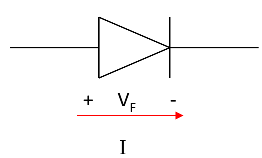
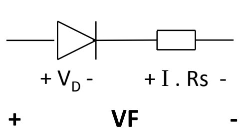
Materiales Eléctricos

Factores Térmicos

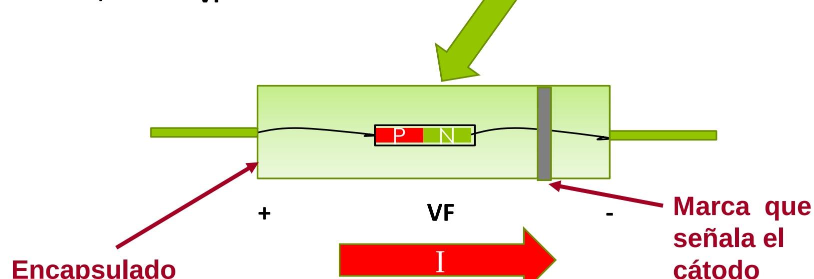
Factores Térmicos

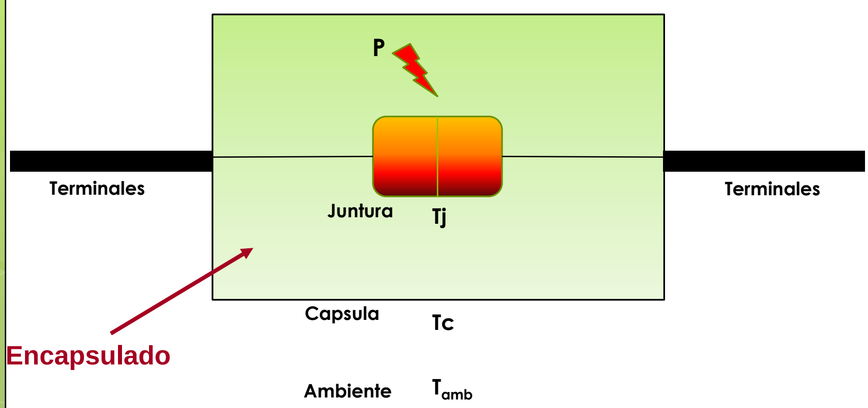




$$V_F = V_D + I \cdot Rs$$

$$P = V_F\, I = V_D\, I + I^2\, Rs$$





La juntura no debe superar $T_{intrinseca}$ (≈ 200 °C para Si)

Modelo Térmico

- La potencia generada $P = V_F\, I = V_D\, I + I^2\, Rs$ origina el calor el cual debe ser removido desde la juntura hasta el exterior
- Recordemos que el calor se puede remover de tres formas:

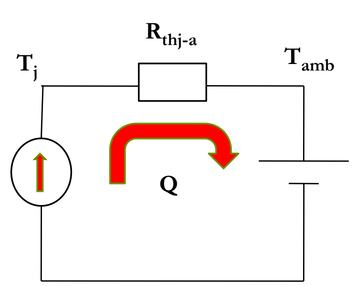
- Conducción
- Convección y
- Radiación

Modelo Térmico

- **Conducción:** el calor se transmite por el choque de los electrones contra la estructura cristalina y la agitación térmica de los átomos alrededor de su posición de equilibrio
- **Convección:** el calor se renueva por el movimiento de la masa de aire que rodea debido a que disminuye la densidad precisamente por que se calienta y se expande.
- **Radiación:** el calor fluye como onda electromagnética, en forma de brillo anaranjado de quemador o pantalla de las estufas. Esta radiación es proporcional a $\mathbf{T^4}$ (ley de Stefan)

Modelo Térmico

- Por lo expuesto se puede hacer una analogía con los circuitos eléctricos



Q es el flujo de calor en W

T es la temperatura en °C

R_{thj-a} es la resistencia térmica

LEY DE OHM TÉRMICA:

Haciendo una analogía con los circuitos eléctricos, se puede definir una

Ley de Ohm para el flujo de calor.

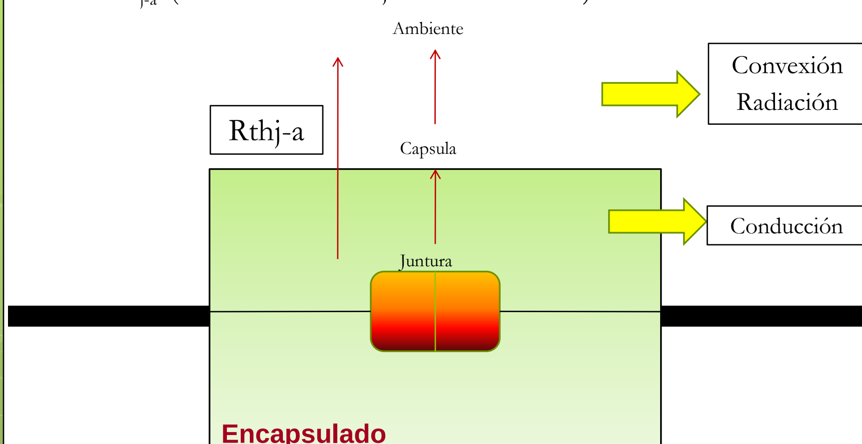
Los componentes térmicos de estos circuitos equivalentes a sus análogos eléctricos son:

- La fuente de corriente es equivalente a la fuente generadora de potencia en forma de calor que se desea evacuar.
- La diferencia de tensión eléctrica es equivalente a la diferencia de temperatura.
- La resistencia eléctrica es equivalente a la resistencia térmica medida en ºC/W (grados centígrados por vatio).

Con estos elementos podemos ya formular la Ley de Ohm térmica:

Modelo Térmico

- $\Delta T = T_j - T_{amb} \propto P$
- $\Delta T = K P$
- $K = Rth_{j\text{-}a}$ (Resistencia térmica juntura – Ambiente)

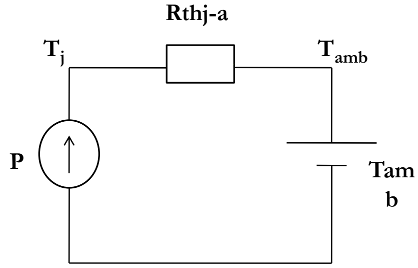


Materiales Eléctricos

Modelo Térmico

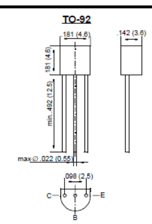
$$\frac{\Delta T}{P} = R_{thj\text{-}a}$$

$$\Delta T = T_J - T_{amb}$$



BC337, BC338

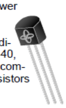
Small Signal Transistors (NPN)



Dimensions in inches and (millimeters)

FEATURES

- NPN Silicon Epitaxial Planar Transistors for switching and amplifier applications. Especially suitable for AF-driver stages and low power output stages.
- These types are also available subdivided into three groups -16, -25, and -40, according to their DC current gain. As complementary types, the PNP transistors BC327 and BC328 are recommended.
- On special request, these transistors are also manufactured in the pin configuration TO-18.



MECHANICAL DATA

Case: TO-92 Plastic Package
Weight: approx. 0.18 g

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Ratings at 25 °C ambient temperature unless otherwise specified

		Symbol	Value	Unit
Collector-Emitter Voltage	**BC337** **BC338**	V_{CES} V_{CES}	50 30	V V
Collector-Emitter Voltage	**BC337** **BC338**	V_{CEO} V_{CEO}	45 25	V V
Emitter-Base Voltage		V_{EBO}	5	V
Collector Current		I_C	800	mA
Peak Collector Current		I_{CM}	1	A
Base Current		I_B	100	mA
Power Dissipation at T_{amb} = 25 °C		P_{tot}	625[1)]	mW
Junction Temperature		T_j	150	°C
Storage Temperature Range		T_S	–65 to +150	°C

[1)] Valid provided that leads are kept at ambient temperature at a distance of 2 mm from case

BC337, BC338

ELECTRICAL CHARACTERISTICS

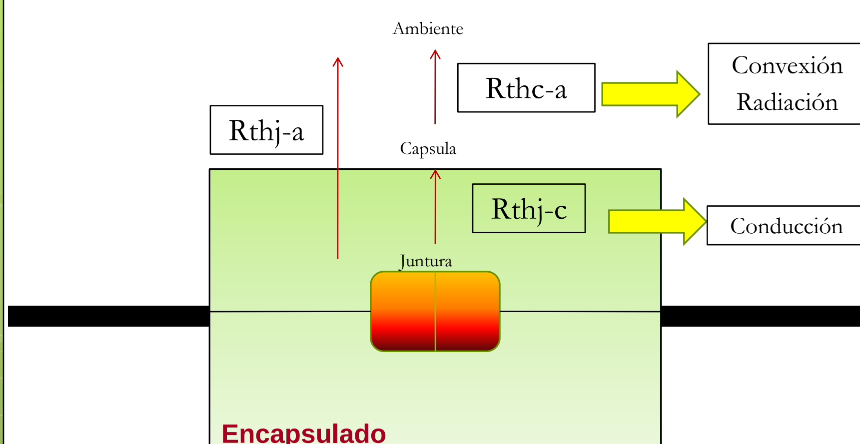
Ratings at 25 °C ambient temperature unless otherwise specified

	Symbol	Min.	Typ.	Max.	Unit
DC Current Gain at V_{CE} = 1 V, I_C = 100 mA **Current Gain Group -16** **-25** **-40** at V_{CE} = 1 V, I_C = 300 mA **Current Gain Group -16** **-25** **-40**	h_{FE} h_{FE} h_{FE} h_{FE} h_{FE} h_{FE}	100 160 250 60 100 170	160 250 400 130 200 320	250 400 630 – – –	– – – – – –
Collector-Emitter Cutoff Current at V_{CE} = 45 V **BC337** at V_{CE} = 25 V **BC338** at V_{CE} = 45 V, T_{amb} = 125 °C **BC337** at V_{CE} = 25 V, T_{amb} = 125 °C **BC338**	I_{CES} I_{CES} I_{CES} I_{CES}	– – – –	2 2 – –	100 100 10 10	nA nA µA µA
Collector-Emitter Breakdown Voltage at I_C = 10 mA **BC338** **BC337**	$V_{(BR)CEO}$ $V_{(BR)CEO}$	20 45	– –	– –	V V
Collector-Emitter Breakdown Voltage at I_C = 0.1 mA **BC338** **BC337**	$V_{(BR)CES}$ $V_{(BR)CES}$	30 50	– –	– –	V V
Emitter-Base Breakdown Voltage at I_E = 0.1 mA	$V_{(BR)EBO}$	5	–	–	V
Collector Saturation Voltage at I_C = 500 mA, I_B = 50 mA	V_{CEsat}	–	–	0.7	V
Base-Emitter Voltage at V_{CE} = 1 V, I_C = 300 mA	V_{BE}	–	–	1.2	V
Gain-Bandwidth Product at V_{CE} = 5 V, I_C = 10 mA, f = 50 MHz	f_T	–	100	–	MHz
Collector-Base Capacitance at V_{CB} = 10 V, f = 1 MHz	C_{CBO}	–	12	–	pF
Thermal Resistance Junction to Ambient Air	R_{thJA}	–	–	200[1]	K/W

[1] Valid provided that leads are kept at ambient temperature at a distance of 2 mm from case

Materiales Eléctricos

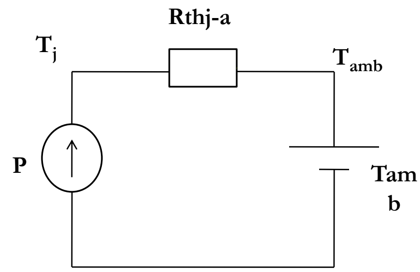
- $\Delta T = T_j - T_{amb} \propto P$
- $\Delta T = K\,P$
- $K = Rth_{j\text{-}a} = Rth_{j\text{-}c}$ (Resist. Térm. juntura – capsula)+ $Rth_{c\text{-}amb}$ (Resist. Térm. Capsula-Amb)



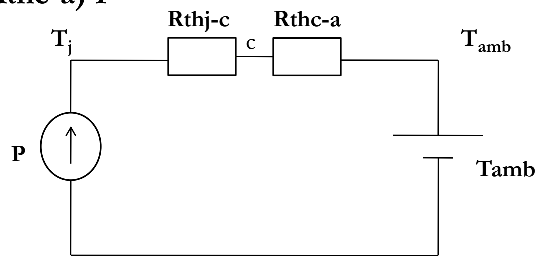
Materiales Eléctricos

$$\frac{\Delta T}{P} = R_{thj\text{-}a}$$

$$\Delta T = T_J - T_{amb}$$



$$\Delta T = (Rthj\text{-}c + Rthc\text{-}a)\ P$$



Complementary Silicon Power Transistors

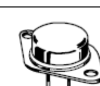
. . . designed for general–purpose switching and amplifier applications.

- DC Current Gain — h_{FE} = 20–70 @ I_C = 4 Adc
- Collector–Emitter Saturation Voltage — $V_{CE(sat)}$ = 1.1 Vdc (Max) @ I_C = 4 Adc
- Excellent Safe Operating Area

NPN
2N3055*
PNP
MJ2955*

*Motorola Preferred Device

15 AMPERE
POWER TRANSISTORS
COMPLEMENTARY
SILICON
60 VOLTS
115 WATTS



CASE 1–07
TO–204AA
(TO–3)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	V_{CEO}	60	Vdc
Collector–Emitter Voltage	V_{CER}	70	Vdc
Collector–Base Voltage	V_{CB}	100	Vdc
Emitter–Base Voltage	V_{EB}	7	Vdc
Collector Current — Continuous	I_C	15	Adc
Base Current	I_B	7	Adc
Total Power Dissipation @ T_C = 25°C Derate above 25°C	P_D	115 0.657	Watts W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	–65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.52	°C/W

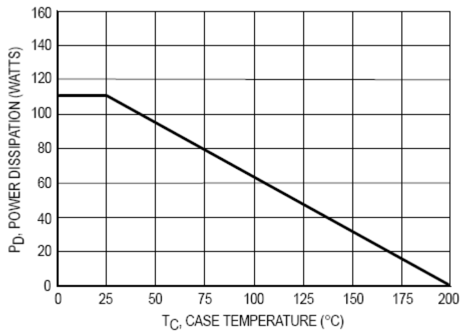


Figure 1. Power Derating

2N3055, MJ2955

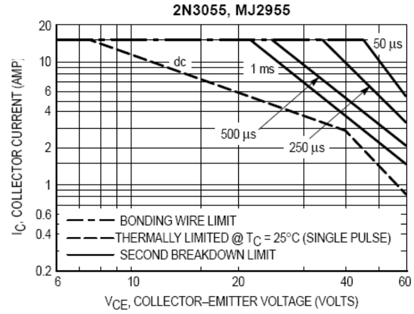


Figure 2. Active Region Safe Operating Area

MOSPEC

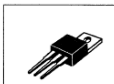
COMPLEMENTARY SILICON PLASTIC POWER TRANSISTORS

... designed for use in general purpose power amplifier and switching applications.

FEATURES:
* Collector-Emitter Sustaining Voltage - $V_{CEO(sus)}$= 40V(Min)- TIP41,TIP42
  60V(Min)- TIP41A,TIP42A
  80V(Min)- TIP41B,TIP42B
  100V(Min)-TIP41C,TIP42C
* Collector-Emitter Saturation Voltage- $V_{CE(sat)}$=1.5V(Max)@I_C= 6.0A
* Current Gain-Bandwidth Product f_T=3.0 MHz (Min)@ I_C=500mA

NPN	PNP
TIP41	TIP42
TIP41A	TIP42A
TIP41B	TIP42B
TIP41C	TIP42C

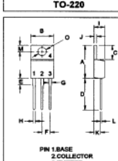
6 AMPERE
COMPLEMENTARY SILICON
POWER TRANSISTORS
40 -100 VOLTS
65 WATTS



TO-220

MAXIMUM RATINGS

Characteristic	Symbol	TIP41 TIP42	TIP41A TIP42A	TIP41B TIP42B	TIP41C TIP42C	Unit
Collector-Emitter Voltage	V_{CEO}	40	60	80	100	V
Collector-Base Voltage	V_{CBO}	40	60	80	100	V
Emitter-Base Voltage	V_{EBO}	5				V
Collector Current - Continuous - Peak	I_C	6 10				A
Base Current	I_B	2				A
Total Power Dissipation@T_C = 25°C Derate above 25°C	P_D	65 0.52				W W/°C
Operating and Storage Junction Temperature Range	T_J,T_{STG}	-65 to +150				°C



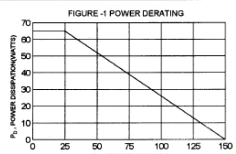
PIN 1.BASE
2.COLLECTOR
3.EMITTER
4.COLLECTOR(CASE)

DIM	MILLIMETERS MIN	MILLIMETERS MAX
A	14.68	15.31
B	9.78	10.42
C	5.01	6.52
D	13.06	14.62
E	3.57	4.07
F	2.42	3.66
G	1.12	1.36
H	0.72	0.96
I	4.22	4.98
J	1.14	1.38
K	2.20	2.97
L	0.33	0.55
M	2.48	2.98
O	3.70	3.90

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance Junction to Case	Rθjc	1.92	°C/W

FIGURE -1 POWER DERATING



MOTOROLA

Three-Terminal Positive Voltage Regulators

These voltage regulators are monolithic integrated circuits designed as fixed–voltage regulators for a wide variety of applications including local, on–card regulation. These regulators employ internal current limiting, thermal shutdown, and safe–area compensation. With adequate heatsinking they can deliver output currents in excess of 1.0 A. Although designed primarily as a fixed voltage regulator, these devices can be used with external components to obtain adjustable voltages and currents.

- Output Current in Excess of 1.0 A
- No External Components Required
- Internal Thermal Overload Protection
- Internal Short Circuit Current Limiting
- Output Transistor Safe–Area Compensation
- Output Voltage Offered in 2% and 4% Tolerance
- Available in Surface Mount D^2PAK and Standard 3–Lead Transistor Packages
- Previous Commercial Temperature Range has been Extended to a Junction Temperature Range of –40°C to +125°C

DEVICE TYPE/NOMINAL OUTPUT VOLTAGE

MC7805AC LM340AT–5 MC7805C LM340T–5	5.0 V	MC7812C LM340T–12	12 V
		MC7815AC LM340AT–15	15 V
MC7806AC MC7806C	6.0 V	MC7815C LM340T–15	
MC7808AC MC7808C	8.0 V	MC7818AC MC7818C	18 V
MC7809C	9.0 V	MC7824AC MC7824C	24 V
MC7812AC LM340AT–12	12 V		

ORDERING INFORMATION

Device	Output Voltage Tolerance	Operating Temperature Range	Package
MC78XXACT	2%	T_J = –40° to +125°C	Insertion Mount
LM340AT–XX			
MC78XXACD2T			Surface Mount
MC78XXCT	4%		Insertion Mount
LM340T–XX			
MC78XXCD2T			Surface Mount

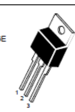
MC7800, MC7800A, LM340, LM340A Series

THREE–TERMINAL POSITIVE FIXED VOLTAGE REGULATORS

SEMICONDUCTOR TECHNICAL DATA

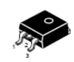
T SUFFIX
PLASTIC PACKAGE
CASE 221A

Heatsink surface connected to Pin 2.



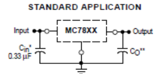
Pin 1. Input
2. Ground
3. Output

D2T SUFFIX
PLASTIC PACKAGE
CASE 936
(D^2PAK)



Heatsink surface (shown as terminal 4 in case outline drawing) is connected to Pin 2.

STANDARD APPLICATION



A common ground is required between the input and the output voltages. The input voltage must remain typically 2.0 V above the output voltage even during the low point on the input ripple voltage.

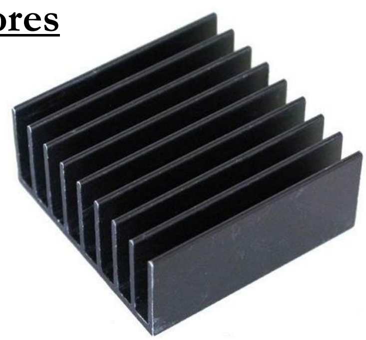
XX. These two digits of the type number indicate nominal voltage.

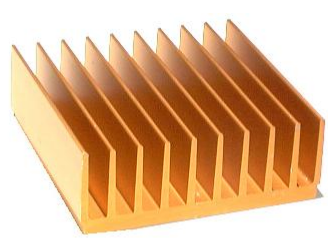
* C_{in} is required if regulator is located an appreciable distance from power supply filter.

** C_O is not needed for stability; however, it does improve transient response. Values of less than 0.1 µF could cause instability.

Materiales Eléctricos

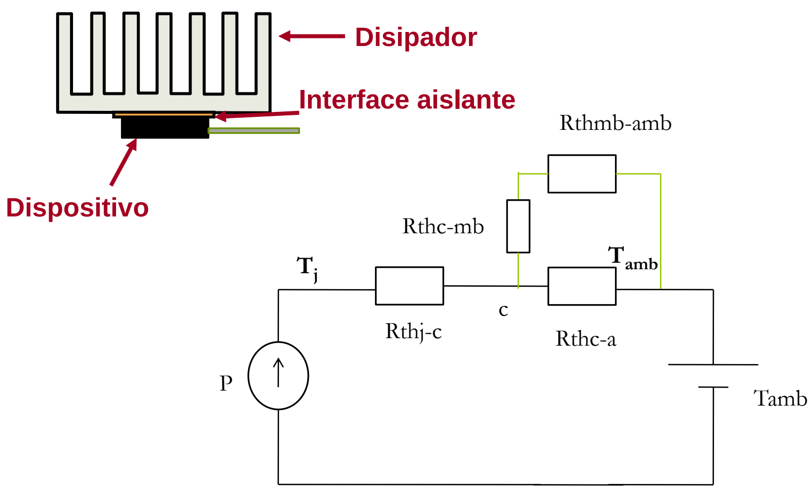
Disipadores



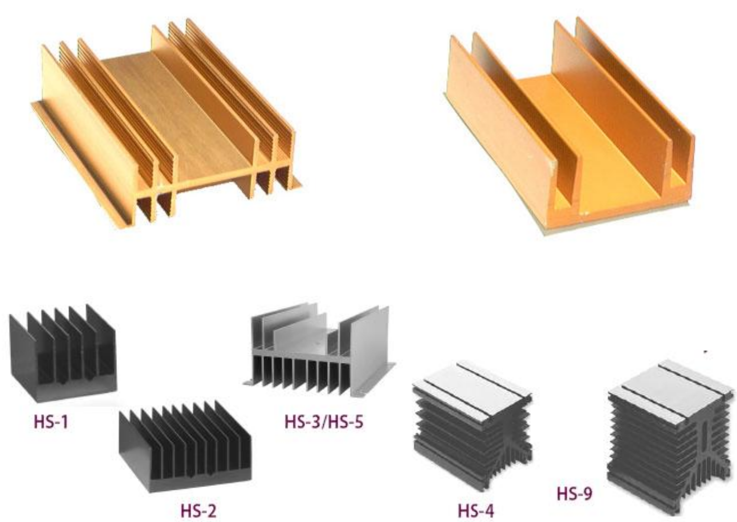


Materiales Eléctricos

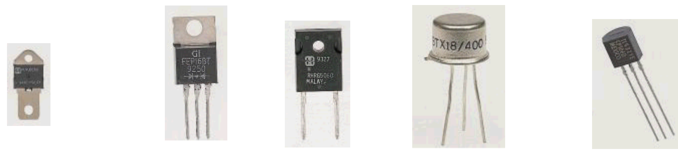
$$Rthj\text{-}a = Rthj\text{-}c + [Rthc\text{-}a // (Rthc\text{-}mb + Rthd\text{-}a)]$$



Materiales Eléctricos



Materiales Eléctricos

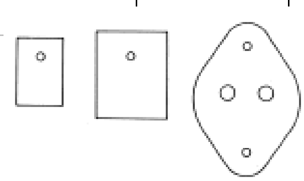


TO-218 TO-220 TO-247 TO-5 TO-92

RESISTENCIA TERMICA UNION -CONTENEDOR Y UNION-AMBIENTE		
Tipo contenedor	Rjc ('C/W)	Ria ('C/W) sin aleta
TO.5-TO.39	de 10 a 60	de 175a 220
TO.202	de 12 a 15	de 80a 90
TO. 1 26-SOT.32	de 3 a 15	de 80a 100
TO.220	de 1,5a 4,2	de 60a 70
TO.66 plástico	de 1,5a 4,2	de 60a 70
TO.3 plástico	de 1 a 2	de 35 a 45
TO.66	de 4 a 5	de 75a 85
SOT.9	de 4 a 5	de 75a 85
TO.59	de 1,5a 3	de 70a 90
TO.60	de 1,5a 3	de 70a 90
TO.3	de 0,8a 3	de 30a 40
TO.117	de 15 a 35	de 70a 90
SOT.48	de 1,8a 6	de 40a 70

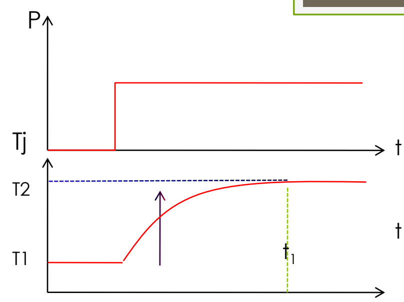
Materiales Eléctricos

RESISTENCIA TERMICA CONTENEDOR -DISIPADOR				
Tipo de contenedor	Contacto directo sin mica	Contacto directo y silicona	Contacto con mica	Contacto con mica silicona
TO.5	1	0,7	--	--
TO.39	1	0,7	2	1,5
TO.126	1,4	1	1,4	1,3
TO.220	0,8	0,5	1,4	1,2
TO.202	0,8	0,5	1,4	1,2
TO.152	0,8	0,5	1,2	0,9
TO.90	0,5	0,3	1	0,7
TO.3P.	0,4	0,2	2,1	1,5
TO.59	1,2	0,7		
TO.117	2	1,7	--	--
SOT.48	1,8	1,5		
DIA.4L	1,1	0,7		
TO.66	1,1	0,65		



Aisladores para TO-220 y TO-3

Materiales Eléctricos



Constante de Tiempo ∝ Masa y Calor Específico

-Cuando se establece la condición de equilibrio: $t > t_1$

- Tj → f (Potencia)
  - → f (Tamb)
  - → f (Camino entre juntura y ambiente) → Geometría / Material

http://www.disipadores.com

- http://www.disipadores.com