Instrumentación y Control - Componentes Electrónicos

22 de Agosto de 2018

Contenido

Clasificación de componentes electrónicos

Clasificación según la estructura física

Discretos: elementos individuales que cumplen un tarea específica

Integrados: circuitos compuestos por varios elementos

Clasificación según la función específica

Pasivos: solo consumen o almacenan energía

- Resistencias
- Capacitores
- Inductores

Activos: transfieren energía, modifican el nivel y la forma de las señales

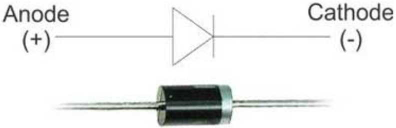
- Diodos
- Transistores

Electromecánicos: conjugan operaciones eléctricas y funciones mecánicas

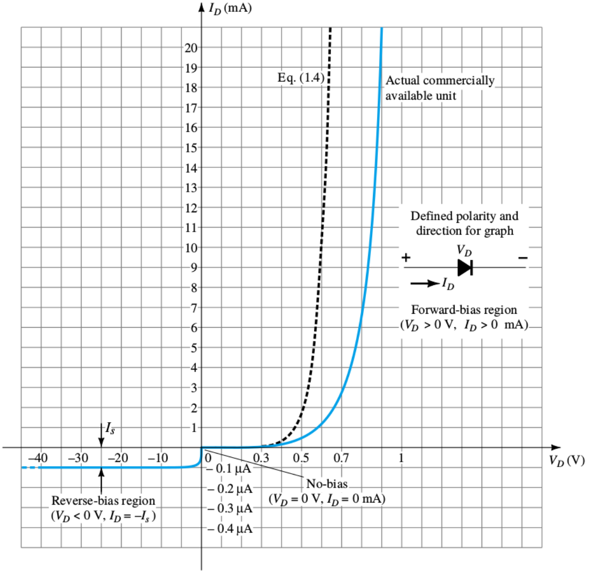
- Relays
- Piezoeléctricos
- Fusibles

Componentes discretos

Diodos: Esquemático y curva característica



$$I_D(V_D) = I_S \left\{ \exp\left(\frac{q\, V_D}{\eta\, K_B\, T} \right) - 1 \right\}$$



Diodos: Especificación de datos

- Potencial de conducción en directa V_F
- Corriente máxima en directa I_F
- Corriente de saturación inversa I_R
- Potencial de ruptura PIV / PRV / $V(\mathrm{BR})$ / V_R
- Potencia disipada P_D
- Capacitancia C_T
- Tiempo de recuperación t_{rr}

Diodos: Hoja de datos

Absolute Maximum Ratings* T_A = 25°C unless otherwise noted

Symbol	Parameter	Value	Units
V_{RRM}	Maximum Repetitive Reverse Voltage	100	V
$I_{F(AV)}$	Average Rectified Forward Current	200	mA
I_{FSM}	Non-repetitive Peak Forward Surge Current Pulse Width = 1.0 second Pulse Width = 1.0 microsecond	 1.0 4.0	 A A
T_{stg}	Storage Temperature Range	-65 to +200	°C
T_J	Operating Junction Temperature	175	°C

Diodos: Hoja de datos

Thermal Characteristics

Symbol	Characteristic	Max	Units
		1N/FDLL 914/A/B / 4148 / 4448	
P_D	Power Dissipation	500	mW
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	300	°C/W

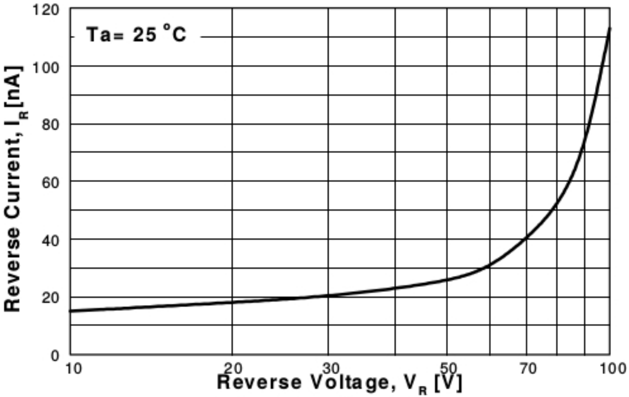
Diodos: Hoja de datos

Electrical Characteristics

$T_A = 25°C$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Max	Units
V_R	Breakdown Voltage	$I_R = 100\ \mu A$	100		V
		$I_R = 5.0\ \mu A$	75		V
V_F	Forward Voltage **1N914B/4448**	$I_F = 5.0$ mA	620	720	mV
	1N916B	$I_F = 5.0$ mA	630	730	mV
	1N914/916/4148	$I_F = 10$ mA		1.0	V
	1N914A/916A	$I_F = 20$ mA		1.0	V
	1N916B	$I_F = 20$ mA		1.0	V
	1N914B/4448	$I_F = 100$ mA		1.0	V
I_R	Reverse Current	$V_R = 20$ V		25	nA
		$V_R = 20$ V, $T_A = 150°C$		50	µA
		$V_R = 75$ V		5.0	µA
C_T	Total Capacitance				
	1N916A/B/4448	$V_R = 0$, f = 1.0 MHz		2.0	pF
	1N914A/B/4148	$V_R = 0$, f = 1.0 MHz		4.0	pF
t_{rr}	Reverse Recovery Time	$I_F = 10$ mA, $V_R = 6.0$ V (60mA), $I_{rr} = 1.0$ mA, $R_L = 100\Omega$		4.0	ns

Diodos: Hoja de datos



GENERAL RULE: The Reverse Current of a diode will approximately double for every ten (10) Degree C increase in Temperature

Figure 2. Reverse Current vs Reverse Voltage IR - 10 to 100 V

Diodos: Hoja de datos

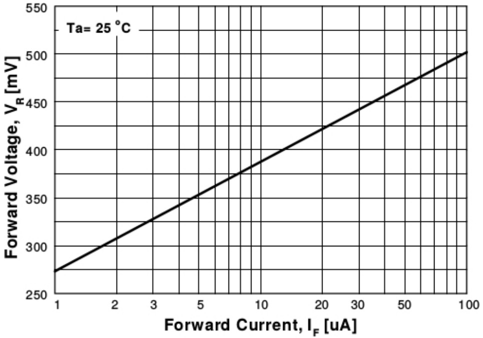


Figure 3. Forward Voltage vs Forward Current VF - 1 to 100 uA

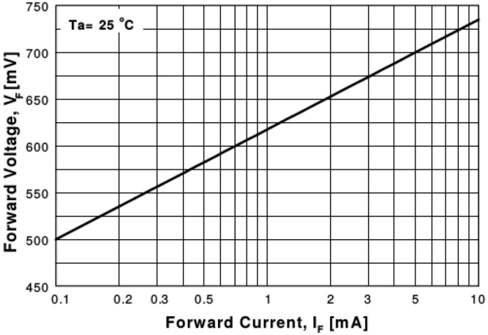


Figure 4. Forward Voltage vs Forward Current VF - 0.1 to 10 mA

Ojo, pueden haber typos!

Diodos: Hoja de datos

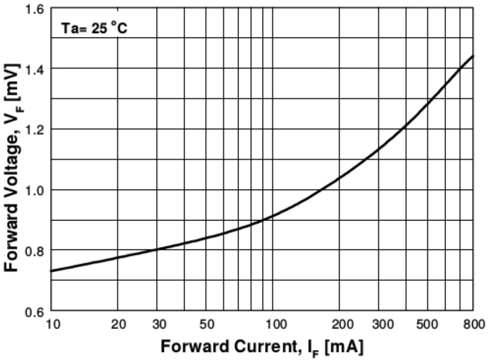


Figure 5. Forward Voltage vs Forward Current
VF - 10 to 800 mA

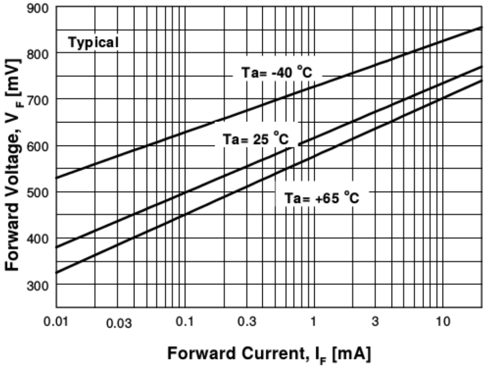


Figure 6. Forward Voltage
vs Ambient Temperature
VF - 0.01 - 20 mA (-40 to +65 Deg C)

Diodos: Hoja de datos

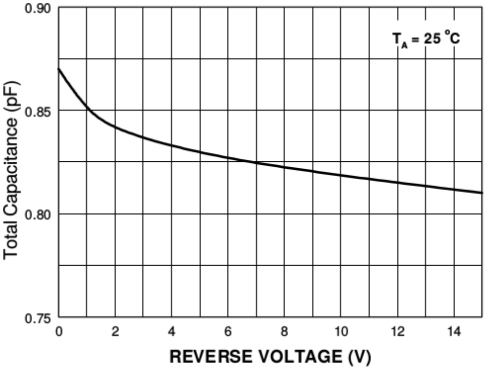


Figure 7. Total Capacitance

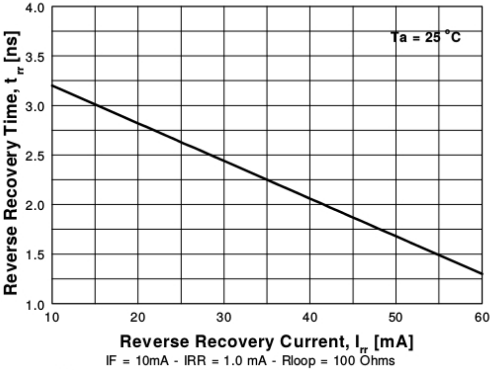


Figure 8. Reverse Recovery Time vs Reverse Recovery Current

Capacitor variable (mirar que pasa con otros diodos)

Diodos: Hoja de datos

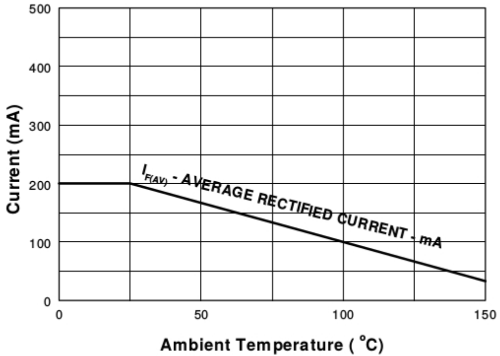


Figure 9. Average Rectified Current ($I_{F(AV)}$) versus Ambient Temperature (T_A)

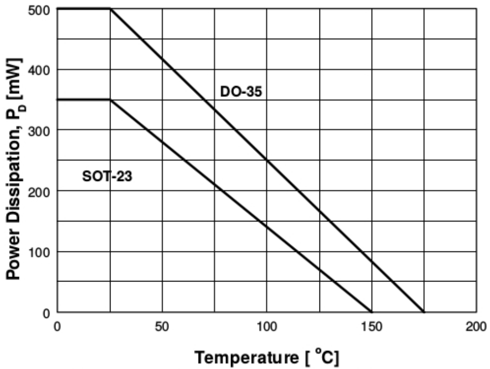
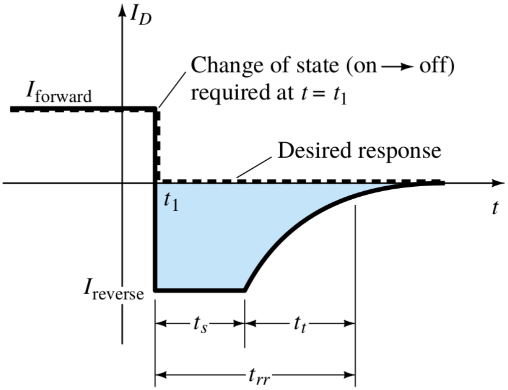


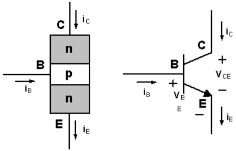
Figure 10. Power Derating Curve

Diodos: Propuesta de trabajo

Medir el tiempo de respuesta inverso t_{rr} para varios dispositivos



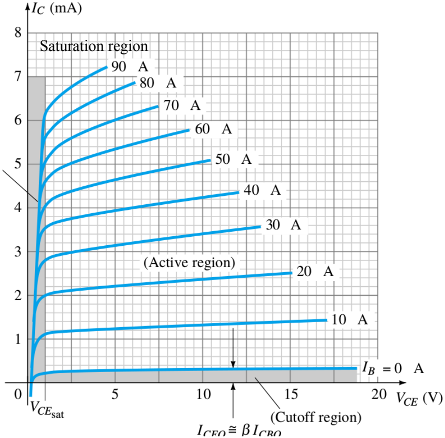
BJT: Esquemático y curvas características

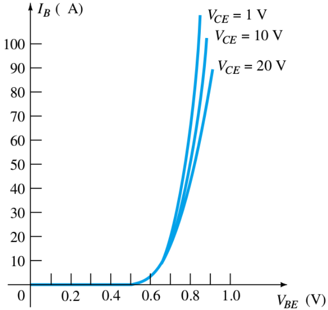


$$V_{BE} \approx 0,7 \text{ V}$$

$$I_C + I_B = I_E$$

$$I_C = \beta \, I_B$$





BJT: Especificación de datos

- Zona de ruptura
- Corrientes y temperaturas máximas
- Factores de ajuste
- Ganancia de corriente

BJT: Hoja de datos

Absolute Maximum Ratings T_a=25°C unless otherwise noted

Symbol	Parameter	Value	Units
V_{CBO}	Collector-Base Voltage : BC546	80	V
	: BC547/550	50	V
	: BC548/549	30	V
V_{CEO}	Collector-Emitter Voltage : BC546	65	V
	: BC547/550	45	V
	: BC548/549	30	V
V_{EBO}	Emitter-Base Voltage : BC546/547	6	V
	: BC548/549/550	5	V
I_C	Collector Current (DC)	100	mA
P_C	Collector Power Dissipation	500	mW
T_J	Junction Temperature	150	°C
T_{STG}	Storage Temperature	-65 ~ 150	°C

BJT: Hoja de datos

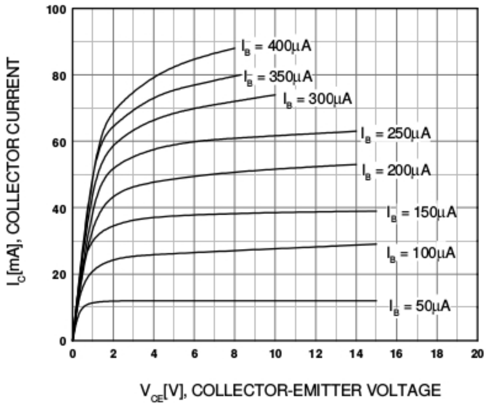
Electrical Characteristics T_a=25°C unless otherwise noted

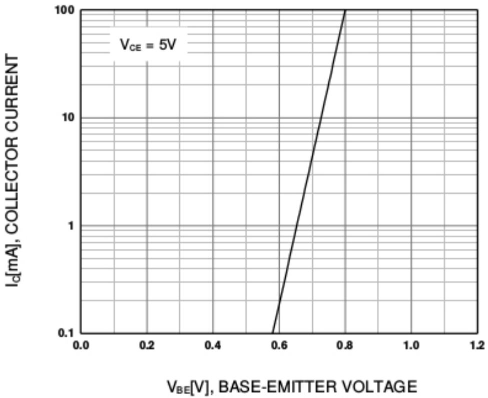
Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Units
I_{CBO}	Collector Cut-off Current	V_{CB}=30V, I_E=0			15	nA
h_{FE}	DC Current Gain	V_{CE}=5V, I_C=2mA	110		800	
V_{CE} (sat)	Collector-Emitter Saturation Voltage	I_C=10mA, I_B=0.5mA I_C=100mA, I_B=5mA		90 200	250 600	mV mV
V_{BE} (sat)	Base-Emitter Saturation Voltage	I_C=10mA, I_B=0.5mA I_C=100mA, I_B=5mA		700 900		mV mV
V_{BE} (on)	Base-Emitter On Voltage	V_{CE}=5V, I_C=2mA V_{CE}=5V, I_C=10mA	580	660	700 720	mV mV
f_T	Current Gain Bandwidth Product	V_{CE}=5V, I_C=10mA, f=100MHz		300		MHz
C_{ob}	Output Capacitance	V_{CB}=10V, I_E=0, f=1MHz		3.5	6	pF
C_{ib}	Input Capacitance	V_{EB}=0.5V, I_C=0, f=1MHz		9		pF
NF	Noise Figure : BC546/547/548 : BC549/550 : BC549 : BC550	V_{CE}=5V, I_C=200μA f=1KHz, R_G=2KΩ V_{CE}=5V, I_C=200μA R_G=2KΩ, f=30~15000MHz		2 1.2 1.4 1.4	10 4 4 3	dB dB dB dB

h_{FE} Classification

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

BJT: Hoja de datos





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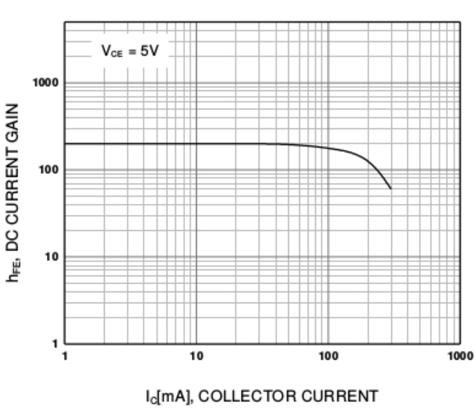


Figure 3. DC current Gain

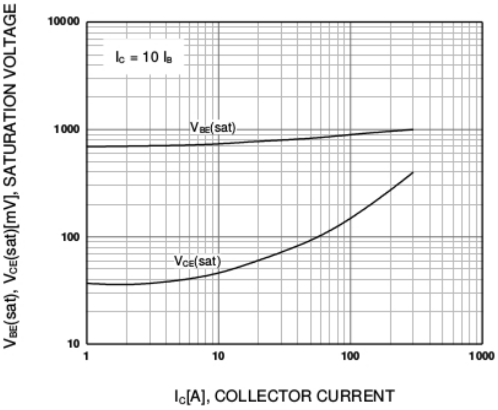


Figure 4. Base-Emitter Saturation Voltage Collector-Emitter Saturation Voltage

BJT: Hoja de datos

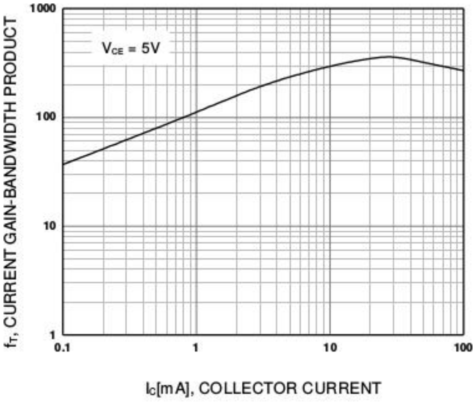
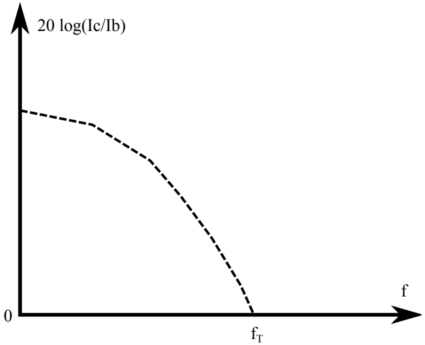
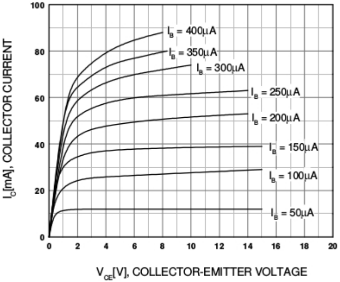


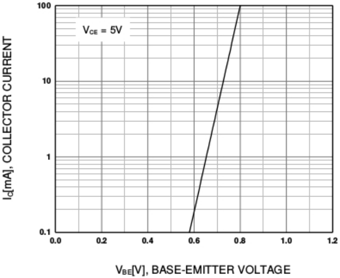
Figure 6. Current Gain Bandwidth Product



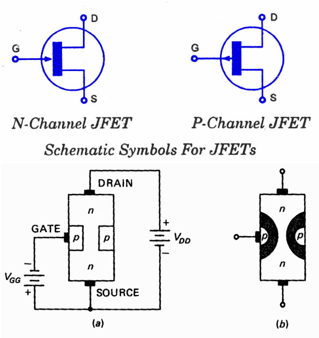
BJT: Propuesta de trabajo

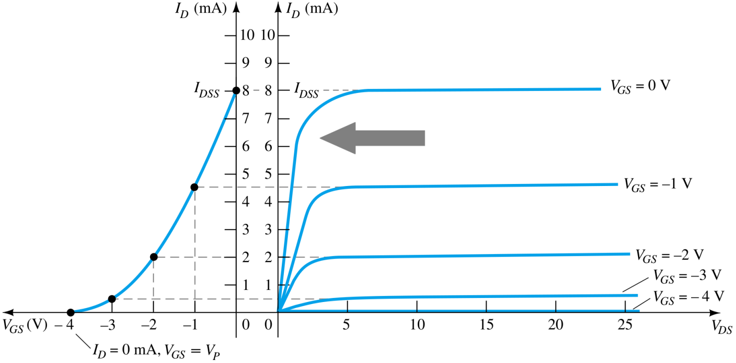
Medir curva caracteristica I_C vs. V_{CE}





JFET: Esquemático y curvas características





$$I_G = 0$$

$$I_D = I_S$$

$$I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2$$

JFET: Hoja de datos

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain–Source Voltage	V_{DS}	25	Vdc
Drain–Gate Voltage	V_{DG}	25	Vdc
Gate–Source Voltage	V_{GS}	–25	Vdc
Gate Current	I_G	10	mAdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	 350 2.8	 mW mW/°C
Junction Temperature Range	T_J	125	°C
Storage Temperature Range	T_{stg}	–65 to +150	°C

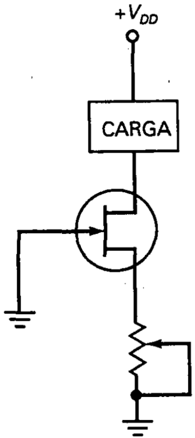
JFET: Hoja de datos

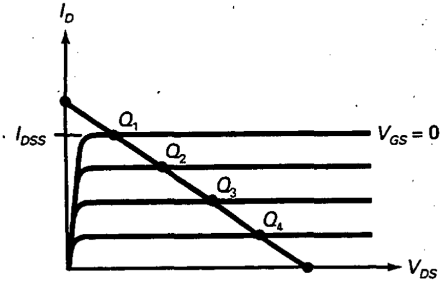
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Gate – Source Breakdown Voltage (I_G = –10 μAdc, V_{DS} = 0)	$V_{(BR)GSS}$	–25	–	Vdc
Gate Reverse Current (V_{GS} = –15 Vdc, V_{DS} = 0)	I_{GSS}	–	–2.0	nAdc
(V_{GS} = –15 Vdc, V_{DS} = 0, T_A = 100°C)		–	–2.0	μAdc
Gate – Source Cutoff Voltage (V_{DS} = 15 Vdc, I_D = 2.0 nAdc)	$V_{GS(off)}$	–	–8.0	Vdc
Gate – Source Voltage (V_{DS} = 15 Vdc, I_D = 0.2 mAdc)	V_{GS}	–0.5	–7.5	Vdc
ON CHARACTERISTICS				
Zero – Gate –Voltage Drain Current (Note 1) (V_{DS} = 15 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	2.0	20	mAdc

JFET: Propuesta de trabajo

Fuente de corriente / Resistencia controlada por tensión





Componentes integrados

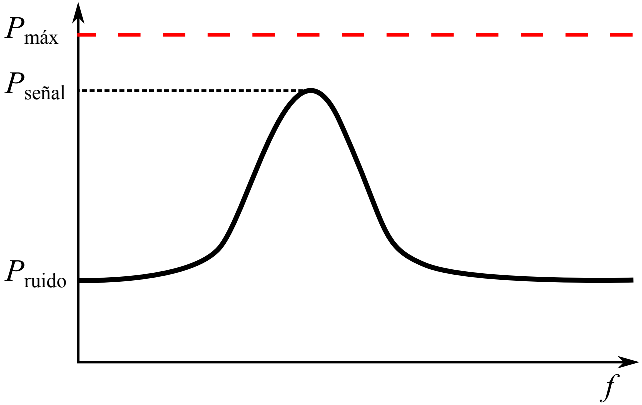
Relación señal-ruido / Rango dinámico / Factor de ruido

$$\mathrm{SNR} = \frac{P_{\mathrm{senial}}}{P_{\mathrm{ruido}}}$$

$$\mathrm{DR} = \frac{P_{\mathrm{max}}}{P_{\mathrm{ruido}}}$$

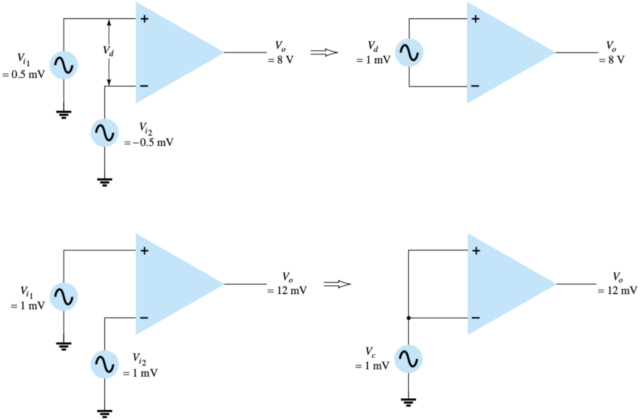
$$\mathrm{F} = \frac{\mathrm{SNR}_I}{\mathrm{SNR}_O}$$

$$\mathrm{F(dB)} = \mathrm{SNR}_I\mathrm{(dB)} - \mathrm{SNR}_O\mathrm{(dB)}$$



- P en dB o dBm?

OPAMP: Esquemático / Rechazo modo común

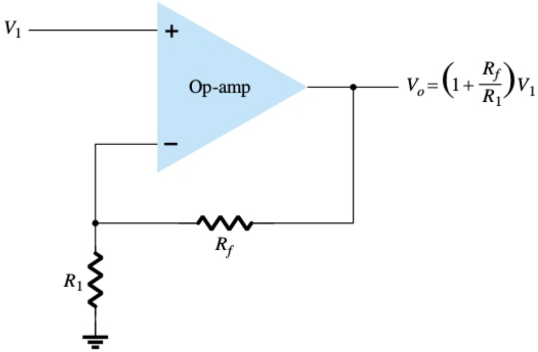


$$V_o = A_d\ V_d + A_c\ V_c$$

$$\mathrm{CMRR} = \frac{A_d}{A_c}$$

OPAMP: Aplicaciones

- Amplificadores
- Operaciones aritméticas
- Adaptador de impedancia
- Filtros
- Comparadores
- Etc.



OPAMP: Especificación de datos

- Tensión de offset de entrada
- Corriente de polarización de entrada
- Corriente de offset de entrada
- Ganancia *vs.* ancho de banda (*Gain-Bandwidth product*)
- Slew rate

OPAMP: Hoja de datos

TABLE 14.2 μA741 Electrical Characteristics: $V_{CC} = \pm 15$ V, $T_A = 25°C$

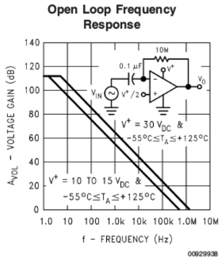
Characteristic	*MIN*	*TYP*	*MAX*	*Unit*
V_{IO} Input offset voltage		1	6	mV
I_{IO} Input offset current		20	200	nA
I_{IB} Input bias current		80	500	nA
V_{ICR} Common-mode input voltage range	±12	±13		V
V_{OM} Maximum peak output voltage swing	±12	±14		V
A_{VD} Large-signal differential voltage amplification	20	200		V/mV
r_i Input resistance	0.3	2		MΩ
r_o Output resistance		75		Ω
C_i Input capacitance		1.4		pF
CMRR Common-mode rejection ratio	70	90		dB
I_{CC} Supply current		1.7	2.8	mA
P_D Total power dissipation		50	85	mW

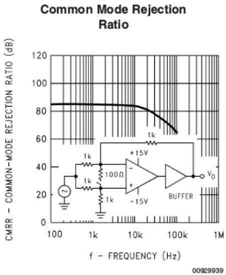
OPAMP: Hoja de datos

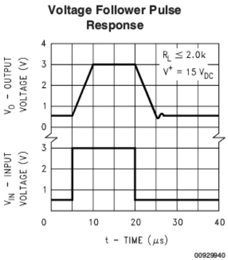
TABLE 14.3 **Operating Characteristics: $V_{CC} = \pm 15$ V, $T_A = 25°C$**

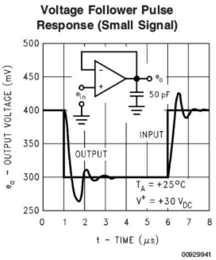
Parameter	*MIN*	*TYP*	*MAX*	*Unit*
B_1 Unity gain bandwidth		1		MHz
t_r Rise time		0.3		μs

OPAMP: Hoja de datos







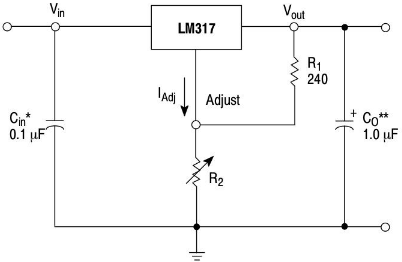


OPAMP: Propuesta de trabajo

Medir ganancia a lazo abierto ($f \gg 0$ Hz)

¿Será posible estimar el tiempo de subida con la placa de audio?

Regulador: Esquemáticos

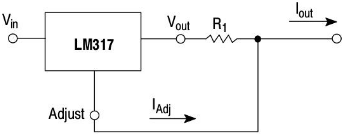


* C_{in} is required if regulator is located an appreciable distance from power supply filter.
** C_O is not needed for stability, however, it does improve transient response.

$$V_{out} = 1.25\ \text{V}\left(1 + \frac{R_2}{R_1}\right) + I_{Adj} R_2$$

Since I_{Adj} is controlled to less than 100 μA, the error associated with this term is negligible in most applications.

Figure 1. Standard Application



$$I_{out} = \left(\frac{V_{ref}}{R_1}\right) + I_{Adj}$$

$$= \frac{1.25\ \text{V}}{R_1}$$

$$10\ \text{mA} \le I_{out} \le 1.5\ \text{A}$$

Figure 26. Current Regulator

Regulador: Especificación de datos

- Regulación de línea
- Regulación de carga
- Tensión de referencia
- Corriente de ajuste
- Rechazo de ripple

Regulador: Hoja de datos

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Input–Output Voltage Differential	$V_I–V_O$	–0.3 to 40	Vdc
Power Dissipation			
Case 221A			
T_A = +25°C	P_D	Internally Limited	W
Thermal Resistance, Junction–to–Ambient	θ_{JA}	65	°C/W
Thermal Resistance, Junction–to–Case	θ_{JC}	5.0	°C/W
Case 936 (D^2PAK–3)			
T_A = +25°C	P_D	Internally Limited	W
Thermal Resistance, Junction–to–Ambient	θ_{JA}	70	°C/W
Thermal Resistance, Junction–to–Case	θ_{JC}	5.0	°C/W
Operating Junction Temperature Range	T_J	–55 to +150	°C
Storage Temperature Range	T_{stg}	–65 to +150	°C

Regulador: Hoja de datos

ELECTRICAL CHARACTERISTICS
(V_I-V_O = 5.0 V; I_O = 0.5 A for D2T and T packages; $T_J = T_{low}$ to T_{high} (Note 1); I_{max} and P_{max} (Note 2); unless otherwise noted.)

Characteristics	Figure	Symbol	Min	Typ	Max	Unit
Line Regulation (Note 3), T_A = +25°C, 3.0 V ≤ V_I-V_O ≤ 40 V	1	Reg_{line}	–	0.01	0.04	%/V
Load Regulation (Note 3), T_A = +25°C, 10 mA ≤ I_O ≤ I_{max} V_O ≤ 5.0 V V_O ≥ 5.0 V	2	Reg_{load}	 – –	 5.0 0.1	 25 0.5	 mV % V_O
Thermal Regulation, T_A = +25°C (Note 4), 20 ms Pulse	–	Reg_{therm}	–	0.03	0.07	% V_O/W
Adjustment Pin Current	3	I_{Adj}	–	50	100	μA
Adjustment Pin Current Change, 2.5 V ≤ V_I-V_O ≤ 40 V, 10 mA ≤ I_L ≤ I_{max}, P_D ≤ P_{max}	1, 2	ΔI_{Adj}	–	0.2	5.0	μA
Reference Voltage, 3.0 V ≤ V_I-V_O ≤ 40 V, 10 mA ≤ I_O ≤ I_{max}, P_D ≤ P_{max}	3	V_{ref}	1.2	1.25	1.3	V
Line Regulation (Note 3), 3.0 V ≤ V_I-V_O ≤ 40 V	1	Reg_{line}	–	0.02	0.07	%/V
Load Regulation (Note 3), 10 mA ≤ I_O ≤ I_{max} V_O ≤ 5.0 V V_O ≥ 5.0 V	2	Reg_{load}	 – –	 20 0.3	 70 1.5	 mV % V_O
Temperature Stability (T_{low} ≤ T_J ≤ T_{high})	3	T_S	–	0.7	–	% V_O
Minimum Load Current to Maintain Regulation (V_I-V_O = 40 V)	3	I_{Lmin}	–	3.5	10	mA
Maximum Output Current V_I-V_O ≤ 15 V, P_D ≤ P_{max}, T Package V_I-V_O = 40 V, P_D ≤ P_{max}, T_A = +25°C, T Package	3	I_{max}	 1.5 0.15	 2.2 0.4	 – –	A
RMS Noise, % of V_O, T_A = +25°C, 10 Hz ≤ f ≤ 10 kHz	–	N	–	0.003	–	% V_O
Ripple Rejection, V_O = 10 V, f = 120 Hz (Note 5) Without C_{Adj} C_{Adj} = 10 μF	4	RR	 – 66	 65 80	 – –	dB
Thermal Shutdown (Note 6)	–	–	–	180	–	°C
Long–Term Stability, $T_J = T_{high}$ (Note 7), T_A = +25°C for Endpoint Measurements	3	S	–	0.3	1.0	%/1.0 kHrs.
Thermal Resistance Junction–to–Case, T Package	–	$R_{\theta JC}$	–	5.0	–	°C/W

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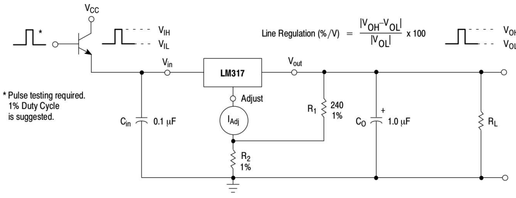
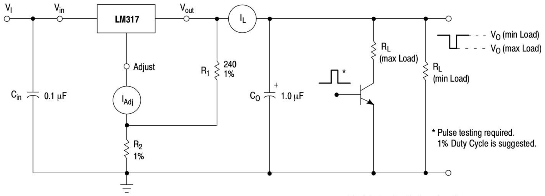


Figure 3. Line Regulation and ΔI_{Adj}/Line Test Circuit



Load Regulation (mV) = V_O (min Load) − V_O (max Load)

Load Regulation (% V_O) = $\frac{V_O \text{ (min Load)} - V_O \text{ (max Load)}}{V_O \text{ (min Load)}}$ x 100

Figure 4. Load Regulation and ΔI_{Adj}/Load Test Circuit

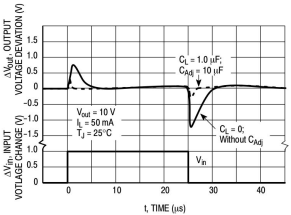


Figure 17. Line Transient Response

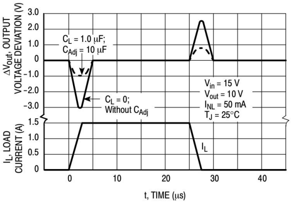


Figure 18. Load Transient Response

Regulador: Hoja de datos

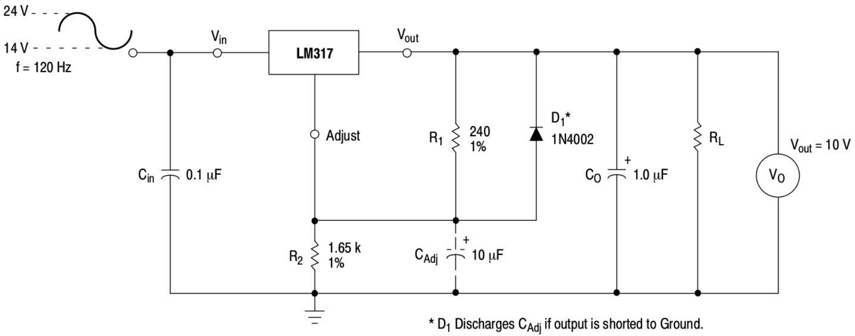


Figure 6. Ripple Rejection Test Circuit