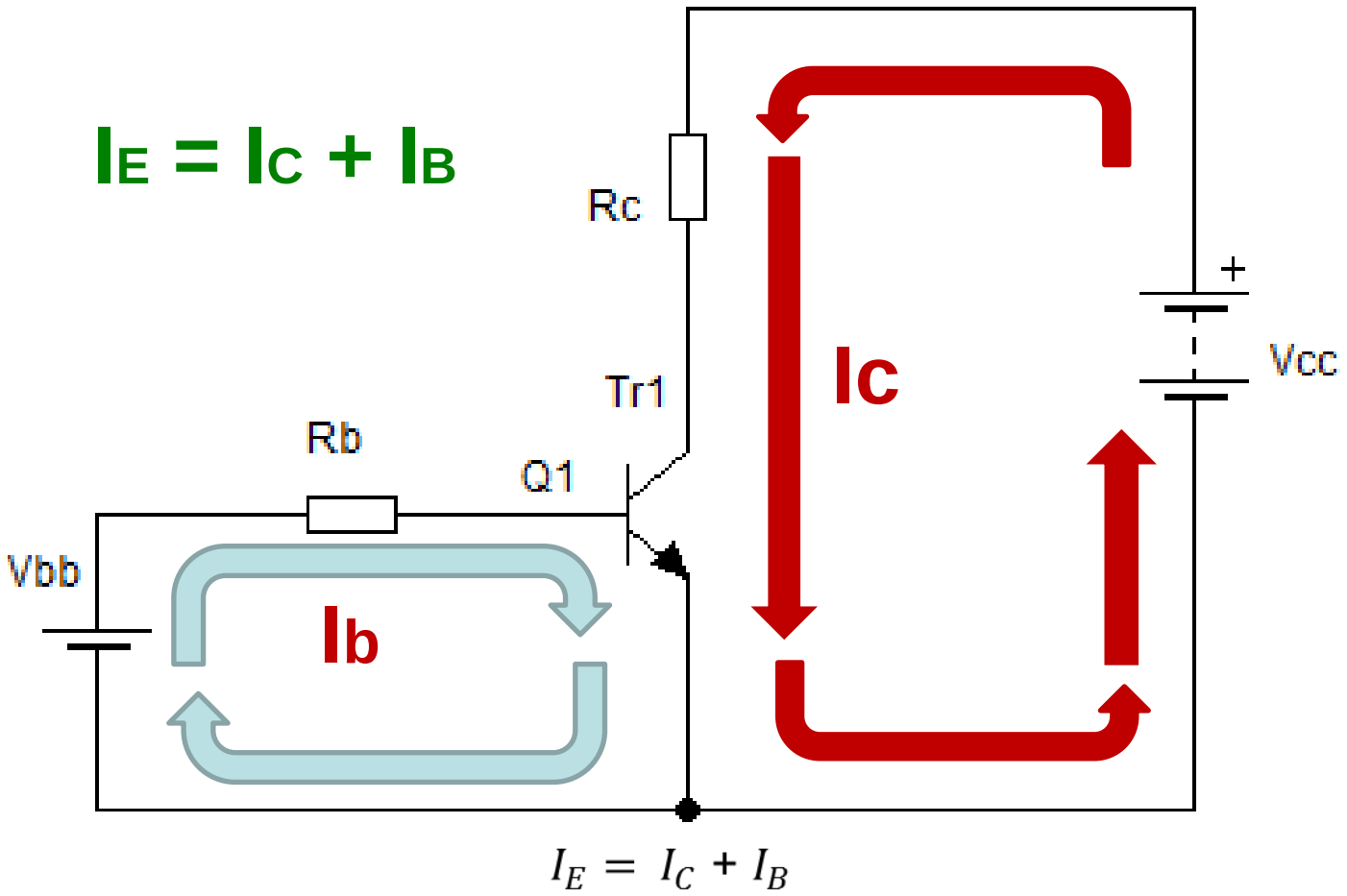
Corriente de Base



Malla de Base



Corrientes en un Transistor



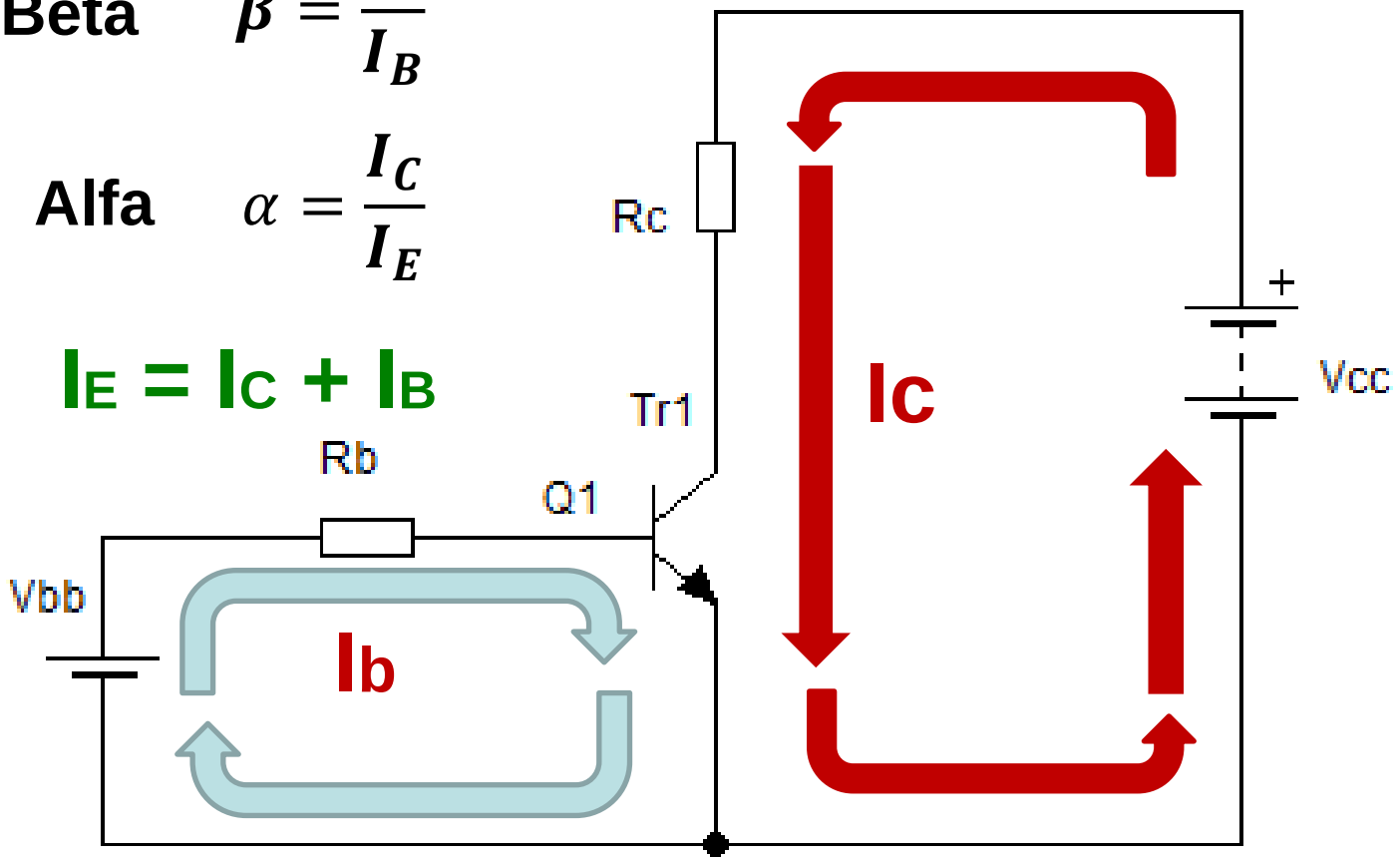
$$I_E = I_C + I_B$$

Corrientes en un Transistor

Beta $\beta = \frac{I_C}{I_B}$

Alfa $\alpha = \frac{I_C}{I_E}$

$I_E = I_C + I_B$



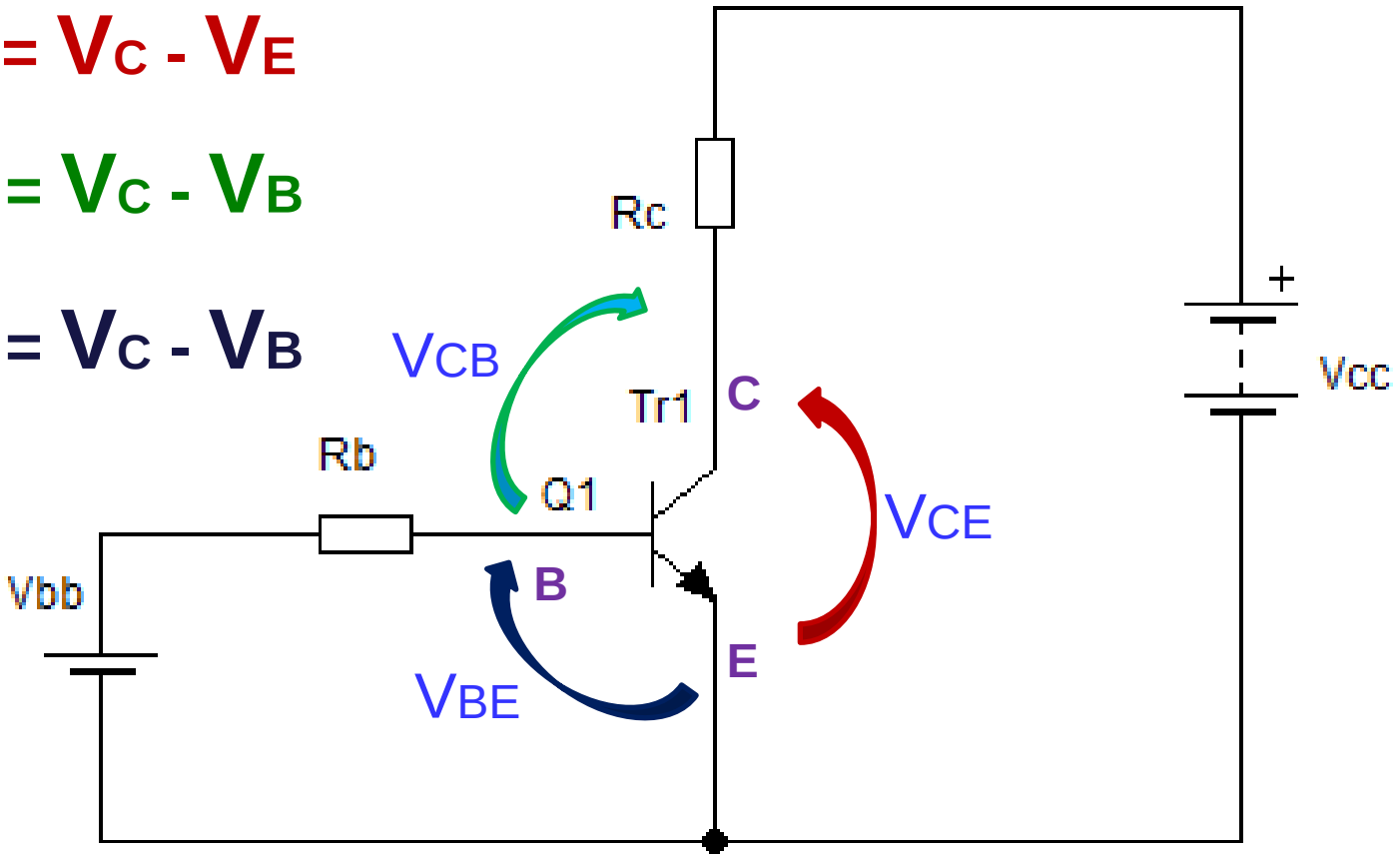
$I_E = I_C + I_B$

Tensiones en un Transistor

$V_{CE} = V_C - V_E$

$V_{CB} = V_C - V_B$

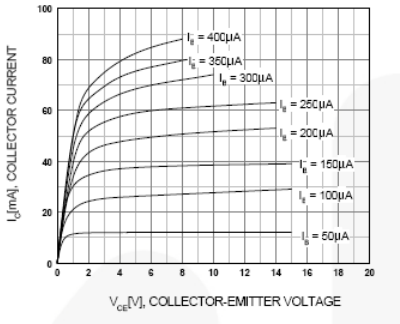
$V_{CB} = V_C - V_B$

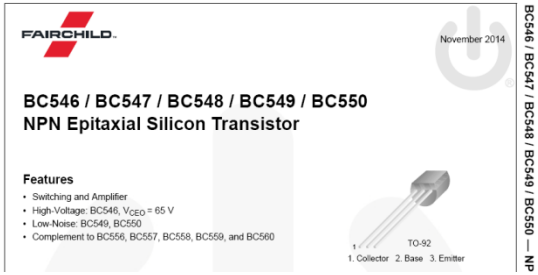


EL TRANSISTOR BIPOLAR BJT

HOJA DE DATOS TECNICOS

DATA SHEETS




FAIRCHILD

November 2014

BC546 / BC547 / BC548 / BC549 / BC550
NPN Epitaxial Silicon Transistor

Features
- Switching and Amplifier
- High-Voltage: BC546, V_{CEO} = 65 V
- Low-Noise: BC549, BC550
- Complement to BC556, BC557, BC558, BC559, and BC560

TO-92
1. Collector 2. Base 3. Emitter

BC546 / BC547 / BC548 / BC549 / BC550 — NP

DATOS TECNICOS

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Values are at T_A = 25°C unless otherwise noted.

Symbol	Parameter		Value	Unit
V_{CBO}	Collector-Base Voltage	BC546	80	V
		BC547 / BC550	50	
		BC548 / BC549	30	
V_{CEO}	Collector-Emitter Voltage	BC546	65	V
		BC547 / BC550	45	
		BC548 / BC549	30	
V_{EBO}	Emitter-Base Voltage	BC546 / BC547	6	V
		BC548 / BC549 / BC550	5	
I_C	Collector Current (DC)		100	mA
P_C	Collector Power Dissipation		500	mW
T_J	Junction Temperature		150	°C
T_{STG}	Storage Temperature Range		-65 to +150	°C

Electrical Characteristics

Values are at T_A = 25°C unless otherwise noted.

DATOS TECNICOS

Electrical Characteristics

Values are at T_A = 25°C unless otherwise noted.

Symbol	Parameter		Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cut-Off Current		V_{CB} = 30 V, I_E = 0			15	nA
h_{FE}	DC Current Gain		V_{CE} = 5 V, I_C = 2 mA	110		800	
V_{CE}(sat)	Collector-Emitter Saturation Voltage		I_C = 10 mA, I_B = 0.5 mA		90	250	mV
			I_C = 100 mA, I_B = 5 mA		250	600	
V_{BE}(sat)	Base-Emitter Saturation Voltage		I_C = 10 mA, I_B = 0.5 mA		700		mV
			I_C = 100 mA, I_B = 5 mA		900		
V_{BE}(on)	Base-Emitter On Voltage		V_{CE} = 5 V, I_C = 2 mA	580	660	700	mV
			V_{CE} = 5 V, I_C = 10 mA			720	
f_T	Current Gain Bandwidth Product		V_{CE} = 5 V, I_C = 10 mA, f = 100 MHz		300		MHz
C_{ob}	Output Capacitance		V_{CB} = 10 V, I_E = 0, f = 1 MHz		3.5	6.0	pF
C_{ib}	Input Capacitance		V_{EB} = 0.5 V, I_C = 0, f = 1 MHz		9		pF
NF	Noise Figure	BC546 / BC547 / BC548	V_{CE} = 5 V, I_C = 200 µA, f = 1 kHz, R_G = 2 kΩ		2.0	10.0	dB
		BC549 / BC550			1.2	4.0	
		BC549	V_{CE} = 5 V, I_C = 200 µA, R_G = 2 kΩ, f = 30 to 15000 MHz		1.4	4.0	
		BC550			1.4	3.0	

axial Silicon Transistor

DATOS TECNICOS

h_{FE} Classification

Classification	A	B	C
h_{FE}	110 ~ 220	200 ~ 450	420 ~ 800

Typical Performance Characteristics

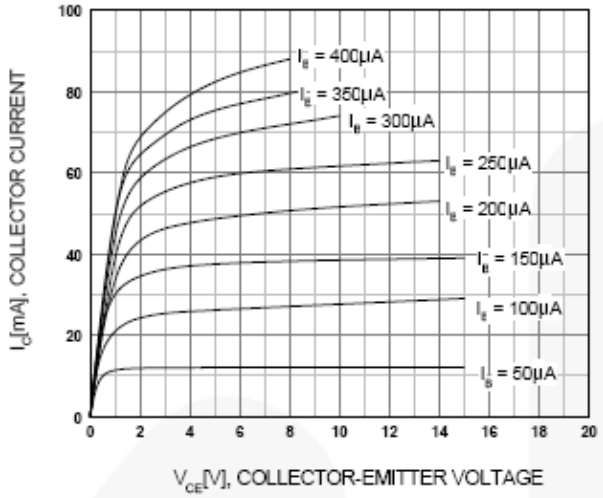


Figure 1. Static Characteristic

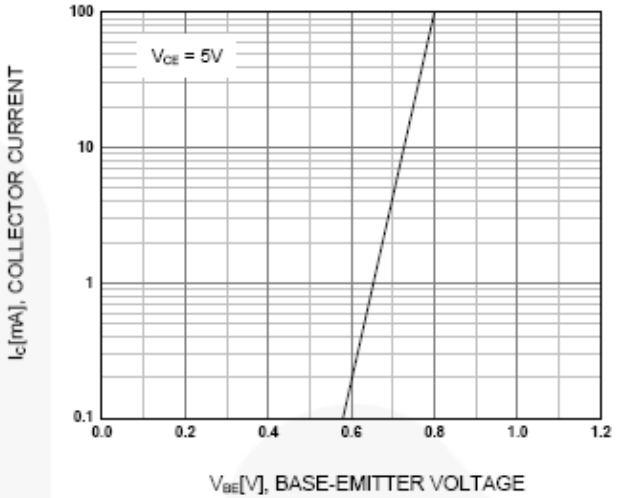
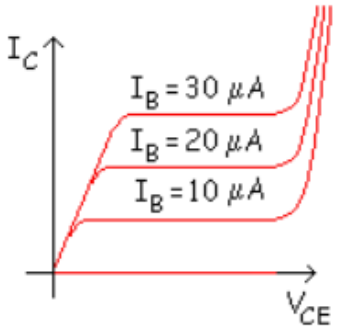


Figure 2. Transfer Characteristic

EL TRANSISTOR BIPOLAR BJT

Curvas Características



Características del transistor bipolar

Curvas Características de un Transistor Bipolar, en configuración **emisor común**

- Se entiende por características de un transistor, al conjunto de curvas que permite la visualización del funcionamiento del transistor, en forma gráfica.
- Cómo se va a relacionar **I_B**, **V_{BE}**, **I_C** e **V_{CE}** , Se verificará la dependencia de las magnitudes de a par. >

Características del transistor bipolar

Curvas Características de un Transistor Bipolar, en configuración **emisor común**

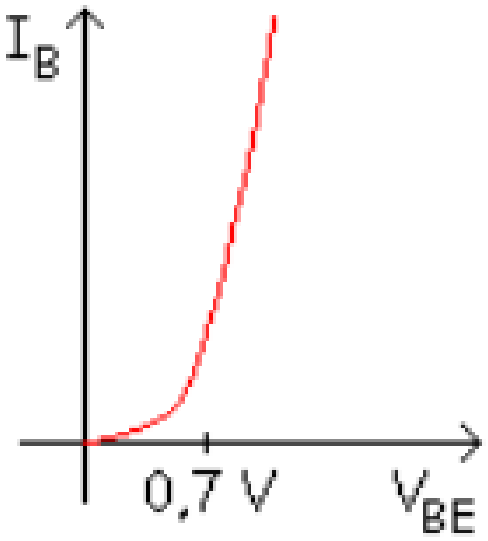
- Característica de **Entrada** (Base)
  - $I_B = f(V_{BE})$, *con* V_{CE} *constante*
- Característica de **Transferencia de Corriente.**
  - $I_C = f(I_B)$, *para* V_{CE} *constante.*
- Característica de **Salida** (Colector)
  - $I_C = f(V_{CE})$ *manteniendo constante* I_B. >

Características del transistor bipolar

Curvas Características de un Transistor Bipolar, en configuración **emisor común**

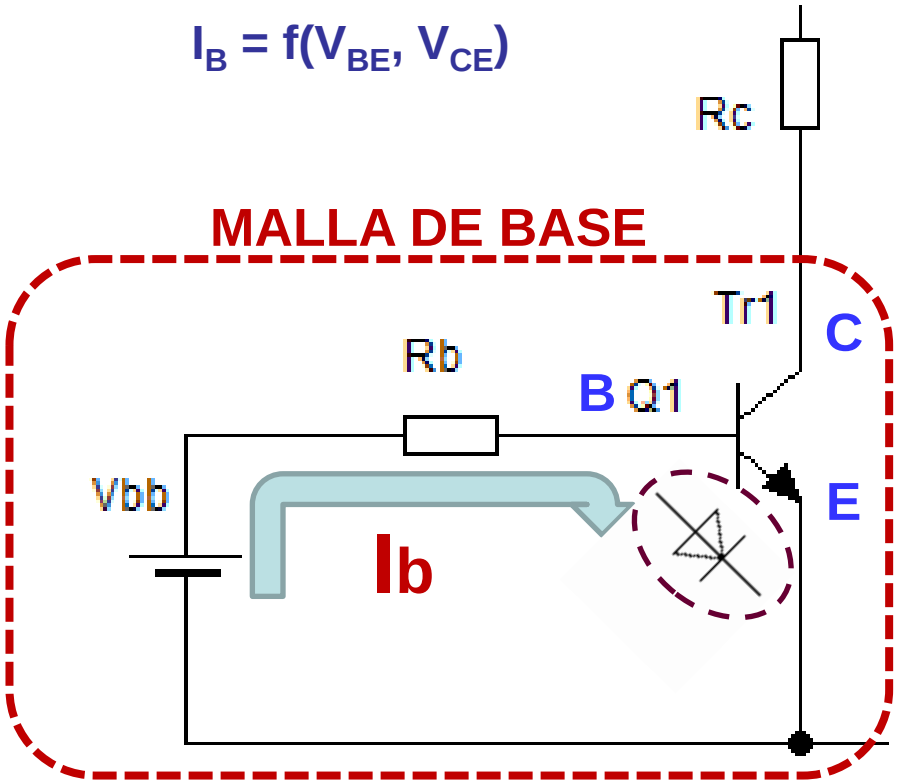
- Característica de **Entrada** (Base)
  - $I_B = f(V_{BE})$, *con* V_{CE} *constante*

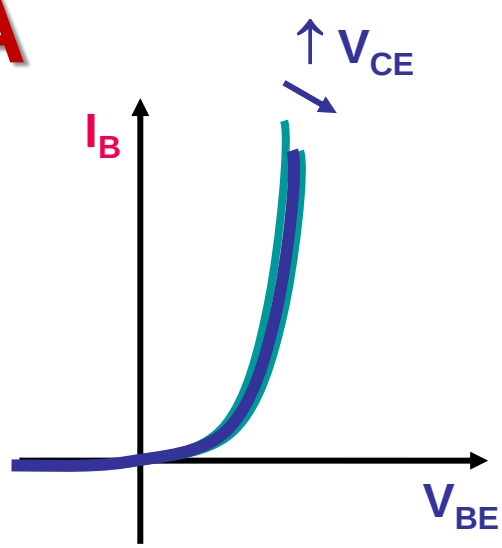
- *De esta característica es posible definir la **resistencia estática de entrada** a la relación V_{BE}/ y I_B. Que estudiará en otro curso.*
- *La grafica obtenida en este caso, tendrá el aspecto similar a la de un diodo de uso general.*



CURVA CARACTERISTICA DE ENTRADA

TRANSISTOR BJT





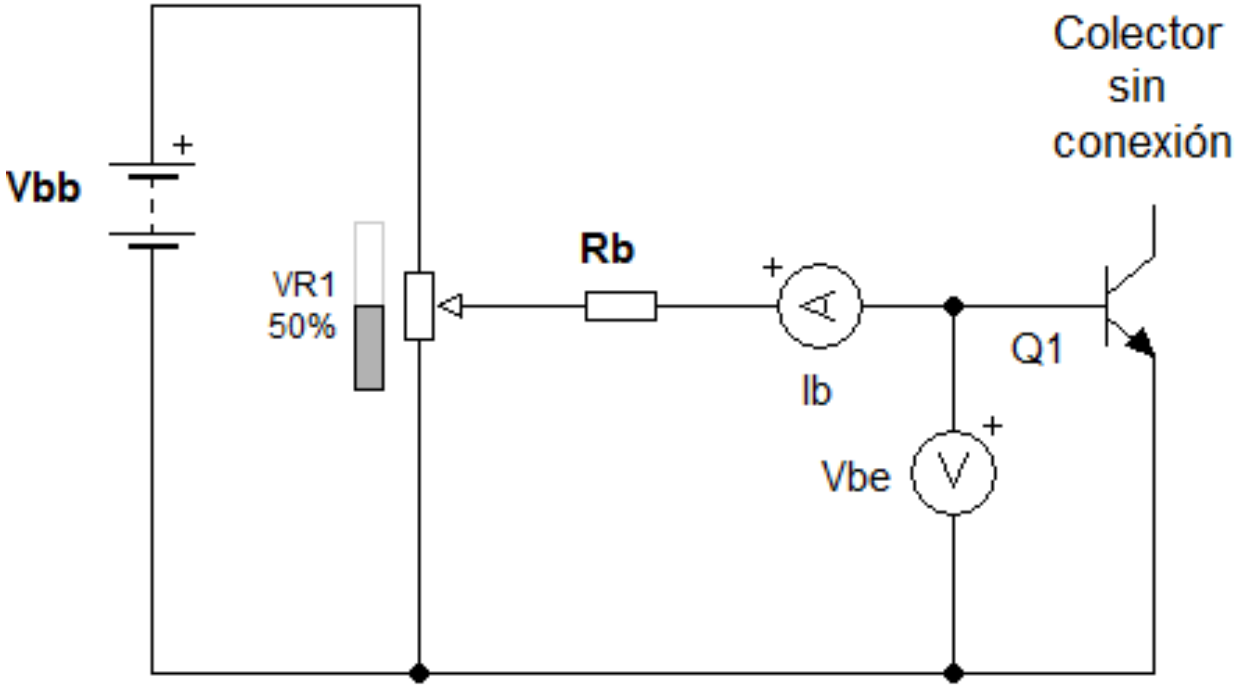
- **Entre base y emisor el transistor se comporta como un diodo.**
- **La característica de este diodo depende de V_{CE} pero la variación es pequeña.**

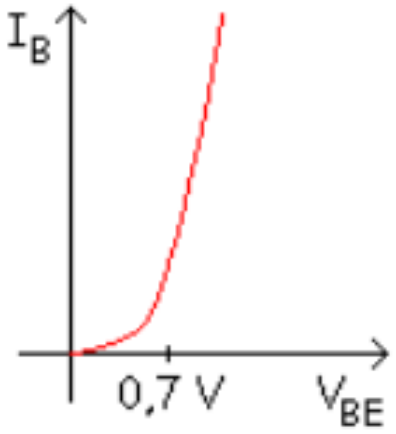
>

CURVA CARACTERISTICA DE ENTRADA - BJT

CIRCUITO EXPERIMENTAL

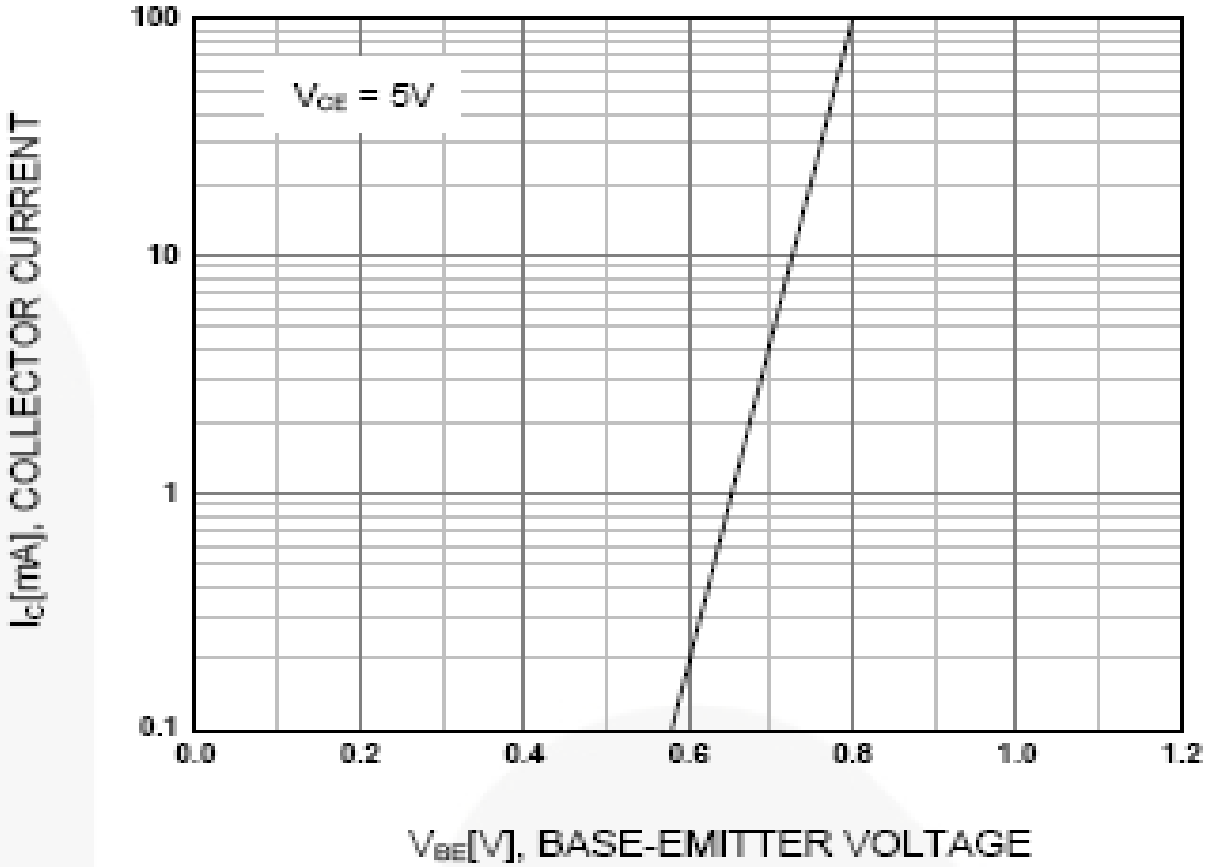
$I_B = f(V_{BE})$, con V_{CE} constante

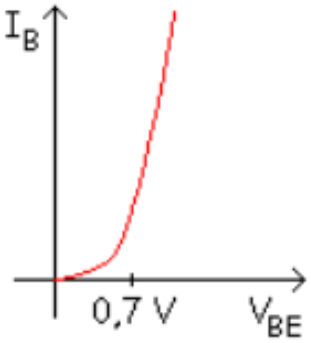




DATOS TECNICOS

Curva de Entrada - BC548





Fuente

TRANSISTOR Bipolar

Curva Característica

TRANSFERENCIA DE CORRIENTE

$I_C = f(I_B)$, *para* V_{CE} *constante*

Características del transistor bipolar

Curvas Características de un Transistor Bipolar, en configuración **emisor común**

Característica de
Transferencia de Corriente

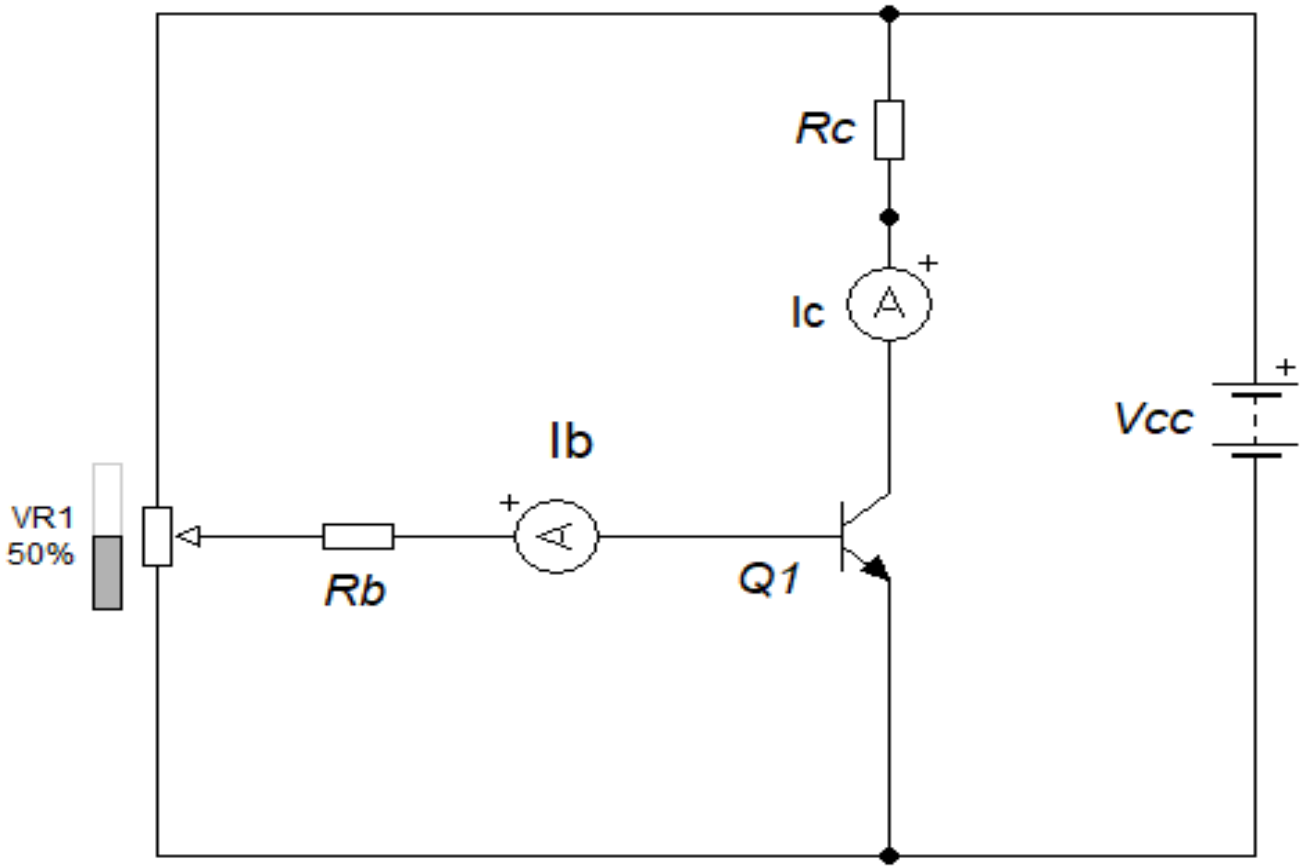
$I_C = f(I_B)$, para V_{CE} constante

- *De esta característica se define la Ganancia en Corriente continua.*
- ***La Ganancia en Corriente se indica como β o h_{FE}.***
- *Indica cuantas veces la corriente de base (I_B). influye en la corriente de colector (I_C).* >

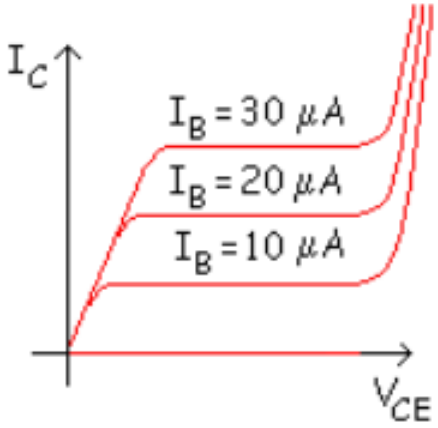
Curva Característica
TRANSFERENCIA DE CORRIENTE- BJT

CIRCUITO EXPERIMENTAL

$I_C = f(I_B)$, para V_{CE} constante



TRANSISTOR Bipolar



CURVA CARACTERISTICA

DE SALIDA (Colector)

$I_C = f(V_{CE})$ manteniendo constante I_B

Característica de **Salida** (Colector)

$I_C = f(V_{CE})$ manteniendo constante I_B

- *La característica de salida o de colector, relaciona la corriente de colector I_C , con la tensión de colector–emisor V_{CE} . Manteniendo constante la corriente de base I_B.*

- *De esta característica es posible definir la **resistencia estática de salida** a la relación V_{CE} / I_C. Que estudiará en otro curso.*

>

Características del transistor bipolar

Curvas Características de un Transistor Bipolar, en configuración **emisor común**

- Característica de **Salida** (Colector)

$I_C = f(V_{CE})$ manteniendo constante I_B.

- En la configuración de emisor común, la corriente de entrada ***IB*** y la tensión ***VCE*** de salida se toman como **variables independientes**.
- Mientras que la tensión de entrada ***VBE*** y la corriente de salida ***IC*** se toman como variables ***dependientes***.

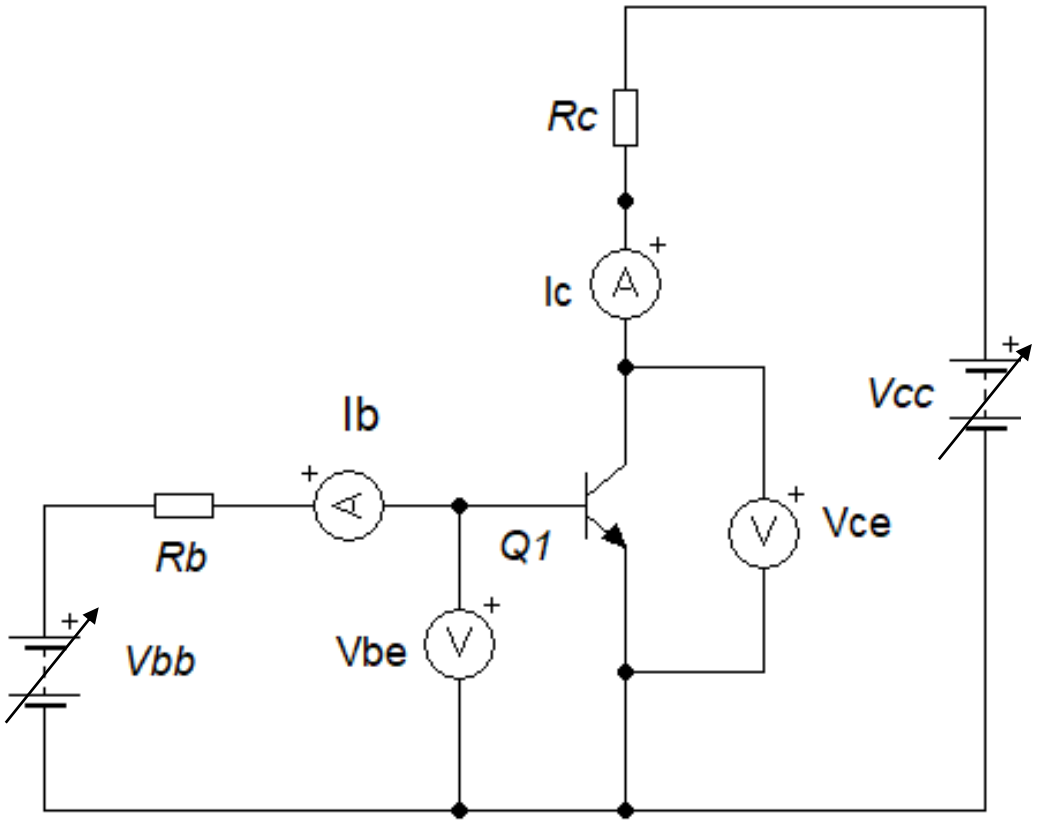
$$V_{BE} = f_1(V_{CE}, I_B) \; ; \; I_C = f_2(V_{CE}, I_B)$$

CURVA CARACTERISTICA DE SALIDA (Colector)

CIRCUITO EXPERIMENTAL

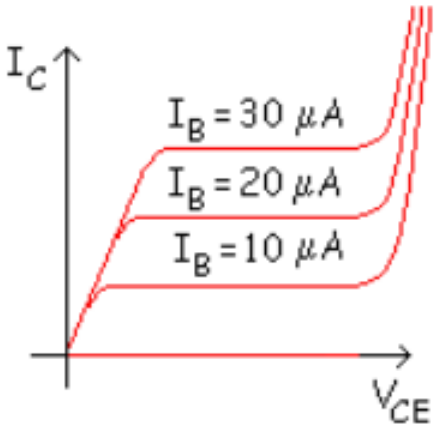
$I_C = f(V_{CE})$ manteniendo constante I_B.

Circuito para relevar la curva de salida de un transistor BJT.



$$V_{BE} = f_1(V_{CE}, I_B)$$

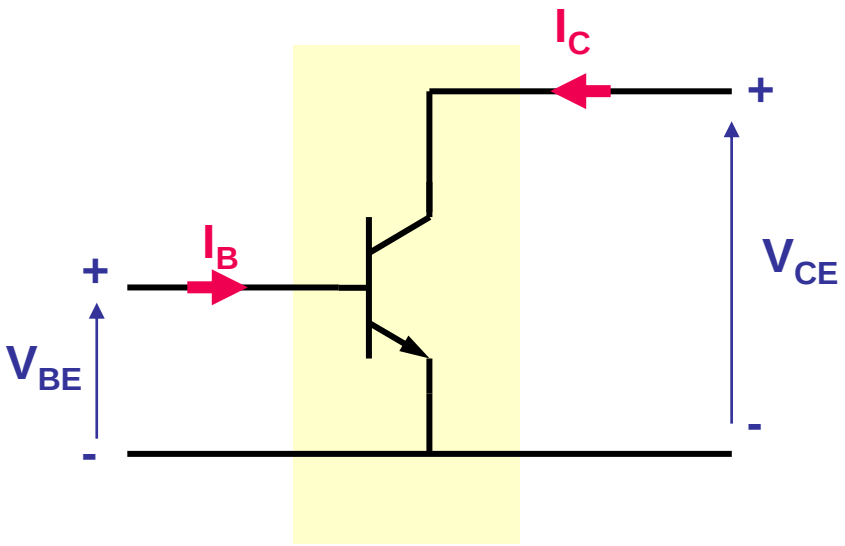
$$I_C = f_2(V_{CE}, I_B)$$

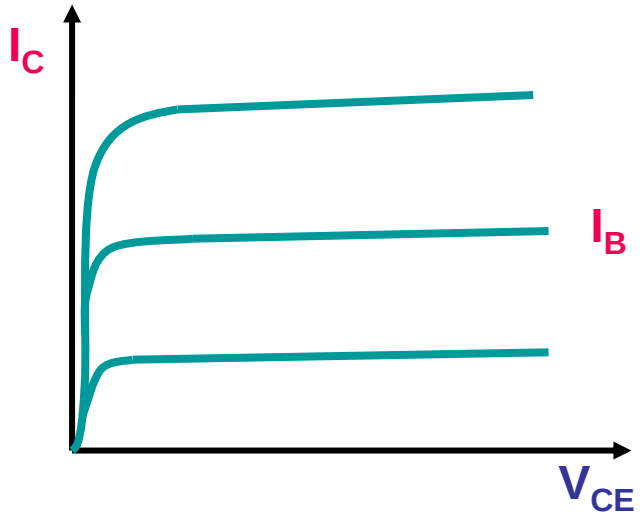


Curvas Características de SALIDA

Transistor NPN

$I_C = f(I_B, V_{CE})$ **Característica de salida**

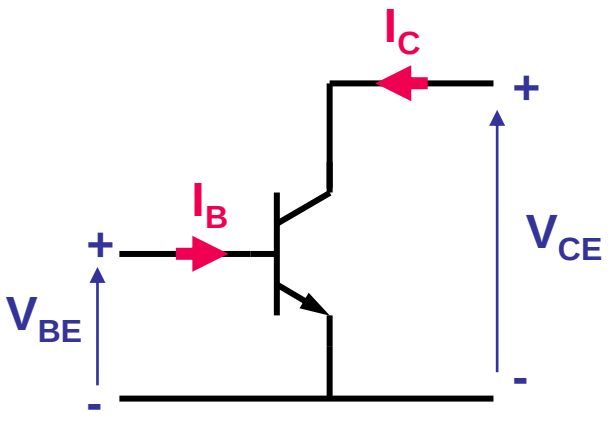


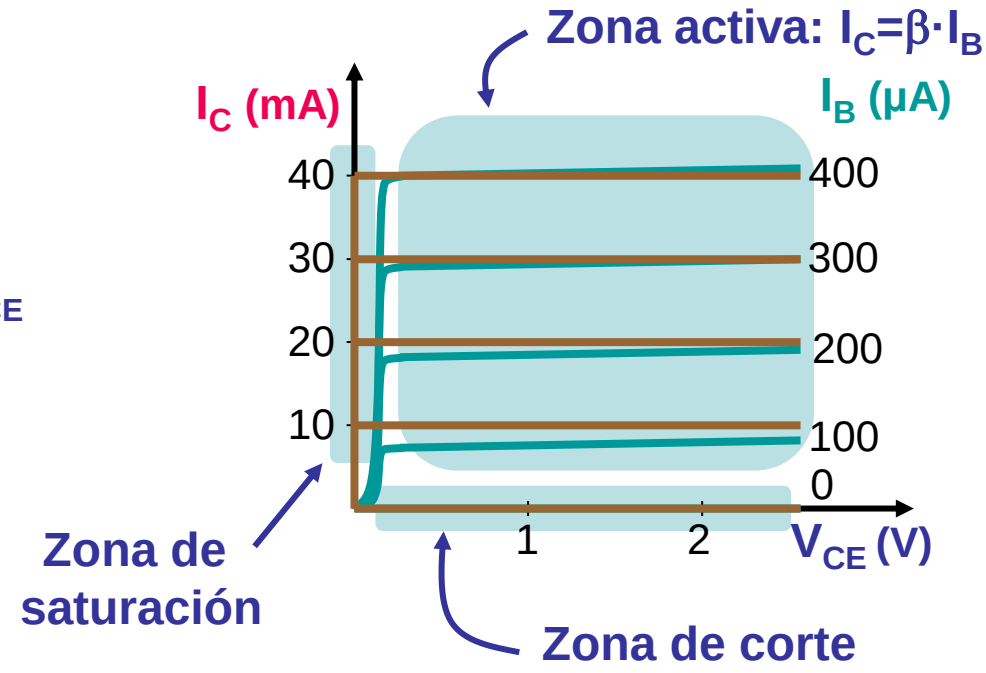


La corriente que circula por el colector se controla mediante la corriente de base I_B.

Características eléctricas del transistor bipolar: linealización

Transistor NPN: linealización de la característica de salida

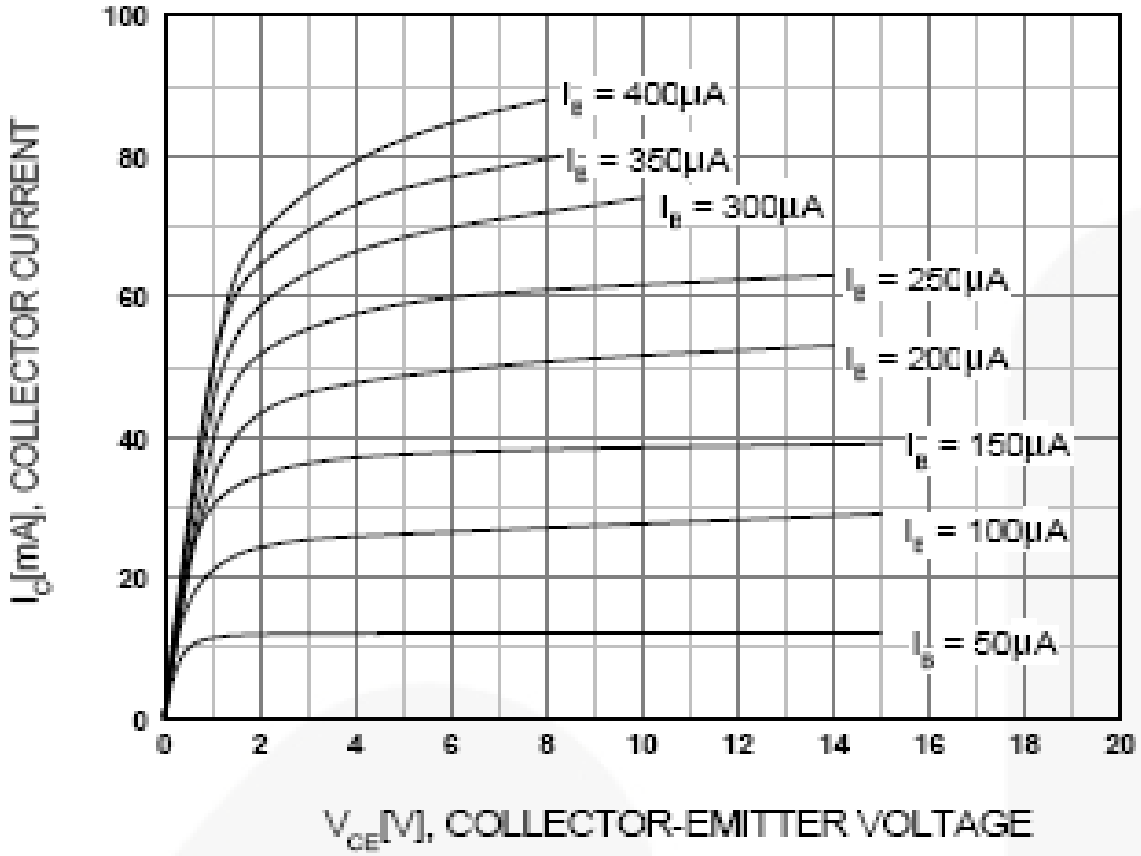


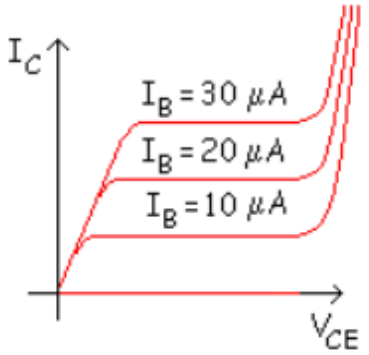


El parámetro fundamental que describe la característica de salida del transistor es la ganancia de corriente β (h_{fe}).

DATOS TECNICOS

Curva de Salida (Colector) - BC548

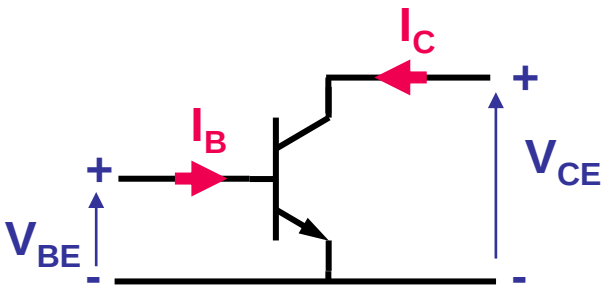


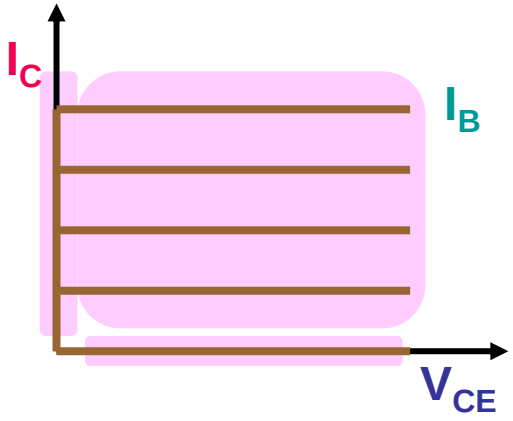


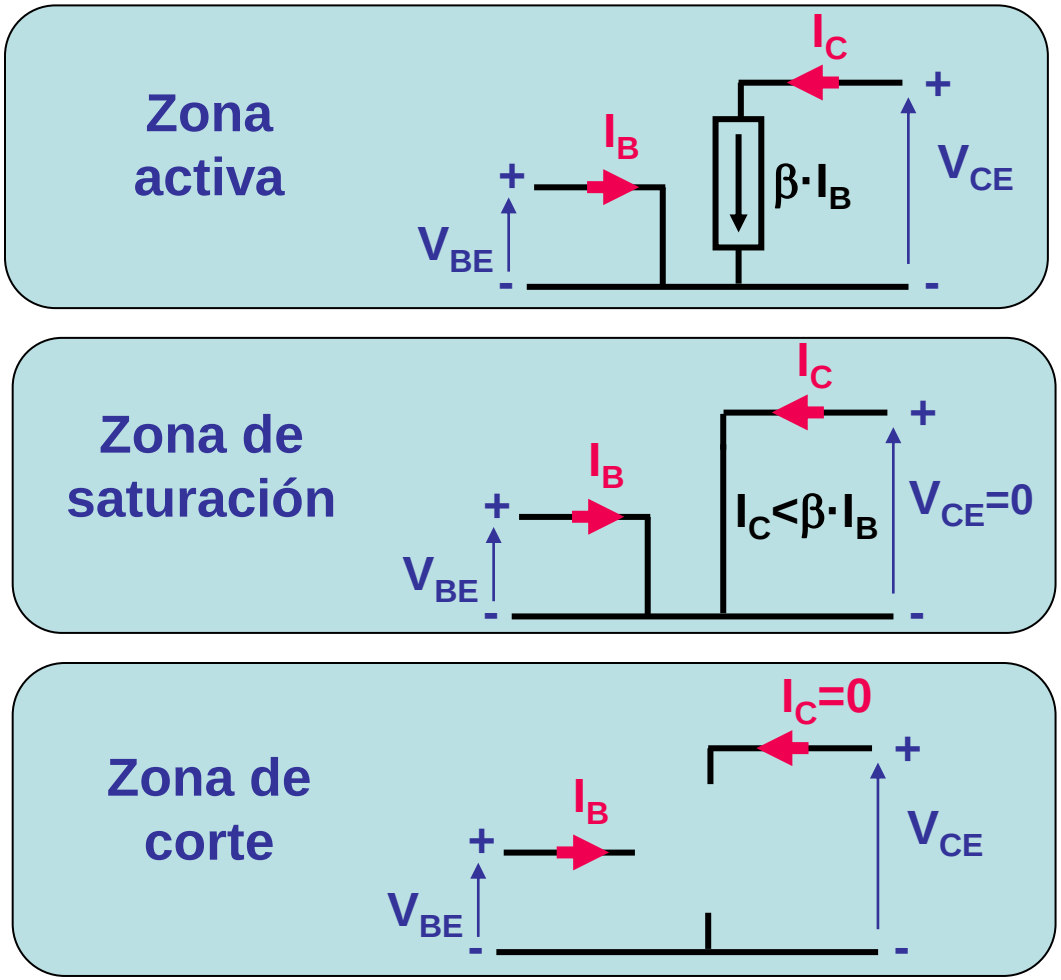
Fuente

Características del transistor bipolar

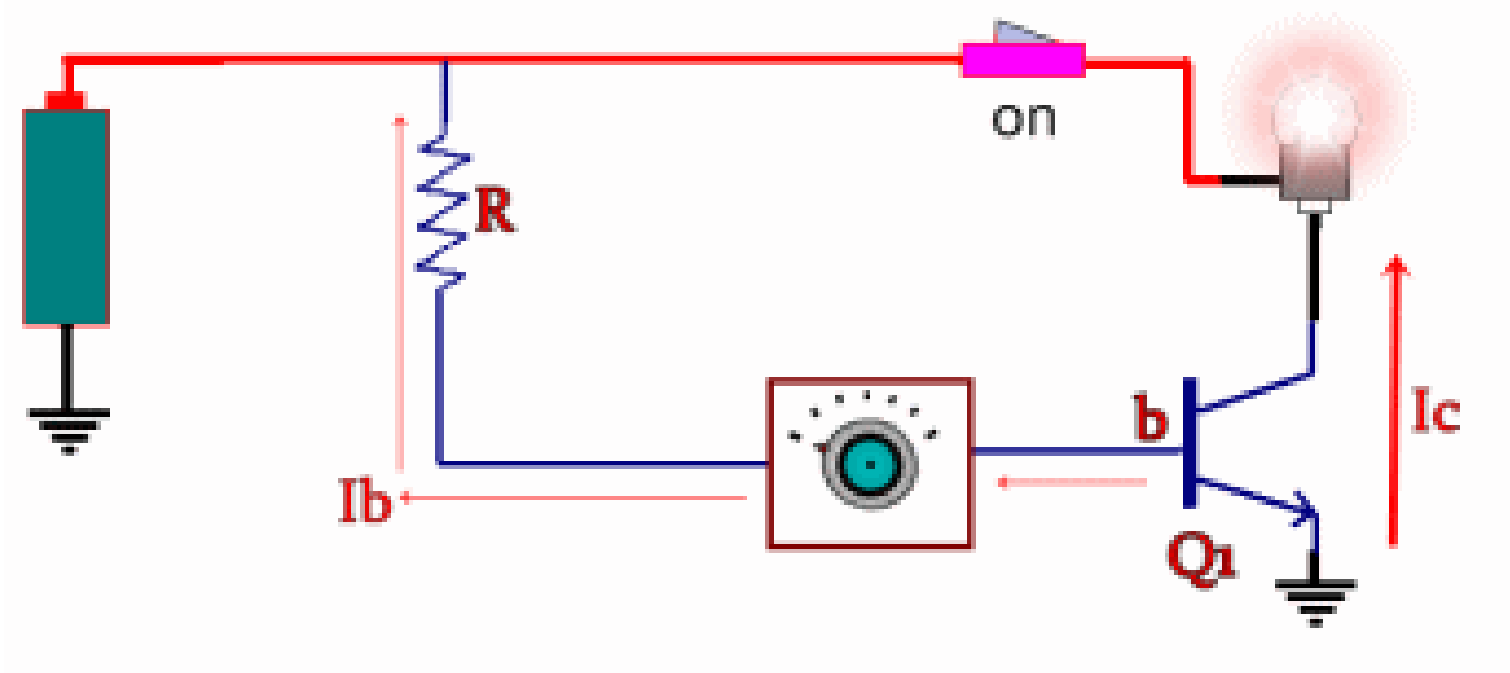
Transistor NPN: zonas de funcionamiento del transistor ideal



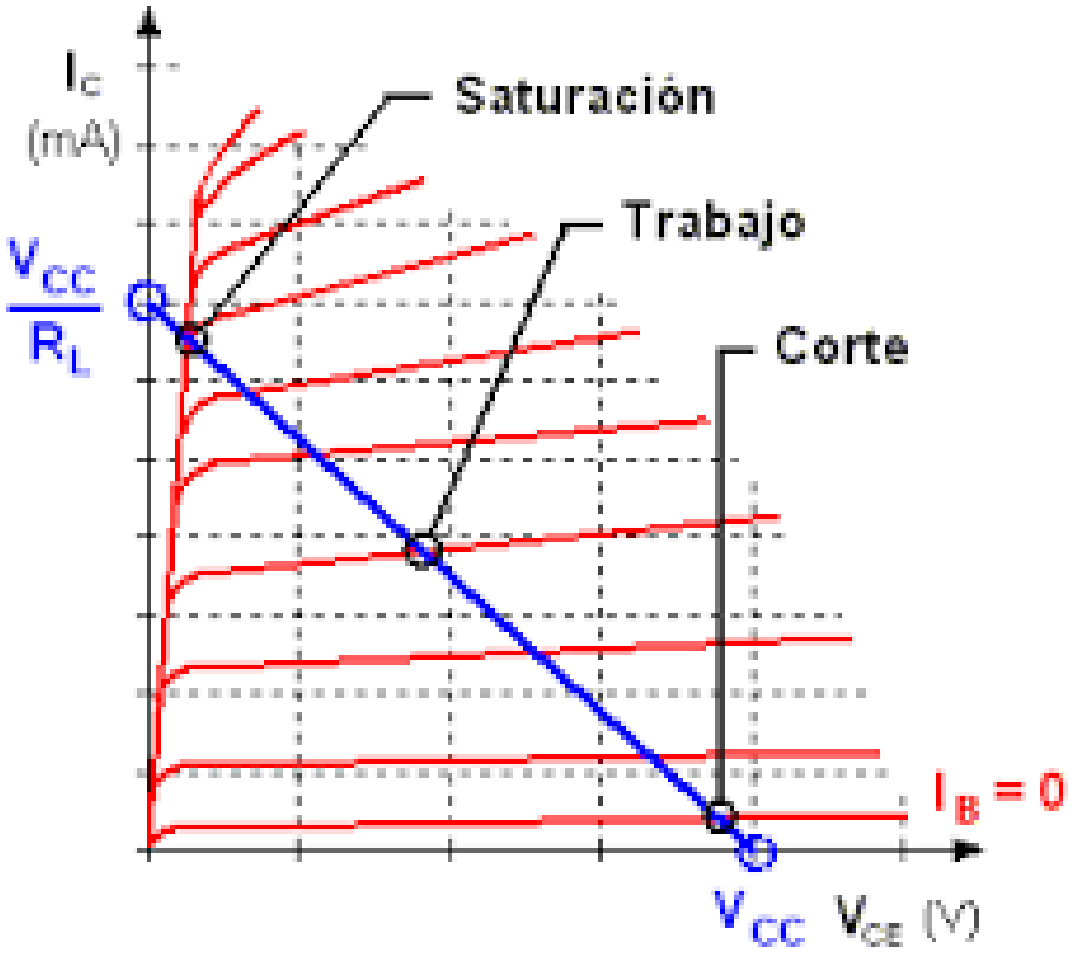




TRANSISTOR: Control Lineal

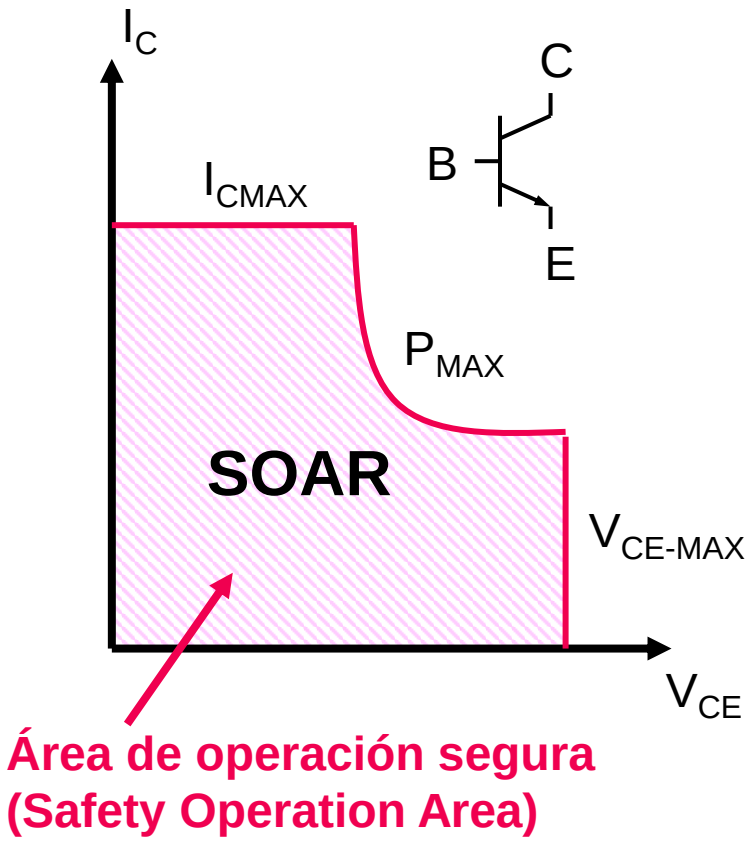


PUNTO "Q" (Punto de Trabajo)

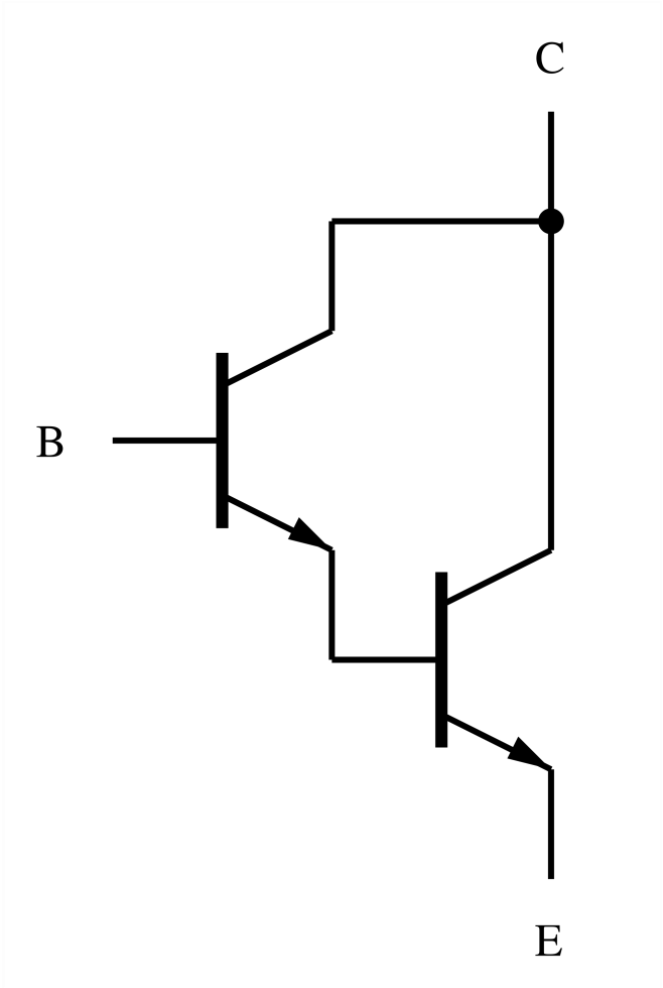


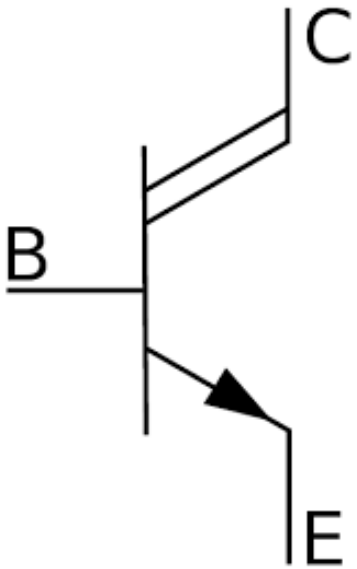
Características reales: datos proporcionados por los fabricantes

$I_{C\text{-}MAX}$	Corriente máxima de colector
$V_{CE\text{-}MAX}$	Tensión máxima CE
P_{MAX}	Potencia máxima
$V_{CE\text{-}SAT}$	Tensión C.E. de saturación
$H_{FE} \cong \beta$	Ganancia



TANSISTOR DARLINGTON





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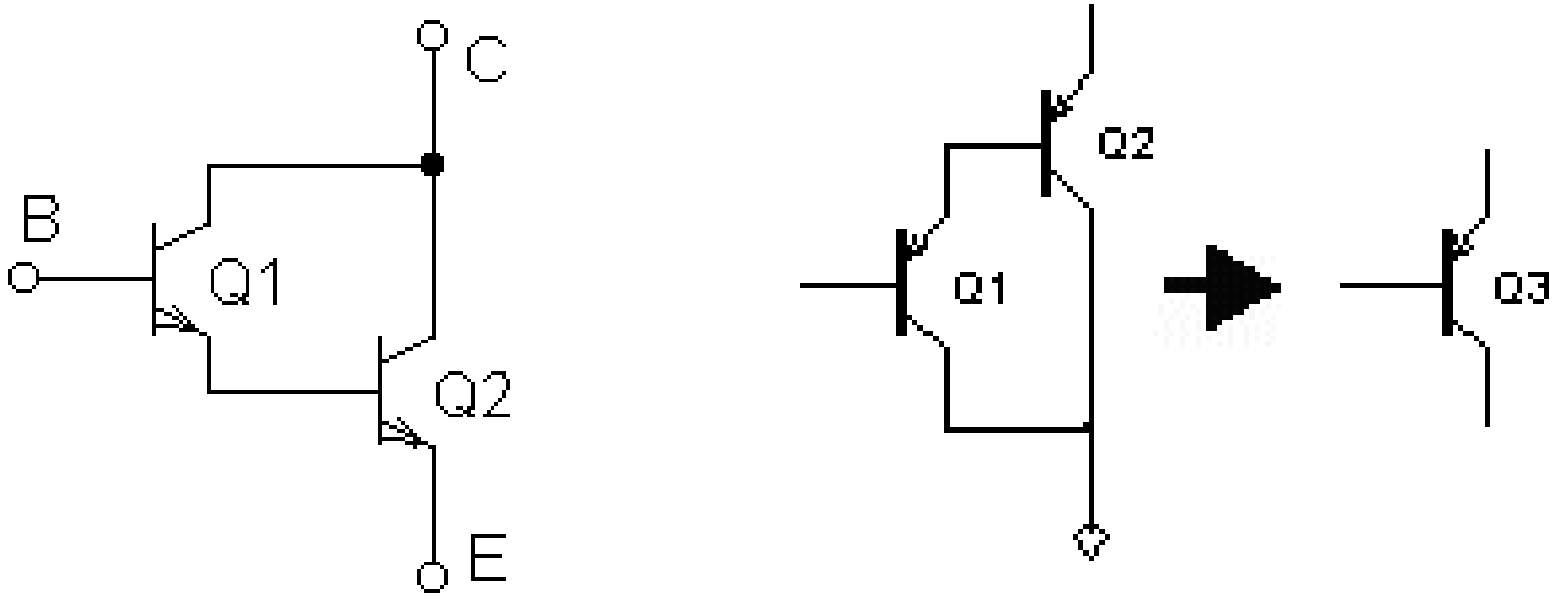

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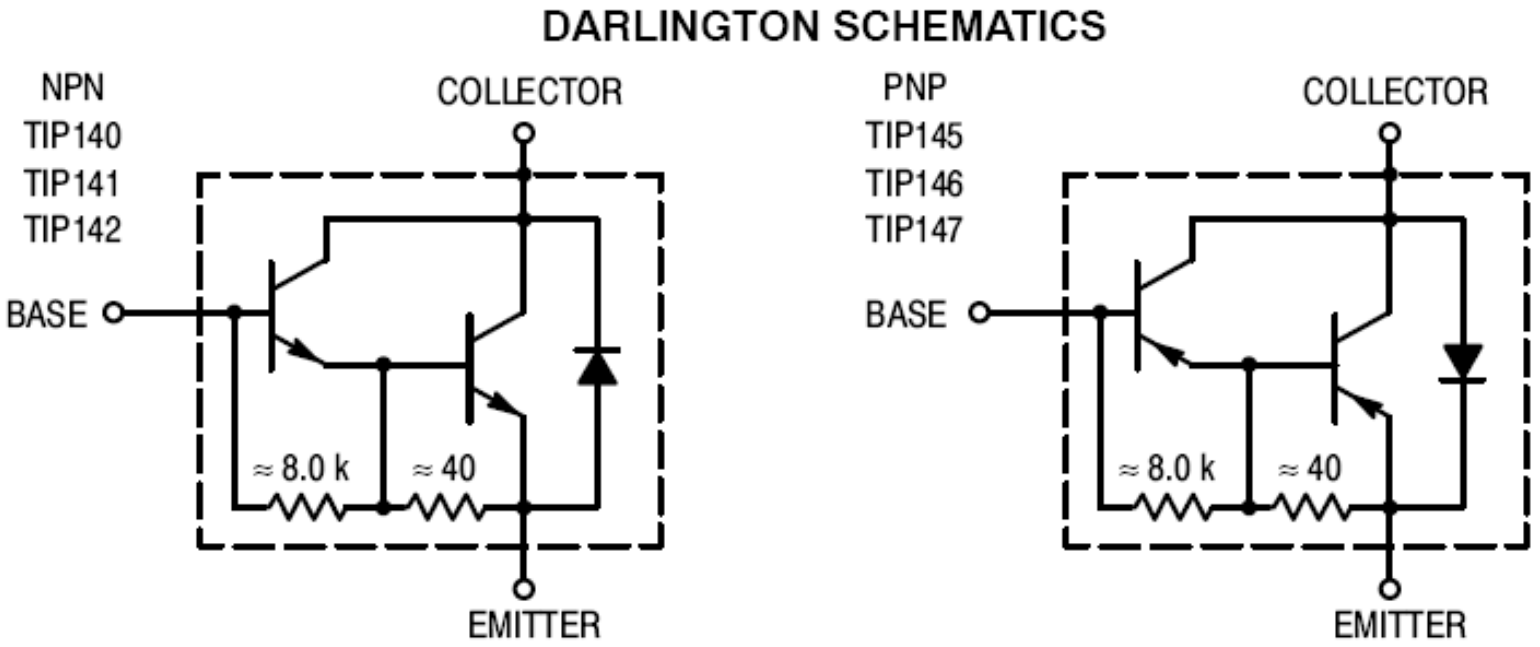

TANSISTOR DARLINGTON

ON CHARACTERISTICS (Note 2)

DC Current Gain (I_C = 5.0 A, V_{CE} = 4.0 V) (I_C = 10 A, V_{CE} = 4.0 V)	h_{FE}	 1000 500	 – –	 – –	–
Collector–Emitter Saturation Voltage (I_C = 5.0 A, I_B = 10 mA) (I_C = 10 A, I_B = 40 mA)	$V_{CE(sat)}$	 – –	 – –	 2.0 3.0	Vdc
Base–Emitter Saturation Voltage (I_C = 10 A, I_B = 40 mA)	$V_{BE(sat)}$	–	–	3.5	Vdc
Base–Emitter On Voltage	$V_{BE(on)}$	–	–	3.0	Vdc

Fin