
DICAS DE COMPONENTES
DO PROFESSOR BAIRROS
1N4007 (1A)
BC337
0A90
1
7805
3
5V
2
TIC106

08/05/2024

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SUMÁRIO

INTRODUÇÃO

Esse pdf mostra uma série de dicas que vão facilitar a escolha dos componentes para o seu projeto, identificação de componentes, e seleção do componente.

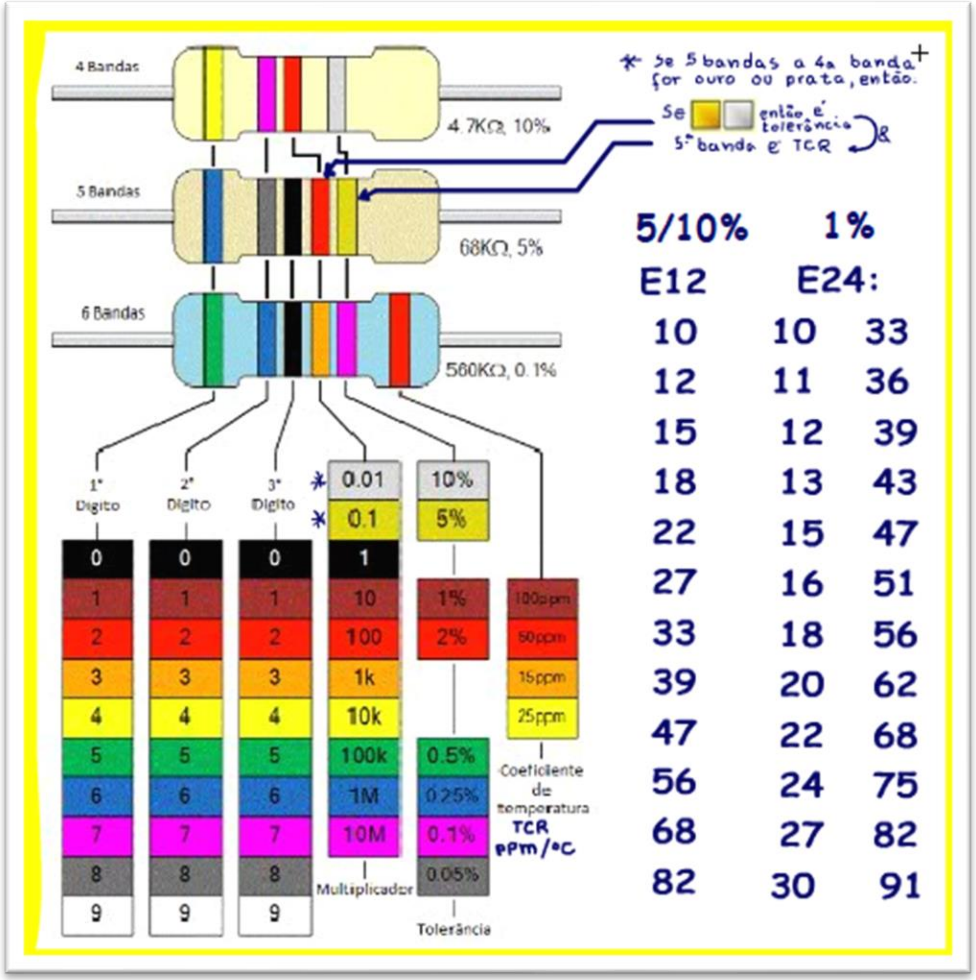
Em cada página você encontra uma lista rápida, o diagrama e pinagem quando necessário e uma descrição dos principais parâmetros e tabelas com os valores máximos.

Bom proveito.

DICAS DE COMPONENTES do Professor Bairros.

27/04/2024

CÓDIGO DE CORES DAS RESISTÊNCIAS VALORES E12/E24



1º Dígito	2º Dígito	3º Dígito	Multiplicador	Tolerância	Coeficiente de temperatura TCR ppm/°C
			* 0.01	10%	
			* 0.1	5%	
0	0	0	1		
1	1	1	10	1%	100ppm
2	2	2	100	2%	50ppm
3	3	3	1k		15ppm
4	4	4	10k		25ppm
5	5	5	100k	0.5%	
6	6	6	1M	0.25%	
7	7	7	10M	0.1%	
8	8	8		0.05%	
9	9	9			

5/10% E12	1% E24:	
10	10	33
12	11	36
15	12	39
18	13	43
22	15	47
27	16	51
33	18	56
39	20	62
47	22	68
56	24	75
68	27	82
82	30	91

Esse é o código de cores das resistências ou resistores.

E12 é a série de valores mais comum no mercado.

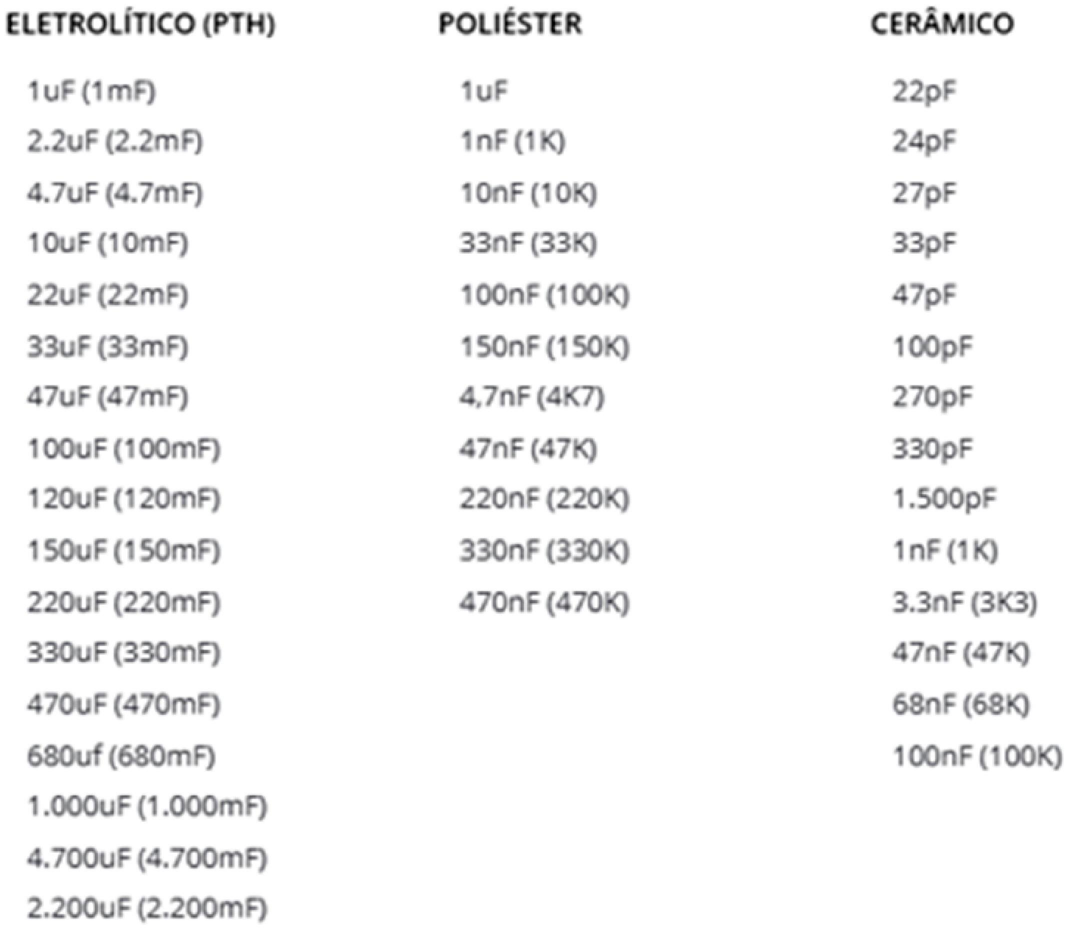
E24 é a série mais comum do mercado com tolerância de 1%.

Se na resistência de 5 bandas a 4a banda for outro ou prata ela significa tolerância e a 5a banda mais afastada significa o TCR.

Resistores com 6 bandas são geralmente para resistores de alta precisão que possuem uma banda adicional para especificar o coeficiente de temperatura (ppm/ ˚C = ppm/K). A cor mais comum para a sexta banda é marrom (100 ppm/ ˚C). Isso significa que para uma mudança de temperatura de 10 ˚C, o valor da resistência pode mudar 100ppm/10ºC = 0,1%. Para o exemplo de resistor de 6 bandas mostrado acima: laranja (3), vermelho (2), marrom (1), marrom (x10), verde (1%), vermelho (50 ppm/ ˚C) representa um resistor de 3,21 kΩ com um 1% de tolerância e um coeficiente de temperatura de 50 ppm/ ˚C.

CAPACITOR

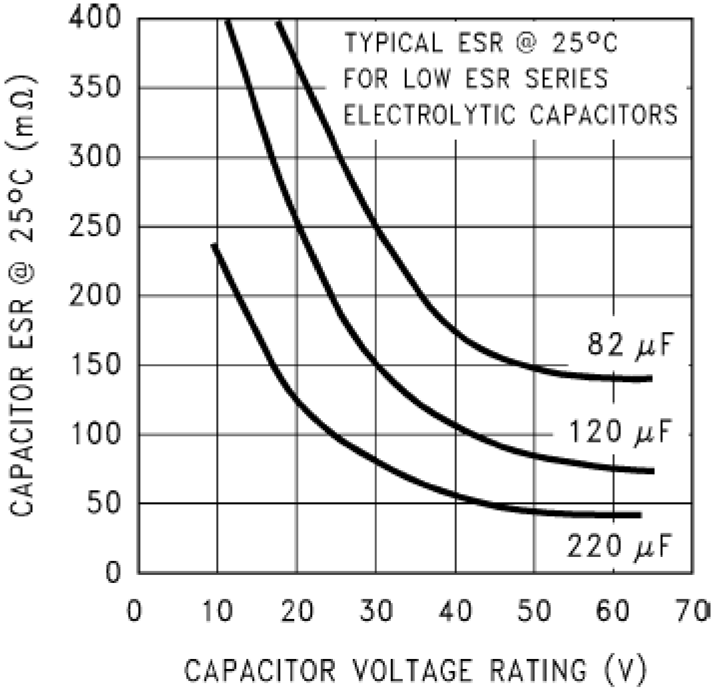
TENSÃO E VALORES NOMINAIS DOS CAPACITORES/ELETROLÍTICOS.



ELETROLÍTICO (PTH)	**POLIÉSTER**	**CERÂMICO**
1uF (1mF)	1uF	22pF
2.2uF (2.2mF)	1nF (1K)	24pF
4.7uF (4.7mF)	10nF (10K)	27pF
10uF (10mF)	33nF (33K)	33pF
22uF (22mF)	100nF (100K)	47pF
33uF (33mF)	150nF (150K)	100pF
47uF (47mF)	4,7nF (4K7)	270pF
100uF (100mF)	47nF (47K)	330pF
120uF (120mF)	220nF (220K)	1.500pF
150uF (150mF)	330nF (330K)	1nF (1K)
220uF (220mF)	470nF (470K)	3.3nF (3K3)
330uF (330mF)		47nF (47K)
470uF (470mF)		68nF (68K)
680uf (680mF)		100nF (100K)
1.000uF (1.000mF)		
4.700uF (4.700mF)		
2.200uF (2.200mF)		

ESR TÍPICO PARA CAPACITOR ELETROLÍTICO

A tabela abaixo mostra os valores típicos do ESR, esse é um parâmetro muito importante para os capacitores usados nas fontes chaveadas.



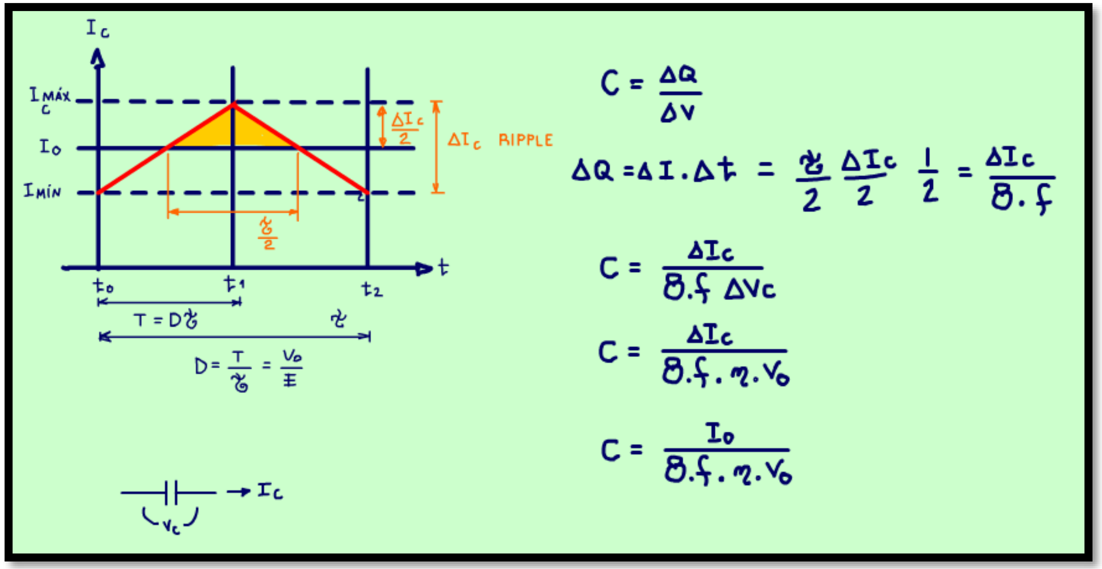
Uma regra de outro é usar capacitores de tensões de no mínimo 100VDC, quanto mais alta a tensão menor o ESR para a mesma capacitância.

Outra dica é usar capacitores de alto valor de capacitância, quanto maior o valor da capacitância menor o capacitor.

Você também pode diminuir o ESR colocando capacitores em paralelo, é como colocar resistências em paralelo.

Essas dicas foram tiradas do manual do LM2596

COMO CALCULAR O CAPACITOR DE FILTRO.



$$C = \frac{\Delta Q}{\Delta V}$$

$$\Delta Q = \Delta I . \Delta t = \frac{\tau}{2} \frac{\Delta I_C}{2} \frac{1}{2} = \frac{\Delta I_C}{8 . f}$$

$$C = \frac{\Delta I_C}{8 . f\ \Delta V_C}$$

$$C = \frac{\Delta I_C}{8 . f . \eta . V_0}$$

$$C = \frac{I_0}{8 . f . \eta . V_0}$$

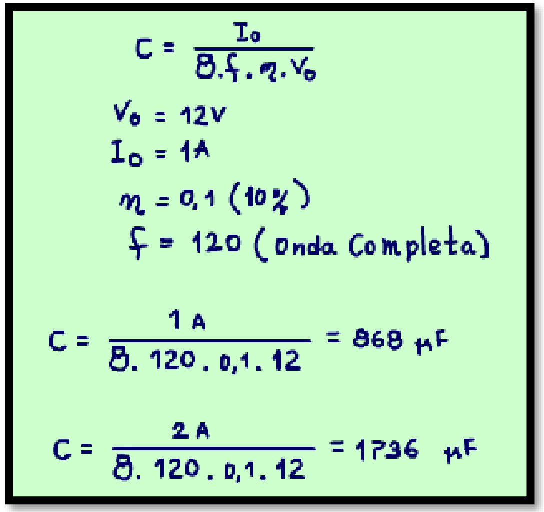
Essa é uma das melhores equações porque leva em conta a carga que deve ser reposta pelo capacitor a cada semiciclo.

O "f" é de frequência da onda retificada, se for um retificador de meia onda deverá ser uma veze a frequência da rede, na frequência da rede de 60 Hz será 60, para onda completa será duas vezes a frequência da rede, para 60 Hz será 120.

O "Ic" é a corrente máxima na carga, "vo" é a tensão contínua na carga, aquele "n" é porcentagem do ripple desejada.

A unidade é o Farad.

Veja o exemplo da figura para uma corrente de 1A, veja que para 2A o capacitor dobra de valor, a tensão de saída é 12Vcc e o ripple desejado é de 10 %, valor típico.



$$C = \frac{I_0}{8 . f . \eta . V_0}$$

$V_0 = 12V$
$I_0 = 1A$
$\eta = 0{,}1\ (10\%)$
$f = 120$ (Onda Completa)

$$C = \frac{1\ A}{8 .\ 120 .\ 0{,}1 .\ 12} = 868\ \mu F$$

$$C = \frac{2\ A}{8 .\ 120 .\ 0{,}1 .\ 12} = 1736\ \mu F$$

FORMA SIMPLIFICADA DE CALCULAR O CAPACITOR DE FILTRO.

Existe uma forma rápida, lépida e rasteira de calcular o capacitor de filtro, basta fazer o capacitor proporcional a corrente máxima da fonte:

Para cada 1A use um capacitor de capacitância igual ou maior do que 1000 uF para retificador de onda completa.

No exemplo anterior para a corrente de 1A você colocaria 1000 uF ou mais, para 2 A você colocaria 2000 uF ou mais.

Para cada 2A use um capacitor de capacitância igual ou maior do que 2000 uF para retificador de meia completa.

No exemplo anterior para a corrente de 1A você colocaria 2000uF ou mais, para 2 A você colocaria 4000 uF ou mais.

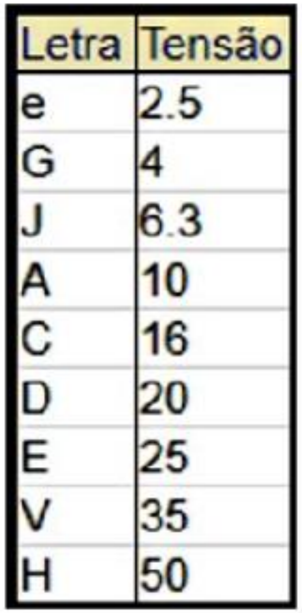
Você também pode pensar em termos de miliamperes, então para retificador de onda completa para cada 1000 mA use um capacitor de 1000 uF ou mais, para onda completa.

Exemplo, para uma corrente de 400 mA, use um capacitor de 400 uF ou mais, pode ser um de 470 uF.

Para meia onda dobre o valor do capacitor, simples assim.

COMO LER CAPACITOR DE TÂNTALO SMD

Sopa de letrinhas do capacitor SMD de tântalo #shorts



Letra	Tensão
e	2.5
G	4
J	6.3
A	10
C	16
D	20
E	25
V	35
H	50

Hoje vou mostrar a sopa de letrinhas dos capacitores smd de tântalo.

O primeiro detalhe é que aquele traço branco não é

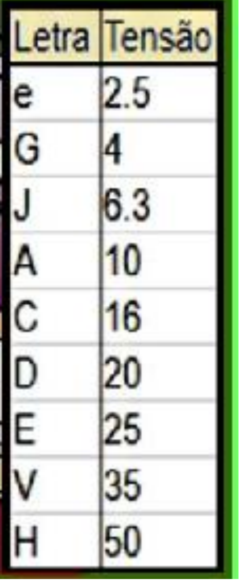
o catodo, é o positivo do capacitor.

O valor do capacitor é descrito na forma de três dígitos, o primeiro e o segundo dígito descrevem o valor numérico e o terceiro digito é o número de zeros, ou multiplicador, e a unidade é o pico Farad, não esqueça.

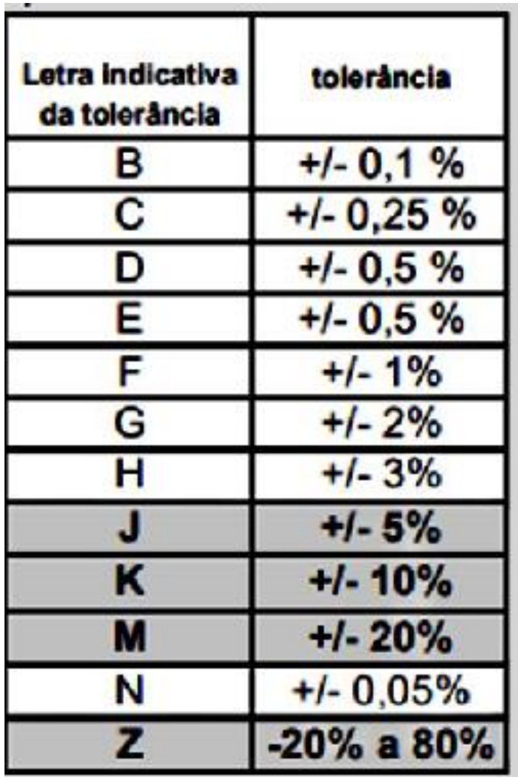
A tensão de trabalho é dada por uma letra conforme a tabela da figura.

27C significa 220uF tensão de 16V, 226E, 22uF tensão de trabalho de 25V.

C	D
Código	Capacitância (µF)
N6	3,3
S6	4,7
W6	6,8
A7	10
E7	15
J7	22
N7	33
S7	47
W7	68
A8	100
E8	150
J8	220
N8	330



Letra	Tensão
e	2.5
G	4
J	6.3
A	10
C	16
D	20
E	25
V	35
H	50



Letra indicativa da tolerância	tolerância
B	+/- 0,1 %
C	+/- 0,25 %
D	+/- 0,5 %
E	+/- 0,5 %
F	+/- 1%
G	+/- 2%
H	+/- 3%
J	+/- 5%
K	+/- 10%
M	+/- 20%
N	+/- 0,05%
Z	-20% a 80%

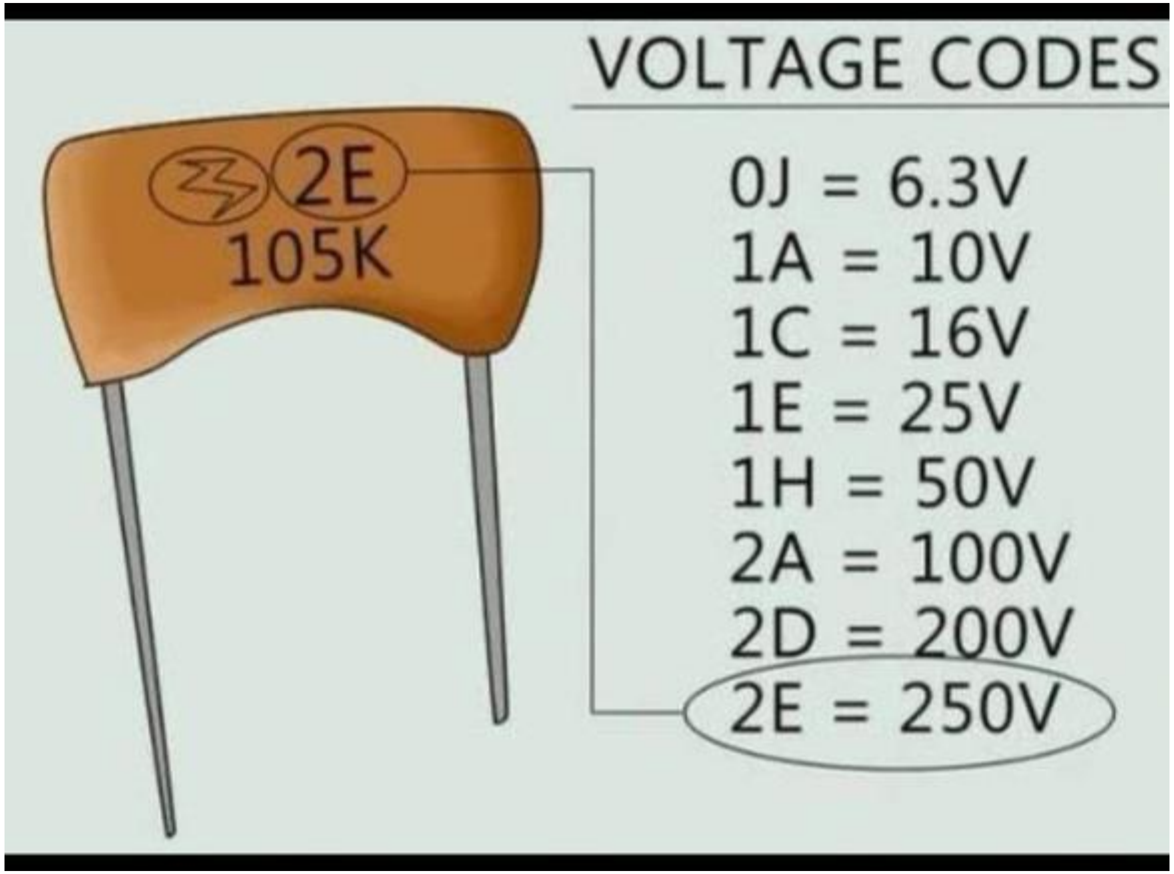
As vezes a capacitância é dada por outra sopa de letrinhas, está na tabela também.

No capacitor da figura a capacitância é igual a 100uF (A8) e o jota tensão de 6,3V.

Cuidado para não se engasgar.

Essa última tabela mostra tolerância e vale para qualquer tipo de capacitor.

TENSÃO DOS CAPACITORES DE CERÂMICA



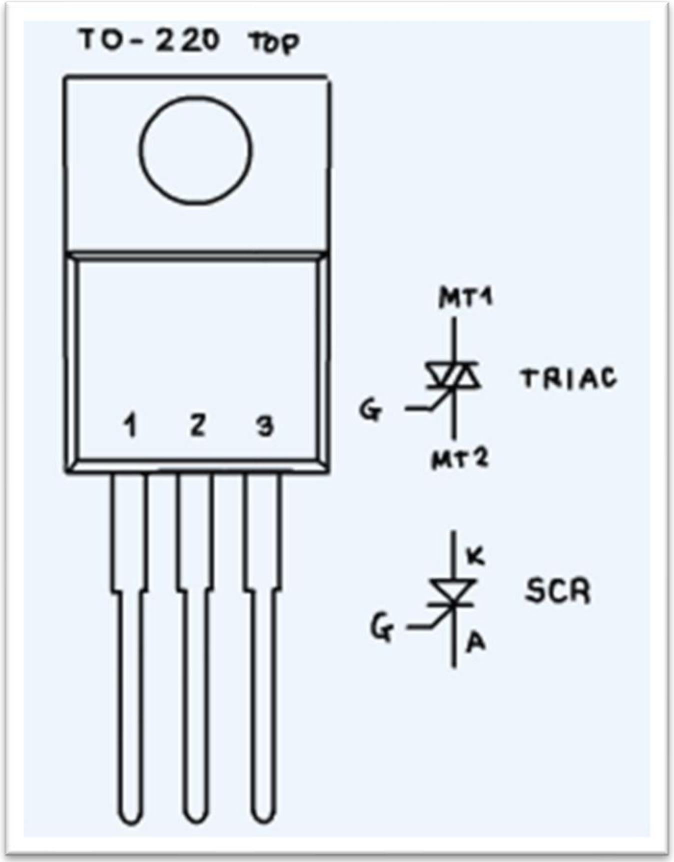
VOLTAGE CODES

0J = 6.3V
1A = 10V
1C = 16V
1E = 25V
1H = 50V
2A = 100V
2D = 200V
2E = 250V

Se não disser nada 50V.

TRIAC TIC206, TIC216

TIC 206/TIC216 /MAC16



TIC 206: 4A

TRIAC para corrente de 4A tensão de trabalho: A=100V, B=200V, D=400V, M=600V, S=700V, N=800V. Pinos: 1=MT1, 2= MT2, 3=G.

TIC 216: 8A

TRIAC para corrente de 8A tensão de trabalho: D=400V, M=600V, S=700V, N=800V.

Pinos: 1=MT1, 2= MT2, 3=G.

MAC16:

TRIAC para corrente de 16A tensão de trabalho: D=400V, M=600V, N=800V,

Pinos: 1=MT1, 2= MT2, 3=G.

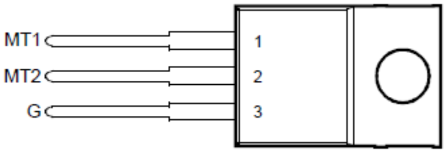
TRIAC TIC246 HIGH CURRENT16A

TIC246 SERIES
SILICON TRIACS

DECEMBER 1971 - REVISED JUNE 2000

- **High Current Triacs**
- **16 A RMS**
- **Glass Passivated Wafer**
- **400 V to 800 V Off-State Voltage**
- **125 A Peak Current**
- **Max I_{GT} of 50 mA (Quadrants 1 - 3)**

TO-220 PACKAGE
(TOP VIEW)



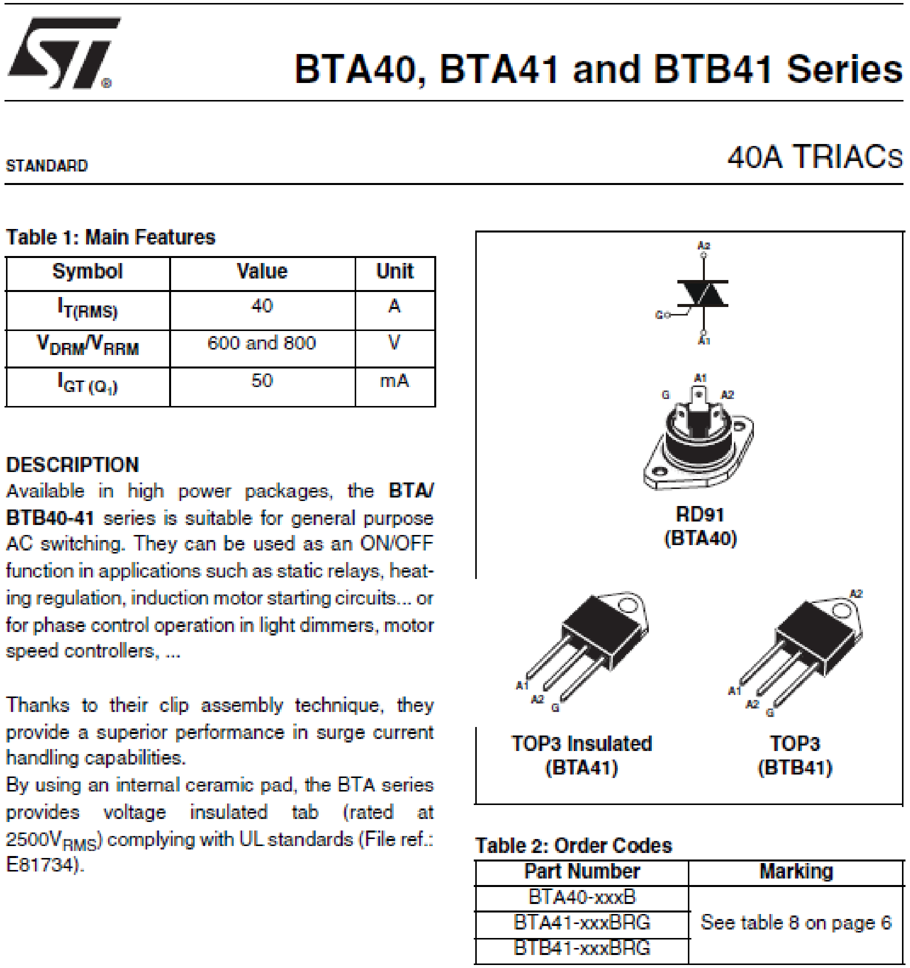
Pin 2 is in electrical contact with the mounting base.

MDC2ACA

absolute maximum ratings over operating case temperature (unless otherwise noted)

RATING		SYMBOL	VALUE	UNIT
Repetitive peak off-state voltage (see Note 1)	TIC246D	V_{DRM}	400	V
	TIC246M		600	
	TIC246S		700	
	TIC246N		800	
Full-cycle RMS on-state current at (or below) 70°C case temperature (see Note 2)		$I_{T(RMS)}$	16	A
Peak on-state surge current full-sine-wave at (or below) 25°C case temperature (see Note 3)		I_{TSM}	125	A
Peak gate current		I_{GM}	±1	A
Operating case temperature range		T_C	-40 to +110	°C
Storage temperature range		T_{stg}	-40 to +125	°C
Lead temperature 1.6 mm from case for 10 seconds		T_L	230	°C

TRIAC BTA40 40A



BTA40, BTA41 and BTB41 Series

STANDARD

40A TRIACs

Table 1: Main Features

Symbol	Value	Unit
$I_{T(RMS)}$	40	A
V_{DRM}/V_{RRM}	600 and 800	V
$I_{GT\ (Q_1)}$	50	mA

RD91
(BTA40)

TOP3 Insulated
(BTA41)

TOP3
(BTB41)

DESCRIPTION

Available in high power packages, the **BTA/ BTB40-41** series is suitable for general purpose AC switching. They can be used as an ON/OFF function in applications such as static relays, heating regulation, induction motor starting circuits... or for phase control operation in light dimmers, motor speed controllers, ...

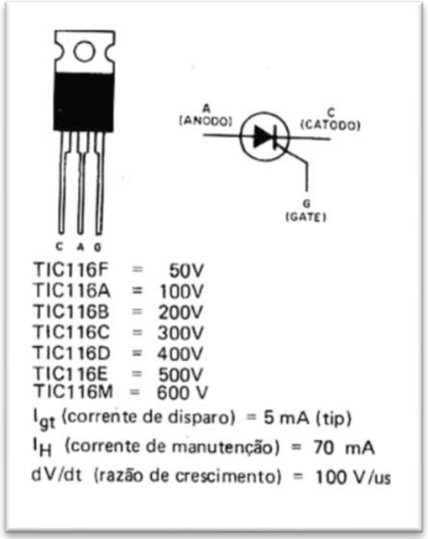
Thanks to their clip assembly technique, they provide a superior performance in surge current handling capabilities.
By using an internal ceramic pad, the BTA series provides voltage insulated tab (rated at 2500V_{RMS}) complying with UL standards (File ref.: E81734).

Table 2: Order Codes

Part Number	Marking
BTA40-xxxB	See table 8 on page 6
BTA41-xxxBRG	
BTB41-xxxBRG	

SCR TIC 106 E FAMÍLIA

TIC106/MCR100



TIC116F = 50V
TIC116A = 100V
TIC116B = 200V
TIC116C = 300V
TIC116D = 400V
TIC116E = 500V
TIC116M = 600 V

I_{gt} (corrente de disparo) = 5 mA (tip)
I_H (corrente de manutenção) = 70 mA
dV/dt (razão de crescimento) = 100 V/us

TIC 106:SCR para corrente de 5A tensão de trabalho: D=400V, M=600V, S=700V, N=800V. Pinos: 1=K, 2= A, 3=G.

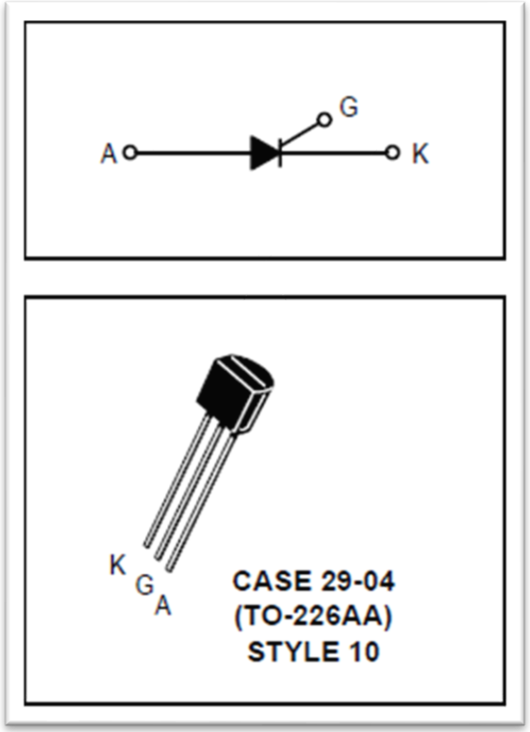
SCR corrente de 0,8A, corrente de Gate bem baixa 200uA e baixa tensão de retenção (Holding current) 5mA.

TIC 116: 6A

para corrente de 8A tensão de trabalho: D=400V, M=600V, S=700V, N=800V. Pinos: 1=K, 2= A, 3=G.

R100: MCR100-3 para 100V,

MCR100 SCR PEQUENO MCR100 E FAMÍLIA



MCR100-4 para 200V, MCR100-5 para 400V, MCR100-6 para 600V.

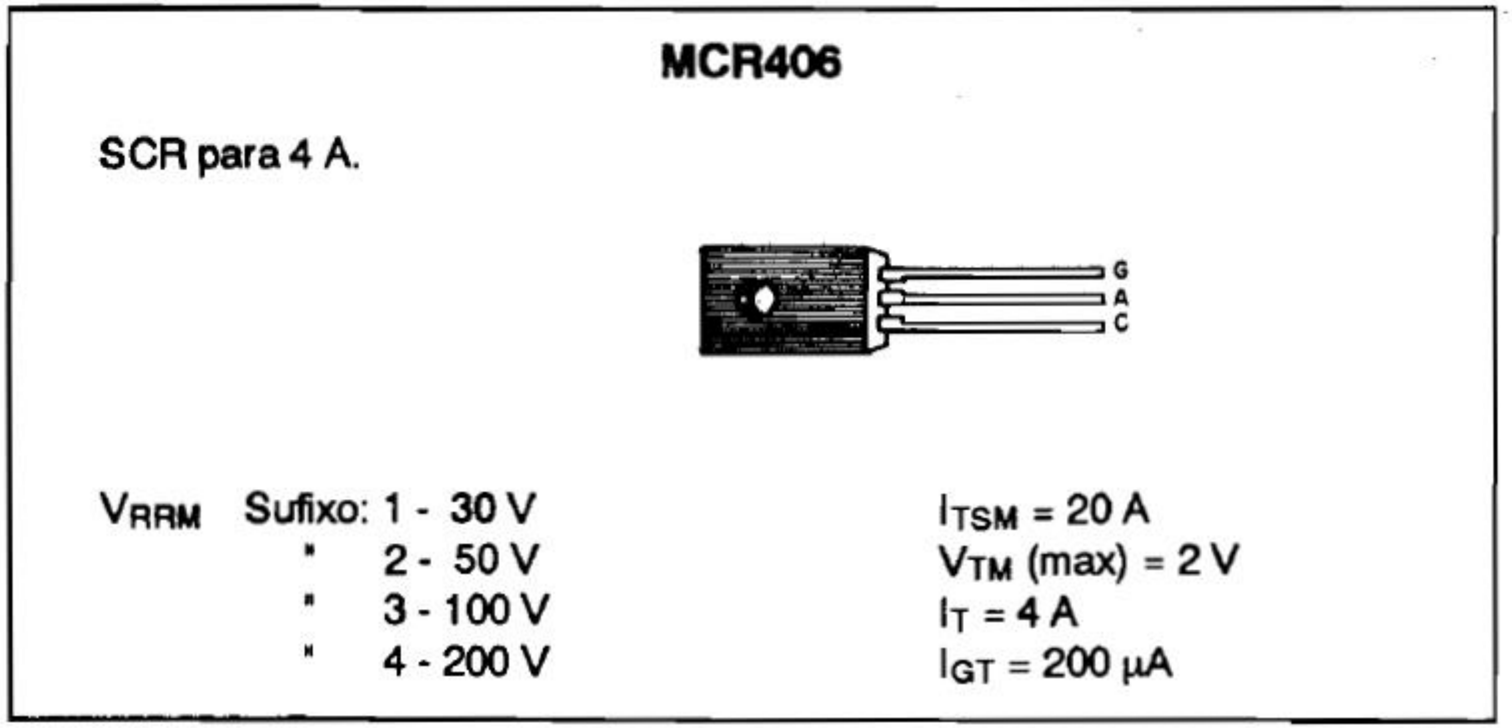
Sensitive Gate Trigger Current — 200 mA Maximum

Low Reverse and Forward Blocking Current — 100 mA Maximum, TC = 125°C

Low Holding Current — 5 mA Maximum

Glass-Passivated Surface for Reliability and Uniformity

MCR406 SCR PARA 4A



MCR406

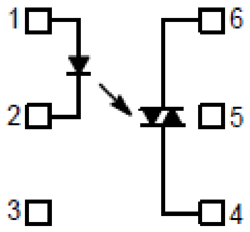
SCR para 4 A.

V_{RRM} Sufixo: 1 - 30 V
" 2 - 50 V
" 3 - 100 V
" 4 - 200 V

$I_{TSM} = 20$ A
V_{TM} (max) = 2 V
$I_T = 4$ A
$I_{GT} = 200$ µA

MOC3021/3022/3023 TRIAC DRIVER

SCHEMATIC

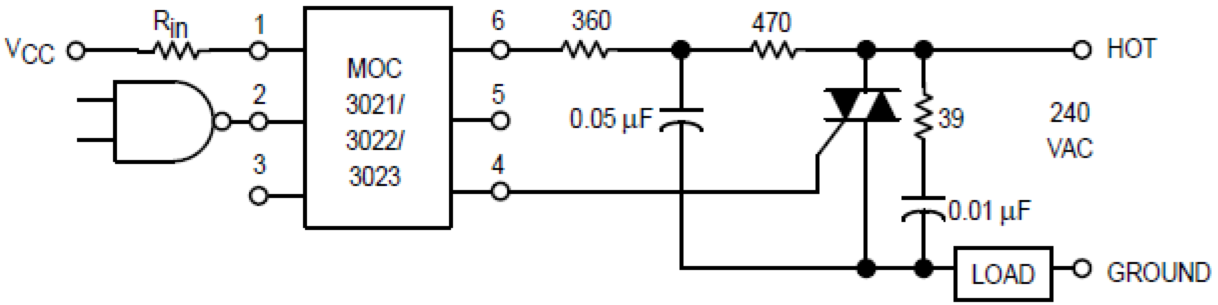


1. ANODE
2. CATHODE
3. NC
4. MAIN TERMINAL
5. SUBSTRATE
   DO NOT CONNECT
6. MAIN TERMINAL

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
INFRARED EMITTING DIODE			
Reverse Voltage	V_R	3	Volts
Forward Current — Continuous	I_F	60	mA
Total Power Dissipation @ T_A = 25°C Negligible Power in Triac Driver Derate above 25°C	P_D	100 1.33	mW mW/°C
OUTPUT DRIVER			
Off–State Output Terminal Voltage	V_{DRM}	400	Volts
Peak Repetitive Surge Current (PW = 1 ms, 120 pps)	I_{TSM}	1	A
Total Power Dissipation @ T_A = 25°C Derate above 25°C	P_D	300 4	mW mW/°C
TOTAL DEVICE			
Isolation Surge Voltage(1) (Peak ac Voltage, 60 Hz, 1 Second Duration)	V_{ISO}	7500	Vac(pk)
Total Power Dissipation @ T_A = 25°C Derate above 25°C	P_D	330 4.4	mW mW/°C
Junction Temperature Range	T_J	–40 to +100	°C
Ambient Operating Temperature Range(2)	T_A	–40 to +85	°C
Storage Temperature Range(2)	T_{stg}	–40 to +150	°C
Soldering Temperature (10 s)	T_L	260	°C

MOC3021 MOC3022 MOC3023



* This optoisolator should not be used to drive a load directly. It is intended to be a trigger device only.

Additional information on the use of optically coupled triac drivers is available in Application Note AN–780A.

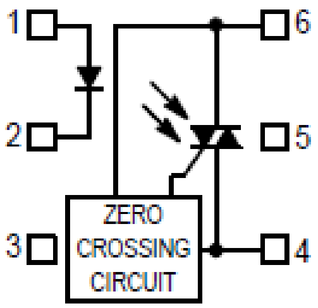
In this circuit the "hot" side of the line is switched and the load connected to the cold or ground side.

The 39 ohm resistor and 0.01 µF capacitor are for snubbing of the triac, and the 470 ohm resistor and 0.05 µF capacitor are for snubbing the coupler. These components may or may not be necessary depending upon the particular triac and load used.

Figure 8. Typical Application Circuit

MOC 3041/ 3042/ 3043 O MOC COM DETECÇÃO DA PASSAGEM POR ZERO

COUPLER SCHEMATIC

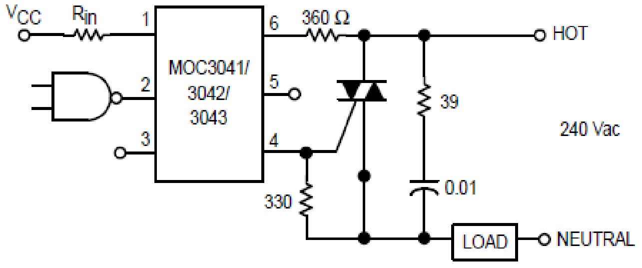


1. ANODE
2. CATHODE
3. NC
4. MAIN TERMINAL
5. SUBSTRATE
   DO NOT CONNECT
6. MAIN TERMINAL

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
INFRARED EMITTING DIODE			
Reverse Voltage	V_R	6	Volts
Forward Current — Continuous	I_F	60	mA
Total Power Dissipation @ T_A = 25°C Negligible Power in Output Driver Derate above 25°C	P_D	120 1.41	mW mW/°C
OUTPUT DRIVER			
Off–State Output Terminal Voltage	V_{DRM}	400	Volts
Peak Repetitive Surge Current (PW = 100 µs, 120 pps)	I_{TSM}	1	A
Total Power Dissipation @ T_A = 25°C Derate above 25°C	P_D	150 1.76	mW mW/°C
TOTAL DEVICE			
Isolation Surge Voltage(1) (Peak ac Voltage, 60 Hz, 1 Second Duration)	V_{ISO}	7500	Vac(pk)
Total Power Dissipation @ T_A = 25°C Derate above 25°C	P_D	250 2.94	mW mW/°C
Junction Temperature Range	T_J	–40 to +100	°C
Ambient Operating Temperature Range(2)	T_A	–40 to +85	°C
Storage Temperature Range(2)	T_{stg}	–40 to +150	°C
Soldering Temperature (10 s)	T_L	260	°C

MOC3041 MOC3042 MOC3043

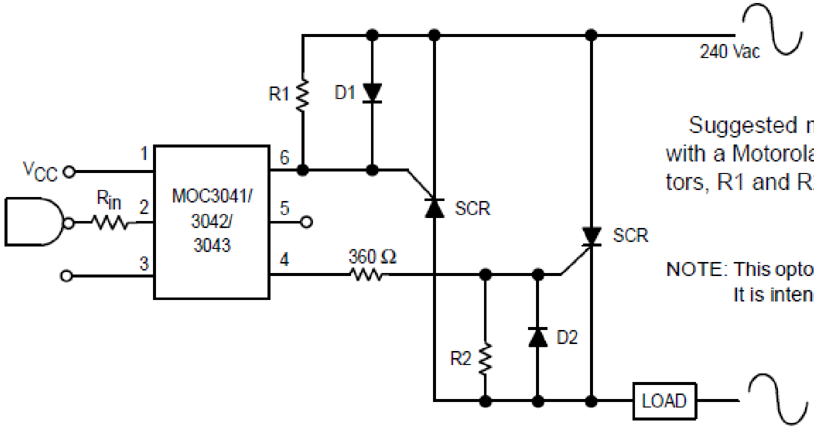


Typical circuit for use when hot line switching is required. In this circuit the "hot" side of the line is switched and the load connected to the cold or neutral side. The load may be connected to either the neutral or hot line.

R_{in} is calculated so that I_F is equal to the rated I_{FT} of the part, 5 mA for the MOC3043, 10 mA for the MOC3042, or 15 mA for the MOC3041. The 39 ohm resistor and 0.01 µF capacitor are for snubbing of the triac and may or may not be necessary depending upon the particular triac and load used.

* For highly inductive loads (power factor < 0.5), change this value to 360 ohms.

Figure 8. Hot–Line Switching Application Circuit



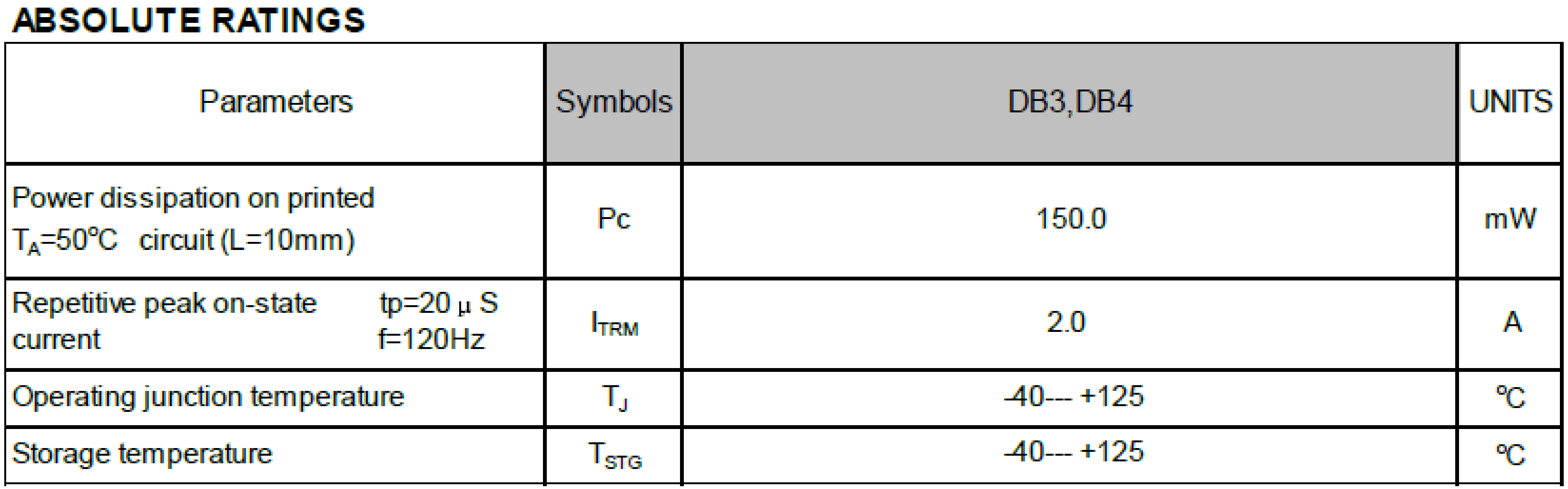
Suggested method of firing two, back–to–back SCR's, with a Motorola triac driver. Diodes can be 1N4001; resistors, R1 and R2, are optional 330 ohms.

NOTE: This optoisolator should not be used to drive a load directly. It is intended to be a trigger device only.

Figure 9. Inverse–Parallel SCR Driver Circuit

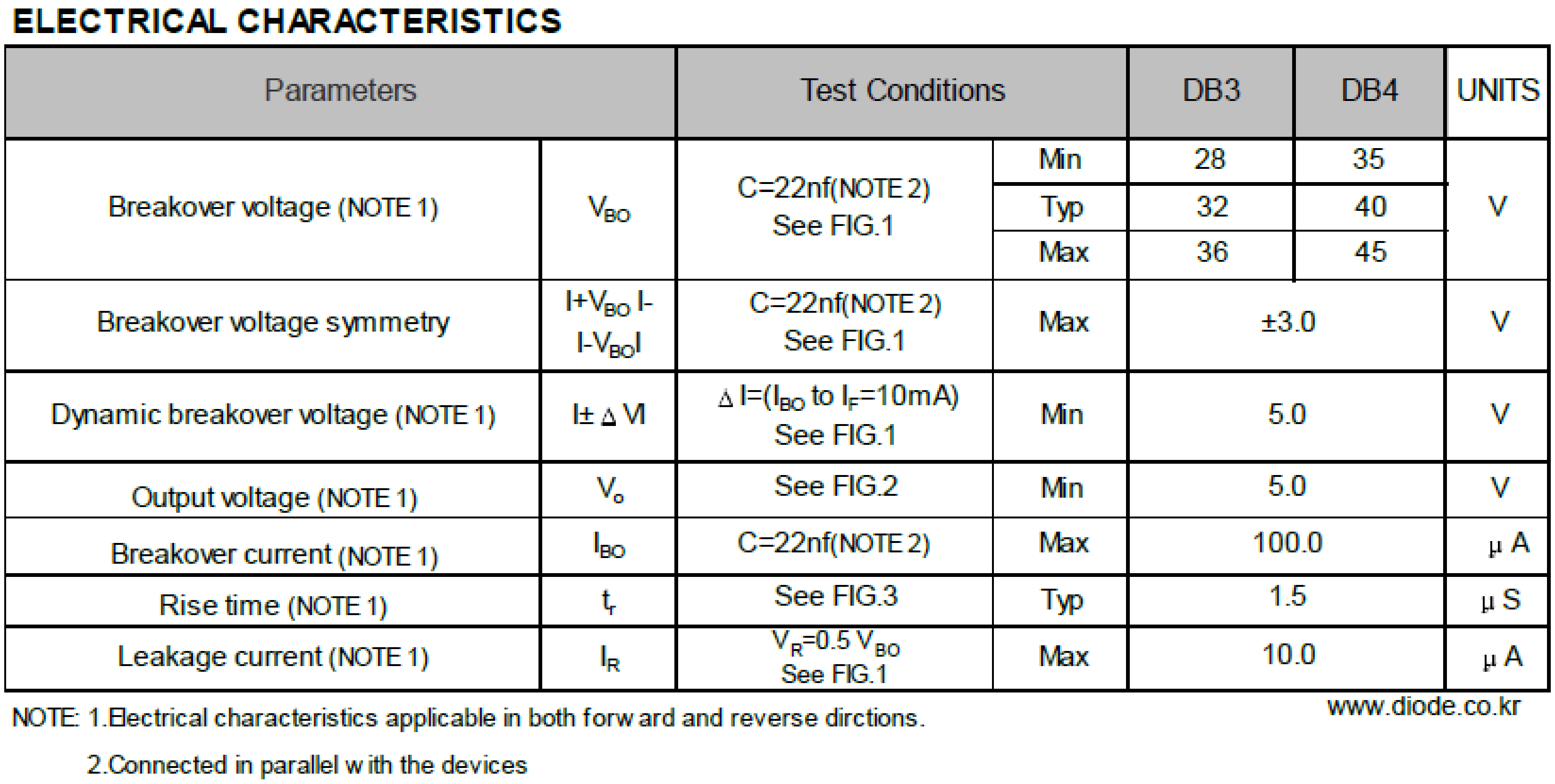
DIAC DB3/DB4

TIRISTOR BIDIRECIONAL.



ABSOLUTE RATINGS

Parameters		Symbols	DB3,DB4	UNITS
Power dissipation on printed T_A=50°C circuit (L=10mm)		Pc	150.0	mW
Repetitive peak on-state current	tp=20 μ S f=120Hz	I_{TRM}	2.0	A
Operating junction temperature		T_J	-40--- +125	℃
Storage temperature		T_{STG}	-40--- +125	℃



ELECTRICAL CHARACTERISTICS

Parameters		Test Conditions		DB3	DB4	UNITS
Breakover voltage (NOTE 1)	V_{BO}	C=22nf(NOTE 2) See FIG.1	Min	28	35	V
			Typ	32	40	
			Max	36	45	
Breakover voltage symmetry	$\lvert +V_{BO}\rvert - \lvert -V_{BO}\rvert$	C=22nf(NOTE 2) See FIG.1	Max	±3.0		V
Dynamic breakover voltage (NOTE 1)	$\lvert \pm \Delta V \rvert$	$\Delta I=(I_{BO}$ to $I_F=10mA)$ See FIG.1	Min	5.0		V
Output voltage (NOTE 1)	V_o	See FIG.2	Min	5.0		V
Breakover current (NOTE 1)	I_{BO}	C=22nf(NOTE 2)	Max	100.0		μ A
Rise time (NOTE 1)	t_r	See FIG.3	Typ	1.5		μ S
Leakage current (NOTE 1)	I_R	$V_R=0.5\ V_{BO}$ See FIG.1	Max	10.0		μ A

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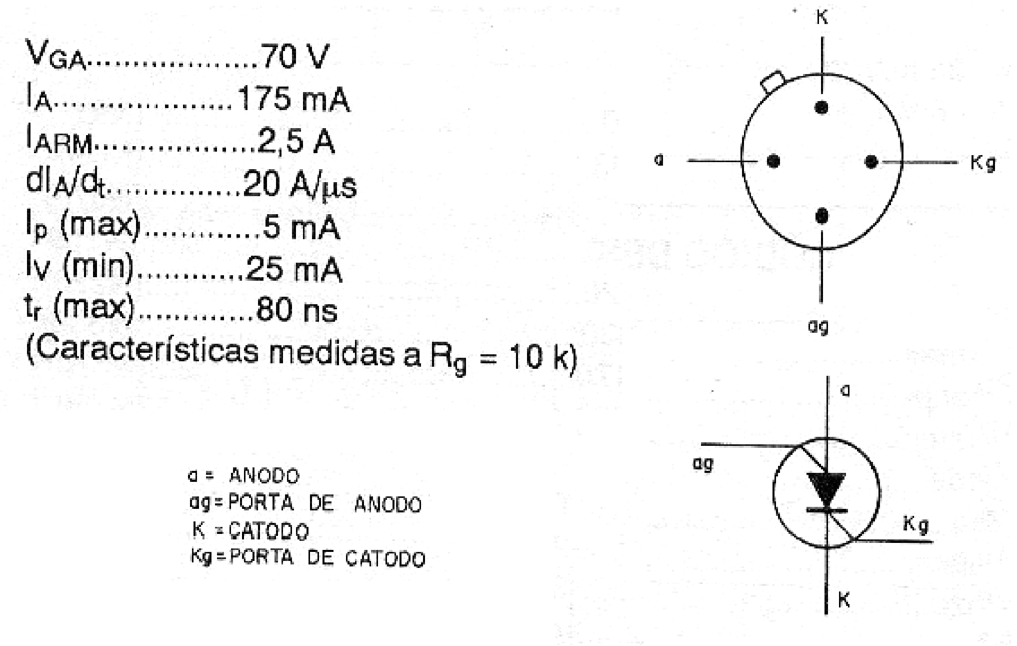
NOTE: 1.Electrical characteristics applicable in both forward and reverse dirctions.

2.Connected in parallel with the devices

PUT BRY39P

O mais popular, mas pouco usado atualmente.



V_{GA}..................70 V
I_A...................175 mA
I_{ARM}.................2,5 A
dI_A/d_t..............20 A/μs
I_p (max)............5 mA
I_V (min)...........25 mA
t_r (max)............80 ns
(Características medidas a R_g = 10 k)

a = ANODO
ag = PORTA DE ANODO
K = CATODO
Kg = PORTA DE CATODO

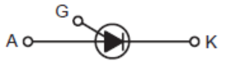
Figura 13 – O BRY39, PUT de uso geral

PUT 2N6027 2N6028

ON Semiconductor

http://onsemi.com

PUTs
40 VOLTS
300 mW



TO–92 (TO–226AA)
CASE 029
STYLE 16

PIN ASSIGNMENT	
1	Anode
2	Gate
3	Cathode

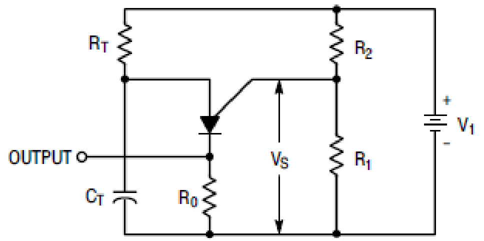


Figure 3.29(a). Typical Oscillator Circuit

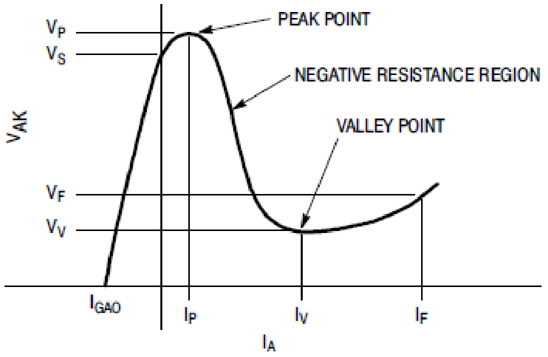


Figure 3.29(b). Static Characteristics

Table 3.1. Typical PUT Characteristics

Symbol	Test Circuit Figure	Test Conditions	2N6027	2N6028	Unit
I_P	3.30	R_G = 1 mΩ R_G = 10 kΩ	1.25 4	0.08 0.70	µA µA
I_V	3.30	R_G = 1 MΩ R_G = 10 kΩ	18 150	18 150	µA µA
V_{AG}		(See Figure 3.31)			
I_{GAO}		V_S = 40 V	(See Figure 3.32)		
I_{GKS}		V_S = 40 V	5	5	nA
V_F	Curve Tracer Used	I_F = 50 mA	0.8	0.8	V
V_O	3.33		11	11	V
t_r	3.34		40	40	ns

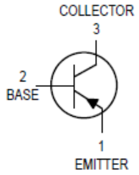
TRANSISTOR

TRANSISTOR DE USO GERAL

BC212 13 14 PNP 0,1A

Amplifier Transistors

PNP Silicon



BC212,B
BC213
BC214

CASE 29–04, STYLE 17
TO–92 (TO–226AA)

MAXIMUM RATINGS

Rating	Symbol	BC 212	BC 213	BC 214	Unit
Collector–Emitter Voltage	V_{CEO}	–50	–30	–30	Vdc
Collector–Base Voltage	V_{CBO}	–60	–45	–45	Vdc
Emitter–Base Voltage	V_{EBO}	–5.0			Vdc
Collector Current — Continuous	I_C	–100			mAdc
Total Device Dissipation @ $T_A = 25°C$ Derate above 25°C	P_D	350 2.8			mW mW/°C
Total Device Dissipation @ $T_C = 25°C$ Derate above 25°C	P_D	1.0 8.0			Watts mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	–55 to +150			°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	357	°C/W
Thermal Resistance, Junction to Case	$R_{\theta JC}$	125	°C/W

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

Characteristic		Symbol	Min	Typ	Max	Unit
Collector–Emitter Breakdown Voltage ($I_C = –2.0$ mAdc, $I_B = 0$)	BC212	$V_{(BR)CEO}$	–50	—	—	Vdc
	BC213		–30	—	—	
	BC214		–30	—	—	
Collector–Base Breakdown Voltage ($I_C = –10$ μA, $I_E = 0$)	BC212	$V_{(BR)CBO}$	–60	—	—	Vdc
	BC213		–45	—	—	
	BC214		–45	—	—	
Emitter–Base Breakdown Voltage ($I_E = –10$ μAdc, $I_C = 0$)	BC212	$V_{(BR)EBO}$	–5	—	—	Vdc
	BC213		–5	—	—	
	BC214		–5	—	—	
Collector–Emitter Leakage Current ($V_{CB} = –30$ V)	BC212	I_{CBO}	—	—	–15	nAdc
	BC213		—	—	–15	
	BC214		—	—	–15	
Emitter–Base Leakage Current ($V_{EB} = –4.0$ V, $I_C = 0$)	BC212	I_{EBO}	—	—	–15	nAdc
	BC213		—	—	–15	
	BC214		—	—	–15	

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

Characteristic		Symbol	Min	Typ	Max	Unit
ON CHARACTERISTICS						
DC Current Gain		h_{FE}				—
($I_C = –10$ μAdc, $V_{CE} = –5.0$ Vdc)	BC212		40	—	—	
	BC213		40	—	—	
	BC214		100	—	—	
($I_C = –2.0$ mAdc, $V_{CE} = –5.0$ Vdc)	BC212		60	—	—	
	BC213		80	—	—	
	BC214		140	—	600	
($I_C = –100$ mAdc, $V_{CE} = –5.0$ Vdc)(1)	BC212, BC214		—	120	—	
	BC213		—	140	—	
Collector–Emitter Saturation Voltage		$V_{CE(sat)}$				Vdc
($I_C = –10$ mAdc, $I_B = –0.5$ mAdc)			—	–0.10	—	
($I_C = –100$ mAdc, $I_B = –5.0$ mAdc)(1)			—	–0.25	–0.6	
Base–Emitter Saturation Voltage ($I_C = –100$ mAdc, $I_B = –5.0$ mAdc)		$V_{BE(sat)}$	—	–1.0	–1.4	Vdc
Base–Emitter On Voltage ($I_C = –2.0$ mAdc, $V_{CE} = –5.0$ Vdc)		$V_{BE(on)}$	–0.6	–0.62	–0.72	Vdc

DYNAMIC CHARACTERISTICS

Current–Gain — Bandwidth Product		f_T				MHz
(I_C = –10 mAdc, V_{CE} = –5.0 Vdc, f = 100 MHz)	BC212		—	280	—	
	BC214		—	320	—	
	BC213		—	360	—	
Common–Base Output Capacitance		C_{ob}	—	—	6.0	pF
(V_{CB} = –10 Vdc, I_C = 0, f = 1.0 MHz)						
Noise Figure		NF				dB
(I_C = –0.2 mAdc, V_{CE} = –5.0 Vdc, R_S = 2.0 kΩ , f = 1.0 kHz)	BC214		—	—	2	
(I_C = –0.2 mAdc, V_{CE} = –5.0 Vdc, R_S = 2.0 kΩ, f = 1.0 kHz, f = 200 Hz)	BC212, BC213		—	—	10	
Small–Signal Current Gain		h_{fe}				—
(I_C = –2.0 mAdc, V_{CE} = –5.0 Vdc, f = 1.0 kHz)	BC212		60	—	—	
	BC213		80	—	—	
	BC214		140	—	—	
	BC212B		200	—	400	

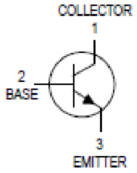
1. Pulse Test: Tp 300 s, Duty Cycle 2.0%.

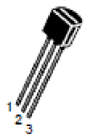
BC547 58 NPN 0,1A

Amplifier Transistors

NPN Silicon

BC546, B
BC547, A, B, C
BC548, A, B, C





CASE 29–04, STYLE 17
TO–92 (TO–226AA)

MAXIMUM RATINGS

Rating	Symbol	BC 546	BC 547	BC 548	Unit
Collector–Emitter Voltage	V_{CEO}	65	45	30	Vdc
Collector–Base Voltage	V_{CBO}	80	50	30	Vdc
Emitter–Base Voltage	V_{EBO}	6.0			Vdc
Collector Current — Continuous	I_C	100			mAdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	625 5.0			mW mW/°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	1.5 12			Watt mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	–55 to +150			°C

THERMAL CHARACTERISTICS

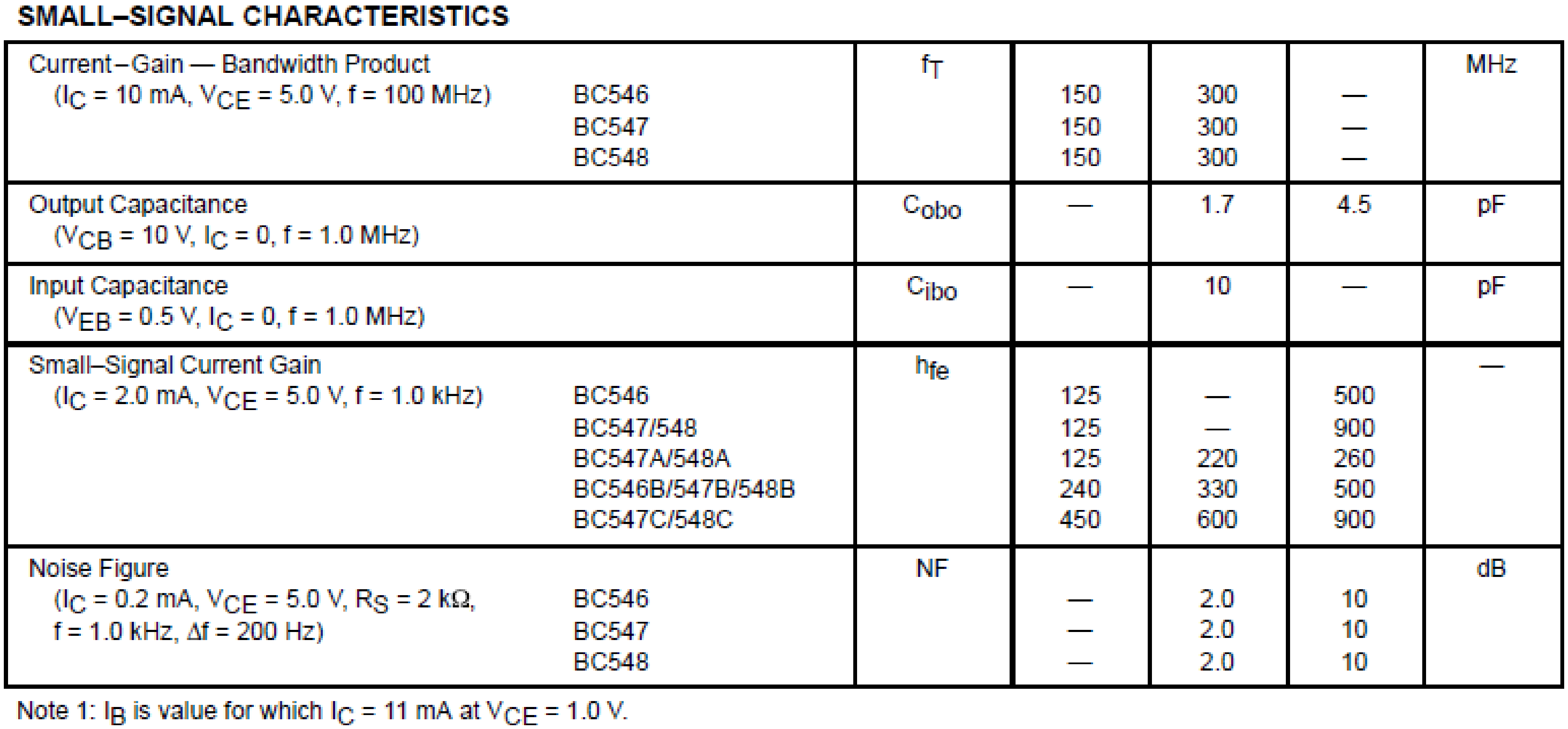
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W

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

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector–Emitter Breakdown Voltage (I_C = 1.0 mA, I_B = 0)	BC546 BC547 BC548	$V_{(BR)CEO}$	65 45 30	— — —	— — —	V
Collector–Base Breakdown Voltage (I_C = 100 µAdc)	BC546 BC547 BC548	$V_{(BR)CBO}$	80 50 30	— — —	— — —	V
Emitter–Base Breakdown Voltage (I_E = 10 µA, I_C = 0)	BC546 BC547 BC548	$V_{(BR)EBO}$	6.0 6.0 6.0	— — —	— — —	V
Collector Cutoff Current (V_{CE} = 70 V, V_{BE} = 0) (V_{CE} = 50 V, V_{BE} = 0) (V_{CE} = 35 V, V_{BE} = 0) (V_{CE} = 30 V, T_A = 125°C)	BC546 BC547 BC548 BC546/547/548	I_{CES}	— — — —	0.2 0.2 0.2 —	15 15 15 4.0	nA µA

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

Characteristic		Symbol	Min	Typ	Max	Unit
ON CHARACTERISTICS						
DC Current Gain		h_{FE}				—
(I_C = 10 µA, V_{CE} = 5.0 V)	BC547A/548A BC546B/547B/548B BC548C		— — —	90 150 270	— — —	
(I_C = 2.0 mA, V_{CE} = 5.0 V)	BC546 BC547 BC548 BC547A/548A BC546B/547B/548B BC547C/BC548C		110 110 110 110 200 420	— — — 180 290 520	450 800 800 220 450 800	
(I_C = 100 mA, V_{CE} = 5.0 V)	BC547A/548A BC546B/547B/548B BC548C		— — —	120 180 300	— — —	
Collector–Emitter Saturation Voltage (I_C = 10 mA, I_B = 0.5 mA) (I_C = 100 mA, I_B = 5.0 mA) (I_C = 10 mA, I_B = See Note 1)		$V_{CE(sat)}$	— — —	0.09 0.2 0.3	0.25 0.6 0.6	V
Base–Emitter Saturation Voltage (I_C = 10 mA, I_B = 0.5 mA)		$V_{BE(sat)}$	—	0.7	—	V
Base–Emitter On Voltage (I_C = 2.0 mA, V_{CE} = 5.0 V) (I_C = 10 mA, V_{CE} = 5.0 V)		$V_{BE(on)}$	0.55 —	— —	0.7 0.77	V



SMALL–SIGNAL CHARACTERISTICS

Current–Gain — Bandwidth Product (I_C = 10 mA, V_{CE} = 5.0 V, f = 100 MHz)	BC546 BC547 BC548	f_T	150 150 150	300 300 300	— — —	MHz
Output Capacitance (V_{CB} = 10 V, I_C = 0, f = 1.0 MHz)		C_{obo}	—	1.7	4.5	pF
Input Capacitance (V_{EB} = 0.5 V, I_C = 0, f = 1.0 MHz)		C_{ibo}	—	10	—	pF
Small–Signal Current Gain (I_C = 2.0 mA, V_{CE} = 5.0 V, f = 1.0 kHz)	BC546 BC547/548 BC547A/548A BC546B/547B/548B BC547C/548C	h_{fe}	125 125 125 240 450	— — 220 330 600	500 900 260 500 900	—
Noise Figure (I_C = 0.2 mA, V_{CE} = 5.0 V, R_S = 2 kΩ, f = 1.0 kHz, Δf = 200 Hz)	BC546 BC547 BC548	NF	— — —	2.0 2.0 2.0	10 10 10	dB

Note 1: I_B is value for which I_C = 11 mA at V_{CE} = 1.0 V.

BC549 BC550 ALTO GANHO

**Philips
Semiconductors**

PHILIPS

Philips Semiconductors **Product specification**

NPN general purpose transistors BC549; BC550

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 45 V).

APPLICATIONS

- Low noise stages in audio frequency equipment.

DESCRIPTION

NPN transistor in a TO-92; SOT54 plastic package.
PNP complements: BC559 and BC560.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

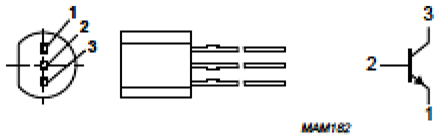
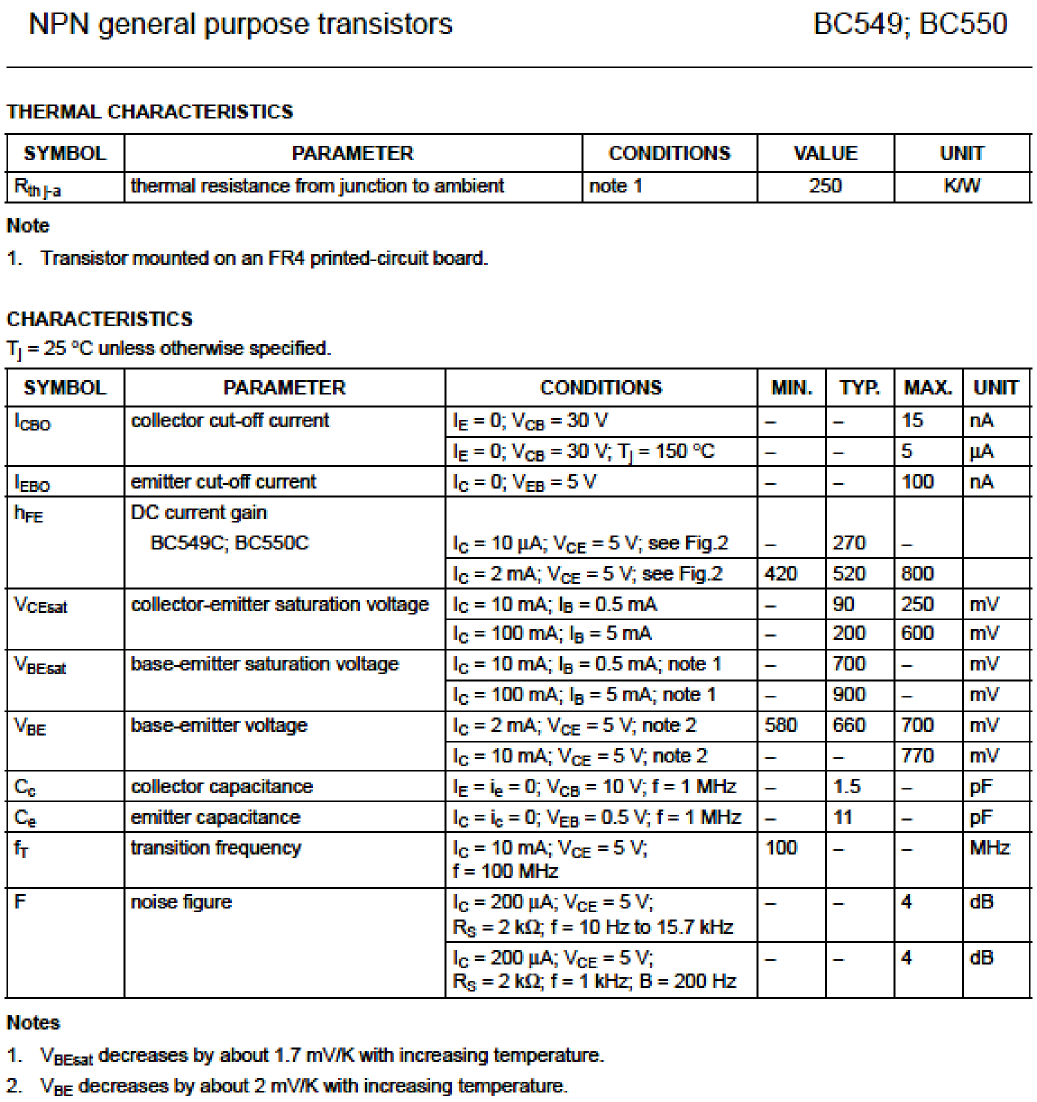


Fig.1 Simplified outline (TO-92; SOT54) and symbol.



NPN general purpose transistors BC549; BC550

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 30$ V	–	–	15	nA
		$I_E = 0$; $V_{CB} = 30$ V; $T_j = 150$ °C	–	–	5	µA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 5$ V	–	–	100	nA
h_{FE}	DC current gain BC549C; BC550C	$I_C = 10$ µA; $V_{CE} = 5$ V; see Fig.2	–	270	–	
		$I_C = 2$ mA; $V_{CE} = 5$ V; see Fig.2	420	520	800	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA	–	90	250	mV
		$I_C = 100$ mA; $I_B = 5$ mA	–	200	600	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 0.5$ mA; note 1	–	700	–	mV
		$I_C = 100$ mA; $I_B = 5$ mA; note 1	–	900	–	mV
V_{BE}	base-emitter voltage	$I_C = 2$ mA; $V_{CE} = 5$ V; note 2	580	660	700	mV
		$I_C = 10$ mA; $V_{CE} = 5$ V; note 2	–	–	770	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	1.5	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	11	–	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 5$ V; f = 100 MHz	100	–	–	MHz
F	noise figure	$I_C = 200$ µA; $V_{CE} = 5$ V; $R_S = 2$ kΩ; f = 10 Hz to 15.7 kHz	–	–	4	dB
		$I_C = 200$ µA; $V_{CE} = 5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz	–	–	4	dB

Notes

1. V_{BEsat} decreases by about 1.7 mV/K with increasing temperature.
2. V_{BE} decreases by about 2 mV/K with increasing temperature.

BC337 38 NPN 0,8A

BC337, BC337-25, BC337-40

Amplifier Transistors

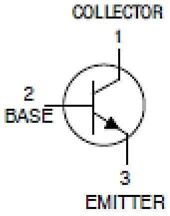
NPN Silicon

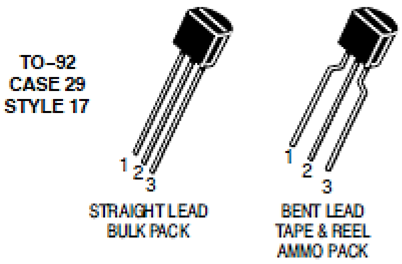
ON Semiconductor®

http://onsemi.com

Features

- These are Pb−Free Devices





MAXIMUM RATINGS

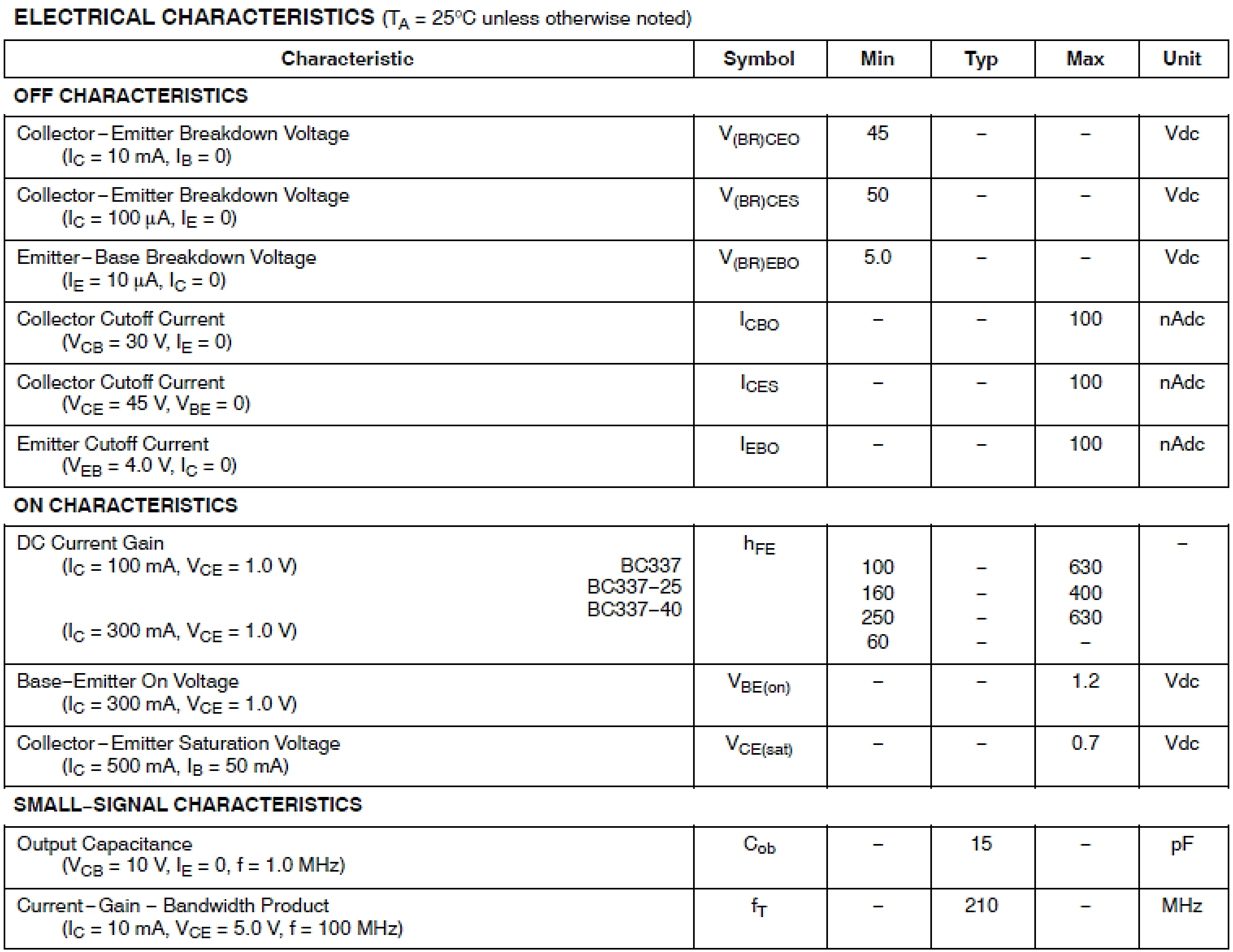
Rating	Symbol	Value	Unit
Collector − Emitter Voltage	V_{CEO}	45	Vdc
Collector − Base Voltage	V_{CBO}	50	Vdc
Emitter − Base Voltage	V_{EBO}	5.0	Vdc
Collector Current − Continuous	I_C	800	mAdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	625 5.0	mW mW/°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	1.5 12	W mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction−to−Ambient	$R_{\theta JA}$	200	°C/W
Thermal Resistance, Junction−to−Case	$R_{\theta JC}$	83.3	°C/W

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

MARKING DIAGRAM



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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector – Emitter Breakdown Voltage (I_C = 10 mA, I_B = 0)	$V_{(BR)CEO}$	45	–	–	Vdc
Collector – Emitter Breakdown Voltage (I_C = 100 µA, I_E = 0)	$V_{(BR)CES}$	50	–	–	Vdc
Emitter – Base Breakdown Voltage (I_E = 10 µA, I_C = 0)	$V_{(BR)EBO}$	5.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 30 V, I_E = 0)	I_{CBO}	–	–	100	nAdc
Collector Cutoff Current (V_{CE} = 45 V, V_{BE} = 0)	I_{CES}	–	–	100	nAdc
Emitter Cutoff Current (V_{EB} = 4.0 V, I_C = 0)	I_{EBO}	–	–	100	nAdc
ON CHARACTERISTICS					
DC Current Gain	h_{FE}				–
(I_C = 100 mA, V_{CE} = 1.0 V) BC337		100	–	630	
BC337–25		160	–	400	
BC337–40		250	–	630	
(I_C = 300 mA, V_{CE} = 1.0 V)		60	–	–	
Base–Emitter On Voltage (I_C = 300 mA, V_{CE} = 1.0 V)	$V_{BE(on)}$	–	–	1.2	Vdc
Collector – Emitter Saturation Voltage (I_C = 500 mA, I_B = 50 mA)	$V_{CE(sat)}$	–	–	0.7	Vdc
SMALL–SIGNAL CHARACTERISTICS					
Output Capacitance (V_{CB} = 10 V, I_E = 0, f = 1.0 MHz)	C_{ob}	–	15	–	pF
Current – Gain – Bandwidth Product (I_C = 10 mA, V_{CE} = 5.0 V, f = 100 MHz)	f_T	–	210	–	MHz

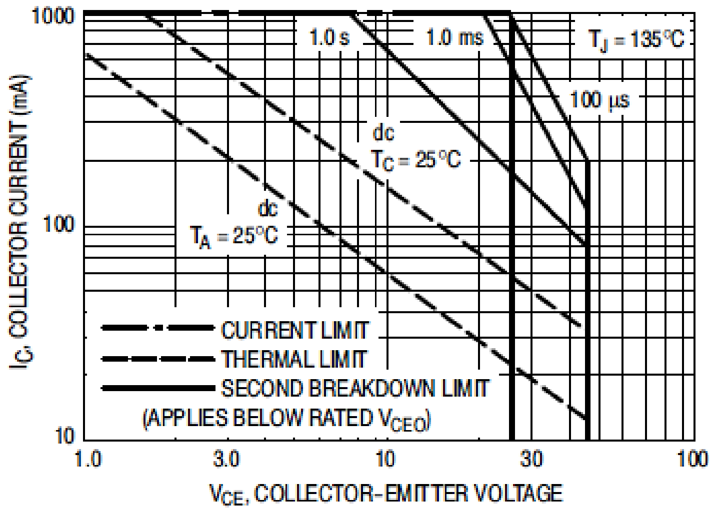


Figure 2. Active Region – Safe Operating Area

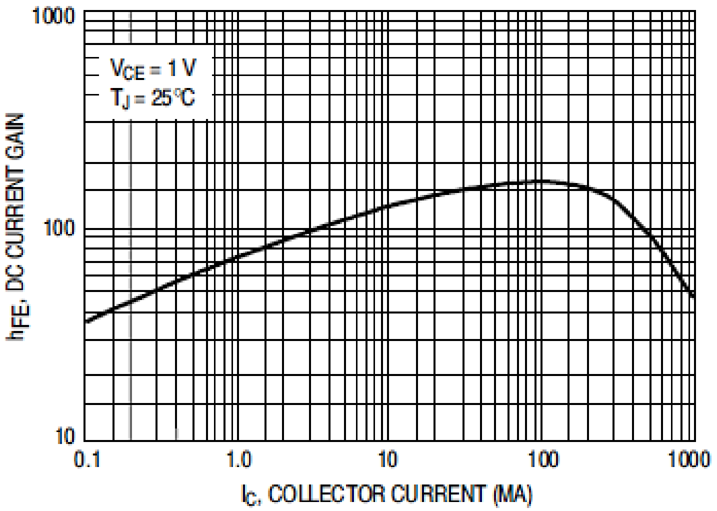


Figure 3. DC Current Gain

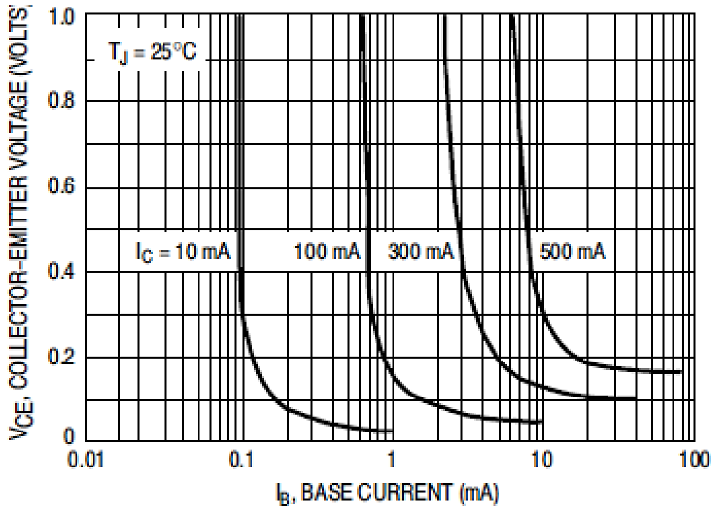


Figure 4. Saturation Region

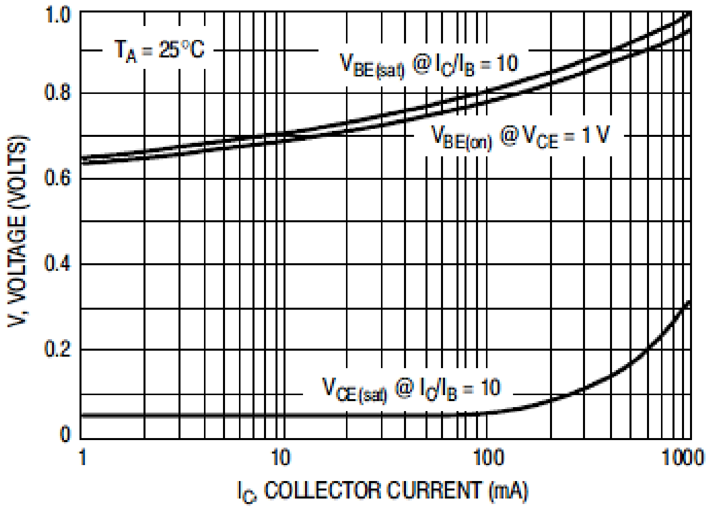


Figure 5. “On” Voltages

BC327 BC328 PNP 0,8A

BC327, BC327-16, BC327-25, BC327-40

Amplifier Transistors

PNP Silicon

ON Semiconductor®

http://onsemi.com

Features

- Pb−Free Packages are Available*

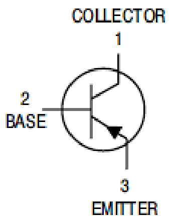
MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector−Emitter Voltage	V_{CEO}	−45	Vdc
Collector−Base Voltage	V_{CES}	−50	Vdc
Collector−Emitter Voltage	V_{EBO}	−5.0	Vdc
Collector Current − Continuous	I_C	−800	mAdc
Total Power Dissipation @ T_A = 25°C Derate above T_A = 25°C	P_D	625 5.0	mW mW/°C
Total Power Dissipation @ T_A = 25°C Derate above T_A = 25°C	P_D	1.5 12	W mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−55 to +150	°C

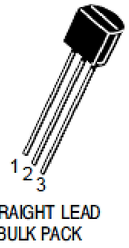
THERMAL CHARACTERISTICS

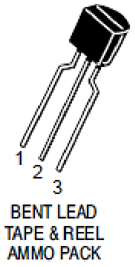
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction−to−Ambient	$R_{\theta JA}$	200	°C/W
Thermal Resistance, Junction−to−Case	$R_{\theta JC}$	83.3	°C/W

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

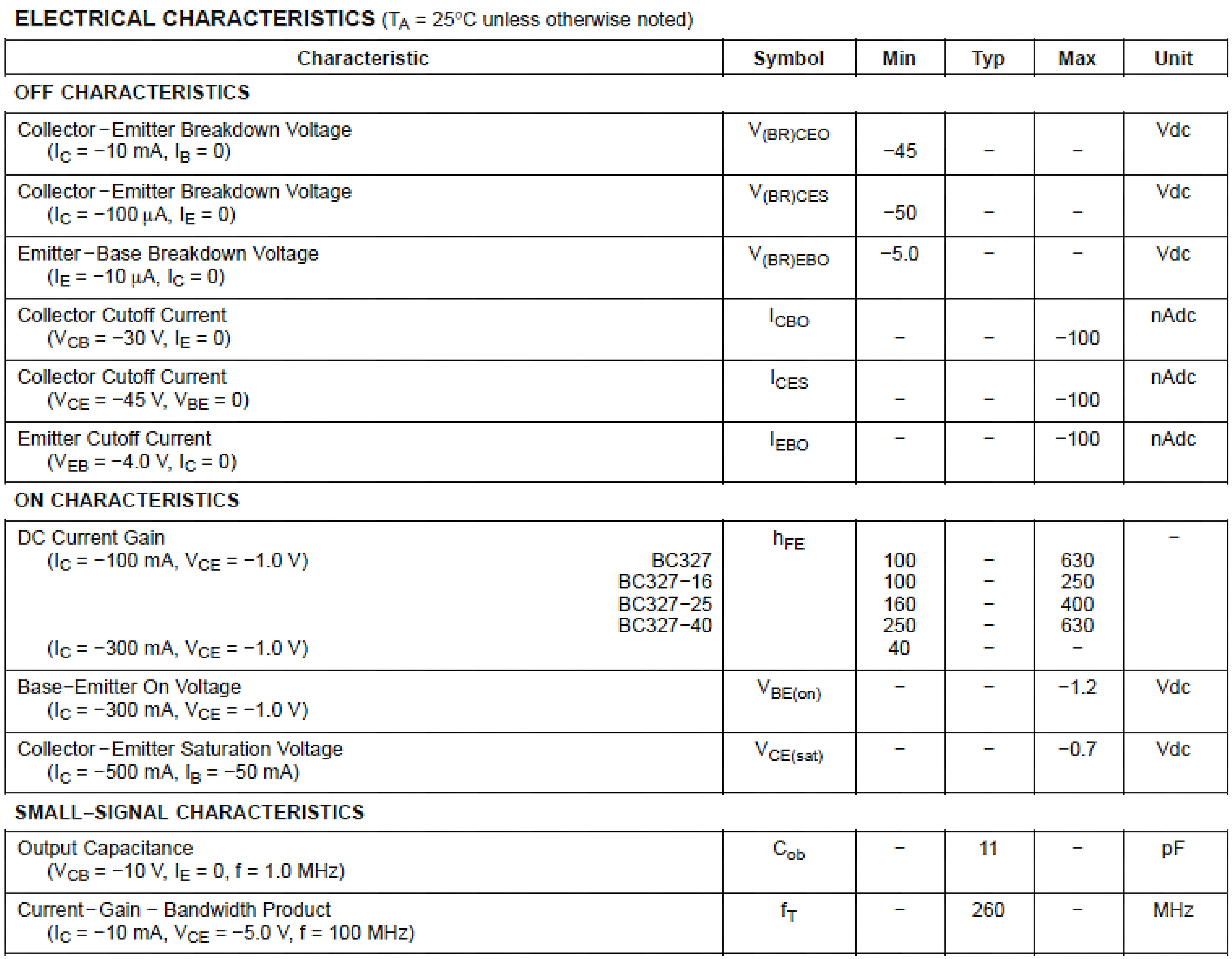


TO−92
CASE 29
STYLE 17





MARKING DIAGRAM



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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector−Emitter Breakdown Voltage (I_C = −10 mA, I_B = 0)	$V_{(BR)CEO}$	−45	–	–	Vdc
Collector−Emitter Breakdown Voltage (I_C = −100 μA, I_E = 0)	$V_{(BR)CES}$	−50	–	–	Vdc
Emitter−Base Breakdown Voltage (I_E = −10 μA, I_C = 0)	$V_{(BR)EBO}$	−5.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = −30 V, I_E = 0)	I_{CBO}	–	–	−100	nAdc
Collector Cutoff Current (V_{CE} = −45 V, V_{BE} = 0)	I_{CES}	–	–	−100	nAdc
Emitter Cutoff Current (V_{EB} = −4.0 V, I_C = 0)	I_{EBO}	–	–	−100	nAdc
ON CHARACTERISTICS					
DC Current Gain	h_{FE}				–
(I_C = −100 mA, V_{CE} = −1.0 V) BC327		100	–	630	
BC327−16		100	–	250	
BC327−25		160	–	400	
BC327−40		250	–	630	
(I_C = −300 mA, V_{CE} = −1.0 V)		40	–	–	
Base−Emitter On Voltage (I_C = −300 mA, V_{CE} = −1.0 V)	$V_{BE(on)}$	–	–	−1.2	Vdc
Collector−Emitter Saturation Voltage (I_C = −500 mA, I_B = −50 mA)	$V_{CE(sat)}$	–	–	−0.7	Vdc
SMALL−SIGNAL CHARACTERISTICS					
Output Capacitance (V_{CB} = −10 V, I_E = 0, f = 1.0 MHz)	C_{ob}	–	11	–	pF
Current−Gain − Bandwidth Product (I_C = −10 mA, V_{CE} = −5.0 V, f = 100 MHz)	f_T	–	260	–	MHz

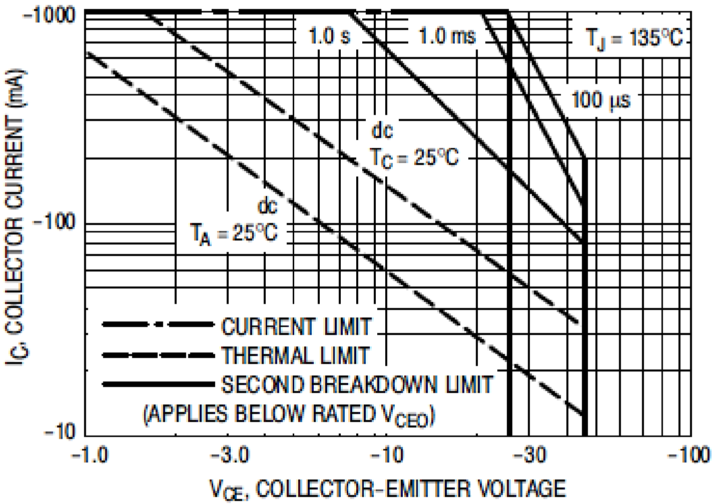


Figure 2. Active Region − Safe Operating Area

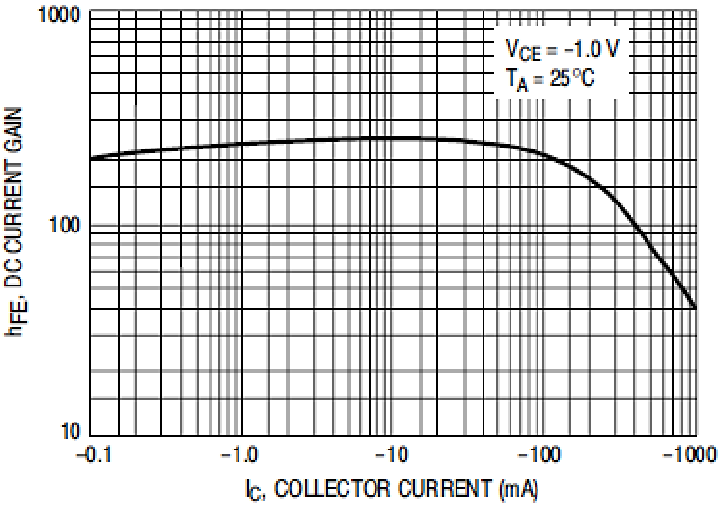


Figure 3. DC Current Gain

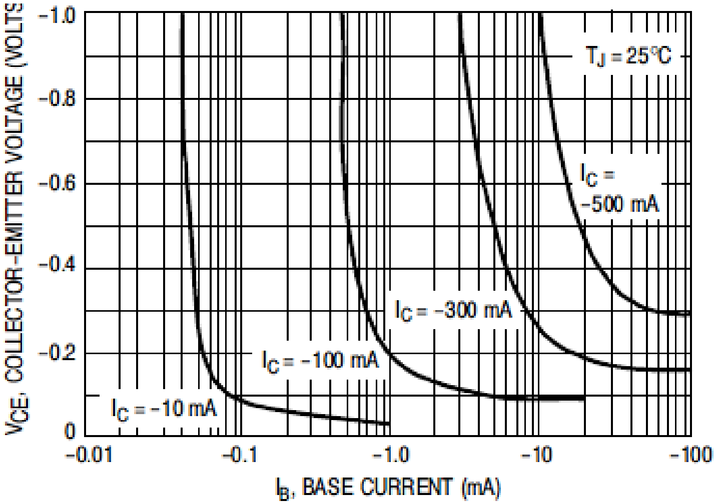


Figure 4. Saturation Region

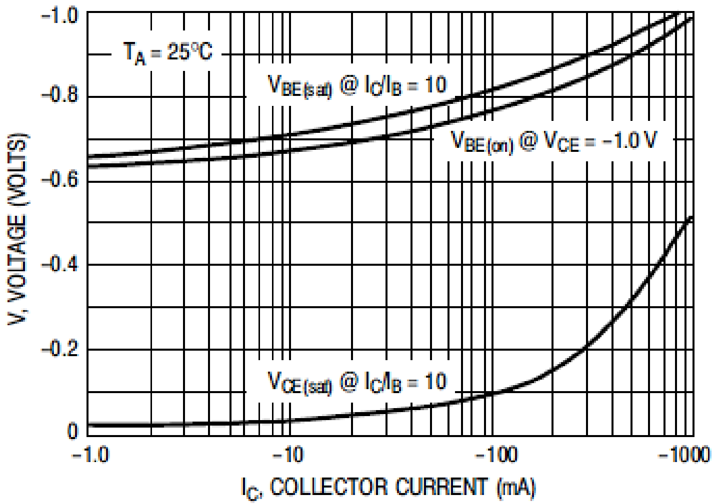
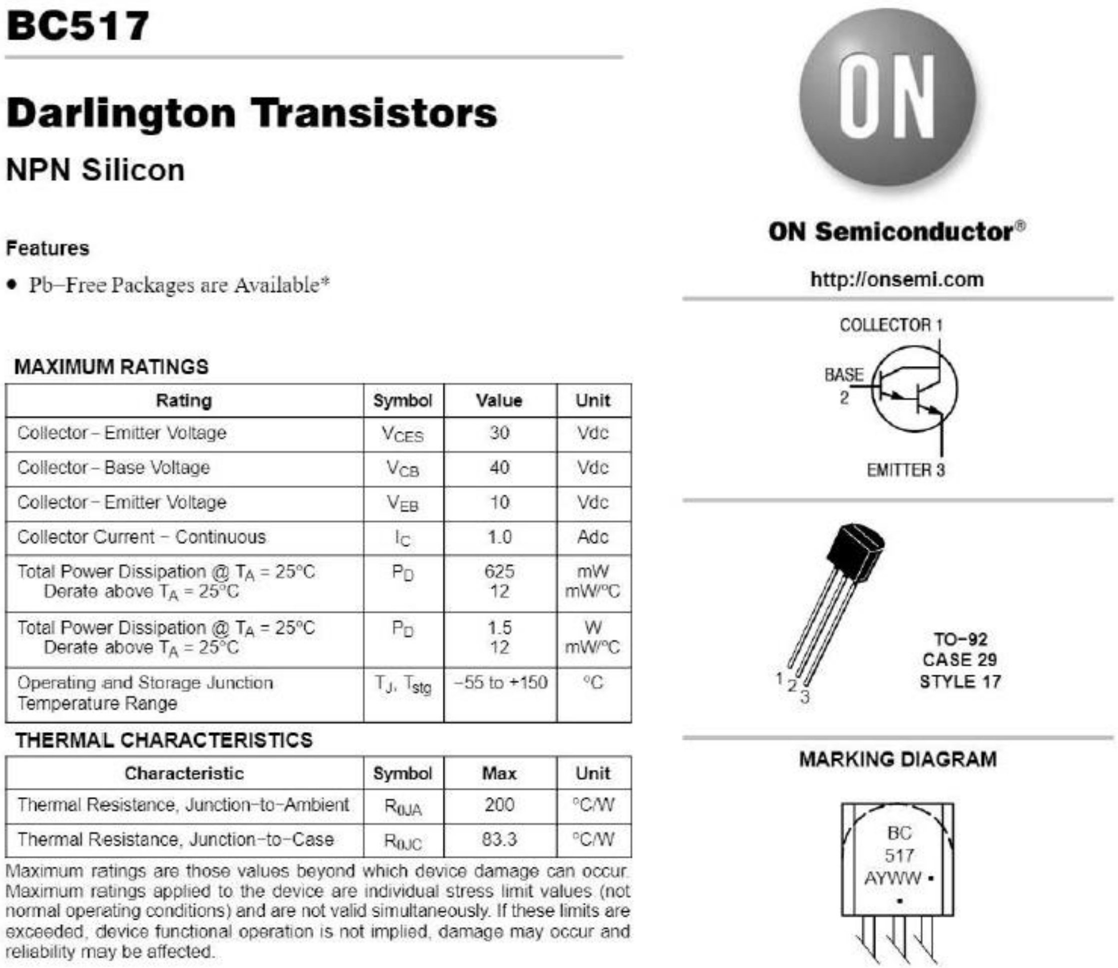


Figure 5. “On” Voltages

BC517 DARLINGTON 1A HFE 30000



BC517

Darlington Transistors

NPN Silicon

Features

- Pb−Free Packages are Available*

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector − Emitter Voltage	V_{CES}	30	Vdc
Collector − Base Voltage	V_{CB}	40	Vdc
Collector − Emitter Voltage	V_{EB}	10	Vdc
Collector Current − Continuous	I_C	1.0	Adc
Total Power Dissipation @ T_A = 25°C Derate above T_A = 25°C	P_D	625 12	mW mW/°C
Total Power Dissipation @ T_A = 25°C Derate above T_A = 25°C	P_D	1.5 12	W mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction−to−Ambient	$R_{\theta JA}$	200	°C/W
Thermal Resistance, Junction−to−Case	$R_{\theta JC}$	83.3	°C/W

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

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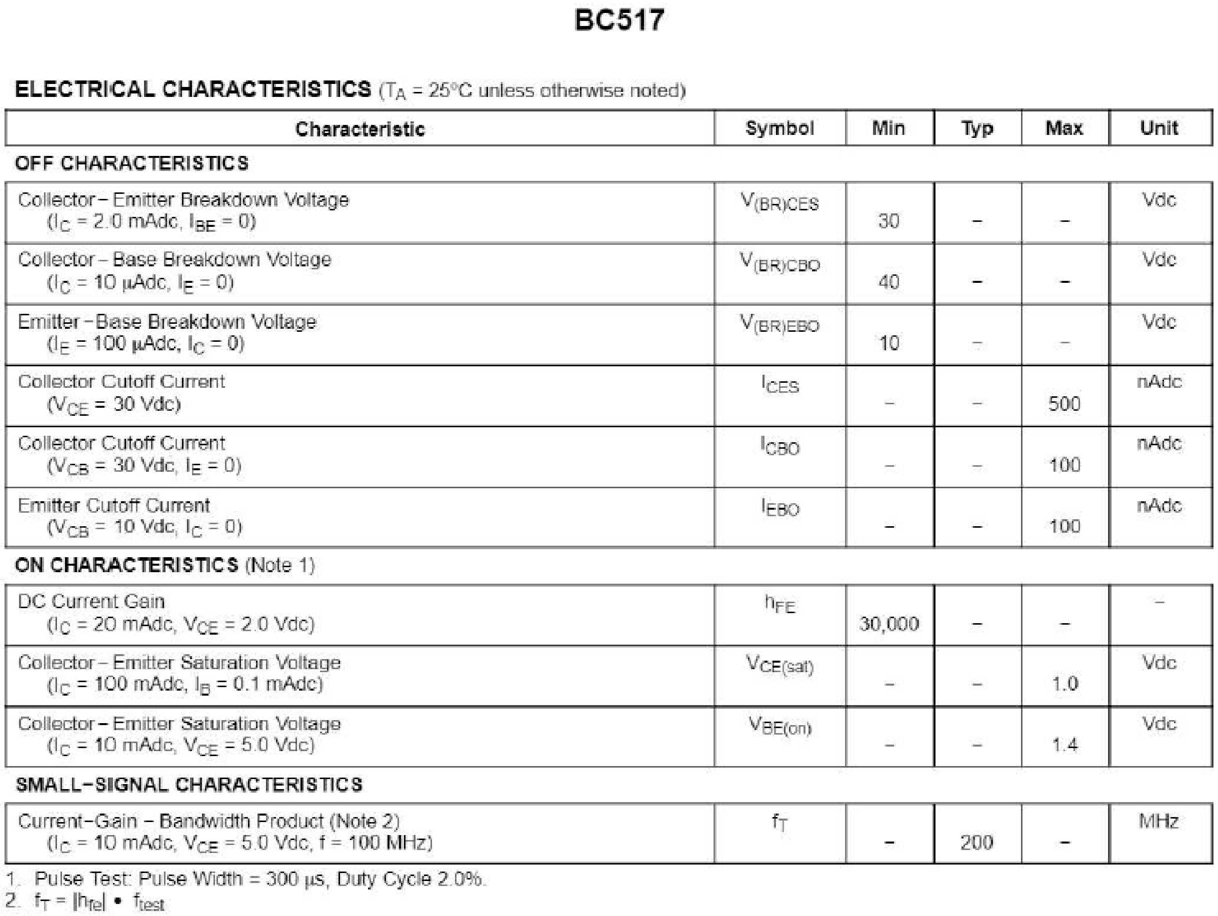
COLLECTOR 1
BASE 2
EMITTER 3

TO−92
CASE 29
STYLE 17

MARKING DIAGRAM



BC517

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector – Emitter Breakdown Voltage (I_C = 2.0 mAdc, I_{BE} = 0)	$V_{(BR)CES}$	30	–	–	Vdc
Collector – Base Breakdown Voltage (I_C = 10 μAdc, I_E = 0)	$V_{(BR)CBO}$	40	–	–	Vdc
Emitter – Base Breakdown Voltage (I_E = 100 μAdc, I_C = 0)	$V_{(BR)EBO}$	10	–	–	Vdc
Collector Cutoff Current (V_{CE} = 30 Vdc)	I_{CES}	–	–	500	nAdc
Collector Cutoff Current (V_{CB} = 30 Vdc, I_E = 0)	I_{CBO}	–	–	100	nAdc
Emitter Cutoff Current (V_{CB} = 10 Vdc, I_C = 0)	I_{EBO}	–	–	100	nAdc
ON CHARACTERISTICS (Note 1)					
DC Current Gain (I_C = 20 mAdc, V_{CE} = 2.0 Vdc)	h_{FE}	30,000	–	–	–
Collector – Emitter Saturation Voltage (I_C = 100 mAdc, I_B = 0.1 mAdc)	$V_{CE(sat)}$	–	–	1.0	Vdc
Collector – Emitter Saturation Voltage (I_C = 10 mAdc, V_{CE} = 5.0 Vdc)	$V_{BE(on)}$	–	–	1.4	Vdc
SMALL–SIGNAL CHARACTERISTICS					
Current–Gain – Bandwidth Product (Note 2) (I_C = 10 mAdc, V_{CE} = 5.0 Vdc, f = 100 MHz)	f_T	–	200	–	MHz

1. Pulse Test: Pulse Width = 300 μs, Duty Cycle 2.0%.
2. $f_T = |h_{fe}| \bullet f_{test}$

O transistor BC517 pode ser substituído pelos seguintes transistores: BC875, BC879, BC517G, BC517P, GC195.

CA3083 MATRIZ TRANSISTOR 0,1A GENERAL PORPOUSE

intersil

CA3083

Data Sheet **September 1998** **File Number 481.4**

General Purpose High Current NPN Transistor Array

The CA3083 is a versatile array of five high current (to 100mA) NPN transistors on a common monolithic substrate. In addition, two of these transistors (Q_1 and Q_2) are matched at low current (i.e., 1mA) for applications in which offset parameters are of special importance.

Independent connections for each transistor plus a separate terminal for the substrate permit maximum flexibility in circuit design.

Ordering Information

PART NUMBER (BRAND)	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
CA3083	-55 to 125	16 Ld PDIP	E16.3
CA3083M (3083)	-55 to 125	16 Ld SOIC	M16.15
CA3083M96 (3083)	-55 to 125	16 Ld SOIC Tape and Reel	M16.15

Features

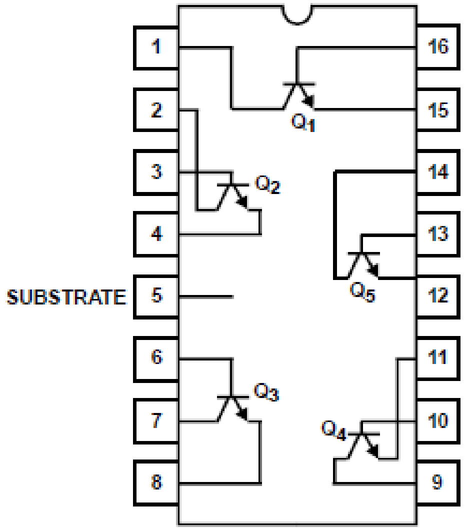
- High I_C . . . . 100mA (Max)
- Low $V_{CE\ sat}$ (at 50mA). . . . . 0.7V (Max)
- Matched Pair (Q_1 and Q_2)
  - V_{IO} (V_{BE} Match). ±5mV (Max)
  - I_{IO} (at 1mA). . . . . 2.5µA (Max)
- 5 Independent Transistors Plus Separate Substrate Connection

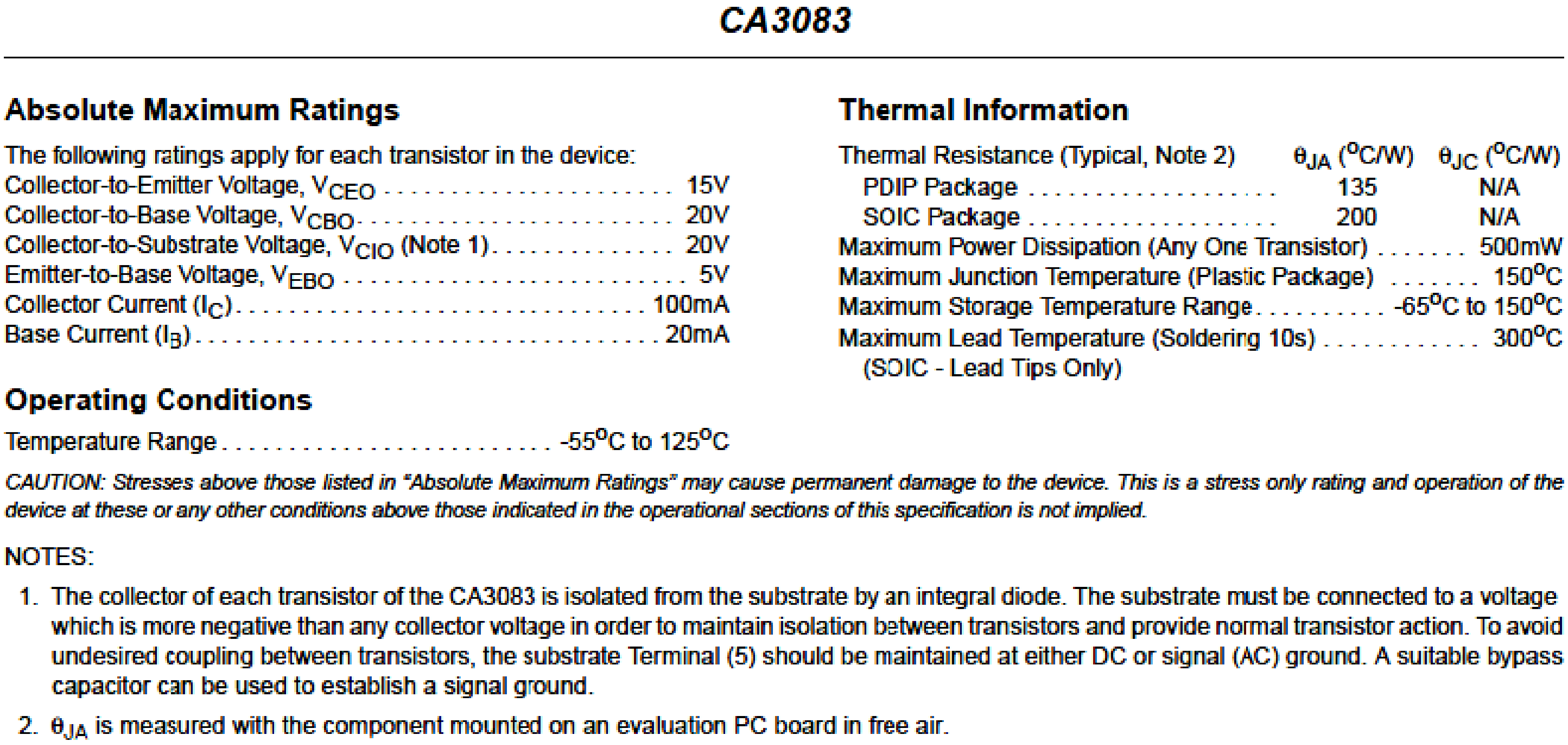
Applications

- Signal Processing and Switching Systems Operating from DC to VHF
- Lamp and Relay Driver
- Differential Amplifier
- Temperature Compensated Amplifier
- Thyristor Firing
- See Application Note AN5296 "Applications of the CA3018 Circuit Transistor Array" for Suggested Applications

Pinout

CA3083
(PDIP, SOIC)
TOP VIEW





CA3083

Absolute Maximum Ratings

The following ratings apply for each transistor in the device:

Collector-to-Emitter Voltage, V_{CEO}	15V
Collector-to-Base Voltage, V_{CBO}	20V
Collector-to-Substrate Voltage, V_{CIO} (Note 1)	20V
Emitter-to-Base Voltage, V_{EBO}	5V
Collector Current (I_C)	100mA
Base Current (I_B)	20mA

Operating Conditions

Temperature Range	-55°C to 125°C

Thermal Information

Thermal Resistance (Typical, Note 2)	θ_{JA} (°C/W)	θ_{JC} (°C/W)
PDIP Package	135	N/A
SOIC Package	200	N/A

Maximum Power Dissipation (Any One Transistor)	500mW
Maximum Junction Temperature (Plastic Package)	150°C
Maximum Storage Temperature Range	-65°C to 150°C
Maximum Lead Temperature (Soldering 10s) (SOIC - Lead Tips Only)	300°C

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTES:

1. The collector of each transistor of the CA3083 is isolated from the substrate by an integral diode. The substrate must be connected to a voltage which is more negative than any collector voltage in order to maintain isolation between transistors and provide normal transistor action. To avoid undesired coupling between transistors, the substrate Terminal (5) should be maintained at either DC or signal (AC) ground. A suitable bypass capacitor can be used to establish a signal ground.
2. θ_{JA} is measured with the component mounted on an evaluation PC board in free air.

TRANSISTORES POTÊNCIA

TABELA DE ESCOLHA COM OS PRINCIPAIS TIPOS DE TRANSISTORES DE POTÊNCIA

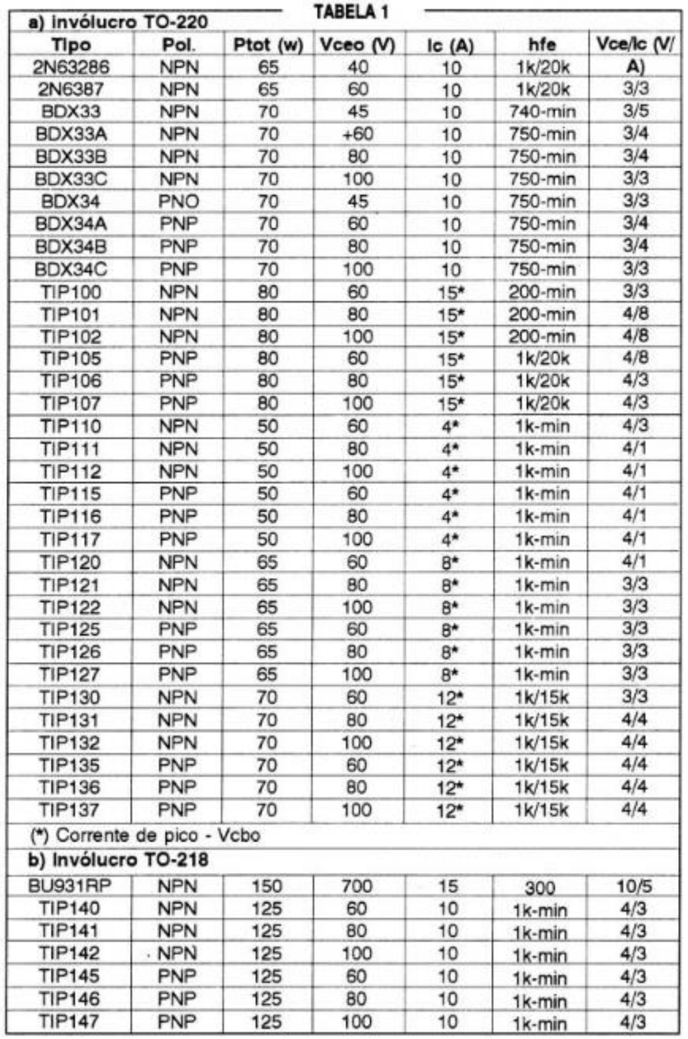


TABELA 1

a) invólucro TO-220

Tipo	Pol.	Ptot (w)	Vceo (V)	Ic (A)	hfe	Vce/Ic (V/A)
2N63286	NPN	65	40	10	1k/20k	
2N6387	NPN	65	60	10	1k/20k	3/3
BDX33	NPN	70	45	10	740-min	3/5
BDX33A	NPN	70	+60	10	750-min	3/4
BDX33B	NPN	70	80	10	750-min	3/4
BDX33C	NPN	70	100	10	750-min	3/3
BDX34	PNO	70	45	10	750-min	3/3
BDX34A	PNP	70	60	10	750-min	3/4
BDX34B	PNP	70	80	10	750-min	3/4
BDX34C	PNP	70	100	10	750-min	3/3
TIP100	NPN	80	60	15*	200-min	3/3
TIP101	NPN	80	80	15*	200-min	4/8
TIP102	NPN	80	100	15*	200-min	4/8
TIP105	PNP	80	60	15*	1k/20k	4/8
TIP106	PNP	80	80	15*	1k/20k	4/3
TIP107	PNP	80	100	15*	1k/20k	4/3
TIP110	NPN	50	60	4*	1k-min	4/3
TIP111	NPN	50	80	4*	1k-min	4/1
TIP112	NPN	50	100	4*	1k-min	4/1
TIP115	PNP	50	60	4*	1k-min	4/1
TIP116	PNP	50	80	4*	1k-min	4/1
TIP117	PNP	50	100	4*	1k-min	4/1
TIP120	NPN	65	60	8*	1k-min	4/1
TIP121	NPN	65	80	8*	1k-min	3/3
TIP122	NPN	65	100	8*	1k-min	3/3
TIP125	PNP	65	60	8*	1k-min	3/3
TIP126	PNP	65	80	8*	1k-min	3/3
TIP127	PNP	65	100	8*	1k-min	3/3
TIP130	NPN	70	60	12*	1k/15k	3/3
TIP131	NPN	70	80	12*	1k/15k	4/4
TIP132	NPN	70	100	12*	1k/15k	4/4
TIP135	PNP	70	60	12*	1k/15k	4/4
TIP136	PNP	70	80	12*	1k/15k	4/4
TIP137	PNP	70	100	12*	1k/15k	4/4

(*) Corrente de pico - Vcbo

b) Invólucro TO-218

BU931RP	NPN	150	700	15	300	10/5
TIP140	NPN	125	60	10	1k-min	4/3
TIP141	NPN	125	80	10	1k-min	4/3
TIP142	NPN	125	100	10	1k-min	4/3
TIP145	PNP	125	60	10	1k-min	4/3
TIP146	PNP	125	80	10	1k-min	4/3
TIP147	PNP	125	100	10	1k-min	4/3

BD 135/137/139 NPN 1,5A

Philips Semiconductors **Product specification**

NPN power transistors BD135; BD137; BD139

FEATURES

- High current (max. 1.5 A)
- Low voltage (max. 80 V).

APPLICATIONS

- Driver stages in hi-fi amplifiers and television circuits.

DESCRIPTION

NPN power transistor in a TO-126; SOT32 plastic package. PNP complements: BD136, BD138 and BD140.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to metal part of mounting surface
3	base

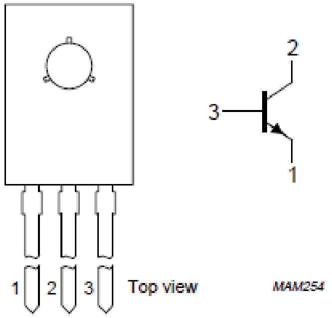
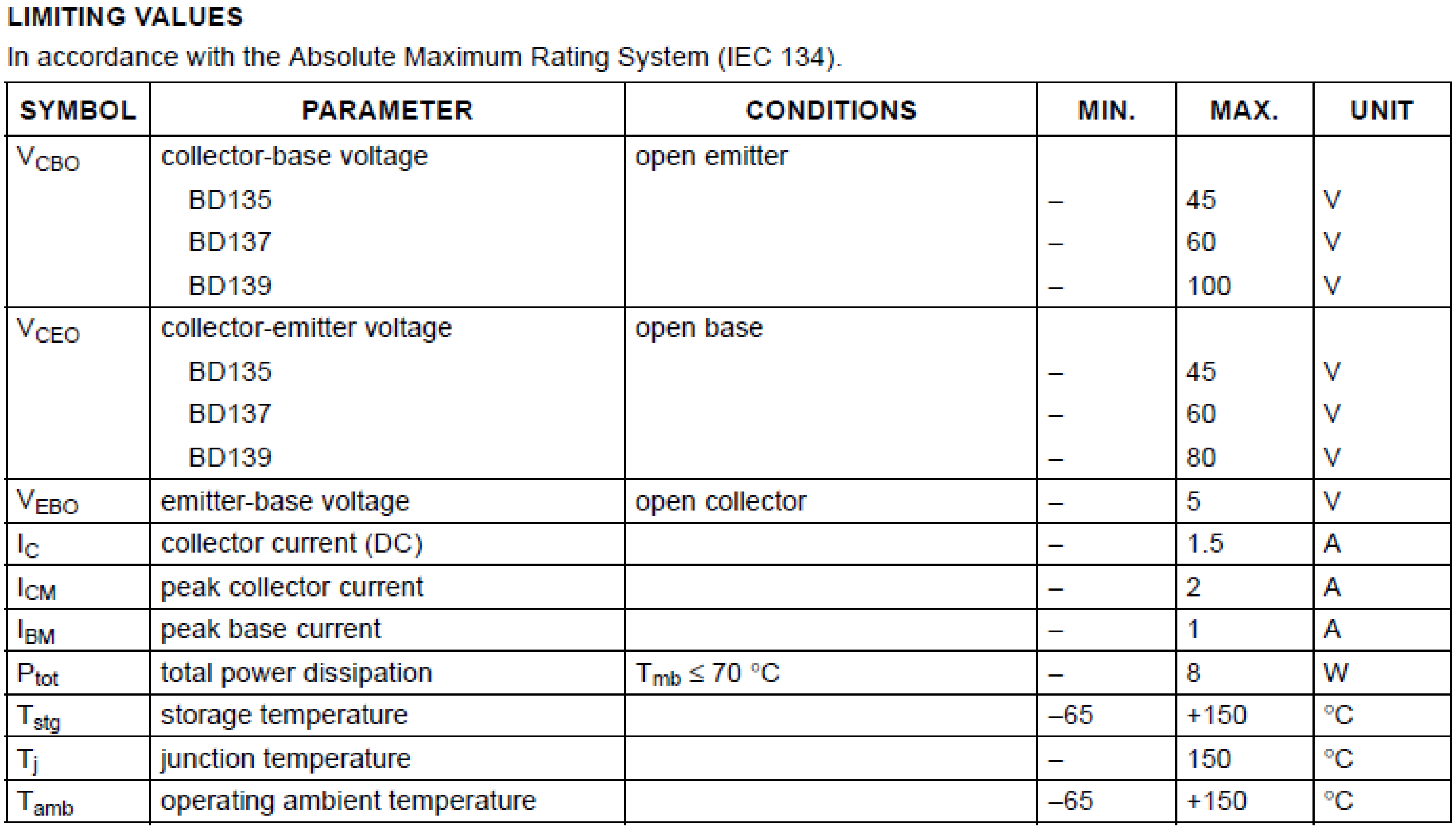


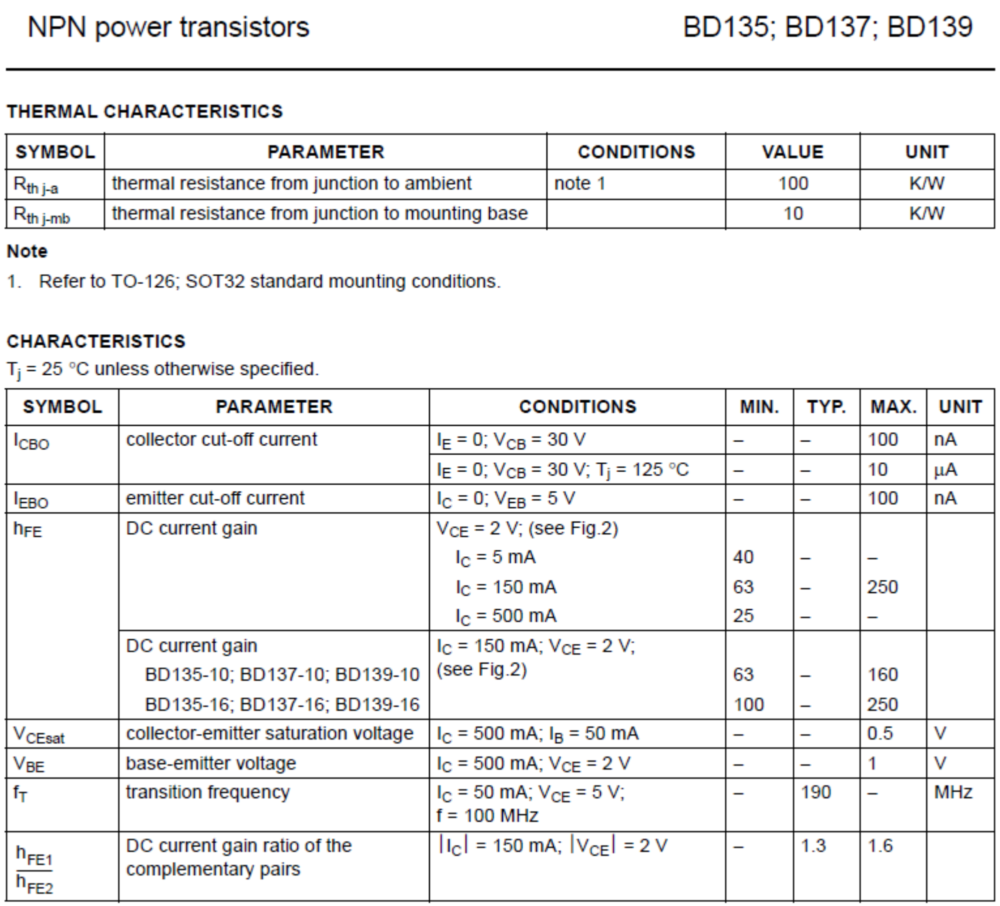
Fig.1 Simplified outline (TO-126; SOT32) and symbol.



LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BD135		–	45	V
	BD137		–	60	V
	BD139		–	100	V
V_{CEO}	collector-emitter voltage	open base			
	BD135		–	45	V
	BD137		–	60	V
	BD139		–	80	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)		–	1.5	A
I_{CM}	peak collector current		–	2	A
I_{BM}	peak base current		–	1	A
P_{tot}	total power dissipation	$T_{mb} \leq 70$ °C	–	8	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C



NPN power transistors BD135; BD137; BD139

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	100	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		10	K/W

Note

1. Refer to TO-126; SOT32 standard mounting conditions.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 30 V	–	–	100	nA
		I_E = 0; V_{CB} = 30 V; T_j = 125 °C	–	–	10	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 5 V	–	–	100	nA
h_{FE}	DC current gain	V_{CE} = 2 V; (see Fig.2)				
		I_C = 5 mA	40	–	–	
		I_C = 150 mA	63	–	250	
		I_C = 500 mA	25	–	–	
	DC current gain	I_C = 150 mA; V_{CE} = 2 V;				
	BD135-10; BD137-10; BD139-10	(see Fig.2)	63	–	160	
	BD135-16; BD137-16; BD139-16		100	–	250	
V_{CEsat}	collector-emitter saturation voltage	I_C = 500 mA; I_B = 50 mA	–	–	0.5	V
V_{BE}	base-emitter voltage	I_C = 500 mA; V_{CE} = 2 V	–	–	1	V
f_T	transition frequency	I_C = 50 mA; V_{CE} = 5 V; f = 100 MHz	–	190	–	MHz
$\frac{h_{FE1}}{h_{FE2}}$	DC current gain ratio of the complementary pairs	$\lvert I_C \rvert$ = 150 mA; $\lvert V_{CE} \rvert$ = 2 V	–	1.3	1.6	

BD 136/138/140 PNP 1,5A 8W

PNP power transistors BD136; BD138; BD140

FEATURES

- High current (max. 1.5 A)
- Low voltage (max. 80 V).

APPLICATIONS

- General purpose power applications, e.g. driver stages in hi-fi amplifiers and television circuits.

DESCRIPTION

PNP power transistor in a TO-126; SOT32 plastic package. NPN complements: BD135, BD137 and BD139.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector, connected to metal part of mounting surface
3	base

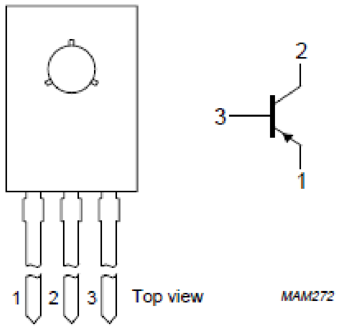
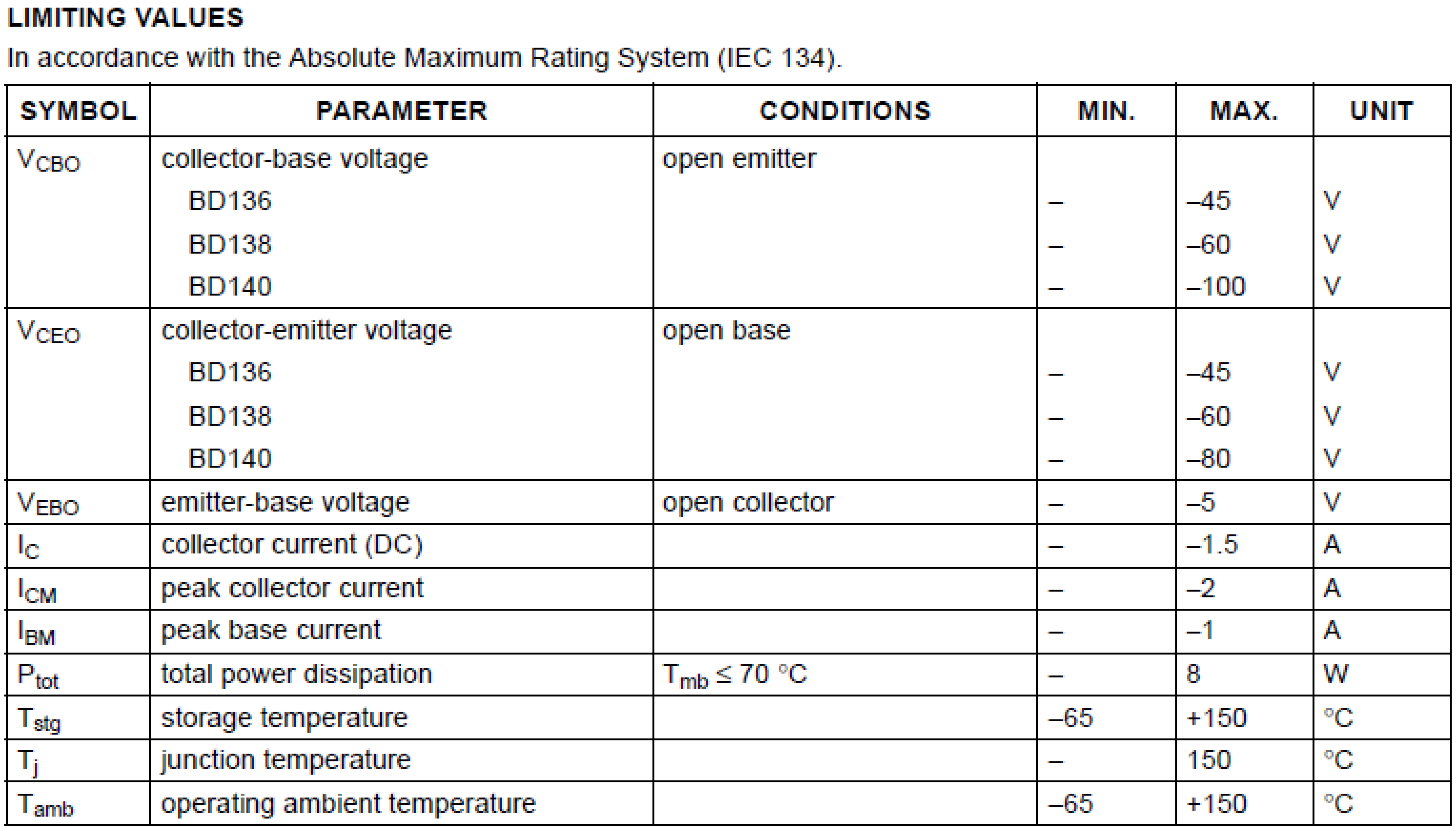


Fig.1 Simplified outline (TO-126; SOT32) and symbol.



LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BD136		–	–45	V
	BD138		–	–60	V
	BD140		–	–100	V
V_{CEO}	collector-emitter voltage	open base			
	BD136		–	–45	V
	BD138		–	–60	V
	BD140		–	–80	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–1.5	A
I_{CM}	peak collector current		–	–2	A
I_{BM}	peak base current		–	–1	A
P_{tot}	total power dissipation	$T_{mb} \leq 70$ °C	–	8	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	100	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		10	K/W

Note

1. Refer to TO-126 (SOT32) standard mounting conditions.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = –30$ V	–	–	–100	nA
		$I_E = 0$; $V_{CB} = –30$ V; $T_j = 125$ °C	–	–	–10	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = –5$ V	–	–	–100	nA
h_{FE}	DC current gain	$V_{CE} = –2$ V; (see Fig.2)				
		$I_C = –5$ mA	40	–	–	
		$I_C = –150$ mA	63	–	250	
		$I_C = –500$ mA	25	–	–	
	DC current gain	$I_C = –150$ mA; $V_{CE} = –2$ V; (see Fig.2)				
	BD136-10; BD138-10; BD140-10		63	–	160	
	BD136-16; BD138-16; BD140-16		100	–	250	
V_{CEsat}	collector-emitter saturation voltage	$I_C = –500$ mA; $I_B = –50$ mA	–	–	–0.5	V
V_{BE}	base-emitter voltage	$I_C = –500$ mA; $V_{CE} = –2$ V	–	–	–1	V
f_T	transition frequency	$I_C = –50$ mA; $V_{CE} = –5$ V; f = 100 MHz	–	160	–	MHz
$\frac{h_{FE1}}{h_{FE2}}$	DC current gain ratio of the complementary pairs	$\lvert I_C \rvert = 150$ mA; $\lvert V_{CE} \rvert = 2$ V	–	1.3	1.6	

TIP 29 NPN TIP 30 PNP 1A 30 W

MOSPEC

COMPLEMENTARY SILICON PLASTIC POWER TRANSISTORS

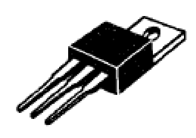
... designed for use in general purpose power amplifier and switching applications.

FEATURES:

- * Collector-Emitter Sustaining Voltage -
  $V_{CEO(sus)}$ = 40V(Min)- TIP29,TIP30
  60V(Min)- TIP29A,TIP30A
  80V(Min)- TIP29B,TIP30B
  100V(Min)-TIP29C,TIP30C
- * Collector-Emitter Saturation Voltage- $V_{CE(sat)}$=0.7V(Max)@I_C= 1.0 A
- * Current Gain-Bandwidth Product f_T=3.0 MHz (Min)@ I_C=200 mA

NPN	PNP
TIP29	TIP30
TIP29A	TIP30A
TIP29B	TIP30B
TIP29C	TIP30C

1.0 AMPERE
COMPLEMENTARY SILICON
POWER TRANSISTORS
40-100 VOLTS
30 WATTS



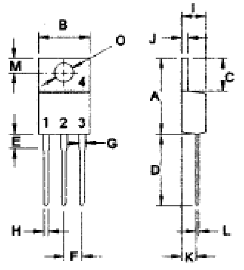
TO-220

MAXIMUM RATINGS

Characteristic	Symbol	TIP29 TIP30	TIP29A TIP30A	TIP29B TIP30B	TIP29C TIP30C	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}	5.0				V
Collector Current - Continuous - Peak	I_C	1.0 3.0				A
Base Current	I_B	0.4				A
Total Power Dissipation@T_C = 25°C Derate above 25°C	P_D	30 0.24				W W/°C
Operating and Storage Junction Temperature Range	T_J,T_{STG}	-65 to +150				°C

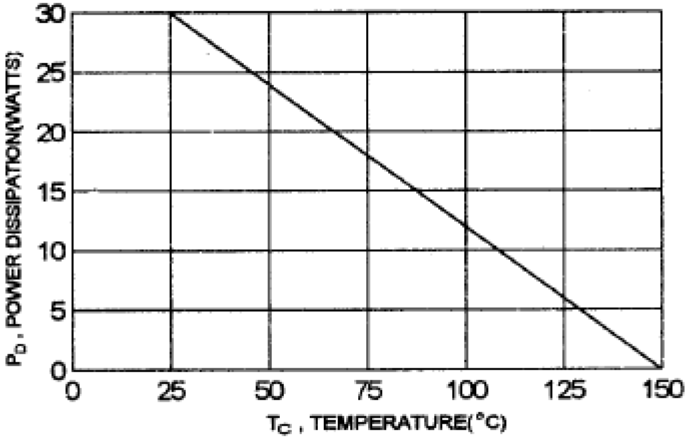
THERMAL CHARACTERISTICS

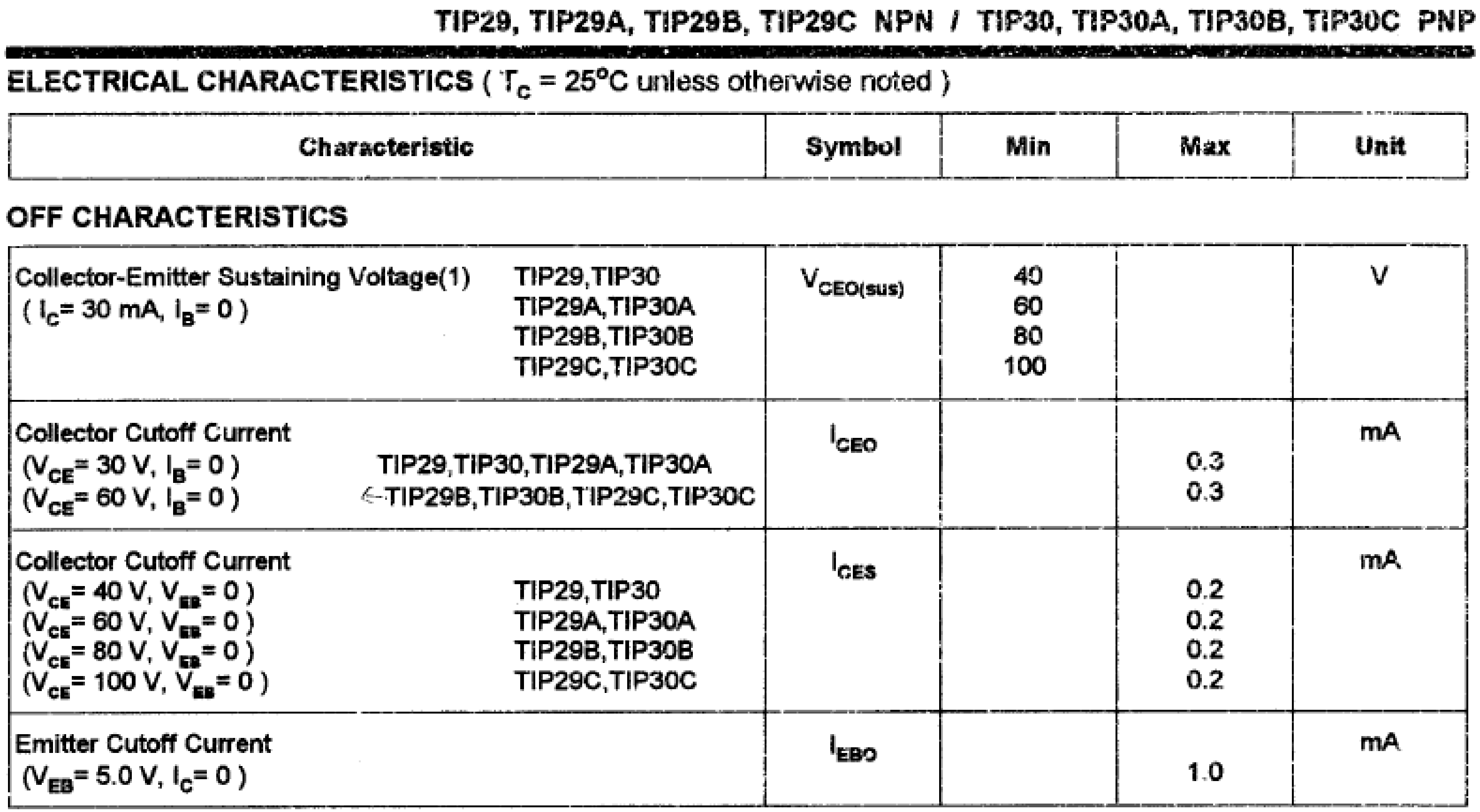
Characteristic	Symbol	Max	Unit
Thermal Resistance Junction to Case	Rθjc	4.167	°C/W



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

FIGURE -1 POWER DERATING

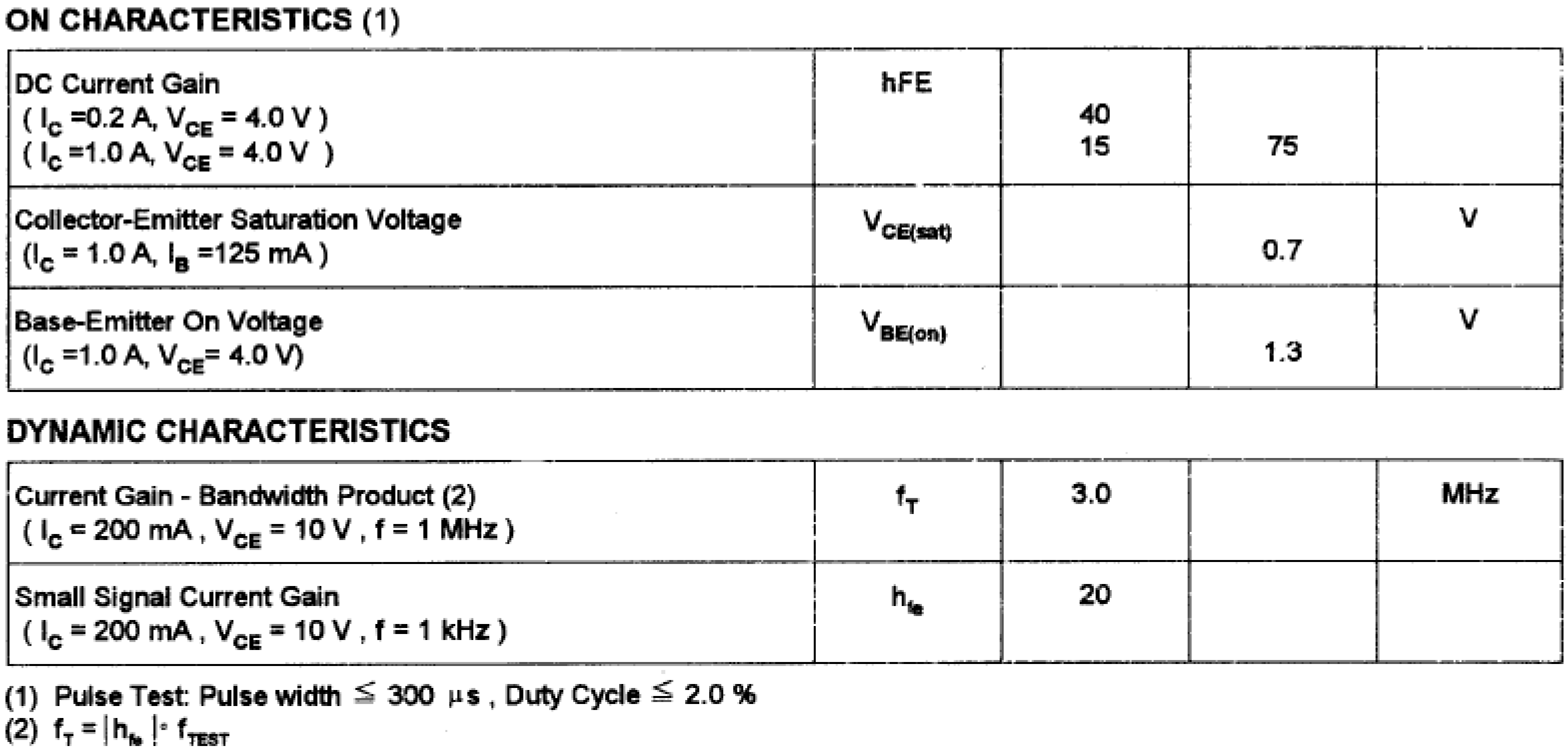




TIP29, TIP29A, TIP29B, TIP29C NPN / TIP30, TIP30A, TIP30B, TIP30C PNP

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Sustaining Voltage(1) (I_C= 30 mA, I_B= 0)	TIP29,TIP30 TIP29A,TIP30A TIP29B,TIP30B TIP29C,TIP30C	$V_{CEO(sus)}$	40 60 80 100		V
Collector Cutoff Current (V_{CE}= 30 V, I_B= 0) (V_{CE}= 60 V, I_B= 0)	TIP29,TIP30,TIP29A,TIP30A TIP29B,TIP30B,TIP29C,TIP30C	I_{CEO}		0.3 0.3	mA
Collector Cutoff Current (V_{CE}= 40 V, V_{EB}= 0) (V_{CE}= 60 V, V_{EB}= 0) (V_{CE}= 80 V, V_{EB}= 0) (V_{CE}= 100 V, V_{EB}= 0)	TIP29,TIP30 TIP29A,TIP30A TIP29B,TIP30B TIP29C,TIP30C	I_{CES}		0.2 0.2 0.2 0.2	mA
Emitter Cutoff Current (V_{EB}= 5.0 V, I_C= 0)		I_{EBO}		1.0	mA



ON CHARACTERISTICS (1)

DC Current Gain (I_C =0.2 A, V_{CE} = 4.0 V) (I_C =1.0 A, V_{CE} = 4.0 V)	hFE	40 15	75	
Collector-Emitter Saturation Voltage (I_C = 1.0 A, I_B =125 mA)	$V_{CE(sat)}$		0.7	V
Base-Emitter On Voltage (I_C =1.0 A, V_{CE}= 4.0 V)	$V_{BE(on)}$		1.3	V

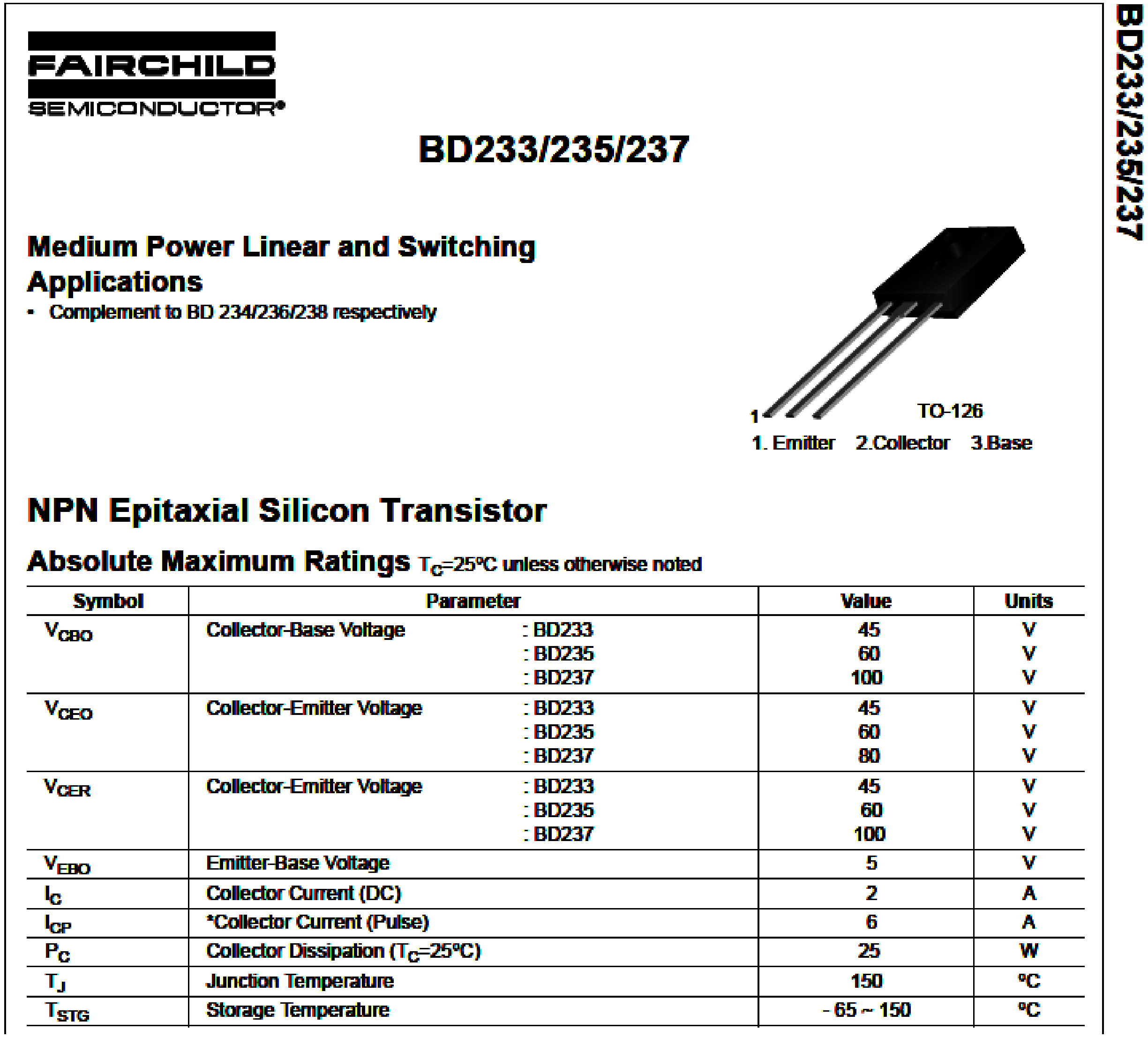
DYNAMIC CHARACTERISTICS

Current Gain - Bandwidth Product (2) (I_C = 200 mA , V_{CE} = 10 V , f = 1 MHz)	f_T	3.0		MHz
Small Signal Current Gain (I_C = 200 mA , V_{CE} = 10 V , f = 1 kHz)	h_{fe}	20		

(1) Pulse Test: Pulse width $\leq$ 300 μs , Duty Cycle $\leq$ 2.0 %

(2) $f_T = |h_{fe}| \cdot f_{TEST}$

BD233 BD235 BD237 NPN 2A



FAIRCHILD SEMICONDUCTOR®

BD233/235/237

BD233/235/237

Medium Power Linear and Switching Applications

- Complement to BD 234/236/238 respectively

1

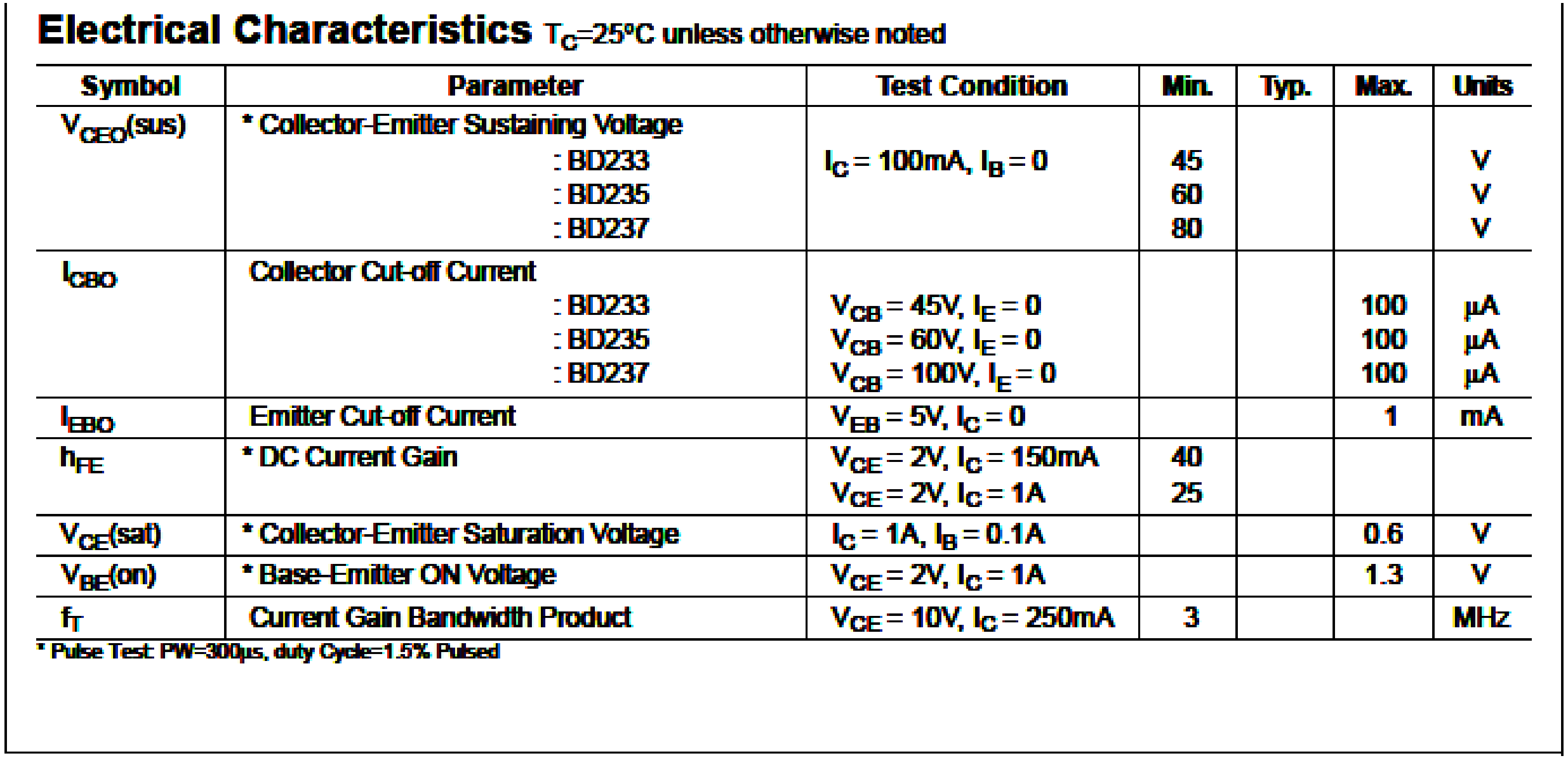
TO-126

1. Emitter 2.Collector 3.Base

NPN Epitaxial Silicon Transistor

Absolute Maximum Ratings T_C=25°C unless otherwise noted

Symbol	Parameter		Value	Units
V_{CBO}	Collector-Base Voltage	: BD233	45	V
		: BD235	60	V
		: BD237	100	V
V_{CEO}	Collector-Emitter Voltage	: BD233	45	V
		: BD235	60	V
		: BD237	80	V
V_{CER}	Collector-Emitter Voltage	: BD233	45	V
		: BD235	60	V
		: BD237	100	V
V_{EBO}	Emitter-Base Voltage		5	V
I_C	Collector Current (DC)		2	A
I_{CP}	*Collector Current (Pulse)		6	A
P_C	Collector Dissipation (T_C=25°C)		25	W
T_J	Junction Temperature		150	°C
T_{STG}	Storage Temperature		- 65 ~ 150	°C



Electrical Characteristics T_C=25°C unless otherwise noted

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Units
V_{CEO}(sus)	* Collector-Emitter Sustaining Voltage : BD233 : BD235 : BD237	I_C = 100mA, I_B = 0	 45 60 80			 V V V
I_{CBO}	Collector Cut-off Current : BD233 : BD235 : BD237	 V_{CB} = 45V, I_E = 0 V_{CB} = 60V, I_E = 0 V_{CB} = 100V, I_E = 0			 100 100 100	 µA µA µA
I_{EBO}	Emitter Cut-off Current	V_{EB} = 5V, I_C = 0			1	mA
h_{FE}	* DC Current Gain	V_{CE} = 2V, I_C = 150mA V_{CE} = 2V, I_C = 1A	40 25			
V_{CE}(sat)	* Collector-Emitter Saturation Voltage	I_C = 1A, I_B = 0.1A			0.6	V
V_{BE}(on)	* Base-Emitter ON Voltage	V_{CE} = 2V, I_C = 1A			1.3	V
f_T	Current Gain Bandwidth Product	V_{CE} = 10V, I_C = 250mA	3			MHz

* Pulse Test: PW=300µs, duty Cycle=1.5% Pulsed

Typical Characteristics

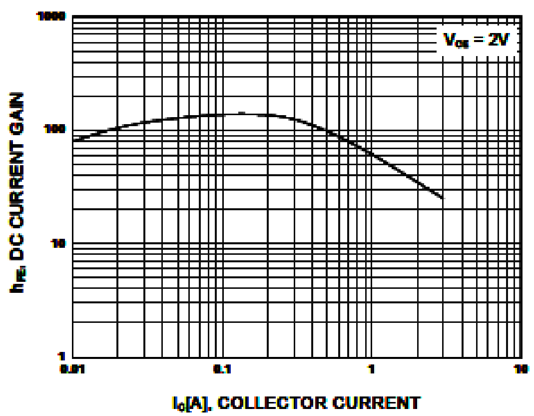


Figure 1. DC current Gain

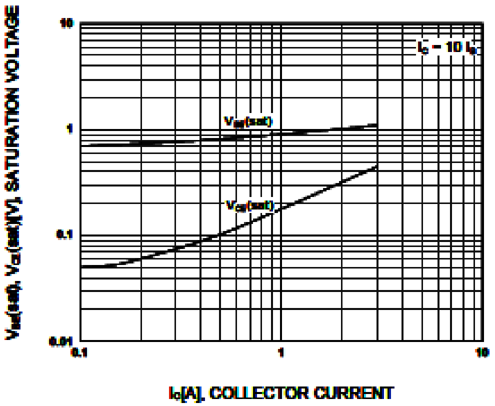


Figure 2. Base-Emitter Saturation Voltage Collector-Emitter Saturation Voltage

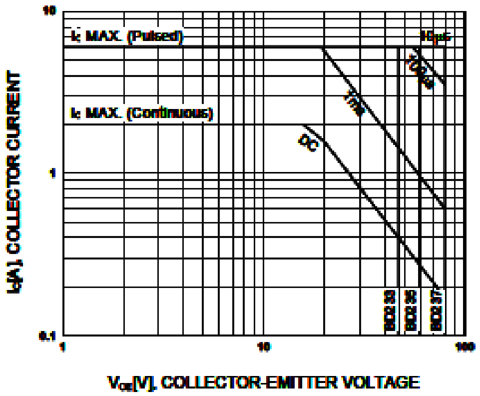


Figure 3. Safe Operating Area

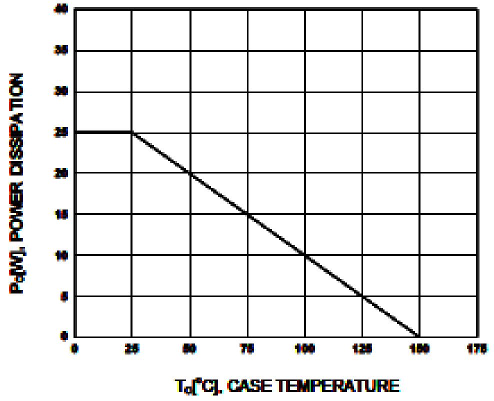
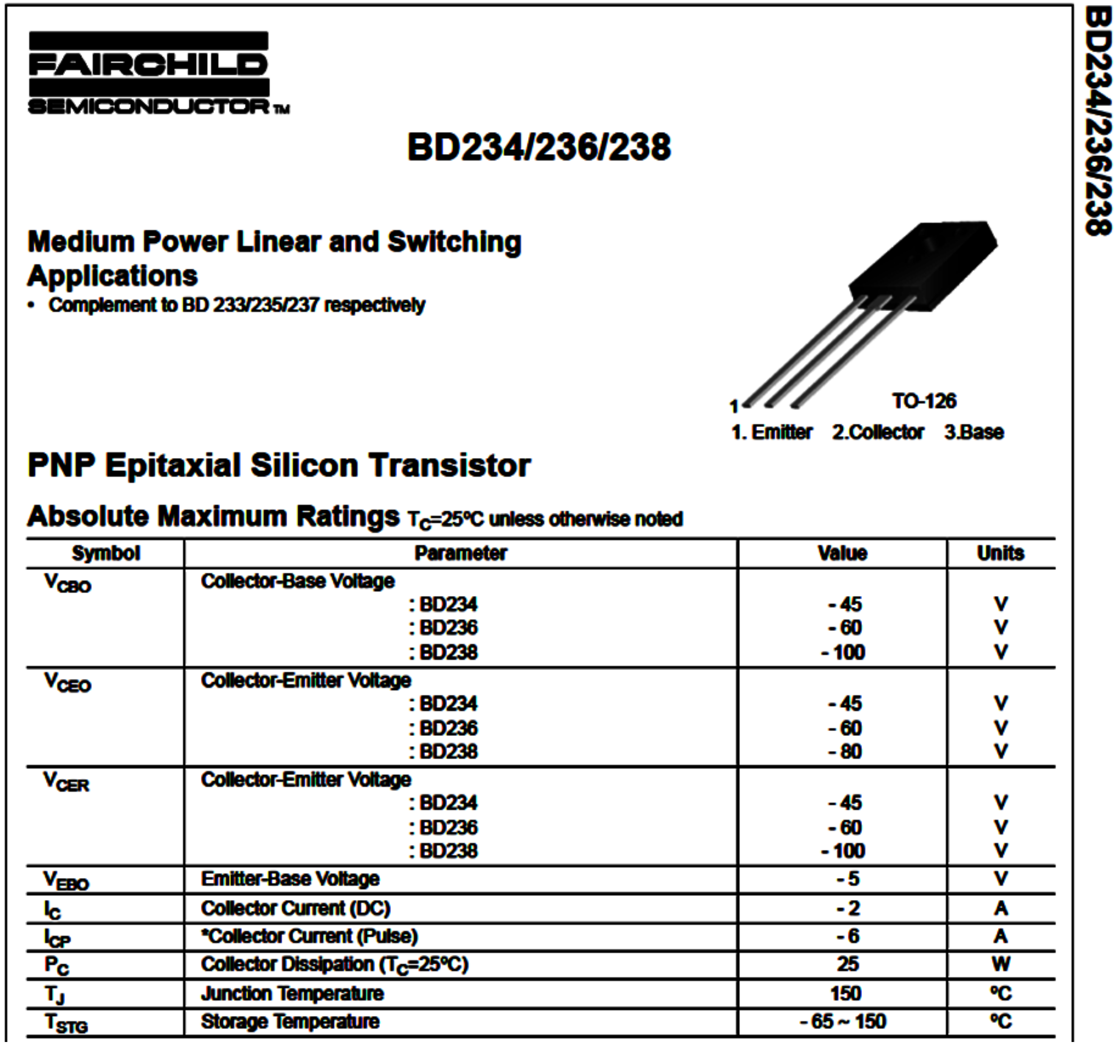


Figure 4. Power Derating

BD234 BD236 BD238 PNP 2A



FAIRCHILD
SEMICONDUCTOR™

BD234/236/238

BD234/236/238

Medium Power Linear and Switching Applications

- Complement to BD 233/235/237 respectively

PNP Epitaxial Silicon Transistor

Absolute Maximum Ratings T_C=25°C unless otherwise noted

Symbol	Parameter	Value	Units
V_{CBO}	Collector-Base Voltage : BD234 : BD236 : BD238	 - 45 - 60 - 100	 V V V
V_{CEO}	Collector-Emitter Voltage : BD234 : BD236 : BD238	 - 45 - 60 - 80	 V V V
V_{CER}	Collector-Emitter Voltage : BD234 : BD236 : BD238	 - 45 - 60 - 100	 V V V
V_{EBO}	Emitter-Base Voltage	- 5	V
I_C	Collector Current (DC)	- 2	A
I_{CP}	*Collector Current (Pulse)	- 6	A
P_C	Collector Dissipation (T_C=25°C)	25	W
T_J	Junction Temperature	150	°C
T_{STG}	Storage Temperature	- 65 ~ 150	°C

Typical Characteristics

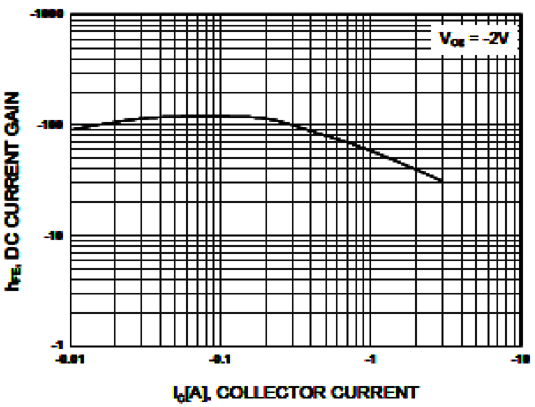


Figure 1. DC current Gain

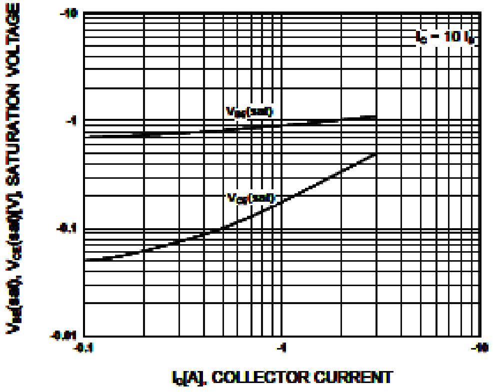


Figure 2. Base-Emitter Saturation Voltage
Collector-Emitter Saturation Voltage

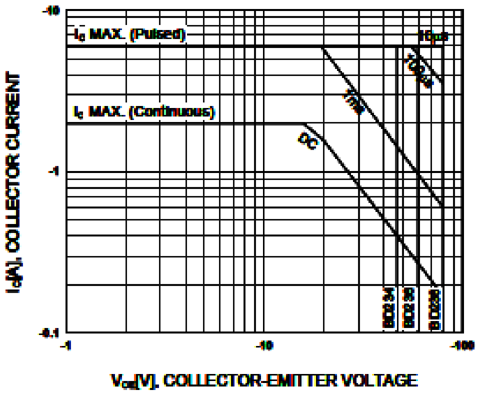


Figure 3. Safe Operating Area

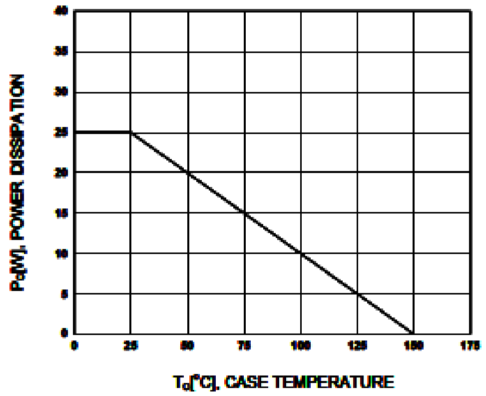


Figure 4. Power Derating

TIP31 NPN TIP32 PNP 3A GANHO BAIXO 10 40W

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)- TIP31,TIP32
  60V(Min)- TIP31A,TIP32A
  80V(Min)- TIP31B,TIP32B
  100V(Min)-TIP31C,TIP32C
- * Collector-Emitter Saturation Voltage- $V_{CE(sat)}$=1.2V(Max)@I_C= 3.0 A
- * Current Gain-Bandwidth Product f_T=3.0 MHz (Min)@ I_C=500 mA

NPN	PNP
TIP31	TIP32
TIP31A	TIP32A
TIP31B	TIP32B
TIP31C	TIP32C

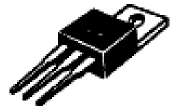
3 AMPERE
COMPLEMENTARY SILICON
POWER TRANSISTORS
40 -100 VOLTS
40 WATTS

MAXIMUM RATINGS

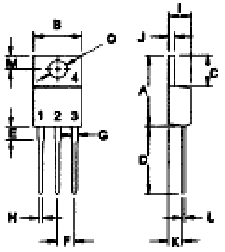
Characteristic	Symbol	TIP31 TIP32	TIP31A TIP32A	TIP31B TIP32B	TIP31C TIP32C	Unit
Collector-Emitter Voltage	V_{CEO}	40	60	80	100	V
Collector-Base Voltage	V_{CBO}	40	60	80	100	V
Emitter-Base Voltage	V_{EBO}	5.0				V
Collector Current - Continuous - Peak	I_C	3.0 5.0				A
Base Current	I_B	1.0				A
Total Power Dissipation@T_C = 25°C Derate above 25°C	P_D	40 0.32				W W/°C
Operating and Storage Junction Temperature Range	T_J,T_{STG}	-65 to +150				°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance Junction to Case	Rθjc	3.125	°C/W

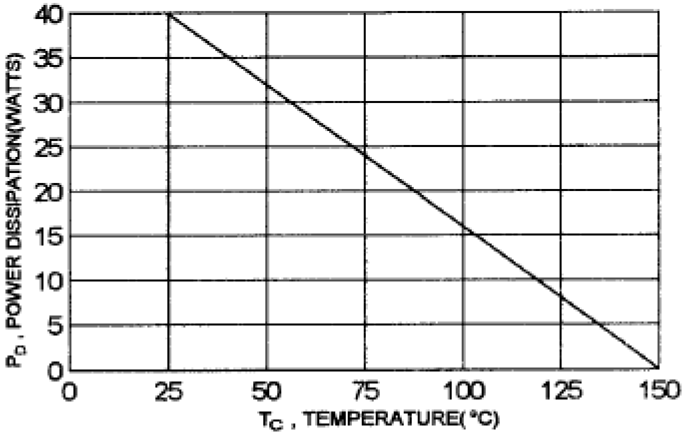


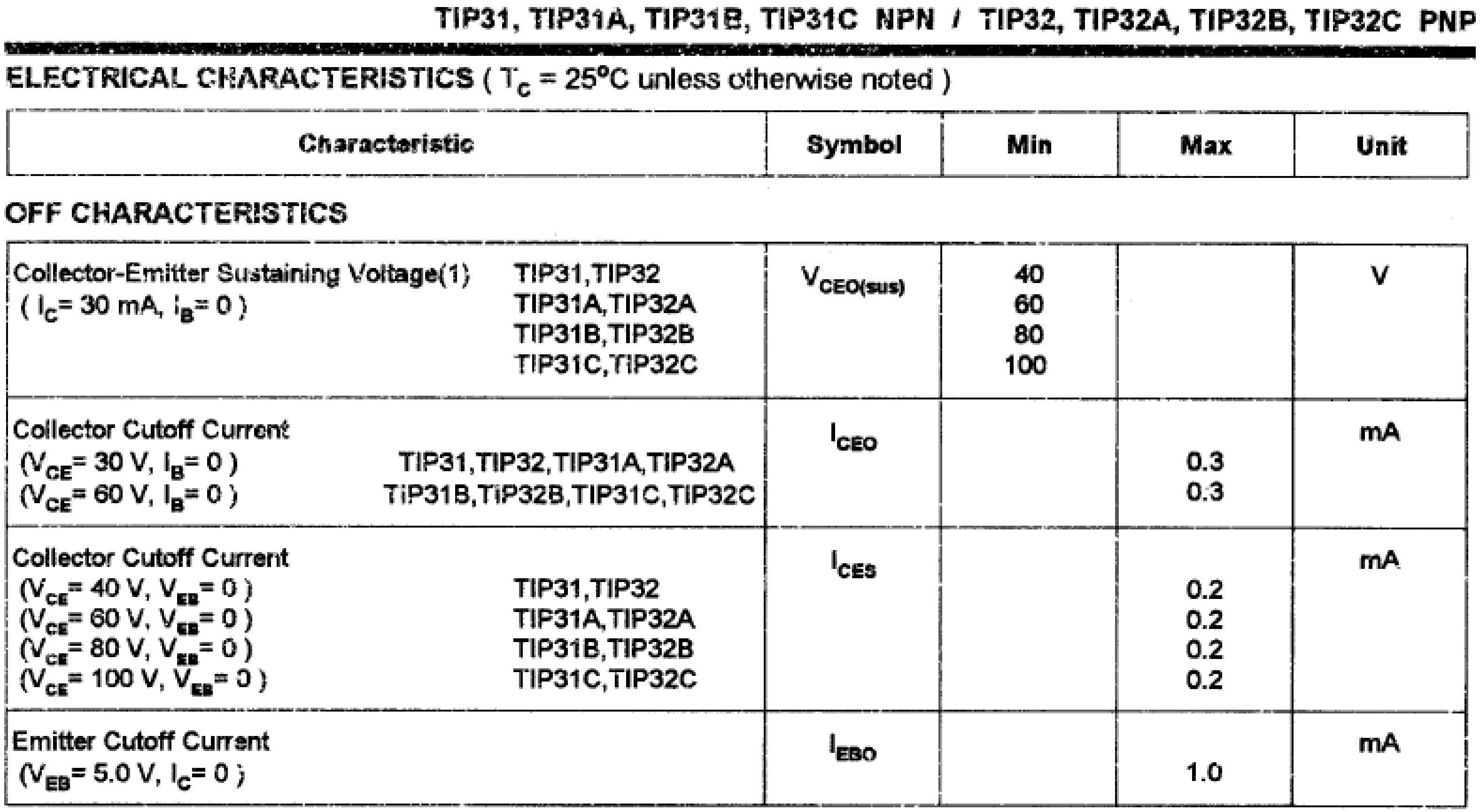
TO-220



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

FIGURE -1 POWER DERATING





TIP31, TIP31A, TIP31B, TIP31C NPN / TIP32, TIP32A, TIP32B, TIP32C PNP

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Sustaining Voltage(1) (I_C= 30 mA, I_B= 0)	TIP31,TIP32 TIP31A,TIP32A TIP31B,TIP32B TIP31C,TIP32C	$V_{CEO(sus)}$	40 60 80 100		V
Collector Cutoff Current (V_{CE}= 30 V, I_B= 0) (V_{CE}= 60 V, I_B= 0)	 TIP31,TIP32,TIP31A,TIP32A TIP31B,TIP32B,TIP31C,TIP32C	I_{CEO}		 0.3 0.3	mA
Collector Cutoff Current (V_{CE}= 40 V, V_{EB}= 0) (V_{CE}= 60 V, V_{EB}= 0) (V_{CE}= 80 V, V_{EB}= 0) (V_{CE}= 100 V, V_{EB}= 0)	 TIP31,TIP32 TIP31A,TIP32A TIP31B,TIP32B TIP31C,TIP32C	I_{CES}		 0.2 0.2 0.2 0.2	mA
Emitter Cutoff Current (V_{EB}= 5.0 V, I_C= 0)		I_{EBO}		1.0	mA

ON CHARACTERISTICS (1)

DC Current Gain (I_C =1.0 A, V_{CE} = 4.0 V) (I_C= 3.0 A, V_{CE} = 4.0 V)	hFE	25 10	50	
Collector-Emitter Saturation Voltage (I_C = 3.0 A, I_B =375 mA)	$V_{CE(sat)}$		1.2	V
Base-Emitter On Voltage (I_C =3.0 A, V_{CE}= 4.0 V)	$V_{BE(on)}$		1.8	V

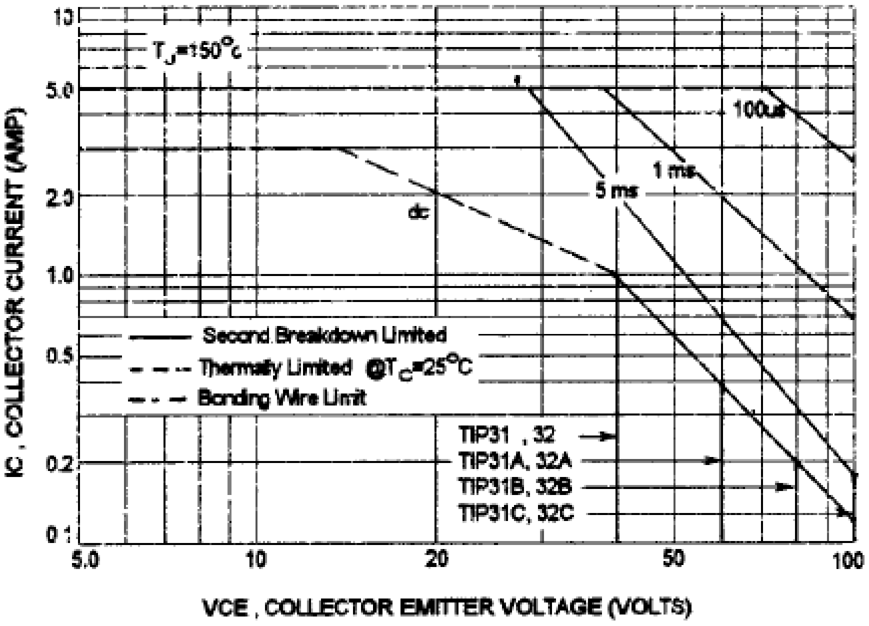
DYNAMIC CHARACTERISTICS

Current Gain - Bandwidth Product (2) (I_C = 500 mA , V_{CE} = 10 V , f_{TEST} = 1 MHz)	f_T	3.0		MHz
Small Signal Current Gain (I_C = 500 mA , V_{CE} = 10 V , f = 1 kHz)	h_{fe}	20		

(1) Pulse Test: Pulse width ≦ 300 μs , Duty Cycle ≦ 2.0 %

(2) $f_T = |h_{fe}| \cdot f_{TEST}$

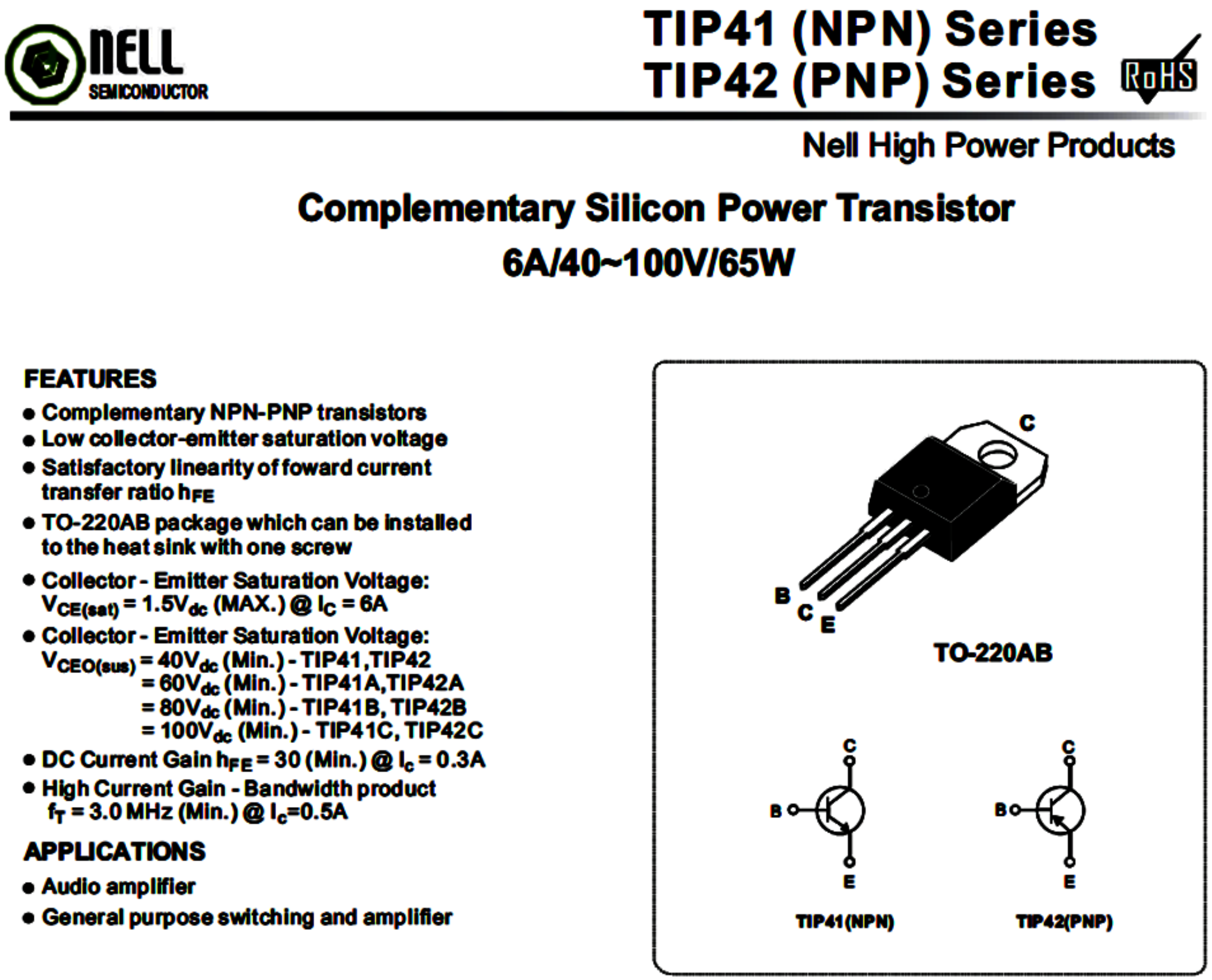
FIG-6 ACTIVE REGION SAFE OPERATING AREA



There are two limitation on the power handling ability of a transistor:average junction temperature and second breakdown safe operating area curves indicate I_C-V_{CE} limits of the transistor that must be observed for reliable operation i.e.. the transistor must not be subjected to greater dissipation than curves indicate.

The data of FIG-6 curve is base on $T_{J(PK)}$=150 °C; T_C is variable depending on power level. second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(PK)} \leq 150$°C,At high case temperatures,thermal limitation will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

TIP41 NPN /TIP42 PNP 6A 65W



NELL SEMICONDUCTOR

TIP41 (NPN) Series
TIP42 (PNP) Series

RoHS

Nell High Power Products

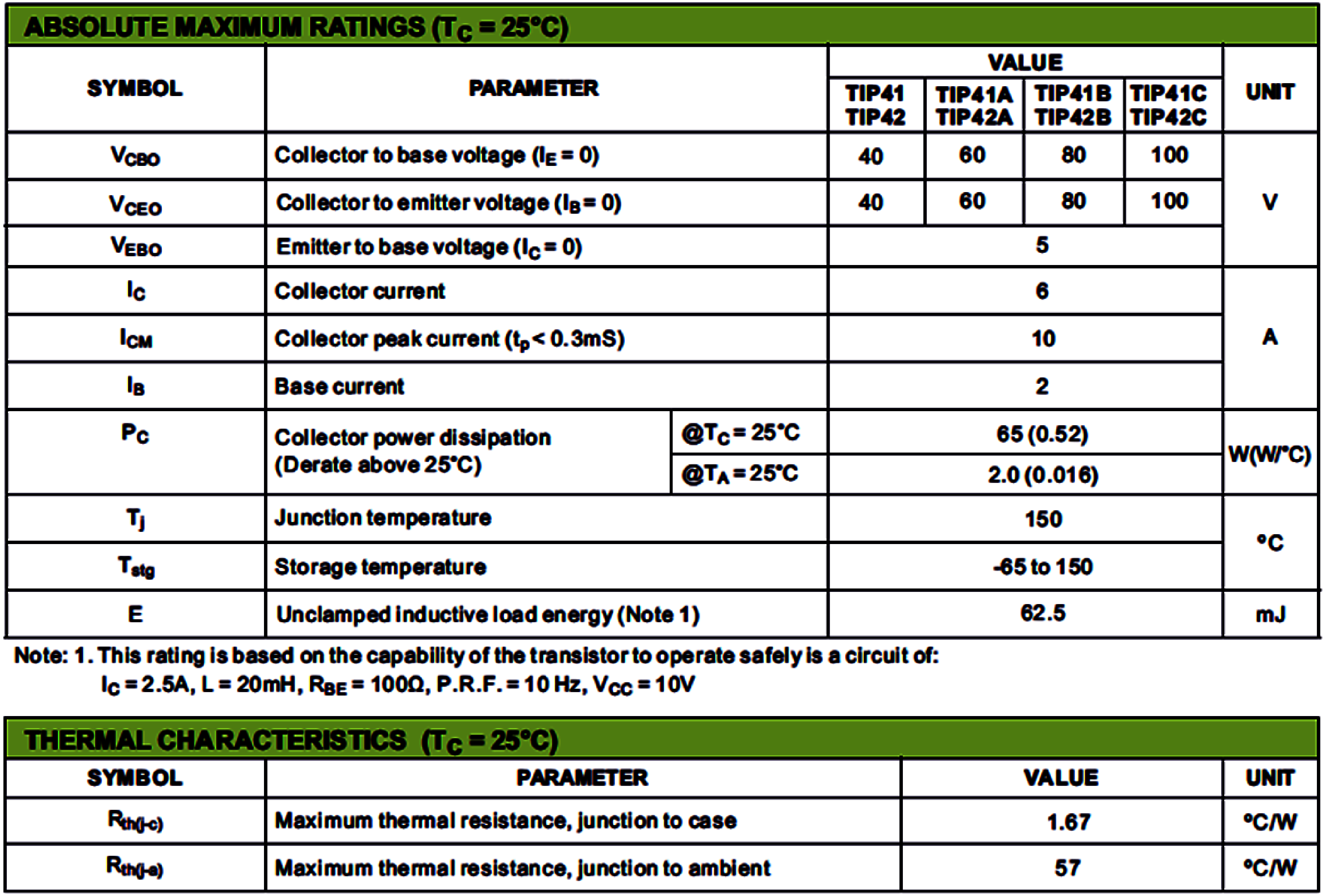
Complementary Silicon Power Transistor
6A/40~100V/65W

FEATURES

- Complementary NPN-PNP transistors
- Low collector-emitter saturation voltage
- Satisfactory linearity of foward current transfer ratio h_{FE}
- TO-220AB package which can be installed to the heat sink with one screw
- Collector - Emitter Saturation Voltage: $V_{CE(sat)} = 1.5V_{dc}$ (MAX.) @ $I_C = 6A$
- Collector - Emitter Saturation Voltage:
  $V_{CEO(sus)} = 40V_{dc}$ (Min.) - TIP41,TIP42
  $= 60V_{dc}$ (Min.) - TIP41A,TIP42A
  $= 80V_{dc}$ (Min.) - TIP41B, TIP42B
  $= 100V_{dc}$ (Min.) - TIP41C, TIP42C
- DC Current Gain $h_{FE} = 30$ (Min.) @ $I_c = 0.3A$
- High Current Gain - Bandwidth product $f_T = 3.0$ MHz (Min.) @ I_c=0.5A

APPLICATIONS

- Audio amplifier
- General purpose switching and amplifier



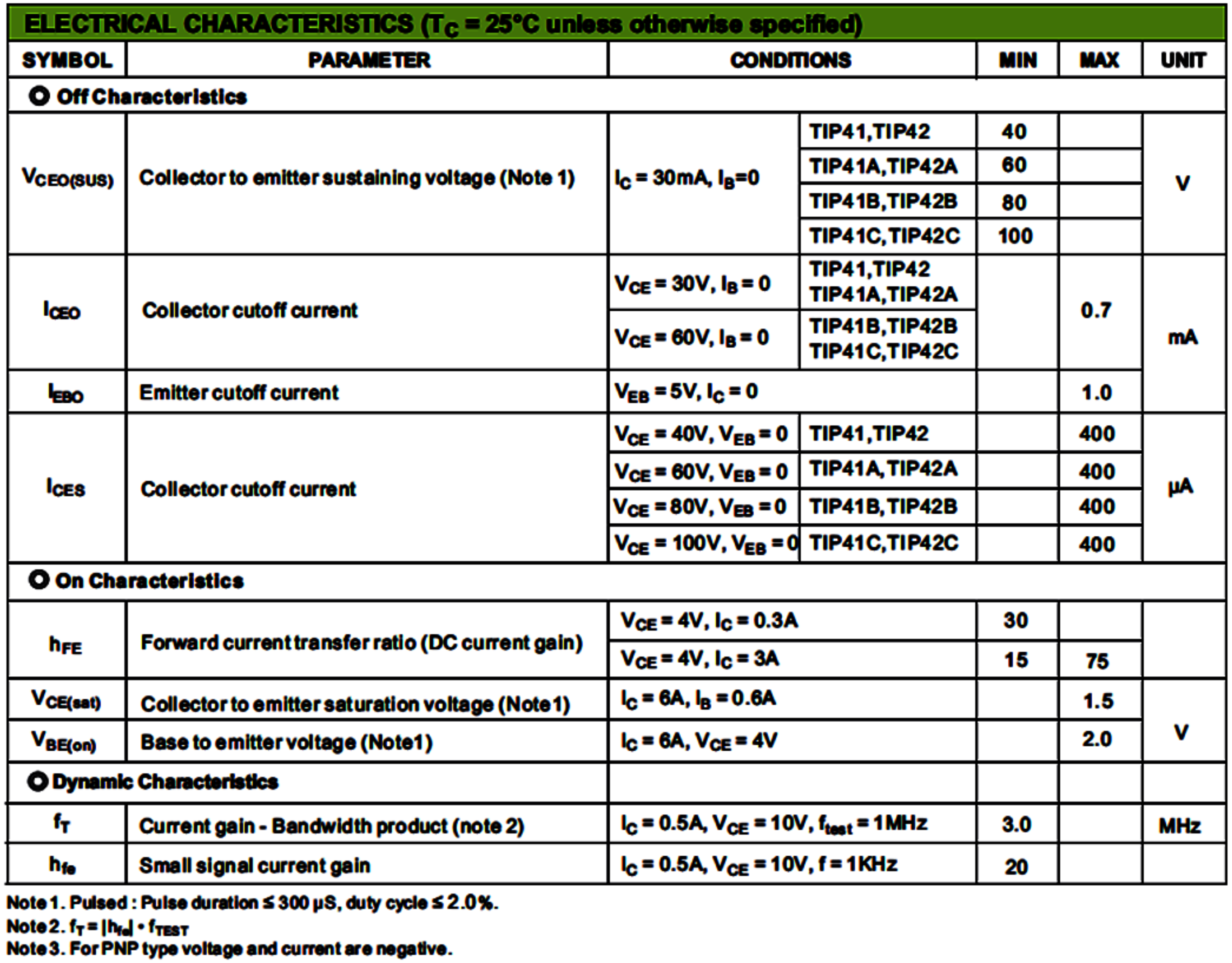
ABSOLUTE MAXIMUM RATINGS (T_C = 25°C)

SYMBOL	PARAMETER		VALUE				UNIT
			TIP41 TIP42	TIP41A TIP42A	TIP41B TIP42B	TIP41C TIP42C	
V_{CBO}	Collector to base voltage (I_E = 0)		40	60	80	100	V
V_{CEO}	Collector to emitter voltage (I_B = 0)		40	60	80	100	
V_{EBO}	Emitter to base voltage (I_C = 0)		5				
I_C	Collector current		6				A
I_{CM}	Collector peak current (t_p < 0.3mS)		10				
I_B	Base current		2				
P_C	Collector power dissipation (Derate above 25°C)	@T_C = 25°C	65 (0.52)				W(W/°C)
		@T_A = 25°C	2.0 (0.016)				
T_J	Junction temperature		150				°C
T_{stg}	Storage temperature		-65 to 150				
E	Unclamped inductive load energy (Note 1)		62.5				mJ

Note: 1. This rating is based on the capability of the transistor to operate safely is a circuit of:
I_C = 2.5A, L = 20mH, R_{BE} = 100Ω, P.R.F. = 10 Hz, V_{CC} = 10V

THERMAL CHARACTERISTICS (T_C = 25°C)

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th(j\text{-}c)}$	Maximum thermal resistance, junction to case	1.67	°C/W
$R_{th(j\text{-}a)}$	Maximum thermal resistance, junction to ambient	57	°C/W

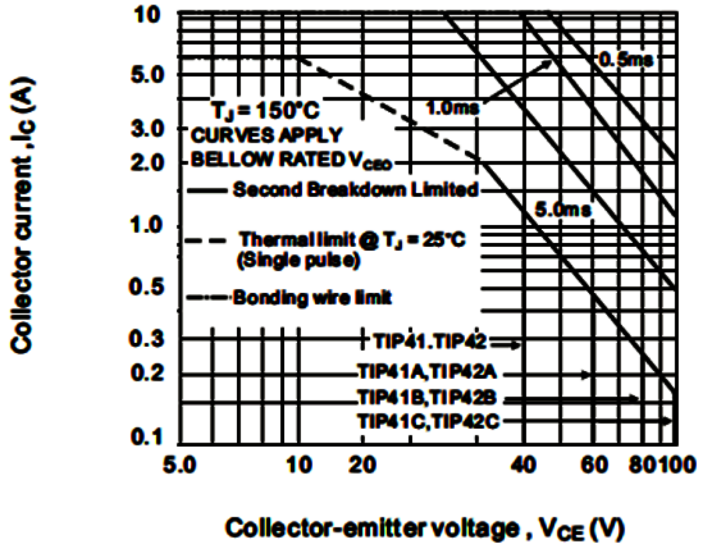


ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise specified)

SYMBOL	PARAMETER	CONDITIONS		MIN	MAX	UNIT
○ Off Characteristics						
$V_{CEO(SUS)}$	Collector to emitter sustaining voltage (Note 1)	I_C = 30mA, I_B=0	TIP41,TIP42	40		V
			TIP41A,TIP42A	60		
			TIP41B,TIP42B	80		
			TIP41C,TIP42C	100		
I_{CEO}	Collector cutoff current	V_{CE} = 30V, I_B = 0	TIP41,TIP42 TIP41A,TIP42A		0.7	mA
		V_{CE} = 60V, I_B = 0	TIP41B,TIP42B TIP41C,TIP42C			
I_{EBO}	Emitter cutoff current	V_{EB} = 5V, I_C = 0			1.0	
I_{CES}	Collector cutoff current	V_{CE} = 40V, V_{EB} = 0	TIP41,TIP42		400	μA
		V_{CE} = 60V, V_{EB} = 0	TIP41A,TIP42A		400	
		V_{CE} = 80V, V_{EB} = 0	TIP41B,TIP42B		400	
		V_{CE} = 100V, V_{EB} = 0	TIP41C,TIP42C		400	
○ On Characteristics						
h_{FE}	Forward current transfer ratio (DC current gain)	V_{CE} = 4V, I_C = 0.3A		30		
		V_{CE} = 4V, I_C = 3A		15	75	
$V_{CE(sat)}$	Collector to emitter saturation voltage (Note1)	I_C = 6A, I_B = 0.6A			1.5	V
$V_{BE(on)}$	Base to emitter voltage (Note1)	I_C = 6A, V_{CE} = 4V			2.0	
○ Dynamic Characteristics						
f_T	Current gain - Bandwidth product (note 2)	I_C = 0.5A, V_{CE} = 10V, f_{test} = 1MHz		3.0		MHz
h_{fe}	Small signal current gain	I_C = 0.5A, V_{CE} = 10V, f = 1KHz		20		

Note 1. Pulsed : Pulse duration ≤ 300 μS, duty cycle ≤ 2.0%.
Note 2. $f_T = |h_{fe}| \cdot f_{TEST}$
Note 3. For PNP type voltage and current are negative.

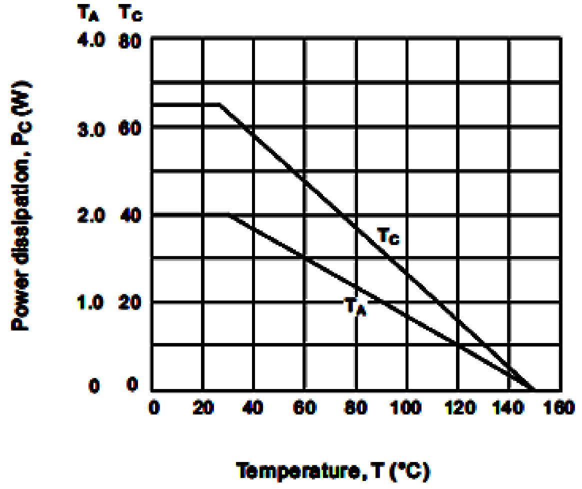
Fig.3 Active region safe operating area



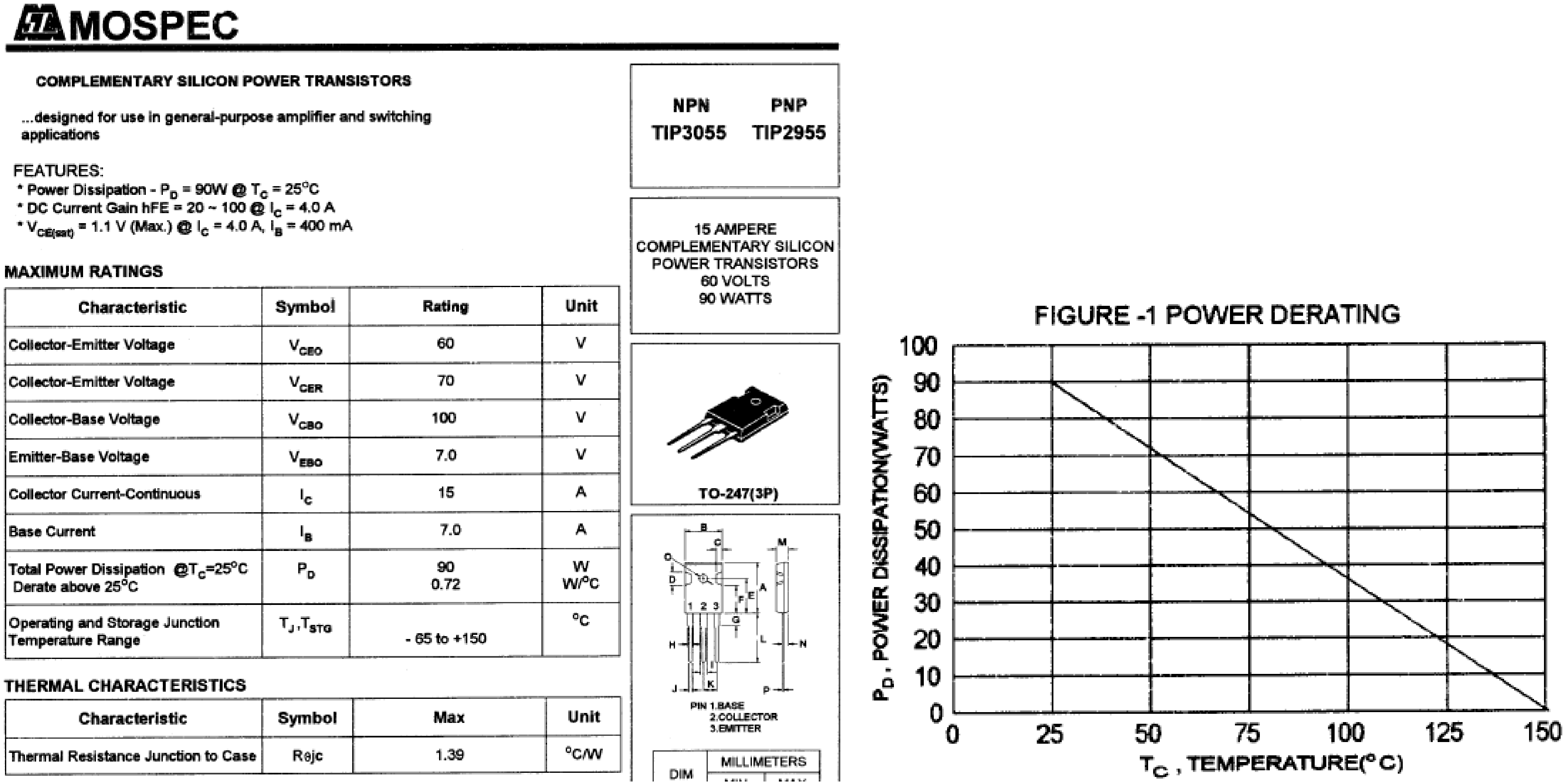
There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate I_C-V_{CE} limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curve indicate.

The data of fig.3 is based on $T_{J(pk)} = 150°C$; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} \leq 150°C$. $T_{J(pk)}$ may be calulated form the data in Figure 13. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

Fig.1 Power Derating



TIP3055 15A 90W



MOSPEC

COMPLEMENTARY SILICON POWER TRANSISTORS

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

FEATURES:

- Power Dissipation - P_D = 90W @ T_C = 25°C
- DC Current Gain hFE = 20 ~ 100 @ I_C = 4.0 A
- $V_{CE(sat)}$ = 1.1 V (Max.) @ I_C = 4.0 A, I_B = 400 mA

NPN TIP3055 | **PNP** TIP2955

15 AMPERE
COMPLEMENTARY SILICON
POWER TRANSISTORS
60 VOLTS
90 WATTS

MAXIMUM RATINGS

Characteristic	Symbol	Rating	Unit
Collector-Emitter Voltage	V_{CEO}	60	V
Collector-Emitter Voltage	V_{CER}	70	V
Collector-Base Voltage	V_{CBO}	100	V
Emitter-Base Voltage	V_{EBO}	7.0	V
Collector Current-Continuous	I_C	15	A
Base Current	I_B	7.0	A
Total Power Dissipation @T_C=25°C Derate above 25°C	P_D	90 0.72	W W/°C
Operating and Storage Junction Temperature Range	T_J,T_{STG}	- 65 to +150	°C

THERMAL CHARACTERISTICS

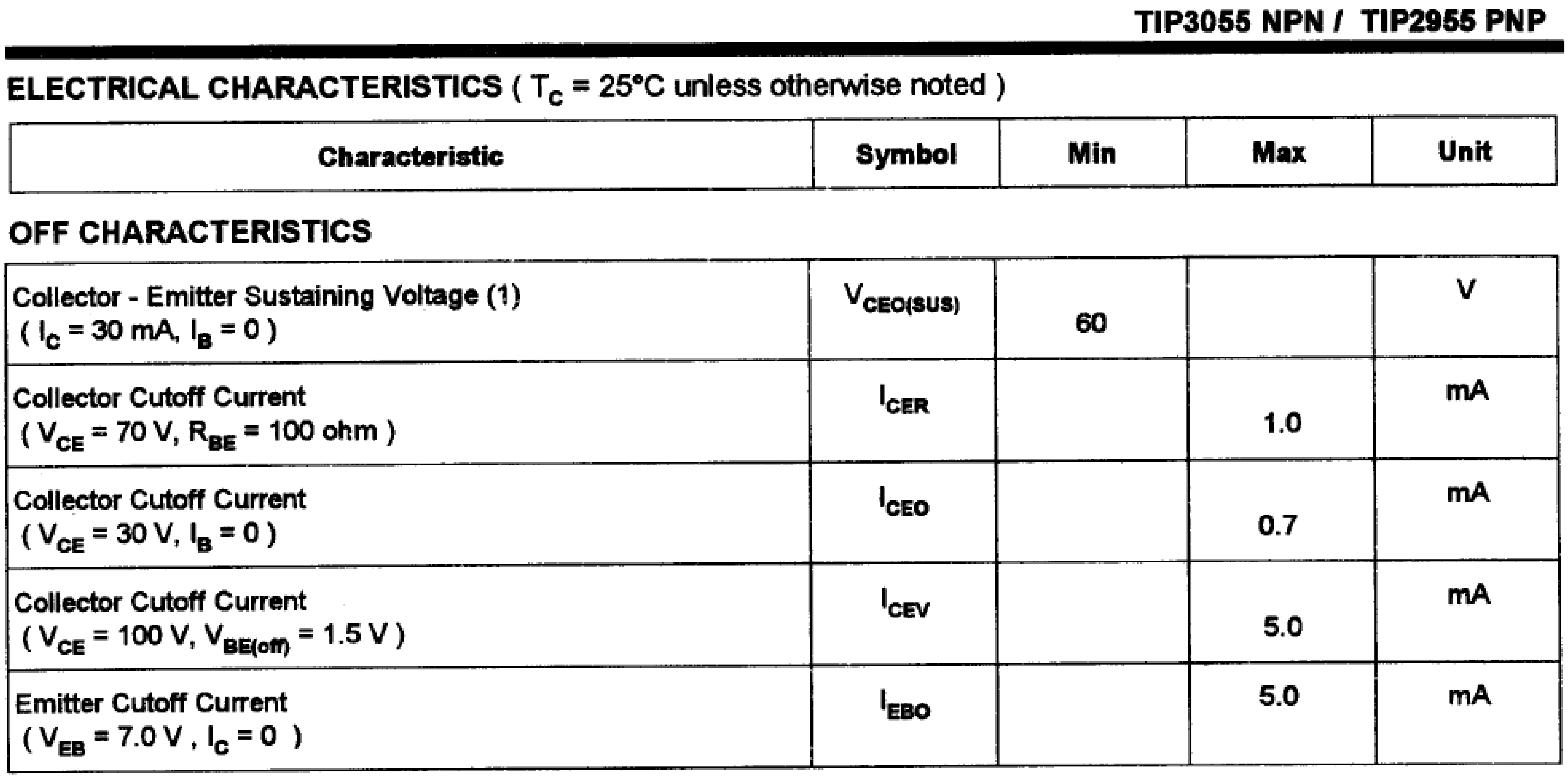
Characteristic	Symbol	Max	Unit
Thermal Resistance Junction to Case	Rθjc	1.39	°C/W

TO-247(3P)

PIN 1.BASE
2.COLLECTOR
3.EMITTER

DIM	MILLIMETERS

FIGURE -1 POWER DERATING



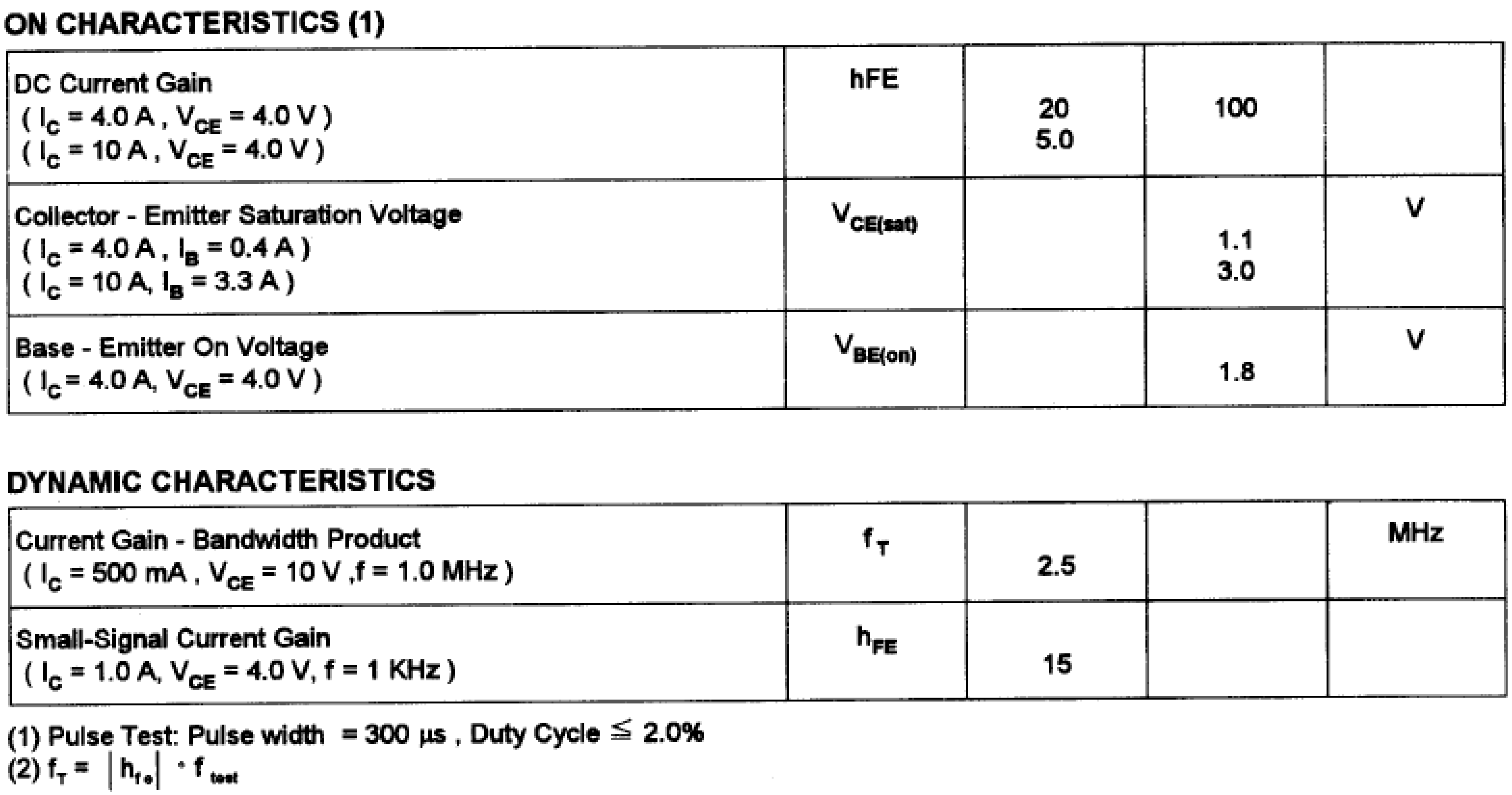
TIP3055 NPN / TIP2955 PNP

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

Characteristic	Symbol	Min	Max	Unit

OFF CHARACTERISTICS

Characteristic	Symbol	Min	Max	Unit
Collector - Emitter Sustaining Voltage (1) (I_C = 30 mA, I_B = 0)	$V_{CEO(SUS)}$	60		V
Collector Cutoff Current (V_{CE} = 70 V, R_{BE} = 100 ohm)	I_{CER}		1.0	mA
Collector Cutoff Current (V_{CE} = 30 V, I_B = 0)	I_{CEO}		0.7	mA
Collector Cutoff Current (V_{CE} = 100 V, $V_{BE(off)}$ = 1.5 V)	I_{CEV}		5.0	mA
Emitter Cutoff Current (V_{EB} = 7.0 V , I_C = 0)	I_{EBO}		5.0	mA



ON CHARACTERISTICS (1)

DC Current Gain (I_C = 4.0 A , V_{CE} = 4.0 V) (I_C = 10 A , V_{CE} = 4.0 V)	hFE	20 5.0	100	
Collector - Emitter Saturation Voltage (I_C = 4.0 A , I_B = 0.4 A) (I_C = 10 A, I_B = 3.3 A)	$V_{CE(sat)}$		1.1 3.0	V
Base - Emitter On Voltage (I_C = 4.0 A, V_{CE} = 4.0 V)	$V_{BE(on)}$		1.8	V

DYNAMIC CHARACTERISTICS

Current Gain - Bandwidth Product (I_C = 500 mA , V_{CE} = 10 V ,f = 1.0 MHz)	f_T	2.5		MHz
Small-Signal Current Gain (I_C = 1.0 A, V_{CE} = 4.0 V, f = 1 KHz)	h_{FE}	15		

(1) Pulse Test: Pulse width = 300 µs , Duty Cycle ≦ 2.0%

(2) $f_T = |h_{fe}| \cdot f_{test}$

2N3055 TO-3 METÁLICO 15A 115W

MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

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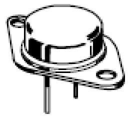
by 2N3055/D

NPN
2N3055*
PNP
MJ2955*

*Motorola Preferred Device

15 AMPERE
POWER TRANSISTORS
COMPLEMENTARY
SILICON
60 VOLTS
115 WATTS



CASE 1–07
TO–204AA
(TO–3)

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

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	$R_{θJC}$	1.52	°C/W

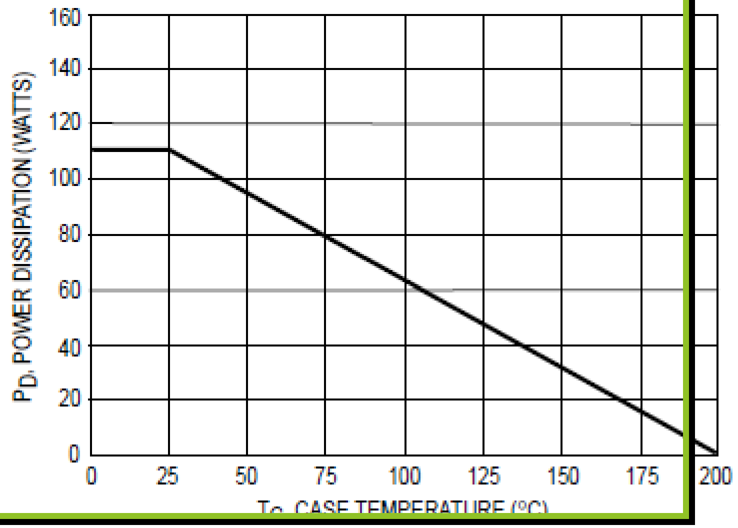
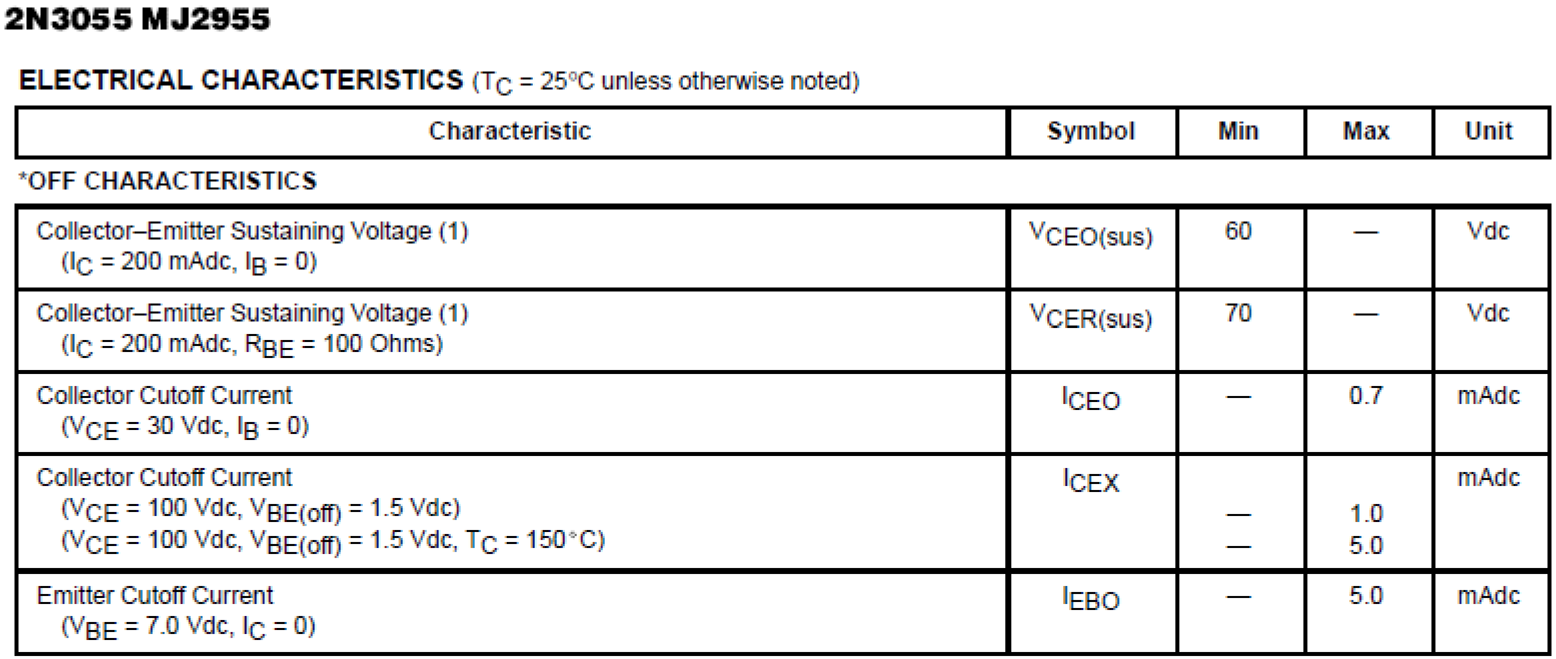


Figure 1. Power Derating



2N3055 MJ2955

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

Characteristic	Symbol	Min	Max	Unit
***OFF CHARACTERISTICS**				
Collector–Emitter Sustaining Voltage (1) (I_C = 200 mAdc, I_B = 0)	$V_{CEO(sus)}$	60	—	Vdc
Collector–Emitter Sustaining Voltage (1) (I_C = 200 mAdc, R_{BE} = 100 Ohms)	$V_{CER(sus)}$	70	—	Vdc
Collector Cutoff Current (V_{CE} = 30 Vdc, I_B = 0)	I_{CEO}	—	0.7	mAdc
Collector Cutoff Current	I_{CEX}			mAdc
(V_{CE} = 100 Vdc, $V_{BE(off)}$ = 1.5 Vdc)		—	1.0	
(V_{CE} = 100 Vdc, $V_{BE(off)}$ = 1.5 Vdc, T_C = 150°C)		—	5.0	
Emitter Cutoff Current (V_{BE} = 7.0 Vdc, I_C = 0)	I_{EBO}	—	5.0	mAdc

*ON CHARACTERISTICS (1)

DC Current Gain (I_C = 4.0 Adc, V_{CE} = 4.0 Vdc) (I_C = 10 Adc, V_{CE} = 4.0 Vdc)	h_{FE}	 20 5.0	 70 —	—
Collector–Emitter Saturation Voltage (I_C = 4.0 Adc, I_B = 400 mAdc) (I_C = 10 Adc, I_B = 3.3 Adc)	$V_{CE(sat)}$	 —	 1.1 3.0	Vdc
Base–Emitter On Voltage (I_C = 4.0 Adc, V_{CE} = 4.0 Vdc)	$V_{BE(on)}$	—	1.5	Vdc

SECOND BREAKDOWN

Second Breakdown Collector Current with Base Forward Biased (V_{CE} = 40 Vdc, t = 1.0 s, Nonrepetitive)	$I_{s/b}$	2.87	—	Adc

DYNAMIC CHARACTERISTICS

Current Gain — Bandwidth Product (I_C = 0.5 Adc, V_{CE} = 10 Vdc, f = 1.0 MHz)	f_T	2.5	—	MHz
*Small–Signal Current Gain (I_C = 1.0 Adc, V_{CE} = 4.0 Vdc, f = 1.0 kHz)	h_{fe}	15	120	—
*Small–Signal Current Gain Cutoff Frequency (V_{CE} = 4.0 Vdc, I_C = 1.0 Adc, f = 1.0 kHz)	f_{hfe}	10	—	kHz

* Indicates Within JEDEC Registration. (2N3055)

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

2SB1184 2SB1243 PNP 3A 50V

Power Transistor (50V, 3A)

2SD1760 / 2SD1864 / 2SD1762

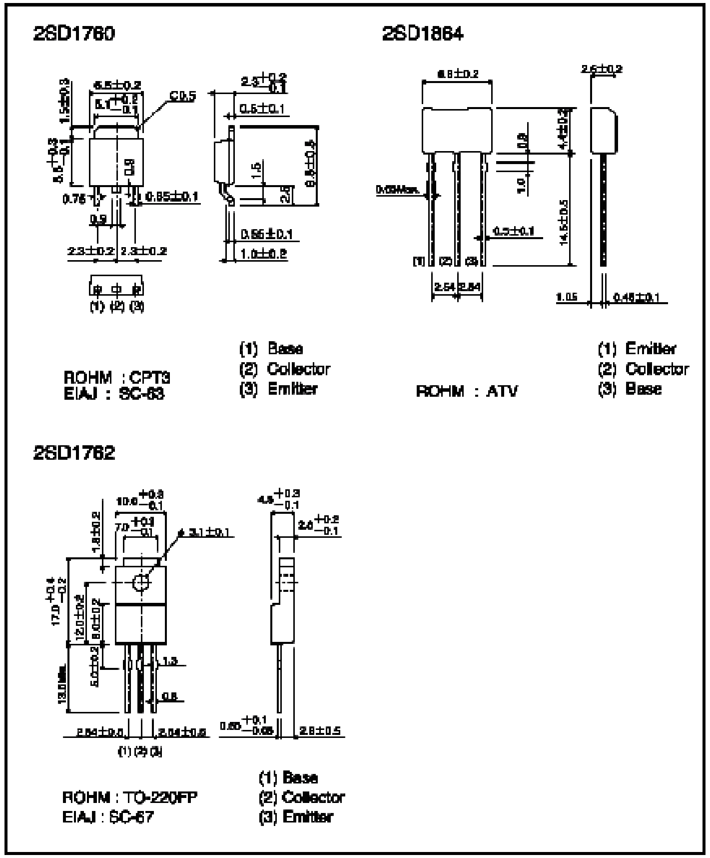
●Features

1) Low $V_{CE(sat)}$.
   $V_{CE(sat)}$ = 0.5V (Typ.)
   (I_C / I_B = 2A / 0.2A)
2) Complements the
   2SB1184 / 2SB1243 / 2SB1185.

●Structure

Epitaxial planar type
NPN silicon transistor

●External dimensions (Units: mm)



Transistors

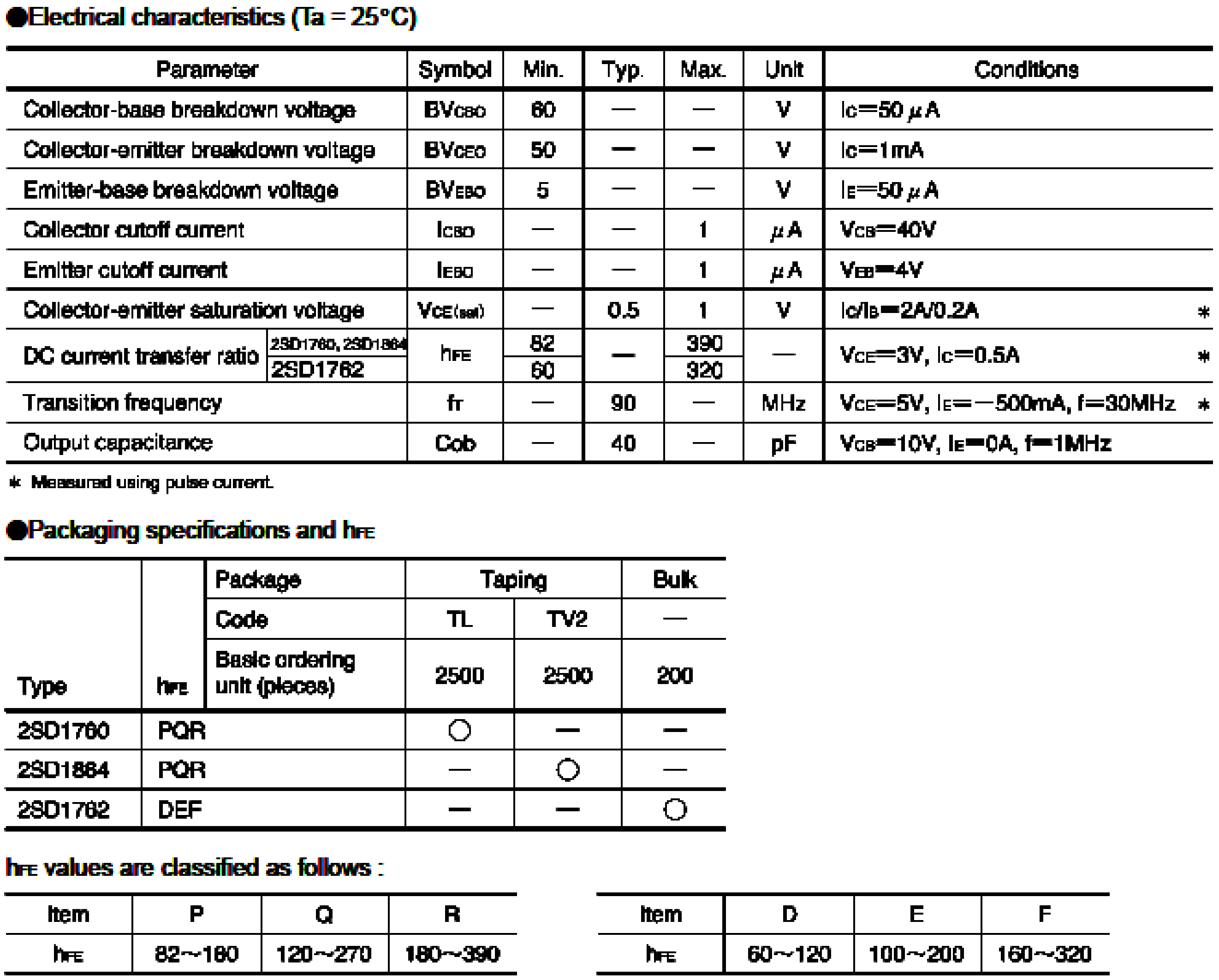
2SD1760 / 2SD1864 / 2SD1762

●Absolute maximum ratings (Ta = 25°C)

Parameter		Symbol	Limits	Unit
Collector-base voltage		V_{CBO}	60	V
Collector-emitter voltage		V_{CEO}	50	V
Emitter-base voltage		V_{EBO}	6	V
Collector current		I_C	3	A(DC)
			4.5	A(Pulse) ∗1
Collector power dissipation	2SD1760	P_C	15	W(Tc=25℃) ∗2
	2SD1864		1	W
	2SD1762		25	W(Tc=25℃) ∗2
Junction temperature		Tj	150	℃
Storage temperature		Tstg	−55~+150	℃

∗1 Single pulse, Pw=10ms

∗2 Printed circuit board, 1.7mm thick, collector copper plating 100mm² or larger.



●Electrical characteristics (Ta = 25°C)

Parameter		Symbol	Min.	Typ.	Max.	Unit	Conditions
Collector-base breakdown voltage		BV_{CBO}	60	—	—	V	I_C=50 μA
Collector-emitter breakdown voltage		BV_{CEO}	50	—	—	V	I_C=1mA
Emitter-base breakdown voltage		BV_{EBO}	5	—	—	V	I_E=50 μA
Collector cutoff current		I_{CBO}	—	—	1	μA	V_{CB}=40V
Emitter cutoff current		I_{EBO}	—	—	1	μA	V_{EB}=4V
Collector-emitter saturation voltage		$V_{CE(sat)}$	—	0.5	1	V	I_C/I_B=2A/0.2A *
DC current transfer ratio	2SD1760, 2SD1864	h_{FE}	82	—	390	—	V_{CE}=3V, I_C=0.5A *
	2SD1762		60		320		
Transition frequency		f_T	—	90	—	MHz	V_{CE}=5V, I_E=−500mA, f=30MHz *
Output capacitance		C_{ob}	—	40	—	pF	V_{CB}=10V, I_E=0A, f=1MHz

* Measured using pulse current.

●Packaging specifications and h_{FE}

		Package	Taping		Bulk
		Code	TL	TV2	—
Type	h_{FE}	Basic ordering unit (pieces)	2500	2500	200
2SD1760	PQR		○	—	—
2SD1864	PQR		—	○	—
2SD1762	DEF		—	—	○

h_{FE} values are classified as follows :

Item	P	Q	R
h_{FE}	82~180	120~270	180~390

Item	D	E	F
h_{FE}	60~120	100~200	160~320

Transistors **2SD1760 / 2SD1864 / 2SD1762**

●Electrical characteristic curves

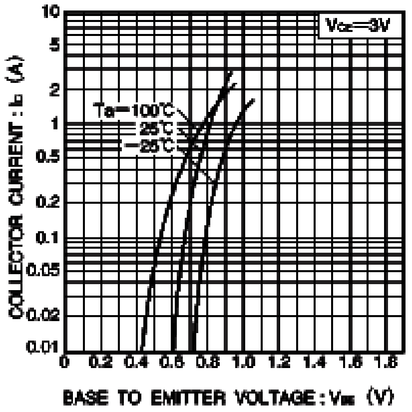


Fig.1 Grounded emitter propagation characteristics

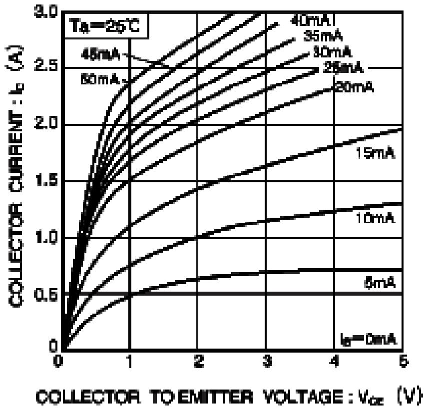


Fig.2 Grounded emitter output characteristics（Ⅰ）

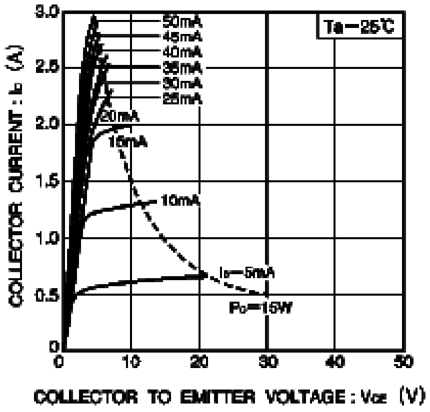


Fig.3 Grounded-emitter output characteristics（Ⅱ）

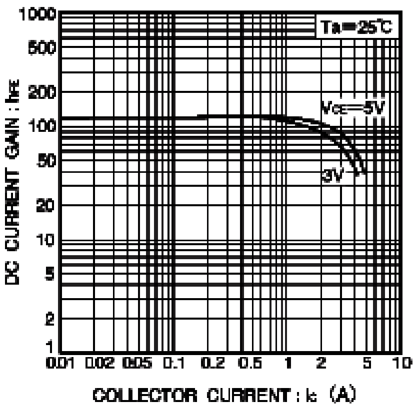


Fig.4 DC current gain vs. collector current（Ⅰ）

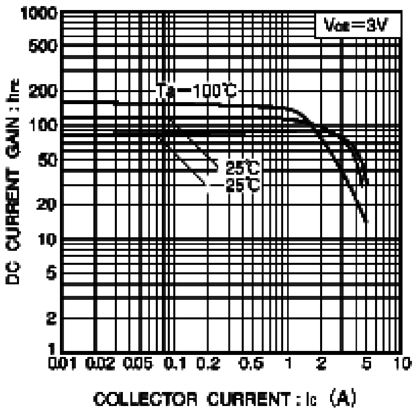


Fig.5 DC current gain vs. collector curren（Ⅱ）

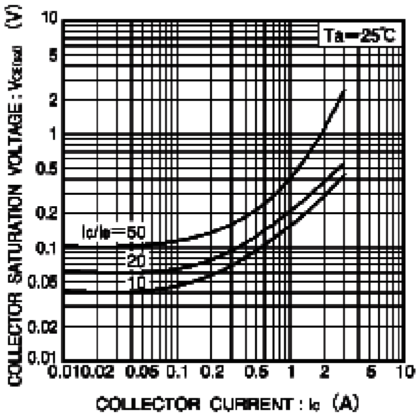


Fig.6 Collector-emitter saturation voltage vs. collector current

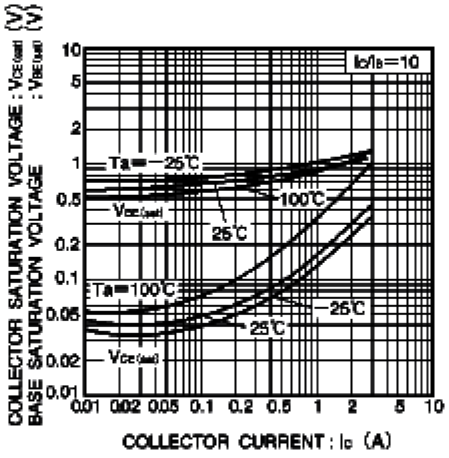


Fig.7 Collector-emitter saturation voltage vs. collector current
Base-emitter saturation voltage vs. collector current

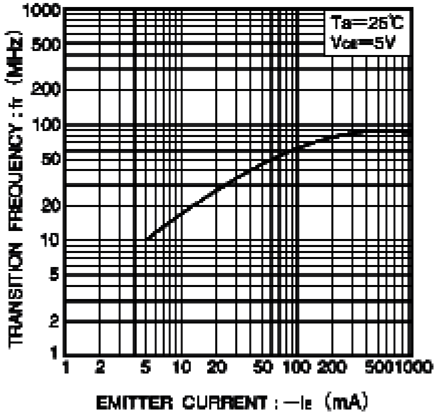


Fig.8 Gain bandwidth product vs. emitter current

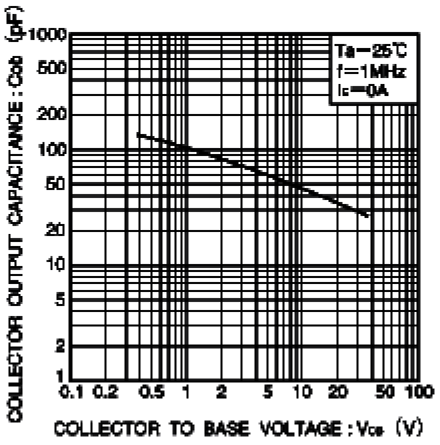


Fig.9 Collector output capacitance vs. collector-base voltage

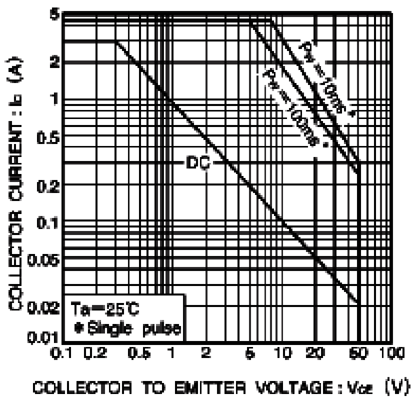


Fig.10 Safe operating area (2SD1760)

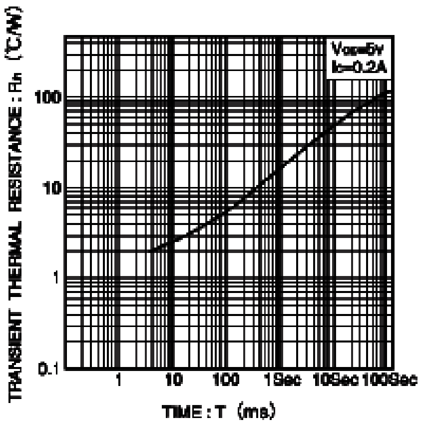


Fig.11 Transient thermal resistance (2SD1760)

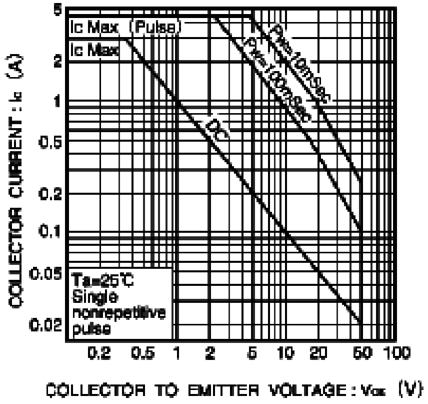


Fig.12 Safe operating area (2SD1864)

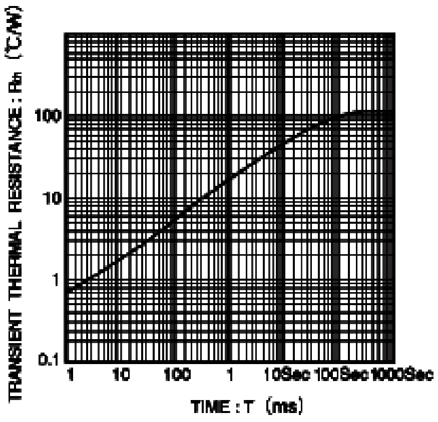


Fig.13 Transient thermal resistance (2SD1864)

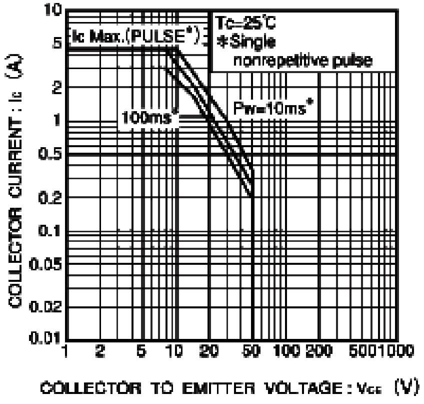


Fig.14 Safe operating area (2SD1762)

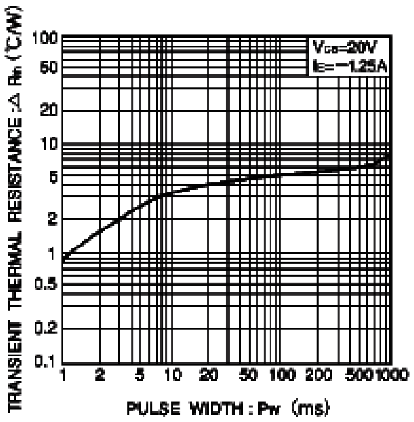


Fig.15 Transient thermal resistance (2SD1762)

2SB1184 2SB1243 PNP 3A 50V

2SB1184 / 2SB1243

Transistors

Power Transistor (–60V, –3A)

2SB1184 / 2SB1243

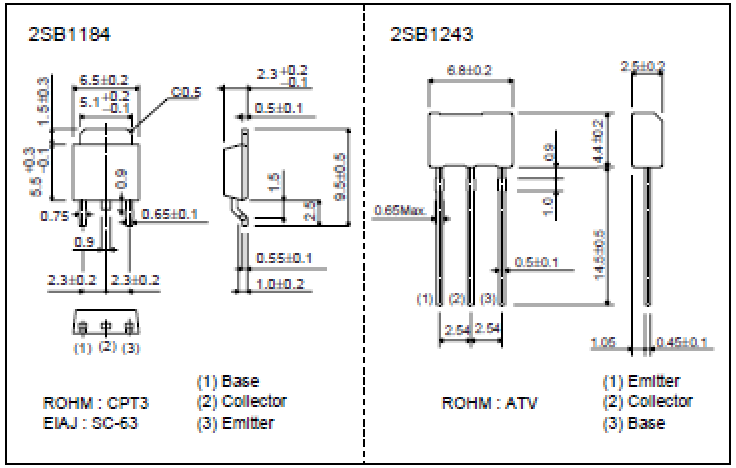
●Features

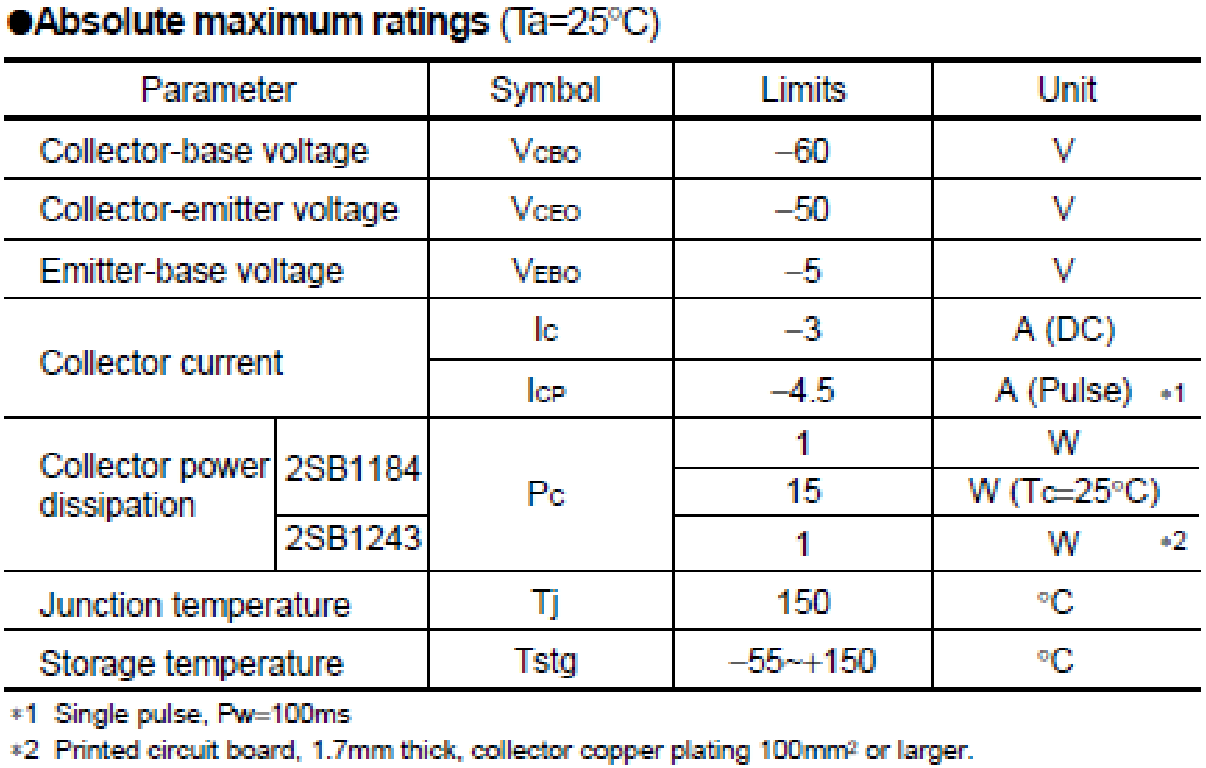
1) Low $V_{CE(sat)}$.
   $V_{CE(sat)}$ = -0.5V (Typ.)
   (I_C/I_B = -2A / -0.2A)
2) Complements the 2SD1760 / 2SD1864.

●Structure

Epitaxial planar type
PNP silicon transistor

●External dimensions (Units : mm)



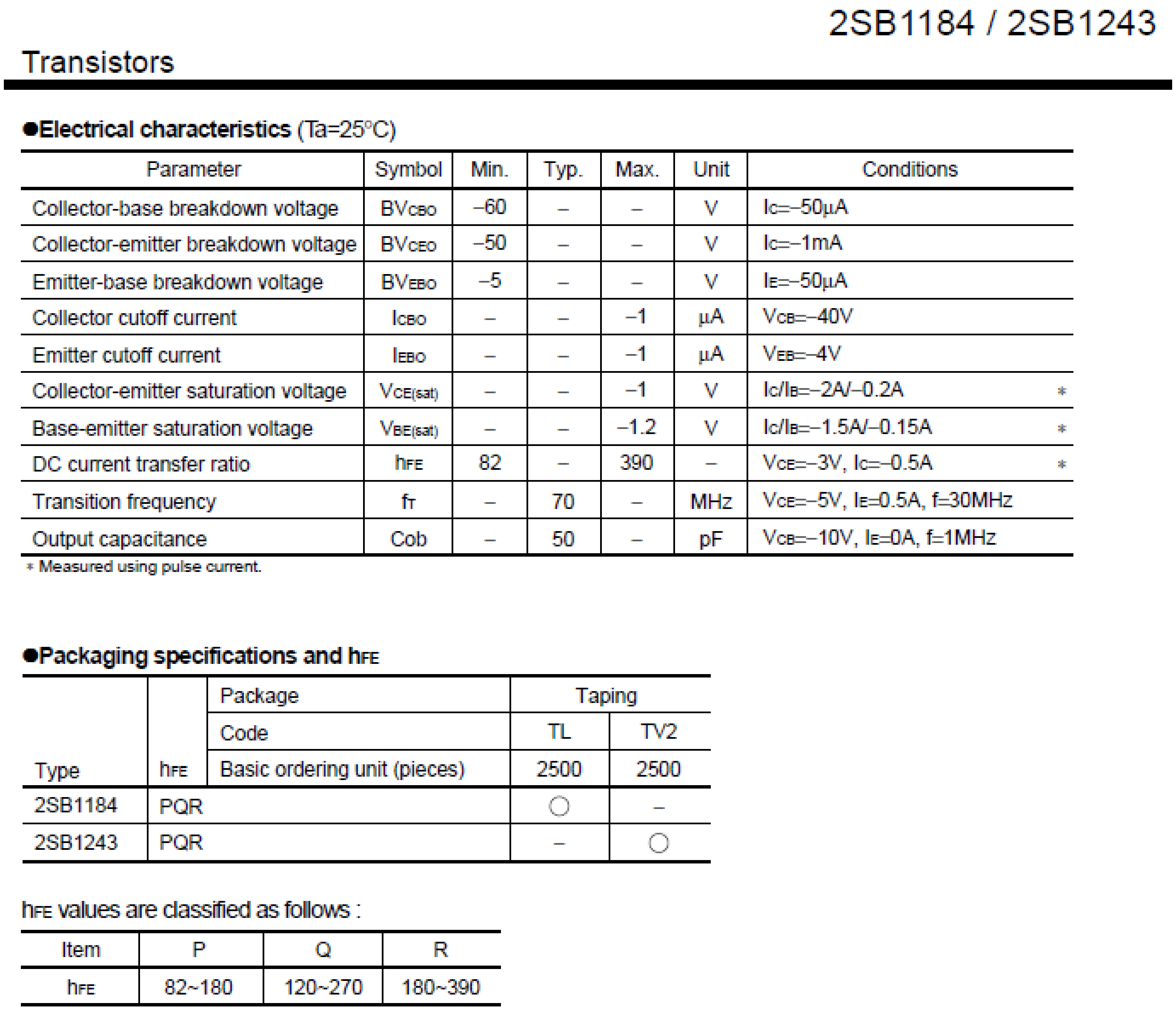


●**Absolute maximum ratings** (Ta=25°C)

Parameter		Symbol	Limits	Unit
Collector-base voltage		V_{CBO}	−60	V
Collector-emitter voltage		V_{CEO}	−50	V
Emitter-base voltage		V_{EBO}	−5	V
Collector current		I_C	−3	A (DC)
		I_{CP}	−4.5	A (Pulse) *1
Collector power dissipation	2SB1184	P_C	1	W
			15	W (Tc=25°C)
	2SB1243		1	W *2
Junction temperature		Tj	150	°C
Storage temperature		Tstg	−55~+150	°C

*1 Single pulse, Pw=100ms

*2 Printed circuit board, 1.7mm thick, collector copper plating $100mm^2$ or larger.



2SB1184 / 2SB1243

Transistors

●Electrical characteristics (Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	
Collector-base breakdown voltage	BV_{CBO}	−60	–	–	V	I_C=−50μA	
Collector-emitter breakdown voltage	BV_{CEO}	−50	–	–	V	I_C=−1mA	
Emitter-base breakdown voltage	BV_{EBO}	−5	–	–	V	I_E=−50μA	
Collector cutoff current	I_{CBO}	–	–	−1	μA	V_{CB}=−40V	
Emitter cutoff current	I_{EBO}	–	–	−1	μA	V_{EB}=−4V	
Collector-emitter saturation voltage	$V_{CE(sat)}$	–	–	−1	V	I_C/I_B=−2A/−0.2A	*
Base-emitter saturation voltage	$V_{BE(sat)}$	–	–	−1.2	V	I_C/I_B=−1.5A/−0.15A	*
DC current transfer ratio	h_{FE}	82	–	390	–	V_{CE}=−3V, I_C=−0.5A	*
Transition frequency	f_T	–	70	–	MHz	V_{CE}=−5V, I_E=0.5A, f=30MHz	
Output capacitance	Cob	–	50	–	pF	V_{CB}=−10V, I_E=0A, f=1MHz	

* Measured using pulse current.

●Packaging specifications and h_{FE}

		Package	Taping	
		Code	TL	TV2
Type	h_{FE}	Basic ordering unit (pieces)	2500	2500
2SB1184	PQR		○	–
2SB1243	PQR		–	○

h_{FE} values are classified as follows :

Item	P	Q	R
h_{FE}	82~180	120~270	180~390

●Electrical characteristic curves

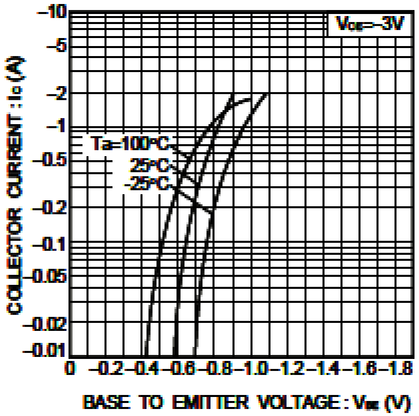


Fig.1 Grounded emitter propagation characteristics

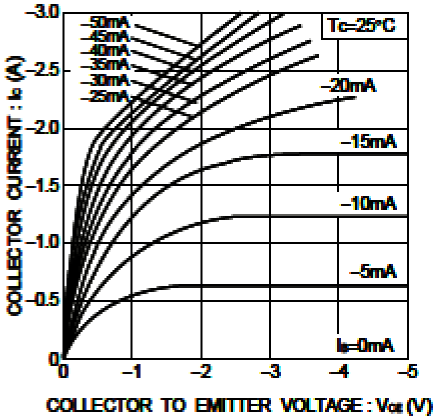


Fig.2 Grounded emitter output characteristics (I)

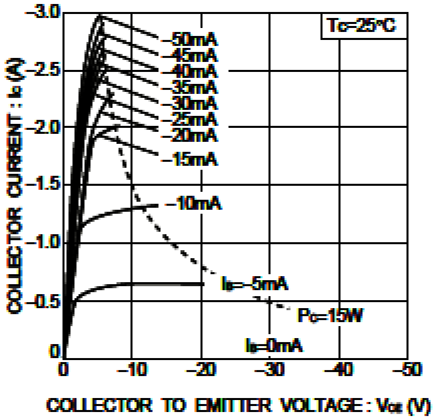


Fig.3 Grounded emitter output characteristics (II)

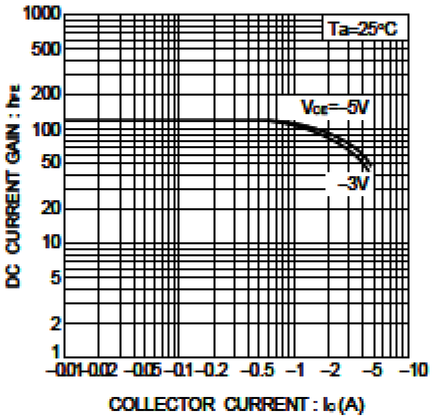


Fig.4 DC current gain vs. collector current (I)

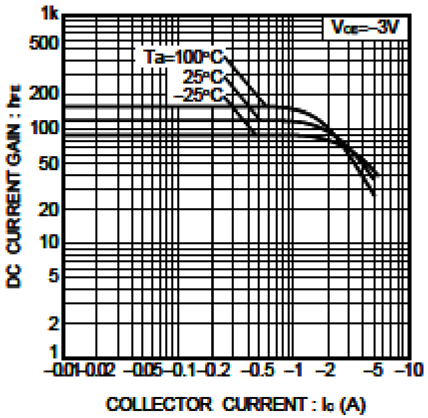


Fig.5 DC current gain vs. collector current (II)

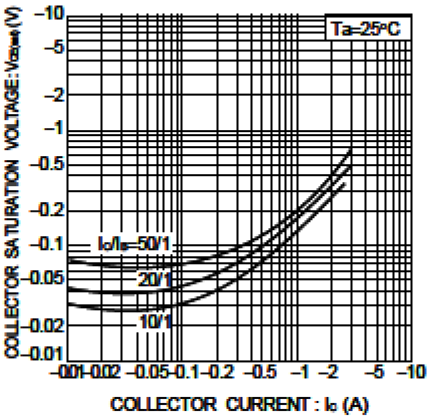


Fig.6 Collector-emitter saturation voltage vs.collector current

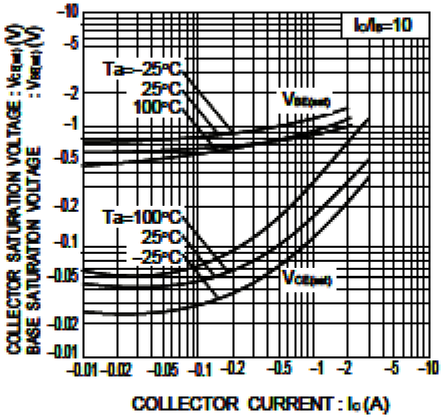


Fig.7 Collector-emitter saturation voltage vs. collector current
Base-emitter saturation voltage vs. collector current

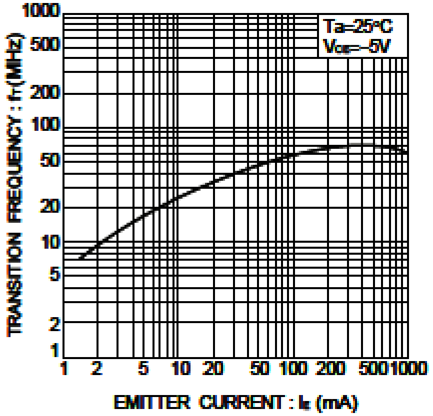


Fig.8 Gain bandwidth product vs. emitter current

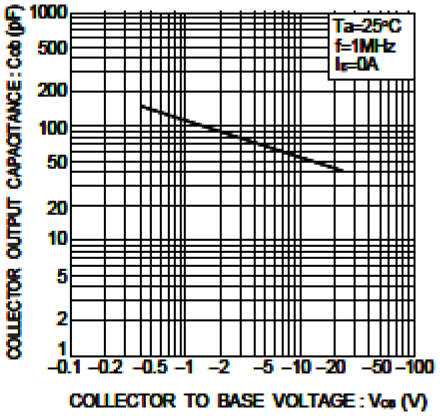


Fig.9 Collector output capacitance vs. collector base voltage

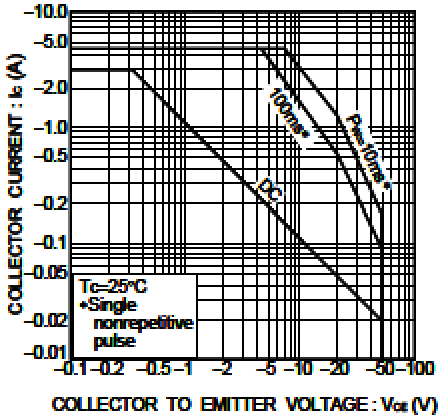


Fig.10 Safe operation area (2SB1184)

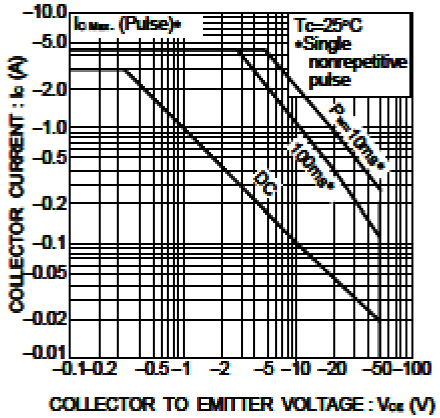
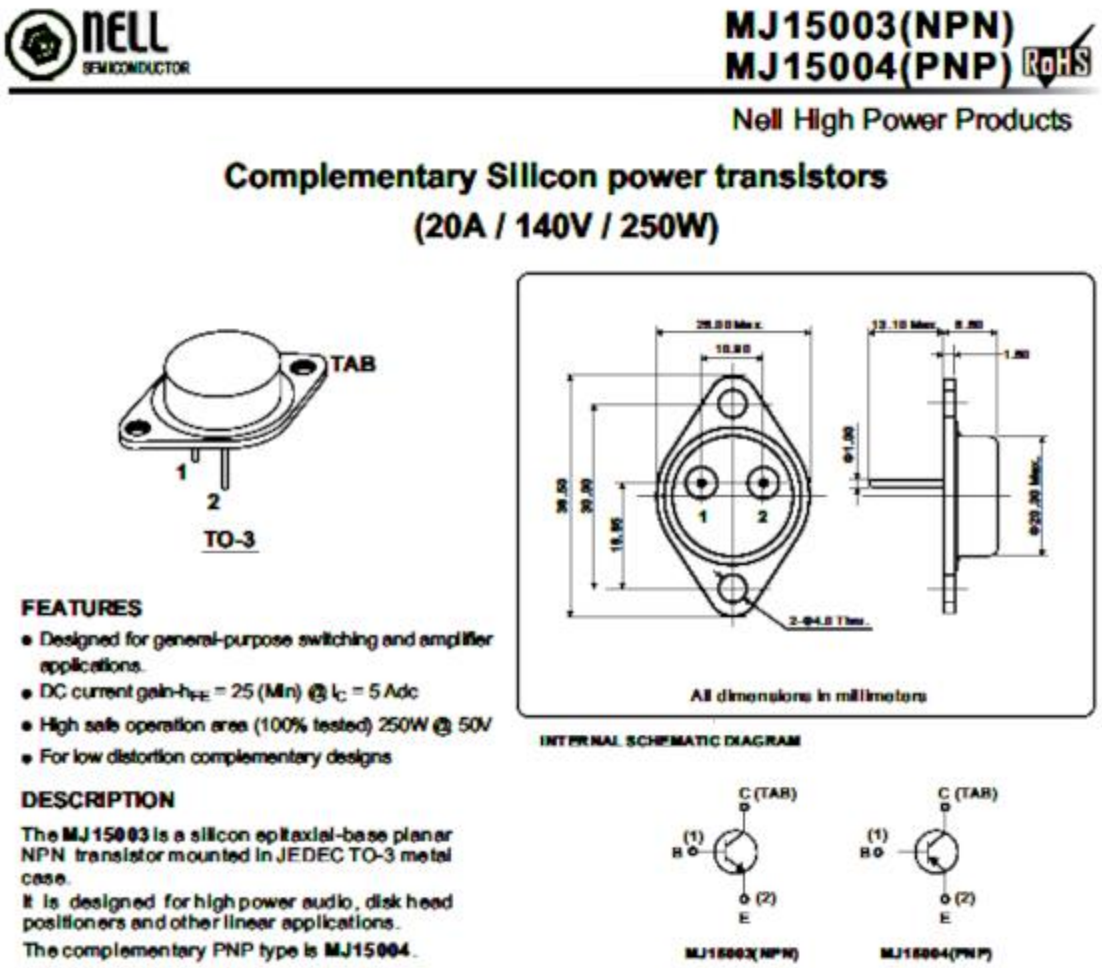


Fig.11 Safe operation area (2SB1243)

MJ15003 NPN MJ15004 PNP POTÊNICA DE AUDIO 20A 140V 250W METÁLICO TO-3



NELL SEMICONDUCTOR

MJ15003(NPN)
MJ15004(PNP) RoHS

Nell High Power Products

Complementary Silicon power transistors
(20A / 140V / 250W)

FEATURES

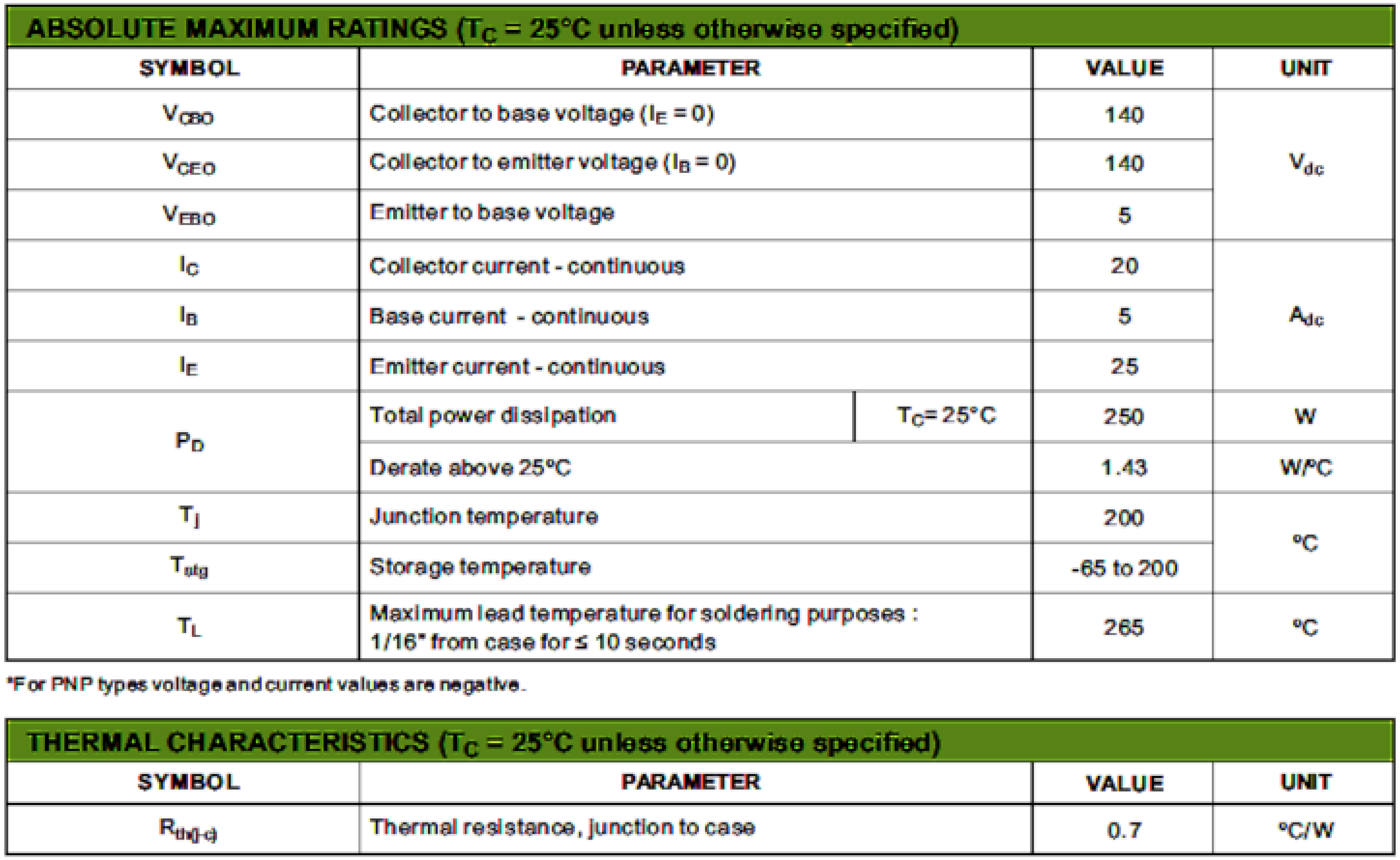
- Designed for general-purpose switching and amplifier applications.
- DC current gain-h_{FE} = 25 (Min) @ I_C = 5 Adc
- High safe operation area (100% tested) 250W @ 50V
- For low distortion complementary designs

DESCRIPTION

The **MJ15003** is a silicon epitaxial-base planar NPN transistor mounted in JEDEC TO-3 metal case.

It is designed for high power audio, disk head positioners and other linear applications.

The complementary PNP type is **MJ15004**.



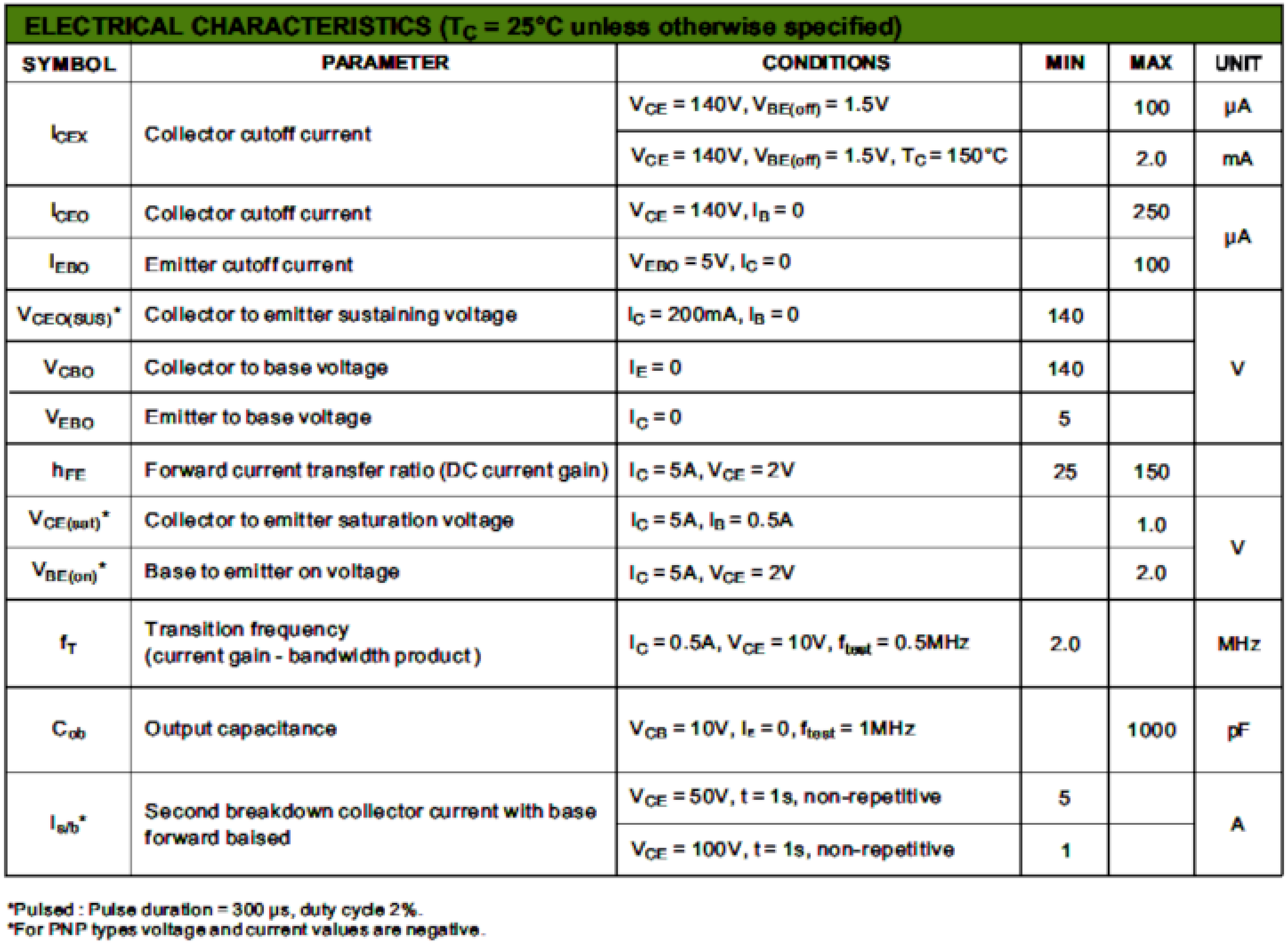
ABSOLUTE MAXIMUM RATINGS (T_C = 25°C unless otherwise specified)

SYMBOL	PARAMETER		VALUE	UNIT
V_{CBO}	Collector to base voltage (I_E = 0)		140	V_{dc}
V_{CEO}	Collector to emitter voltage (I_B = 0)		140	
V_{EBO}	Emitter to base voltage		5	
I_C	Collector current - continuous		20	A_{dc}
I_B	Base current - continuous		5	
I_E	Emitter current - continuous		25	
P_D	Total power dissipation	T_C= 25°C	250	W
	Derate above 25°C		1.43	W/°C
T_J	Junction temperature		200	°C
T_{stg}	Storage temperature		-65 to 200	
T_L	Maximum lead temperature for soldering purposes : 1/16" from case for ≤ 10 seconds		265	°C

*For PNP types voltage and current values are negative.

THERMAL CHARACTERISTICS (T_C = 25°C unless otherwise specified)

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th(j-c)}$	Thermal resistance, junction to case	0.7	°C/W



ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise specified)

SYMBOL	PARAMETER	CONDITIONS	MIN	MAX	UNIT
I_{CEX}	Collector cutoff current	V_{CE} = 140V, $V_{BE(off)}$ = 1.5V		100	μA
		V_{CE} = 140V, $V_{BE(off)}$ = 1.5V, T_C = 150°C		2.0	mA
I_{CEO}	Collector cutoff current	V_{CE} = 140V, I_B = 0		250	μA
I_{EBO}	Emitter cutoff current	V_{EBO} = 5V, I_C = 0		100	
$V_{CEO(SUS)}$*	Collector to emitter sustaining voltage	I_C = 200mA, I_B = 0	140		V
V_{CBO}	Collector to base voltage	I_E = 0	140		
V_{EBO}	Emitter to base voltage	I_C = 0	5		
h_{FE}	Forward current transfer ratio (DC current gain)	I_C = 5A, V_{CE} = 2V	25	150	
$V_{CE(sat)}$*	Collector to emitter saturation voltage	I_C = 5A, I_B = 0.5A		1.0	V
$V_{BE(on)}$*	Base to emitter on voltage	I_C = 5A, V_{CE} = 2V		2.0	
f_T	Transition frequency (current gain - bandwidth product)	I_C = 0.5A, V_{CE} = 10V, f_{test} = 0.5MHz	2.0		MHz
C_{ob}	Output capacitance	V_{CB} = 10V, I_E = 0, f_{test} = 1MHz		1000	pF
$I_{s/b}$*	Second breakdown collector current with base forward baised	V_{CE} = 50V, t = 1s, non-repetitive	5		A
		V_{CE} = 100V, t = 1s, non-repetitive	1		

*Pulsed : Pulse duration = 300 μs, duty cycle 2%.
*For PNP types voltage and current values are negative.

Fig.1 Power derating

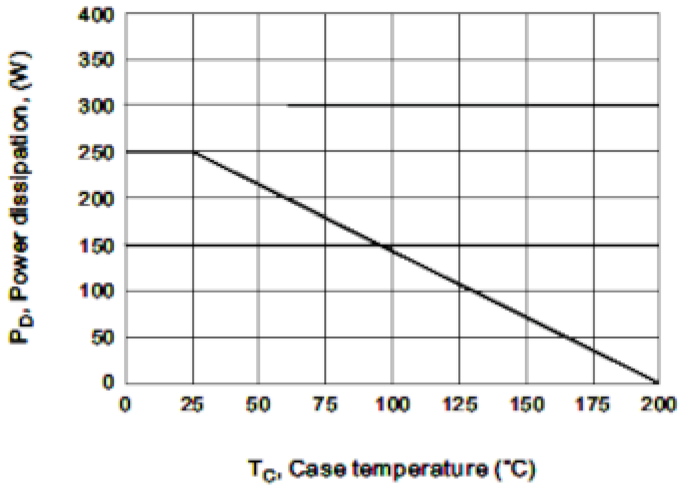
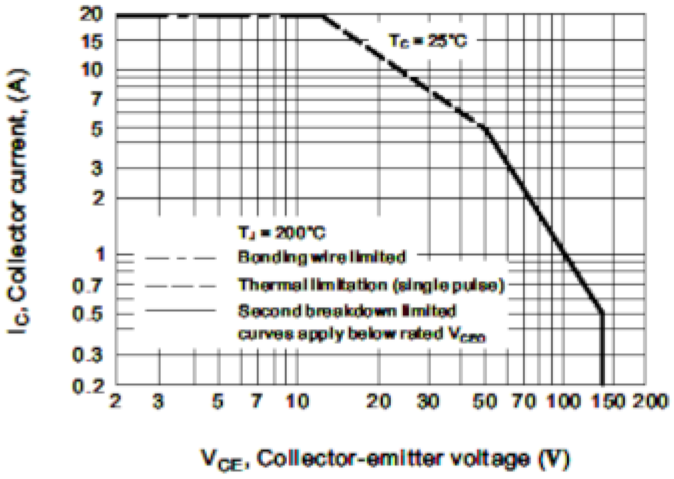


Fig.2 Active region safe operating area



There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate I_C-V_{CE} limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of fig.2 is based on $T_{J(pk)}$ = 200°C; T_C is variable depending on conditions. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

Fig.3 DC Current gain

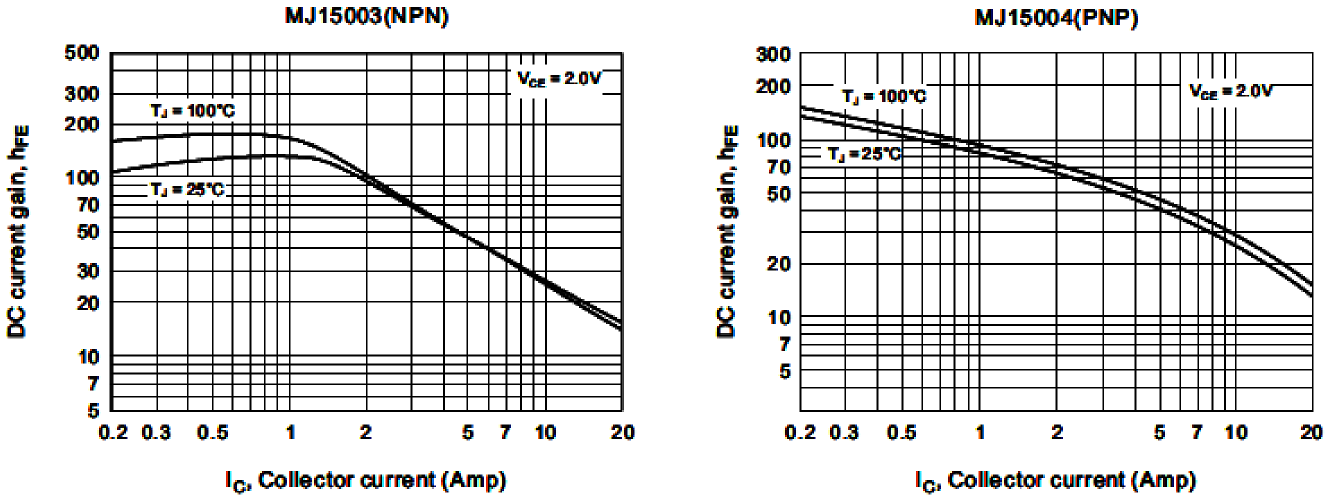
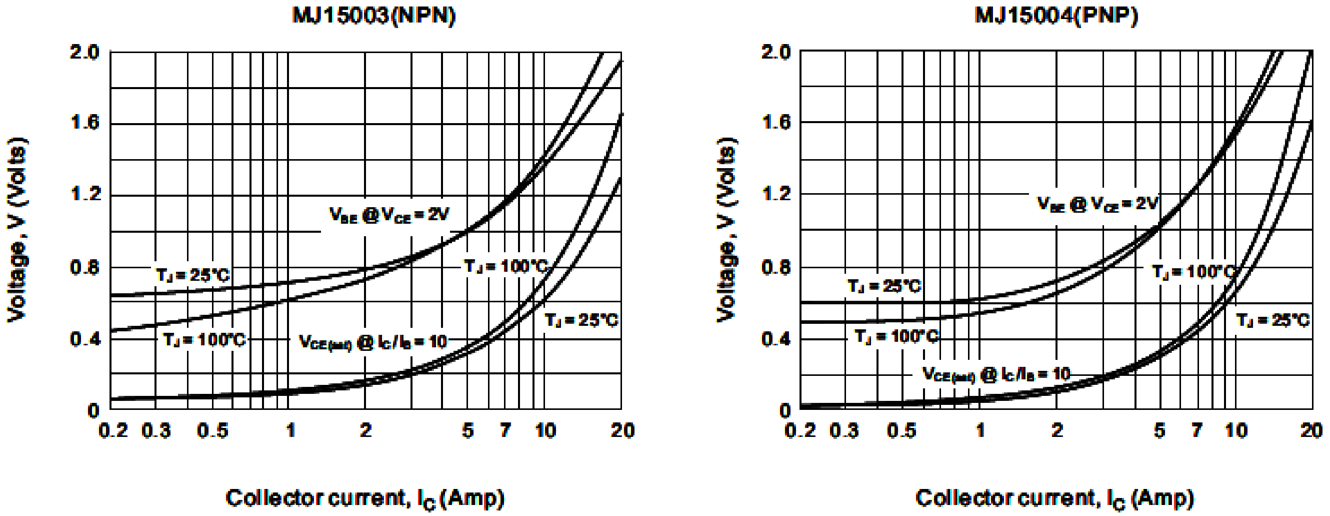

MJ15003(NPN) MJ15004(PNP)

Fig.4 "ON" Characteristics


MJ15003(NPN) MJ15004(PNP)

MJE15028 MJE15030 NPN MJE15029 MJE15031 PNP 8A 50 W 120_150V

MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

Order this document
by MJE15028/D

Complementary Silicon Plastic Power Transistors

NPN
MJE15028*
MJE15030*
PNP
MJE15029*
MJE15031*

*Motorola Preferred Device

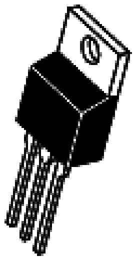
. . . designed for use as high–frequency drivers in audio amplifiers.

- DC Current Gain Specified to 4.0 Amperes
  h_{FE} = 40 (Min) @ I_C = 3.0 Adc
  = 20 (Min) @ I_C = 4.0 Adc
- Collector–Emitter Sustaining Voltage —
  $V_{CEO(sus)}$ = 120 Vdc (Min) — MJE15028, MJE15029
  = 150 Vdc (Min) — MJE15030, MJE15031
- High Current Gain — Bandwidth Product
  f_T = 30 MHz (Min) @ I_C = 500 mAdc
- TO–220AB Compact Package

8 AMPERE
POWER TRANSISTORS
COMPLEMENTARY
SILICON
120–150 VOLTS
50 WATTS

MAXIMUM RATINGS

Rating	Symbol	MJE15028 MJE15029	MJE15030 MJE15031	Unit
Collector–Emitter Voltage	V_{CEO}	120	150	Vdc
Collector–Base Voltage	V_{CB}	120	150	Vdc
Emitter–Base Voltage	V_{EB}	5.0		Vdc
Collector Current — Continuous — Peak	I_C	8.0 16		Adc
Base Current	I_B	2.0		Adc
Total Power Dissipation @ T_C = 25°C Derate above 25°C	P_D	50 0.40		Watts W/°C
Total Power Dissipation @ T_A = 25°C Derate above 25°C	P_D	2.0 0.016		Watts W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	–65 to +150		°C



CASE 221A–06
TO–220AB

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.5	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	62.5	°C/W

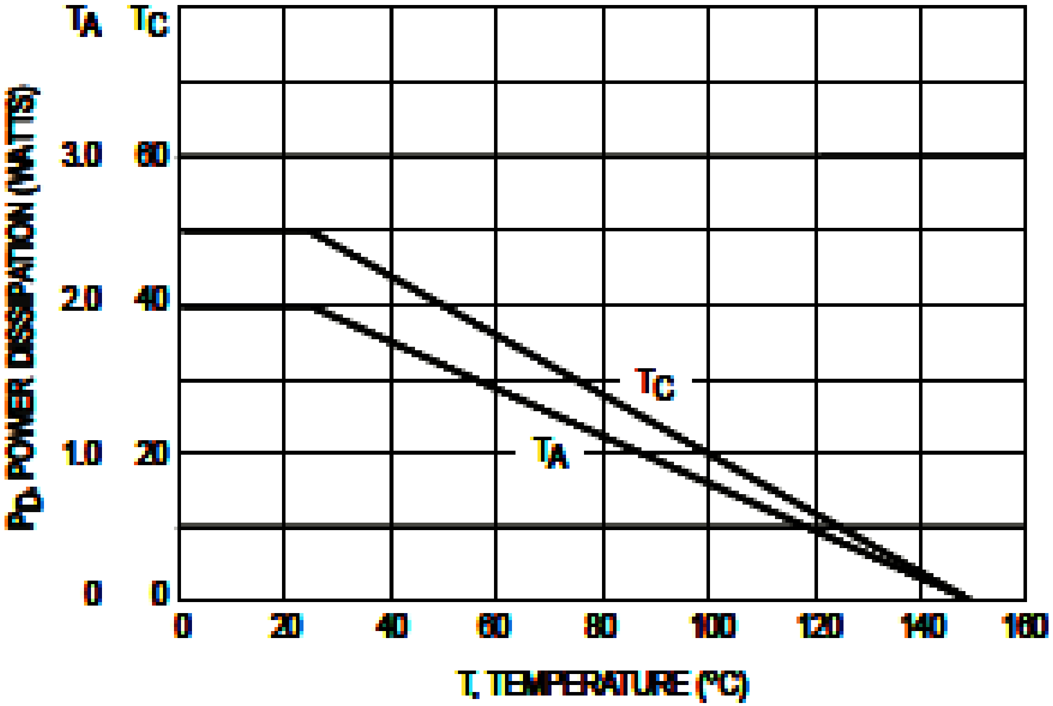
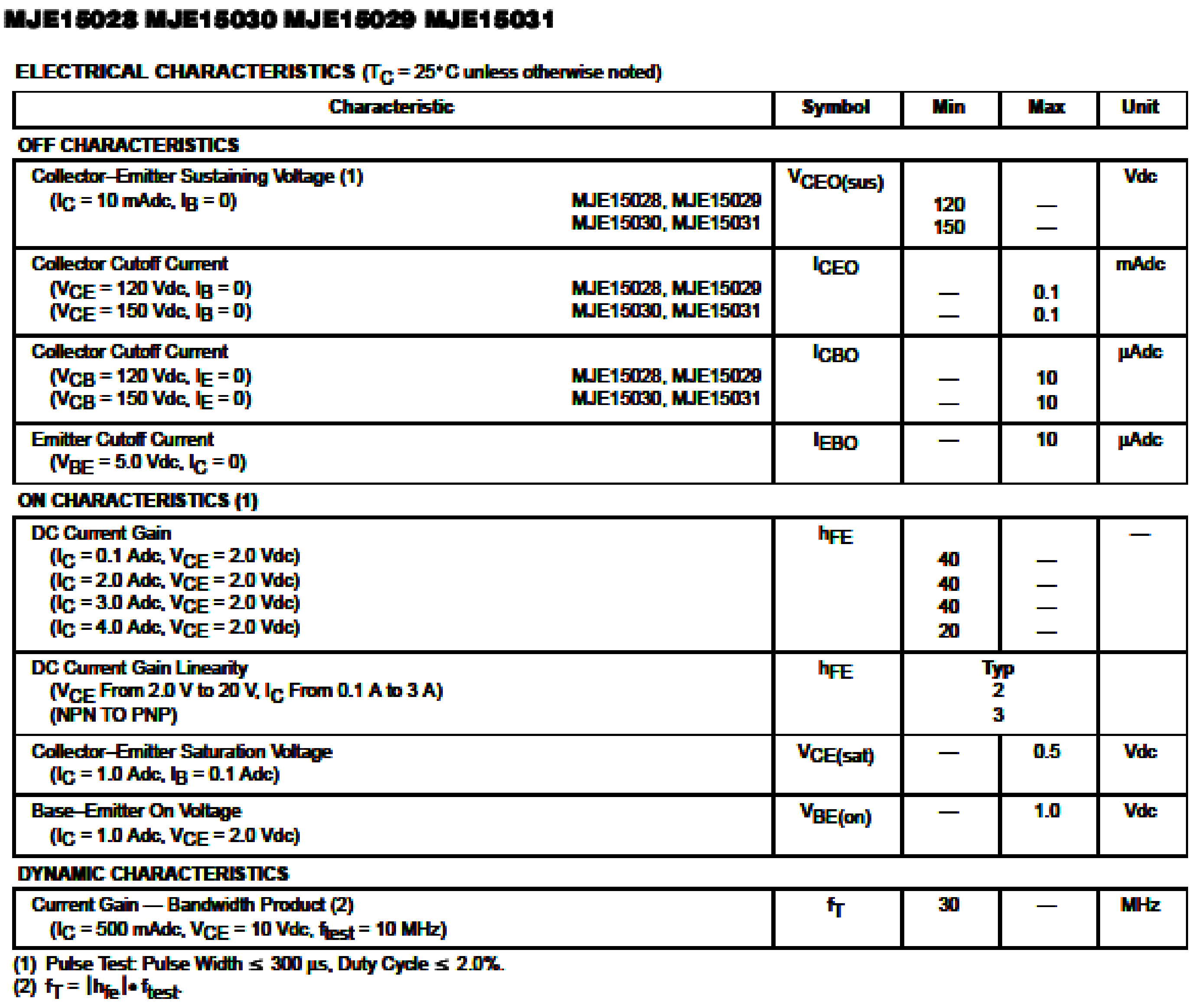


Figure 1. Power Derating



MJE15028 MJE15030 MJE15029 MJE15031

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Sustaining Voltage (1) (I_C = 10 mAdc, I_B = 0) MJE15028, MJE15029 MJE15030, MJE15031	$V_{CEO(sus)}$	120 150	— —	Vdc
Collector Cutoff Current (V_{CE} = 120 Vdc, I_B = 0) MJE15028, MJE15029 (V_{CE} = 150 Vdc, I_B = 0) MJE15030, MJE15031	I_{CEO}	— —	0.1 0.1	mAdc
Collector Cutoff Current (V_{CB} = 120 Vdc, I_E = 0) MJE15028, MJE15029 (V_{CB} = 150 Vdc, I_E = 0) MJE15030, MJE15031	I_{CBO}	— —	10 10	μAdc
Emitter Cutoff Current (V_{BE} = 5.0 Vdc, I_C = 0)	I_{EBO}	—	10	μAdc
ON CHARACTERISTICS (1)				
DC Current Gain (I_C = 0.1 Adc, V_{CE} = 2.0 Vdc) (I_C = 2.0 Adc, V_{CE} = 2.0 Vdc) (I_C = 3.0 Adc, V_{CE} = 2.0 Vdc) (I_C = 4.0 Adc, V_{CE} = 2.0 Vdc)	h_{FE}	40 40 40 20	— — — —	—
DC Current Gain Linearity (V_{CE} From 2.0 V to 20 V, I_C From 0.1 A to 3 A) (NPN TO PNP)	h_{FE}	Typ 2 3		
Collector–Emitter Saturation Voltage (I_C = 1.0 Adc, I_B = 0.1 Adc)	$V_{CE(sat)}$	—	0.5	Vdc
Base–Emitter On Voltage (I_C = 1.0 Adc, V_{CE} = 2.0 Vdc)	$V_{BE(on)}$	—	1.0	Vdc
DYNAMIC CHARACTERISTICS				
Current Gain — Bandwidth Product (2) (I_C = 500 mAdc, V_{CE} = 10 Vdc, f_{test} = 10 MHz)	f_T	30	—	MHz

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
(2) $f_T = |h_{fe}| \cdot f_{test}$.

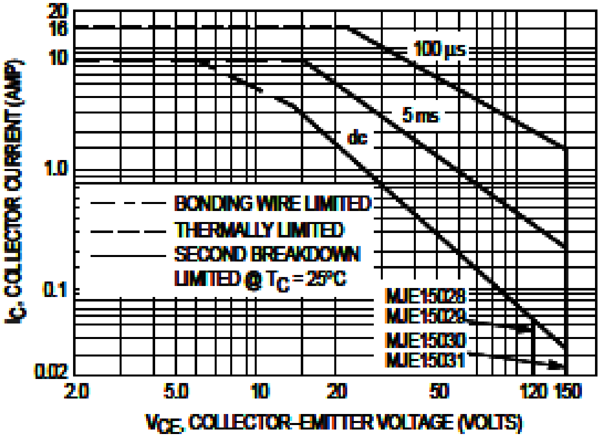


Figure 3. Forward Bias Safe Operating Area

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate $I_C - V_{CE}$ limits of the transistor that must be observed for reliable operation, i.e., the transistor must not be subjected to greater dissipation then the curves indicate.

The data of Figures 3 and 4 is based on $T_{J(pk)} = 150°C$; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} < 150°C$. $T_{J(pk)}$ may be calculated from the data in Figure 2. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

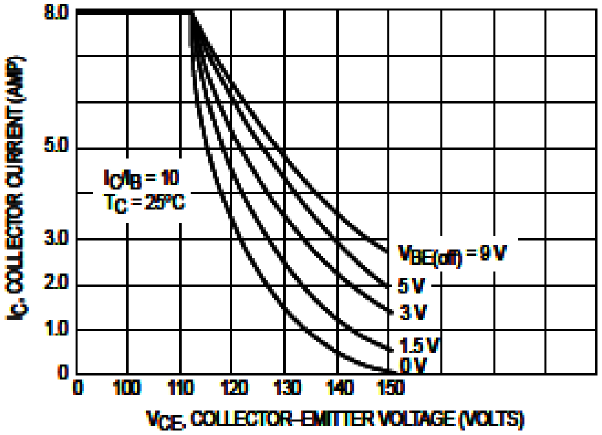


Figure 4. Reverse–Bias Switching Safe Operating Area

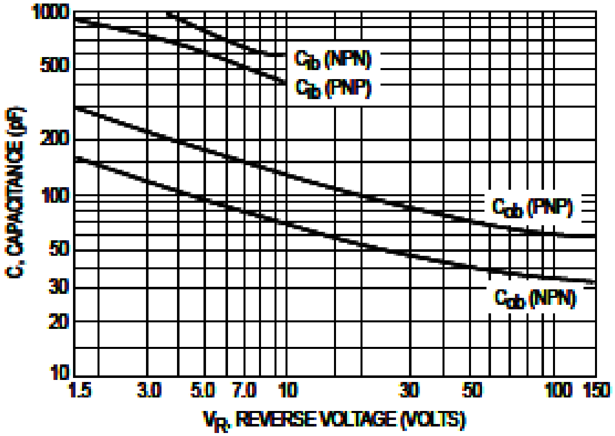


Figure 5. Capacitances

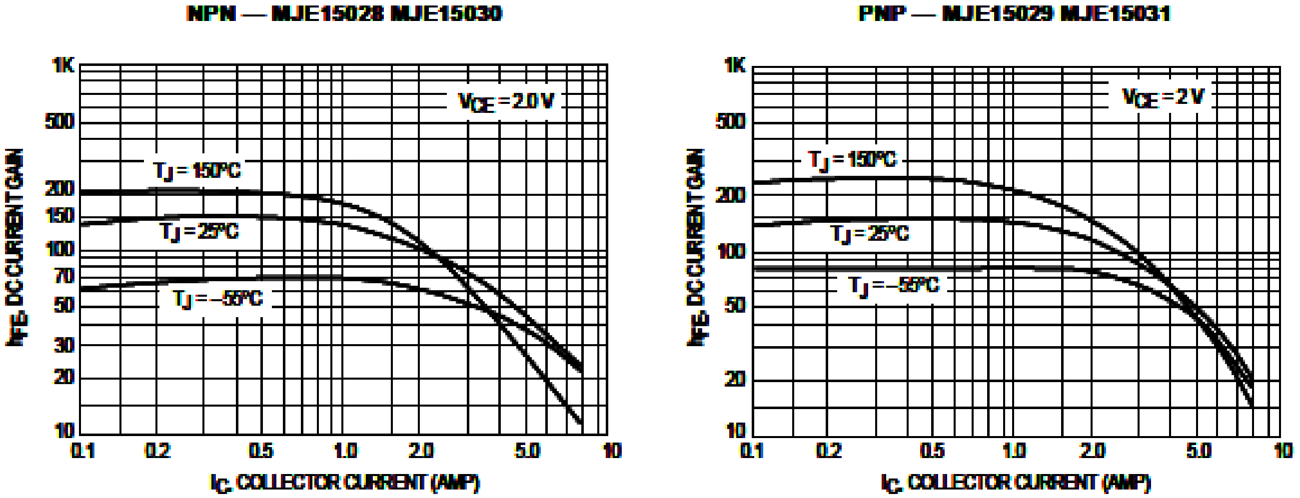


Figure 8. DC Current Gain

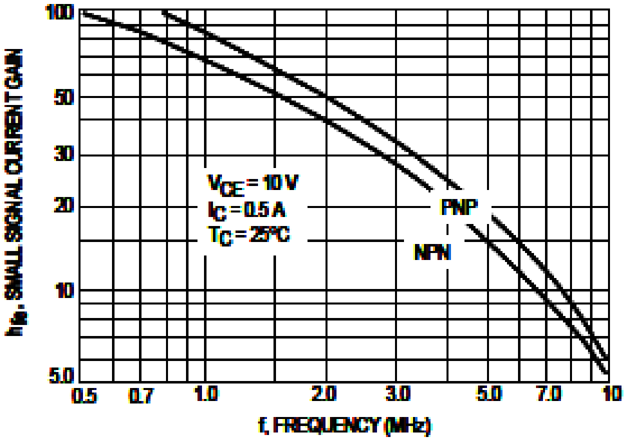


Figure 6. Small–Signal Current Gain

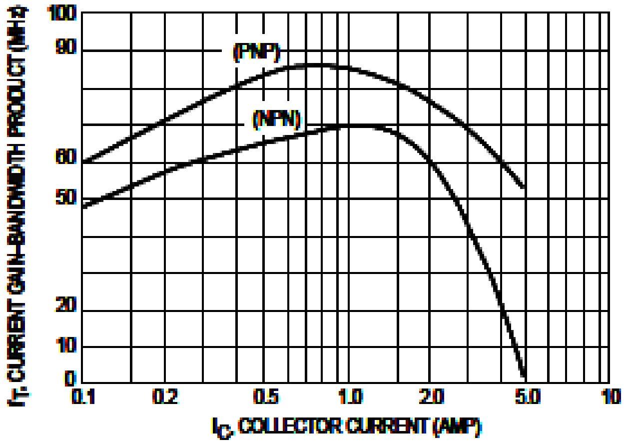


Figure 7. Current Gain–Bandwidth Product

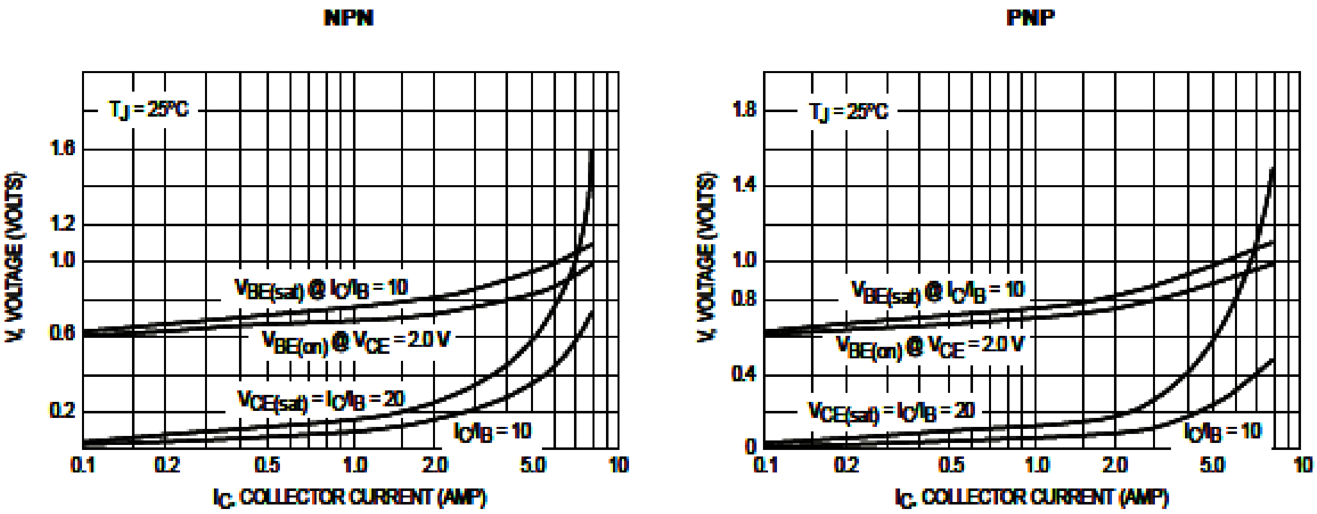


Figure 9. "On" Voltage

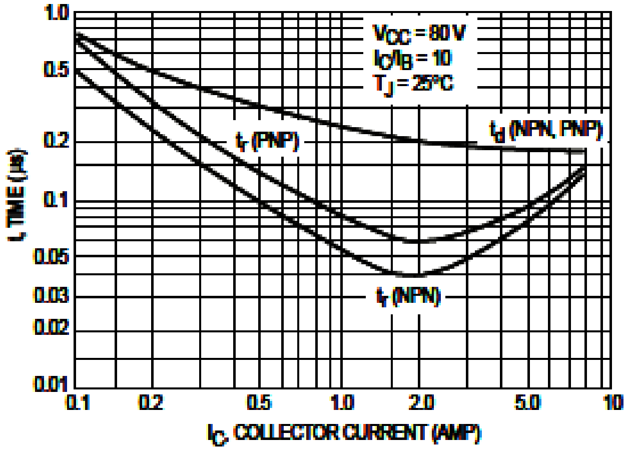


Figure 10. Turn–On Times

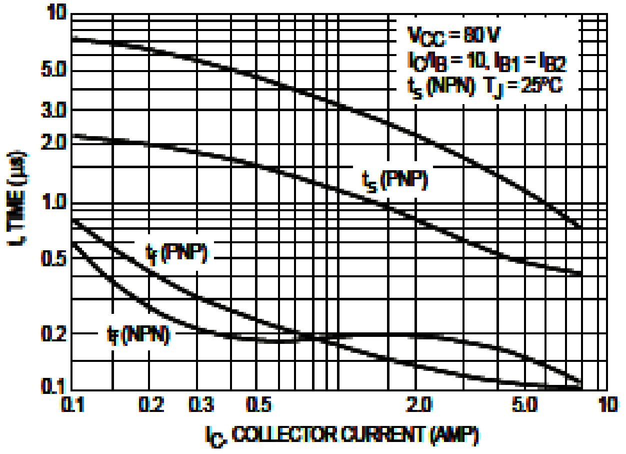
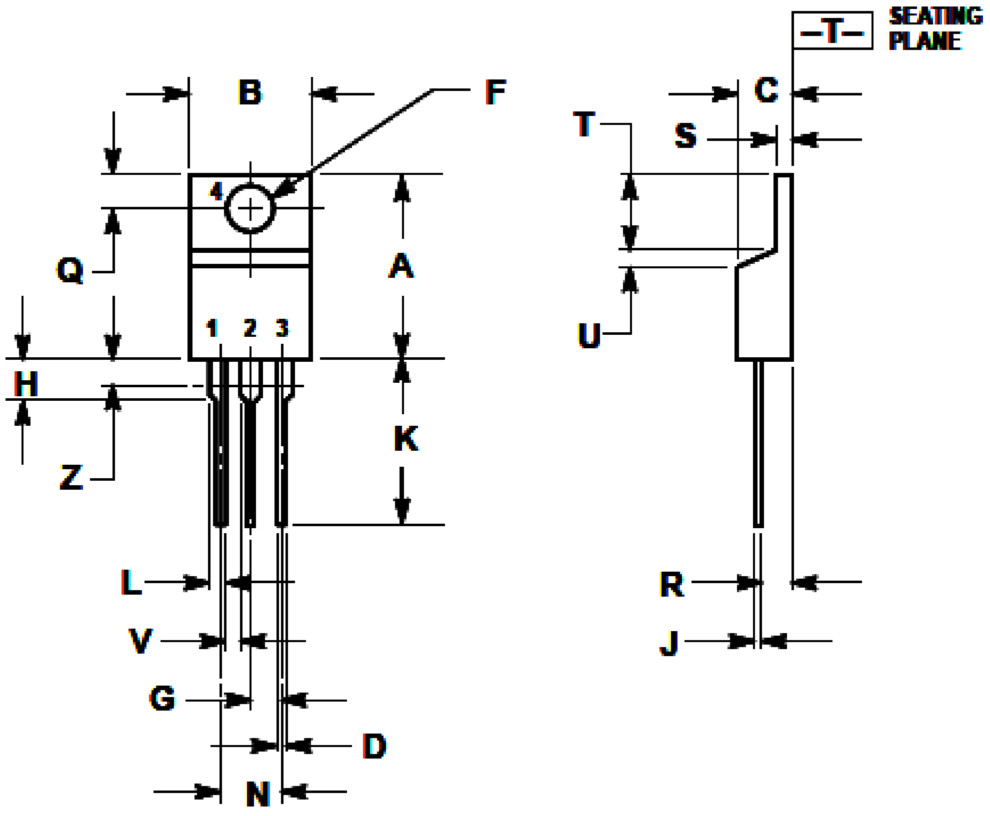


Figure 11. Turn–Off Times

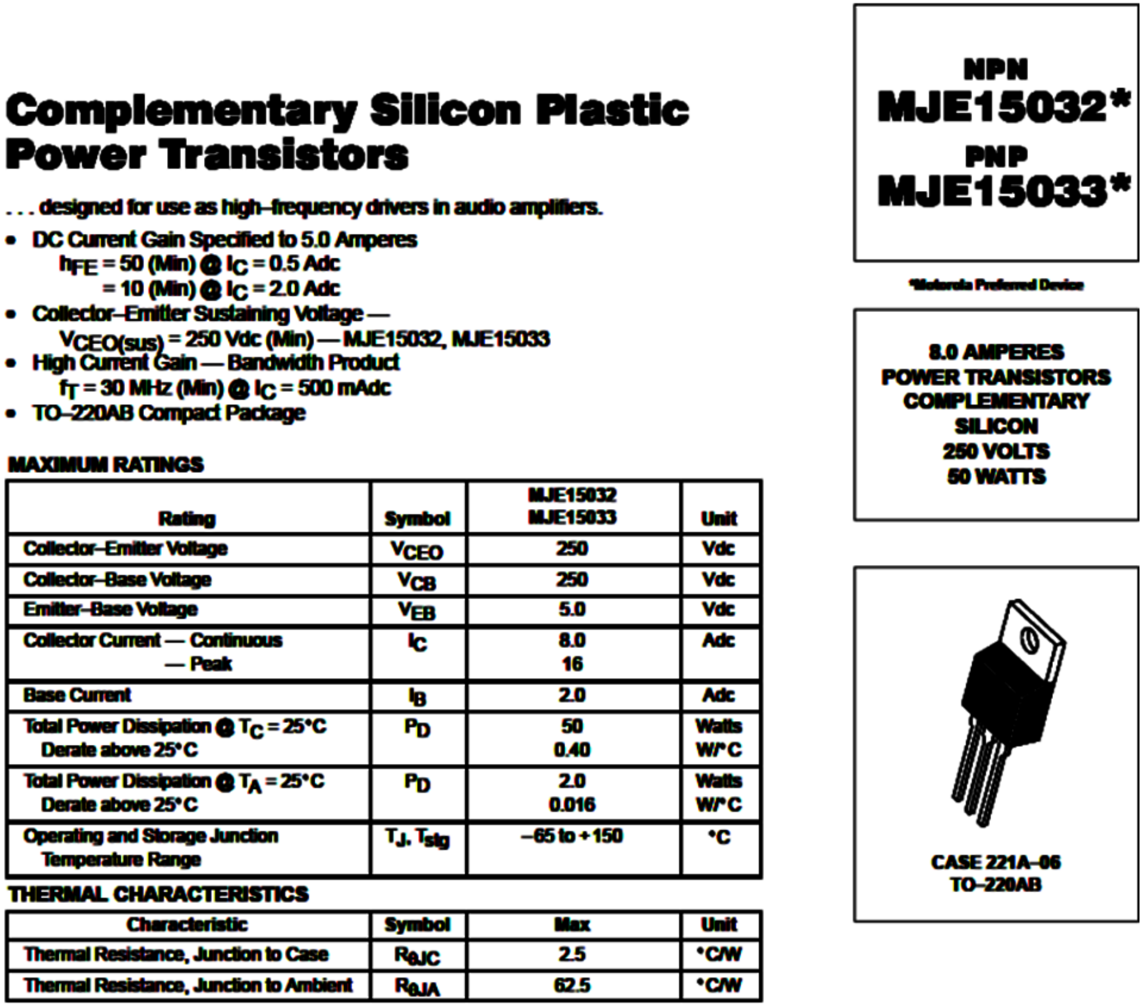


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.570	0.620	14.48	15.75
B	0.380	0.405	9.66	10.28
C	0.160	0.190	4.07	4.82
D	0.025	0.035	0.64	0.88
F	0.142	0.147	3.61	3.73
G	0.095	0.105	2.42	2.66
H	0.110	0.155	2.80	3.93
J	0.018	0.025	0.46	0.64
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.15	1.39
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	—	1.15	—
Z	—	0.080	—	2.04

STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

MJE15032 (NPN) MJE15033 (PNP) 8A 250V 50W DRIVER DE POTÊNCIA DE AUDIO



Complementary Silicon Plastic Power Transistors

. . . designed for use as high–frequency drivers in audio amplifiers.

- DC Current Gain Specified to 5.0 Amperes
  h_{FE} = 50 (Min) @ I_C = 0.5 Adc
  = 10 (Min) @ I_C = 2.0 Adc
- Collector–Emitter Sustaining Voltage —
  $V_{CEO(sus)}$ = 250 Vdc (Min) — MJE15032, MJE15033
- High Current Gain — Bandwidth Product
  f_T = 30 MHz (Min) @ I_C = 500 mAdc
- TO–220AB Compact Package

NPN
MJE15032*
PNP
MJE15033*

*Motorola Preferred Device

8.0 AMPERES
POWER TRANSISTORS
COMPLEMENTARY
SILICON
250 VOLTS
50 WATTS

CASE 221A–06
TO–220AB

MAXIMUM RATINGS

Rating	Symbol	MJE15032 MJE15033	Unit
Collector–Emitter Voltage	V_{CEO}	250	Vdc
Collector–Base Voltage	V_{CB}	250	Vdc
Emitter–Base Voltage	V_{EB}	5.0	Vdc
Collector Current — Continuous — Peak	I_C	8.0 16	Adc
Base Current	I_B	2.0	Adc
Total Power Dissipation @ T_C = 25°C Derate above 25°C	P_D	50 0.40	Watts W/°C
Total Power Dissipation @ T_A = 25°C Derate above 25°C	P_D	2.0 0.016	Watts W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	–65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.5	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	62.5	°C/W

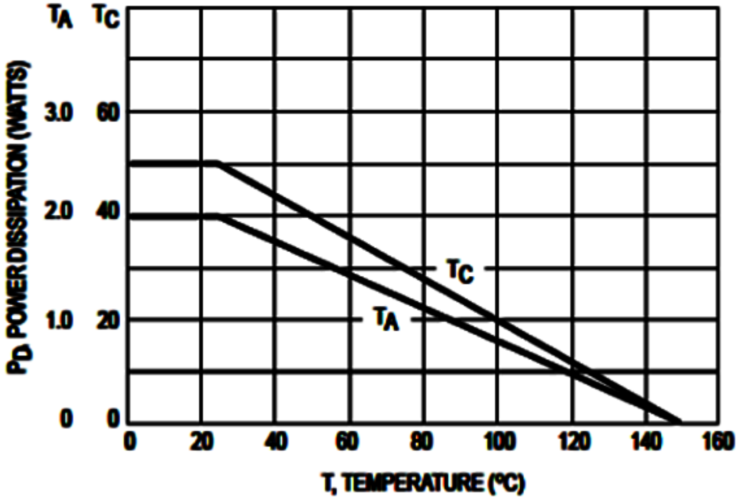


Figure 1. Power Derating

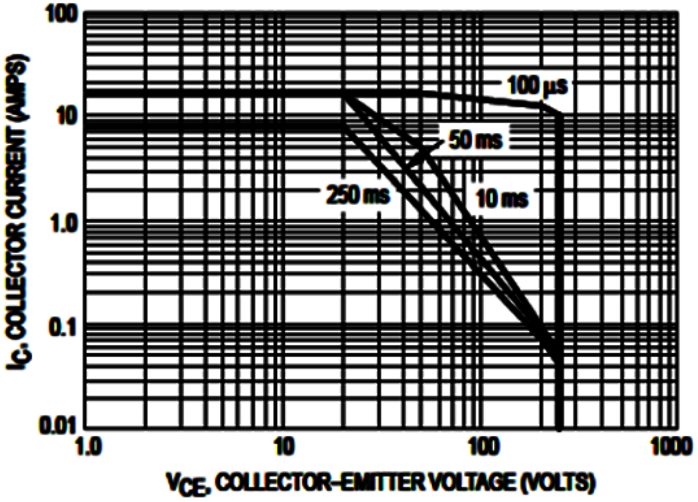


Figure 3. MJE15032 & MJE15033 Safe Operating Area

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate $I_C - V_{CE}$ limits of the transistor that must be observed for reliable operation, i.e., the transistor must not be subjected to greater dissipation then the curves indicate.

The data of Figures 3 and 4 is based on $T_{J(pk)} = 150°C$; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} < 150°C$. $T_{J(pk)}$ may be calculated from the data in Figure 2. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

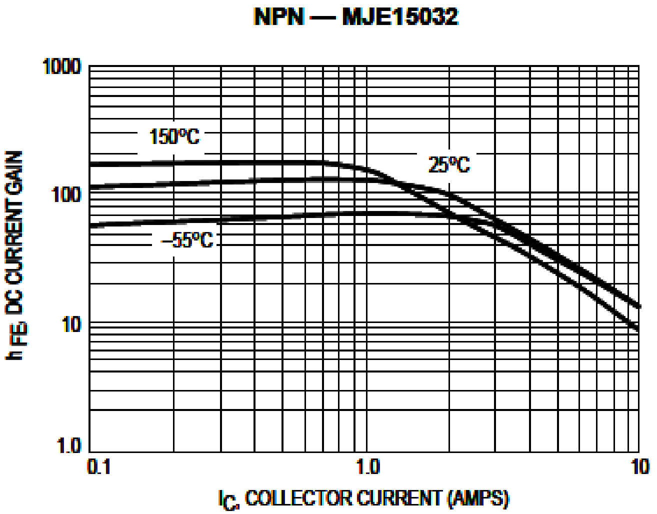


Figure 4. NPN — MJE15032
V_{CE} = 5 V DC Current Gain

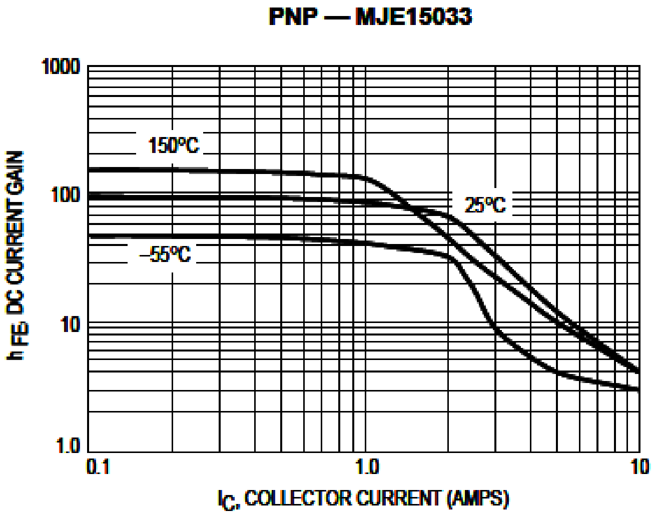


Figure 5. PNP — MJE15033
V_{CE} = 5 V DC Current Gain

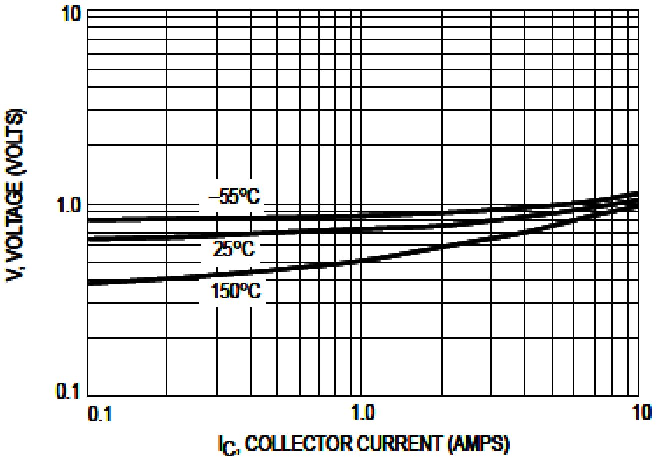


Figure 6. NPN — MJE15032
V_{CE} = 5 V $V_{BE(on)}$ Curve

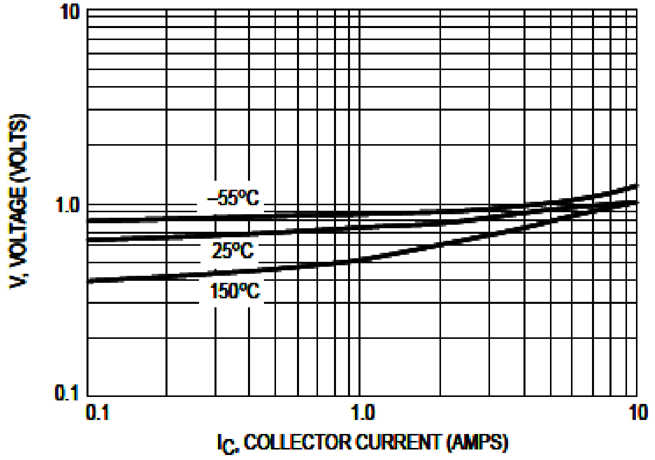


Figure 7. PNP — MJE15033
V_{CE} = 5 V $V_{BE(on)}$ Curve

MJE15032 MJE15033

NPN — MJE15032

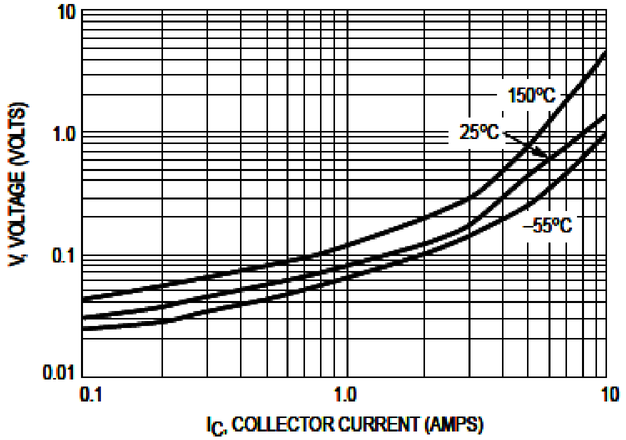


Figure 8. NPN — MJE15032
$V_{CE(sat)}$ $I_C/I_B = 10$

PNP — MJE15033

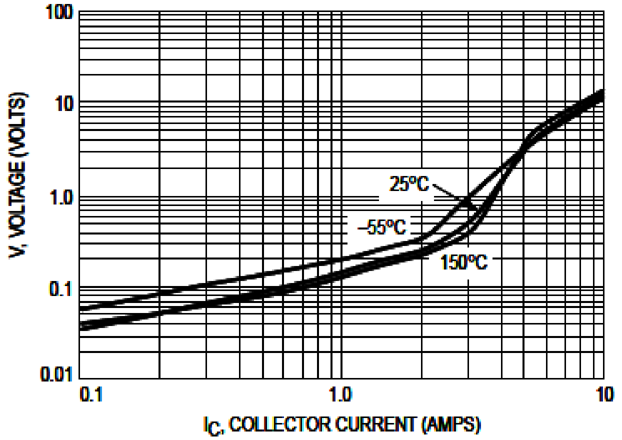


Figure 9. PNP — MJE15033
$V_{CE(sat)}$ $I_C/I_B = 10$

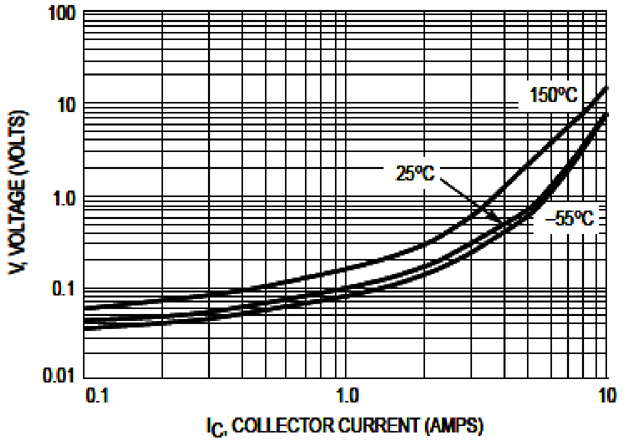


Figure 10. NPN — MJE15032
$V_{CE(sat)}$ $I_C/I_B = 20$

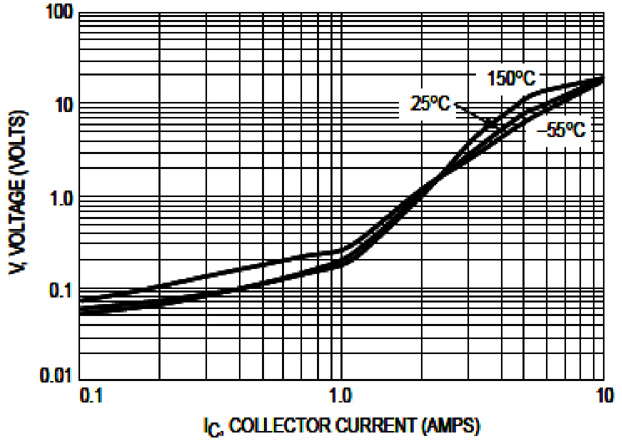


Figure 11. PNP — MJE15033
$V_{CE(sat)}$ $I_C/I_B = 20$

Figure 10. NPN — MJE15032
$V_{CE(sat)}$ $I_C/I_B = 20$

Figure 11. PNP — MJE15033
$V_{CE(sat)}$ $I_C/I_B = 20$

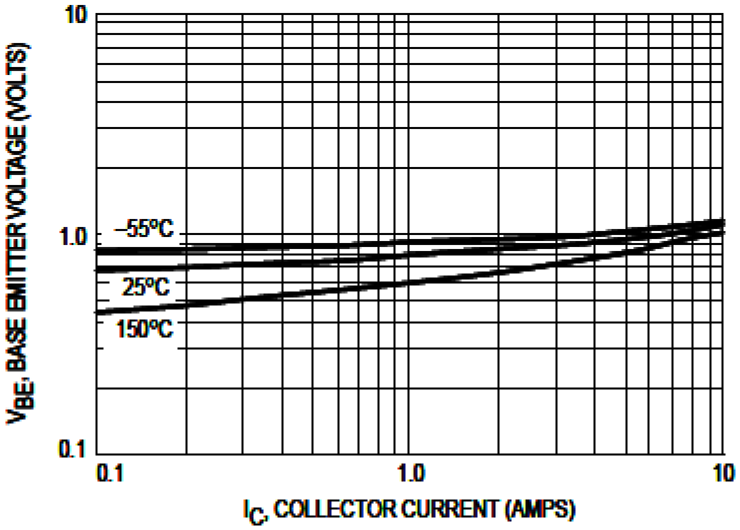


Figure 12. NPN — MJE15032
$V_{BE(sat)}$ $I_C/I_B = 10$

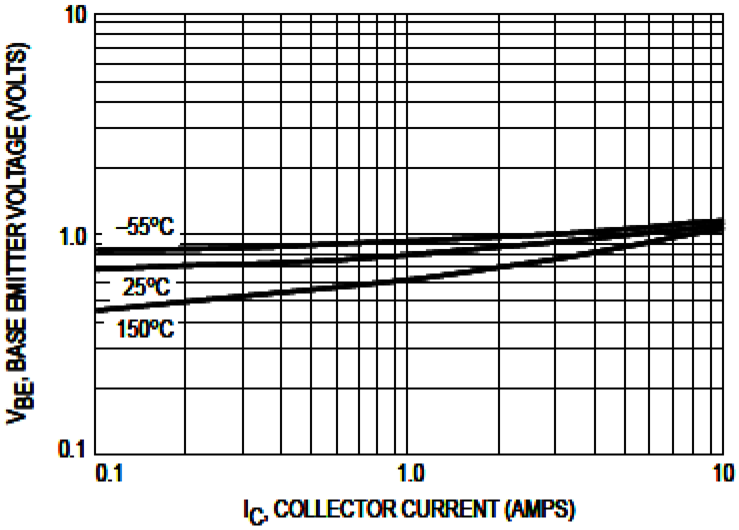


Figure 13. PNP — MJE15033
$V_{BE(sat)}$ $I_C/I_B = 10$

2SC5200 FJL4315 (NPN) 15A 230V POTÊNICA SAÍDA DE AUDIO (COMPLEMENTAR DO 2SA1943)

FAIRCHILD
SEMICONDUCTOR®

March 2008

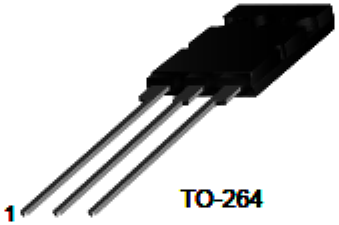
2SC5200/FJL4315
NPN Epitaxial Silicon Transistor

Applications

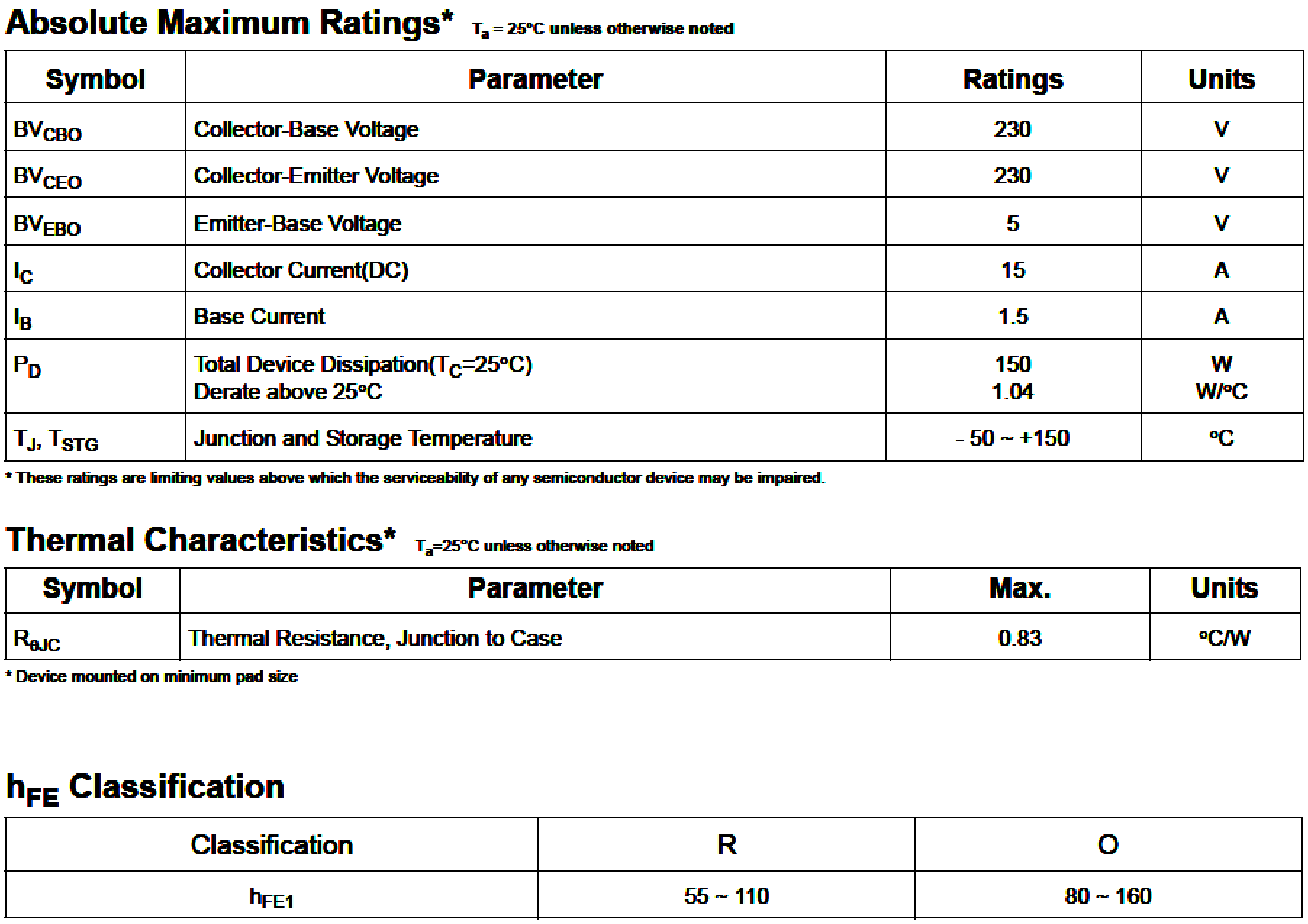
- High-Fidelity Audio Output Amplifier
- General Purpose Power Amplifier

Features

- High Current Capability: I_C = 15A.
- High Power Dissipation : 150watts.
- High Frequency : 30MHz.
- High Voltage : V_{CEO}=230V
- Wide S.O.A for reliable operation.
- Excellent Gain Linearity for low THD.
- Complement to 2SA1943/FJL4215.
- Thermal and electrical Spice models are available.
- Same transistor is also available in:
  - TO3P package, 2SC5242/FJA4313 : 130 watts
  - TO220 package, FJP5200 : 80 watts
  - TO220F package, FJPF5200 : 50 watts



1.Base 2.Collector 3.Emitter



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

Symbol	Parameter	Ratings	Units
BV_{CBO}	Collector-Base Voltage	230	V
BV_{CEO}	Collector-Emitter Voltage	230	V
BV_{EBO}	Emitter-Base Voltage	5	V
I_C	Collector Current(DC)	15	A
I_B	Base Current	1.5	A
P_D	Total Device Dissipation(T_C=25°C) Derate above 25°C	150 1.04	W W/°C
T_J, T_{STG}	Junction and Storage Temperature	- 50 ~ +150	°C

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

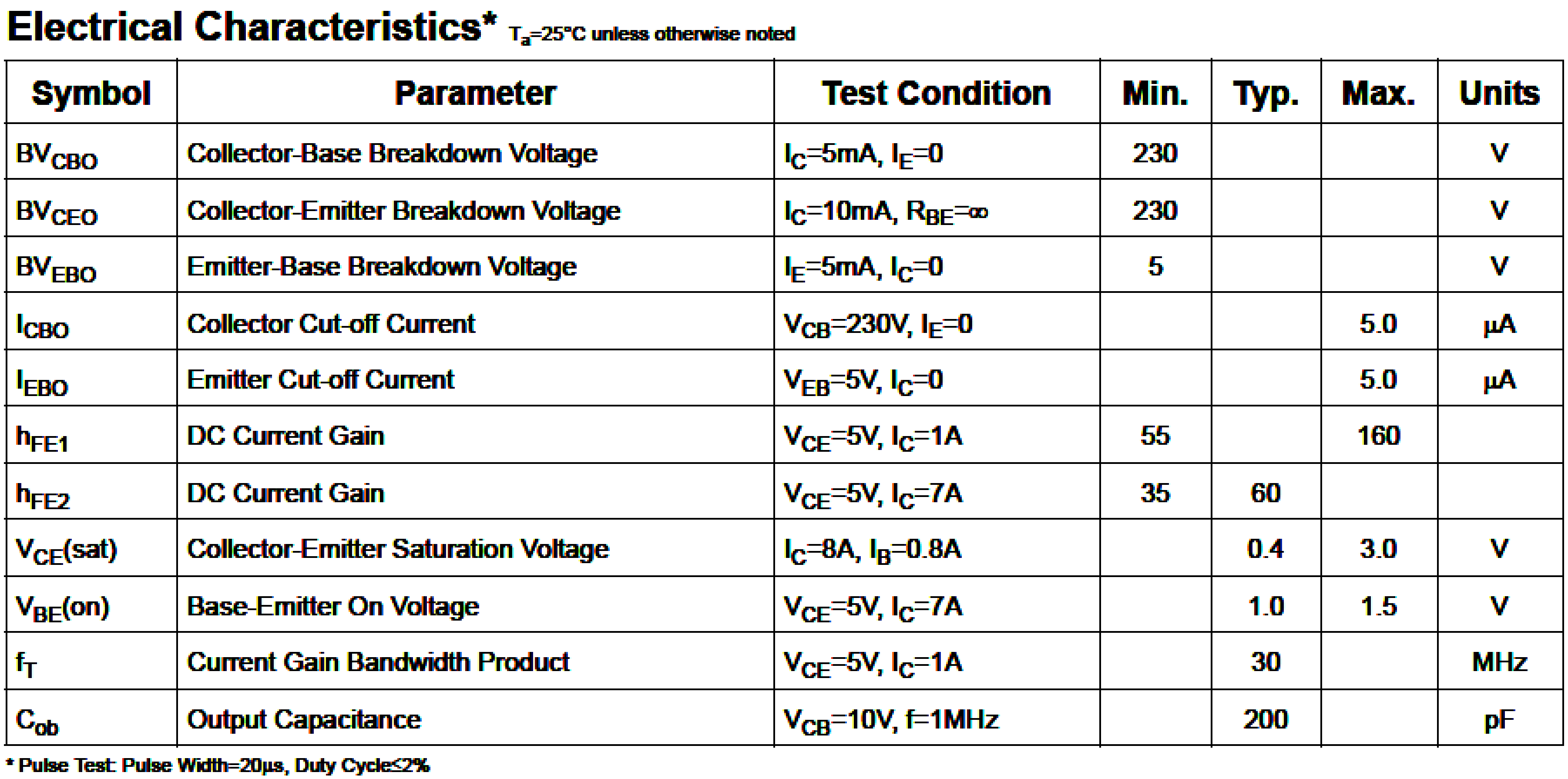
Thermal Characteristics* T_a=25°C unless otherwise noted

Symbol	Parameter	Max.	Units
$R_{\theta JC}$	Thermal Resistance, Junction to Case	0.83	°C/W

* Device mounted on minimum pad size

h_{FE} Classification

Classification	R	O
h_{FE1}	55 ~ 110	80 ~ 160



Electrical Characteristics* T_a=25°C unless otherwise noted

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Units
BV_{CBO}	Collector-Base Breakdown Voltage	I_C=5mA, I_E=0	230			V
BV_{CEO}	Collector-Emitter Breakdown Voltage	I_C=10mA, $R_{BE}=\infty$	230			V
BV_{EBO}	Emitter-Base Breakdown Voltage	I_E=5mA, I_C=0	5			V
I_{CBO}	Collector Cut-off Current	V_{CB}=230V, I_E=0			5.0	µA
I_{EBO}	Emitter Cut-off Current	V_{EB}=5V, I_C=0			5.0	µA
h_{FE1}	DC Current Gain	V_{CE}=5V, I_C=1A	55		160	
h_{FE2}	DC Current Gain	V_{CE}=5V, I_C=7A	35	60		
V_{CE}(sat)	Collector-Emitter Saturation Voltage	I_C=8A, I_B=0.8A		0.4	3.0	V
V_{BE}(on)	Base-Emitter On Voltage	V_{CE}=5V, I_C=7A		1.0	1.5	V
f_T	Current Gain Bandwidth Product	V_{CE}=5V, I_C=1A		30		MHz
C_{ob}	Output Capacitance	V_{CB}=10V, f=1MHz		200		pF

* Pulse Test: Pulse Width=20µs, Duty Cycle≤2%

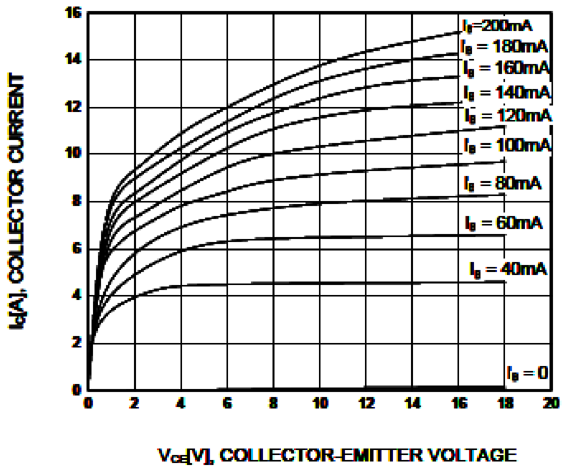


Figure 1. Static Characteristic

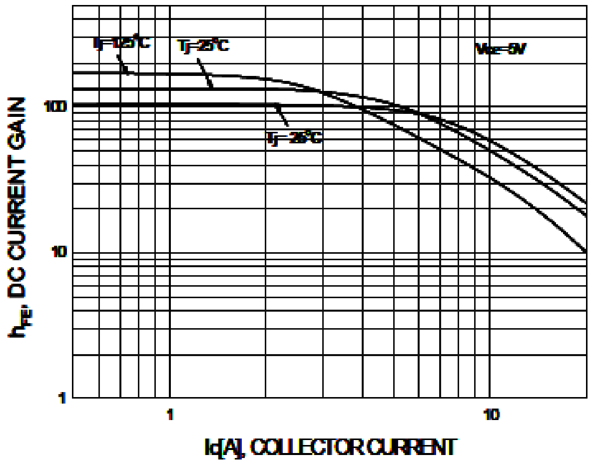


Figure 2. DC current Gain

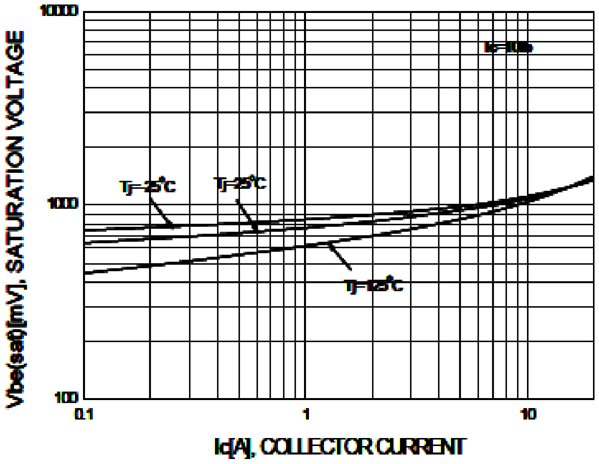


Figure 3. Base-Emitter Saturation Voltage

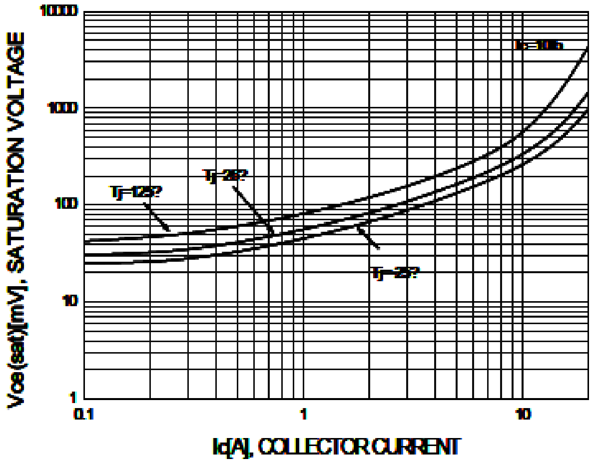


Figure 4. Collector-Emitter Saturation Voltage

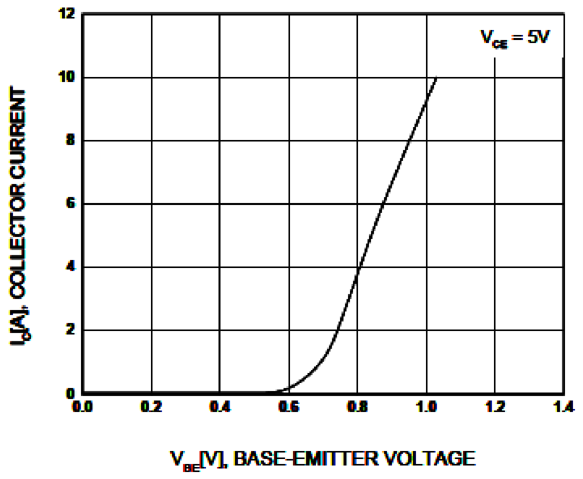


Figure 5. Base-Emitter On Voltage

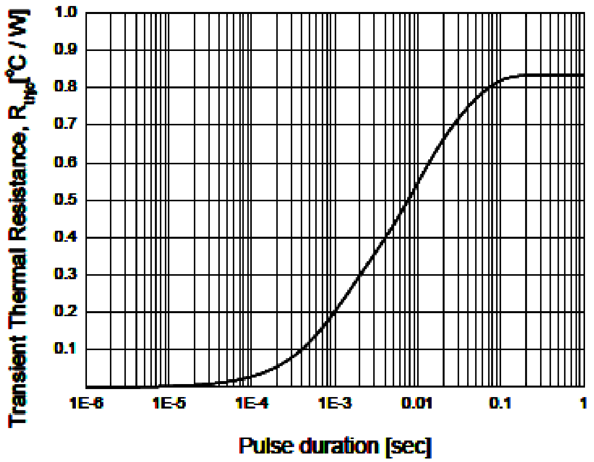


Figure 6. Thermal Resistance

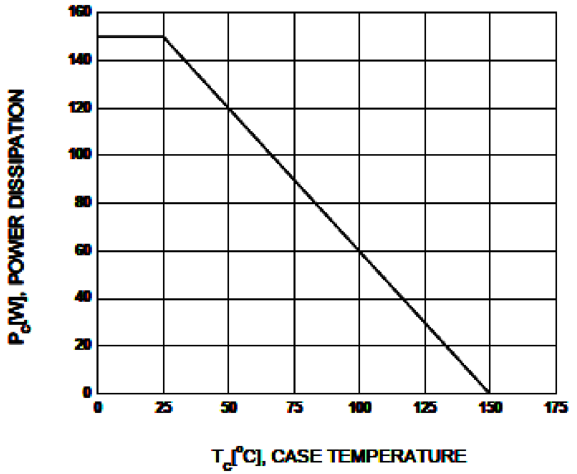


Figure 7. Power Derating

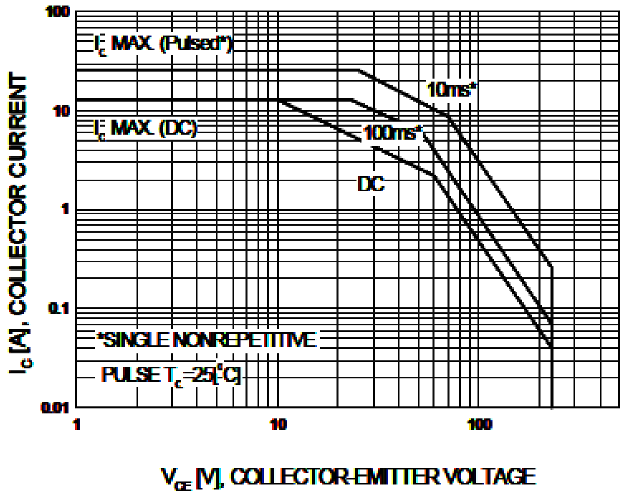


Figure 8. Safe Operating Area

2SA1943 FJL4215 (PNP) -15A -230V 150W ÁUDIO POTÊNCIA

FAIRCHILD
SEMICONDUCTOR®

March 2008

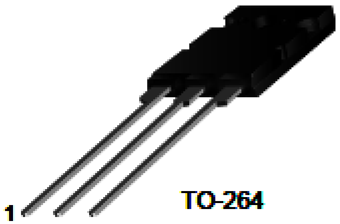
2SA1943/FJL4215
PNP Epitaxial Silicon Transistor

Applications

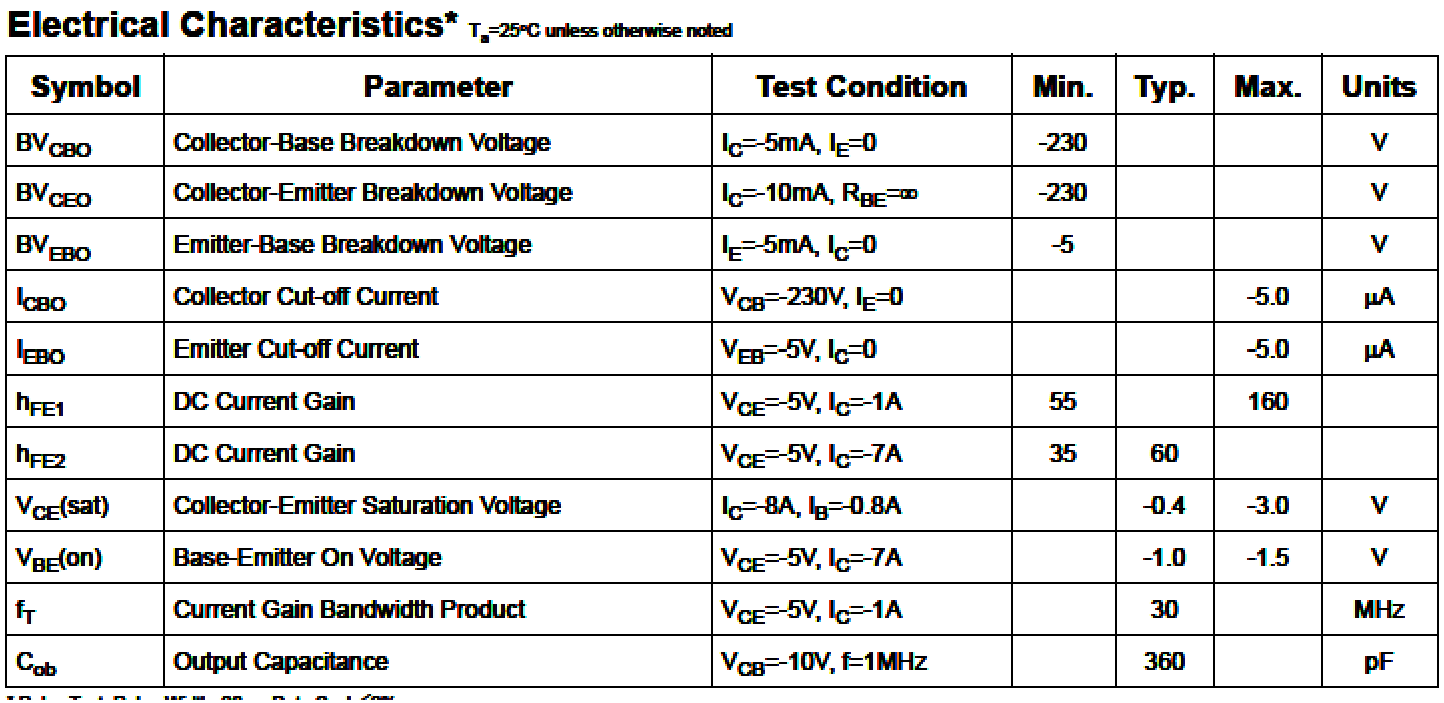
- High-Fidelity Audio Output Amplifier
- General Purpose Power Amplifier

Features

- High Current Capability: I_C = -15A.
- High Power Dissipation : 150watts.
- High Frequency : 30MHz.
- High Voltage : V_{CEO}= -230V
- Wide S.O.A for reliable operation.
- Excellent Gain Linearity for low THD.
- Complement to 2SC5200/FJL4315.
- Full thermal and electrical Spice models are available.
- Same transistor is also available in:
  - TO3P package, 2SA1962/FJA4213 : 130 watts
  - TO220 package, FJP1943 : 80 watts
  - TO220F package, FJPF1943 : 50 watts



1.Base 2.Collector 3.Emitter



Electrical Characteristics* T_a=25°C unless otherwise noted

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Units
BV_{CBO}	Collector-Base Breakdown Voltage	I_C=-5mA, I_E=0	-230			V
BV_{CEO}	Collector-Emitter Breakdown Voltage	I_C=-10mA, R_{BE}=∞	-230			V
BV_{EBO}	Emitter-Base Breakdown Voltage	I_E=-5mA, I_C=0	-5			V
I_{CBO}	Collector Cut-off Current	V_{CB}=-230V, I_E=0			-5.0	μA
I_{EBO}	Emitter Cut-off Current	V_{EB}=-5V, I_C=0			-5.0	μA
h_{FE1}	DC Current Gain	V_{CE}=-5V, I_C=-1A	55		160	
h_{FE2}	DC Current Gain	V_{CE}=-5V, I_C=-7A	35	60		
V_{CE}(sat)	Collector-Emitter Saturation Voltage	I_C=-8A, I_B=-0.8A		-0.4	-3.0	V
V_{BE}(on)	Base-Emitter On Voltage	V_{CE}=-5V, I_C=-7A		-1.0	-1.5	V
f_T	Current Gain Bandwidth Product	V_{CE}=-5V, I_C=-1A		30		MHz
C_{ob}	Output Capacitance	V_{CB}=-10V, f=1MHz		360		pF

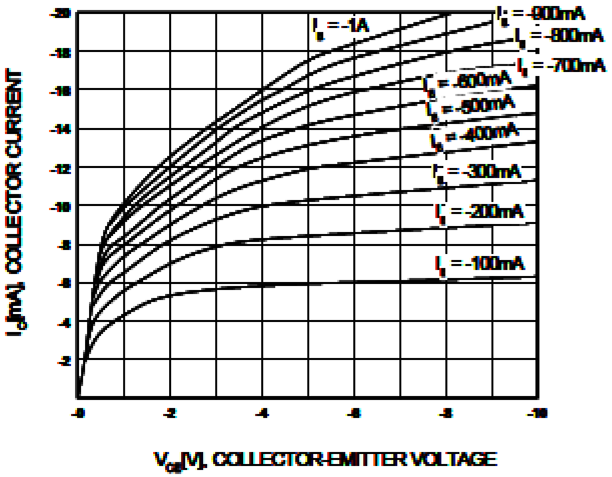


Figure 1. Static Characteristic

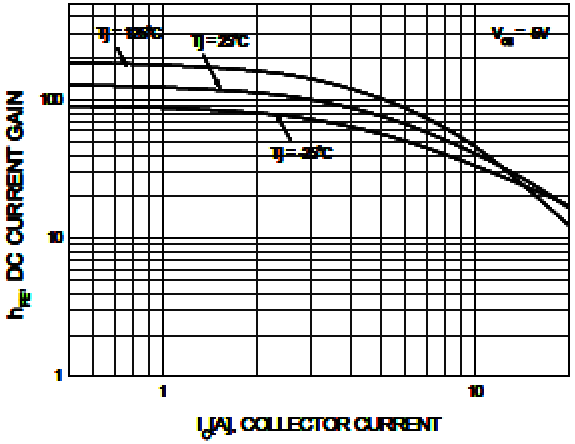
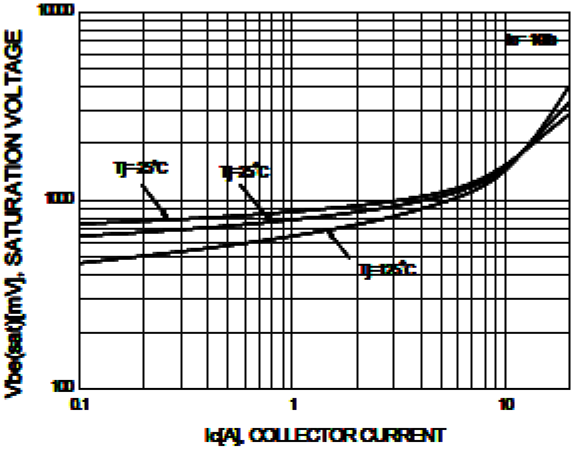
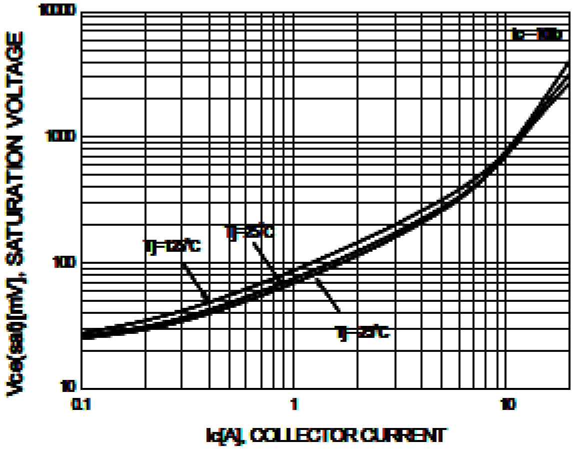


Figure 2. DC current Gain





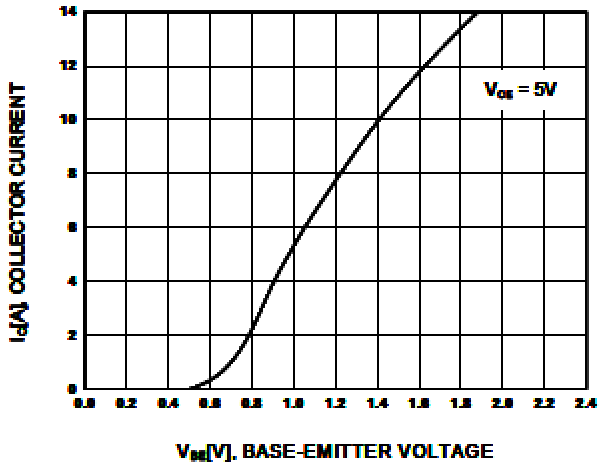


Figure 5. Base-Emitter On Voltage

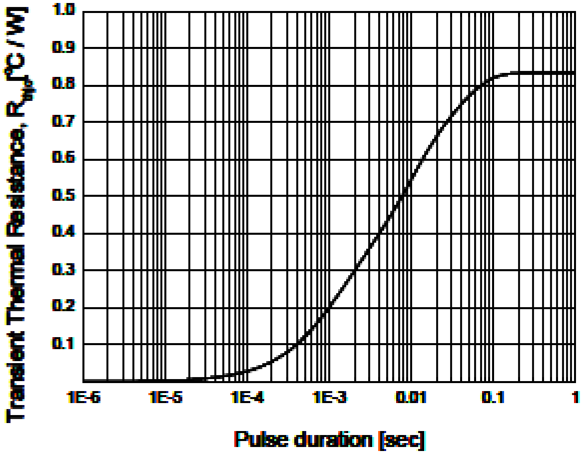


Figure 6. Thermal Resistance

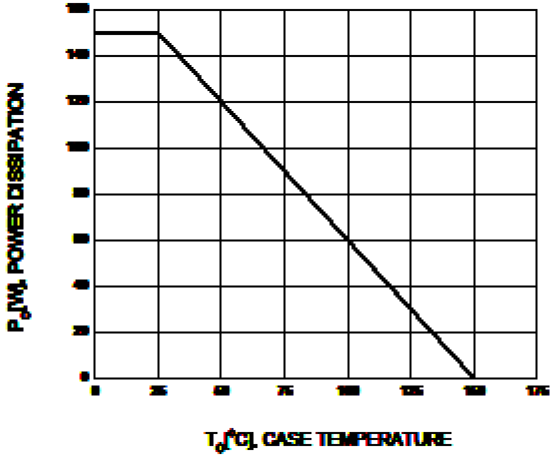


Figure 7. Power Derating

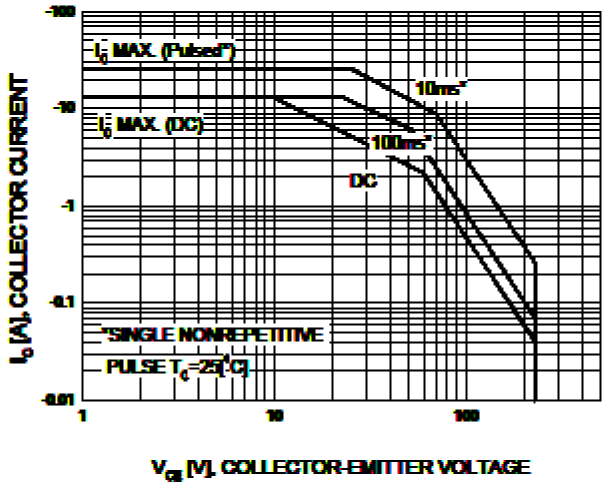
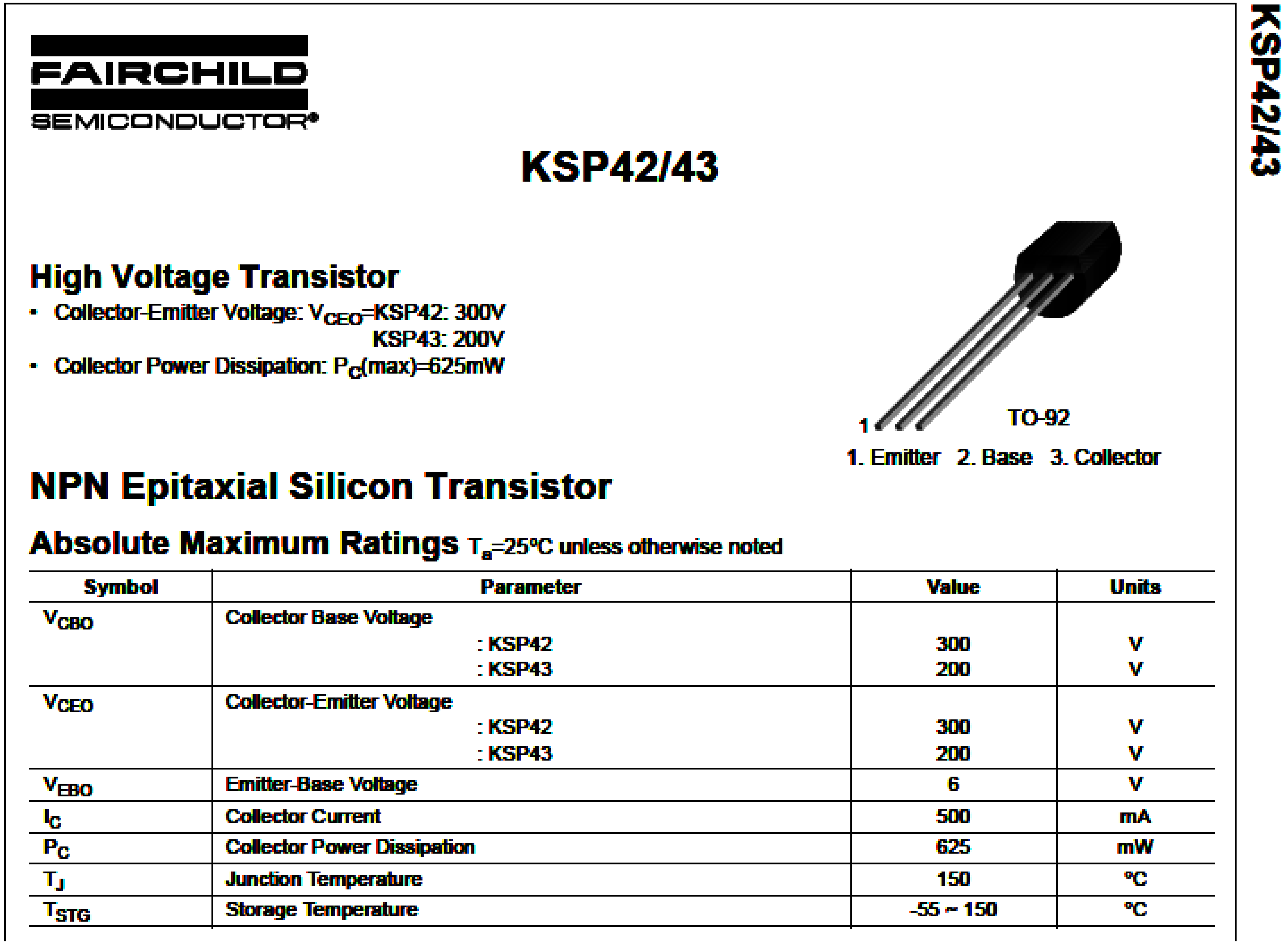


Figure 8. Safe Operating Area

KSP42 KSP43 HIGH VOLTAGE TRANSISTOR 300V NPN



FAIRCHILD SEMICONDUCTOR®

KSP42/43

High Voltage Transistor

- Collector-Emitter Voltage: V_{CEO}=KSP42: 300V
  KSP43: 200V
- Collector Power Dissipation: P_C(max)=625mW

TO-92

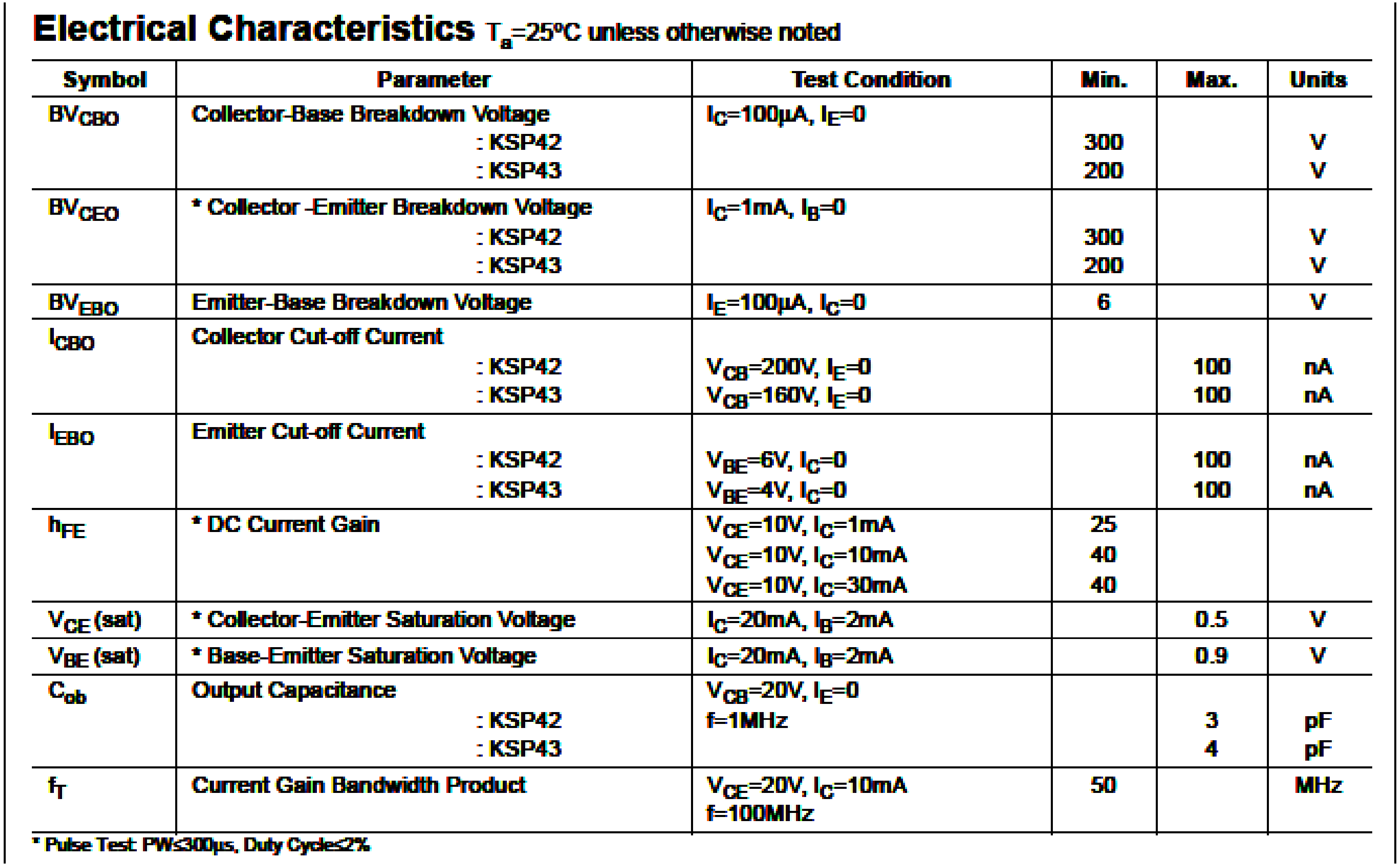
1. Emitter 2. Base 3. Collector

NPN Epitaxial Silicon Transistor

Absolute Maximum Ratings T_a=25°C unless otherwise noted

Symbol	Parameter	Value	Units
V_{CBO}	Collector Base Voltage : KSP42 : KSP43	 300 200	 V V
V_{CEO}	Collector-Emitter Voltage : KSP42 : KSP43	 300 200	 V V
V_{EBO}	Emitter-Base Voltage	6	V
I_C	Collector Current	500	mA
P_C	Collector Power Dissipation	625	mW
T_J	Junction Temperature	150	°C
T_{STG}	Storage Temperature	-55 ~ 150	°C

KSP42/43



Electrical Characteristics T_a=25°C unless otherwise noted

Symbol	Parameter	Test Condition	Min.	Max.	Units
BV_{CBO}	Collector-Base Breakdown Voltage	I_C=100µA, I_E=0			
	: KSP42		300		V
	: KSP43		200		V
BV_{CEO}	* Collector -Emitter Breakdown Voltage	I_C=1mA, I_B=0			
	: KSP42		300		V
	: KSP43		200		V
BV_{EBO}	Emitter-Base Breakdown Voltage	I_E=100µA, I_C=0	6		V
I_{CBO}	Collector Cut-off Current				
	: KSP42	V_{CB}=200V, I_E=0		100	nA
	: KSP43	V_{CB}=160V, I_E=0		100	nA
I_{EBO}	Emitter Cut-off Current				
	: KSP42	V_{BE}=6V, I_C=0		100	nA
	: KSP43	V_{BE}=4V, I_C=0		100	nA
h_{FE}	* DC Current Gain	V_{CE}=10V, I_C=1mA	25		
		V_{CE}=10V, I_C=10mA	40		
		V_{CE}=10V, I_C=30mA	40		
V_{CE} (sat)	* Collector-Emitter Saturation Voltage	I_C=20mA, I_B=2mA		0.5	V
V_{BE} (sat)	* Base-Emitter Saturation Voltage	I_C=20mA, I_B=2mA		0.9	V
C_{ob}	Output Capacitance	V_{CB}=20V, I_E=0			
	: KSP42	f=1MHz		3	pF
	: KSP43			4	pF
f_T	Current Gain Bandwidth Product	V_{CE}=20V, I_C=10mA f=100MHz	50		MHz

* Pulse Test: PW≤300µs, Duty Cycle≤2%

Typical Characteristics

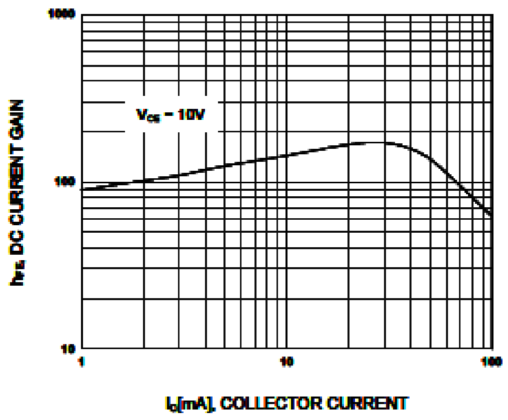


Figure 1. DC current Gain

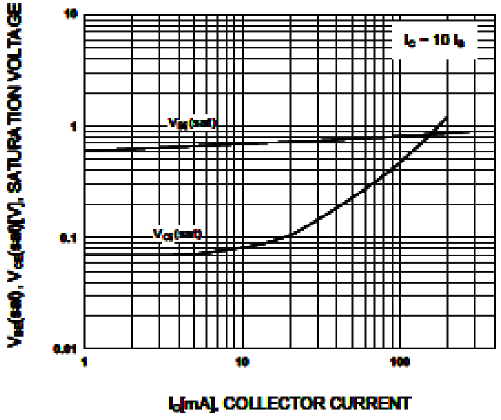


Figure 2. Collector-Emitter Saturation Voltage Base-Emitter Saturation Voltage

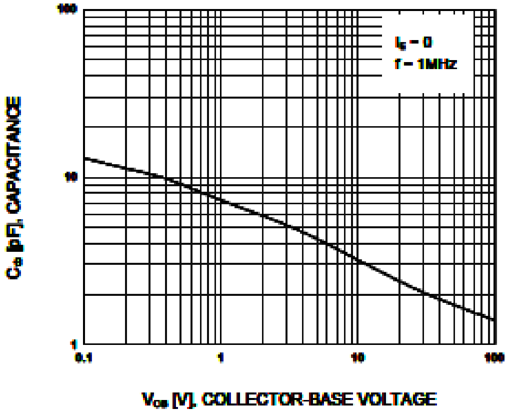


Figure 3. Collector-Base Capacitance

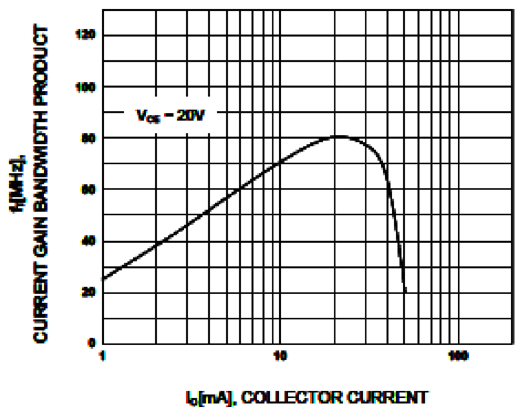
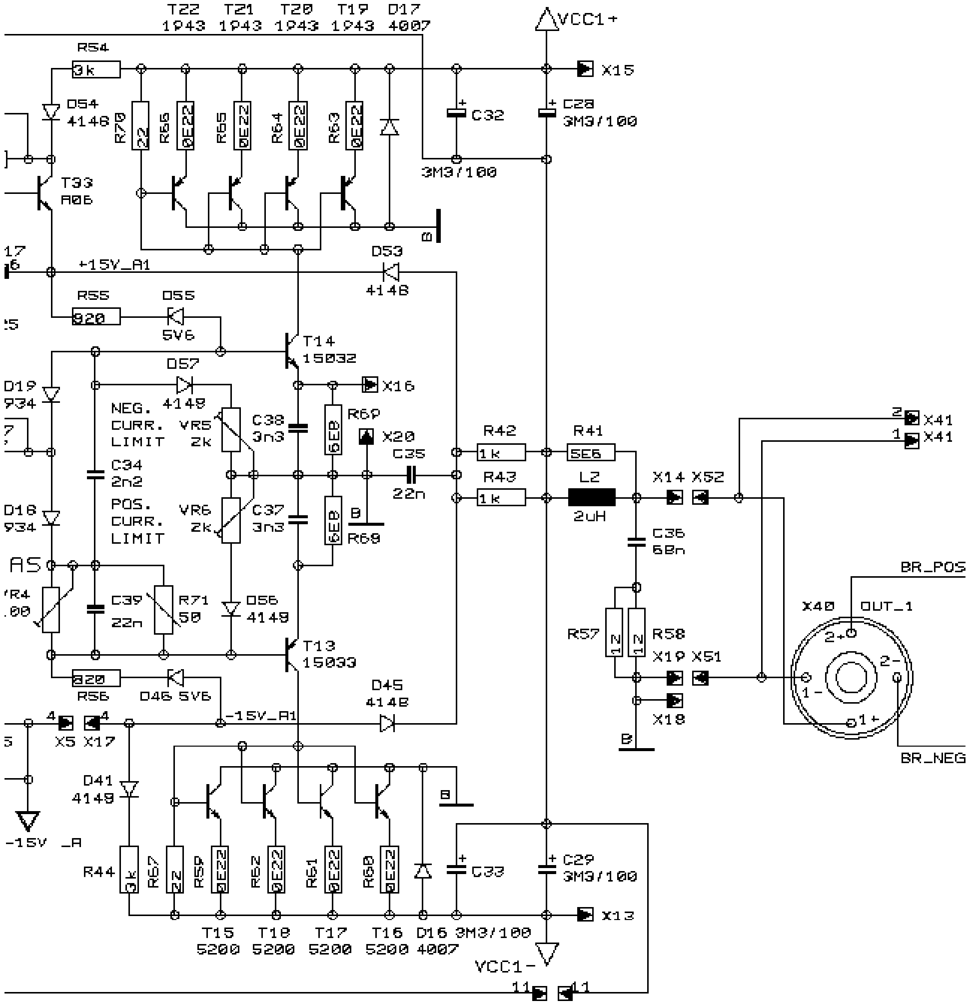


Figure 4. Current Gain Bandwidth Product

APLICAÇÃO TÍPICA DOS TRANSISTORES DE ÁUDIO



2SD1760 2SD1864 2SD1762 NPN 3A 50V DRIVER BP

2SB1184 2SB1243 PNP 3A 50V DRIVER BP

MJE1528 MJE1530 MJE1532 8A 50W NPN DRIVER POT

MJE1529 MJE1531 MJE1533 8A 50W PNP DRIVER POT

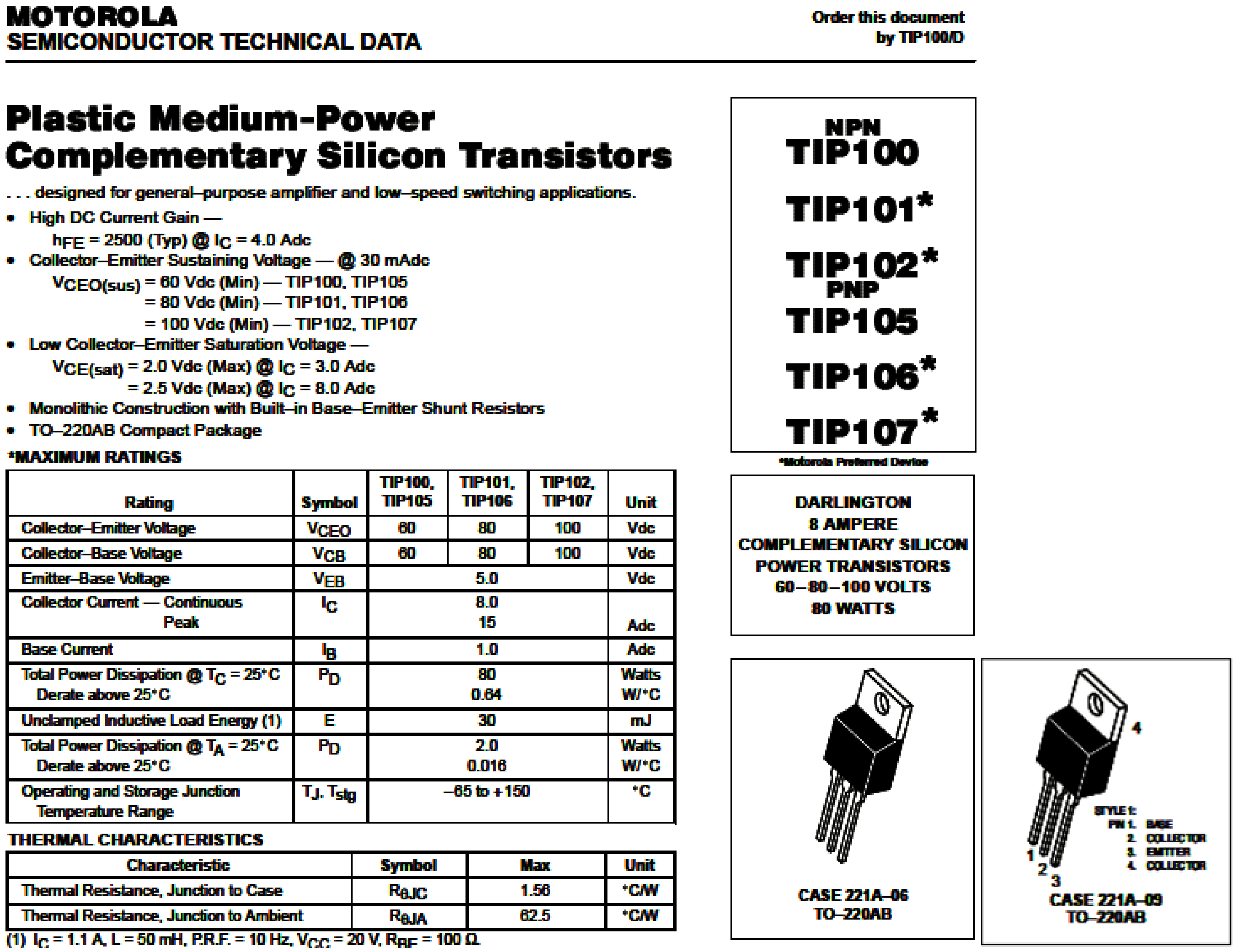
2SA1943 15A 150W PNP POT

2SC5200 15A 150W NPN POT

KSP42 KSP42 HIGH VOLTAGE DRIVER

TRANSISTOR DARLINGTON

TIP 100 101 102 NPN TIP 105 106 107 PNP DARLINGTON 8A 80W



MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

Order this document
by TIP100/D

Plastic Medium-Power Complementary Silicon Transistors

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

- High DC Current Gain —
  h_{FE} = 2500 (Typ) @ I_C = 4.0 Adc
- Collector–Emitter Sustaining Voltage — @ 30 mAdc
  $V_{CEO(sus)}$ = 60 Vdc (Min) — TIP100, TIP105
  = 80 Vdc (Min) — TIP101, TIP106
  = 100 Vdc (Min) — TIP102, TIP107
- Low Collector–Emitter Saturation Voltage —
  $V_{CE(sat)}$ = 2.0 Vdc (Max) @ I_C = 3.0 Adc
  = 2.5 Vdc (Max) @ I_C = 8.0 Adc
- Monolithic Construction with Built–in Base–Emitter Shunt Resistors
- TO–220AB Compact Package

NPN
TIP100
TIP101*
TIP102*
PNP
TIP105
TIP106*
TIP107*

*Motorola Preferred Device

DARLINGTON
8 AMPERE
COMPLEMENTARY SILICON
POWER TRANSISTORS
60–80–100 VOLTS
80 WATTS

*MAXIMUM RATINGS

Rating	Symbol	TIP100, TIP105	TIP101, TIP106	TIP102, TIP107	Unit
Collector–Emitter Voltage	V_{CEO}	60	80	100	Vdc
Collector–Base Voltage	V_{CB}	60	80	100	Vdc
Emitter–Base Voltage	V_{EB}	5.0			Vdc
Collector Current — Continuous Peak	I_C	8.0 15			Adc
Base Current	I_B	1.0			Adc
Total Power Dissipation @ T_C = 25°C Derate above 25°C	P_D	80 0.64			Watts W/°C
Unclamped Inductive Load Energy (1)	E	30			mJ
Total Power Dissipation @ T_A = 25°C Derate above 25°C	P_D	2.0 0.016			Watts W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	–65 to +150			°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.56	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	62.5	°C/W

(1) I_C = 1.1 A, L = 50 mH, P.R.F. = 10 Hz, V_{CC} = 20 V, R_{BE} = 100 Ω

CASE 221A–06
TO–220AB

STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

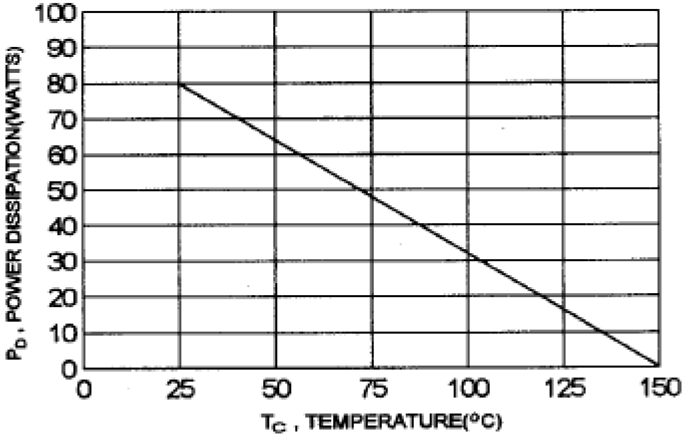
CASE 221A–09
TO–220AB

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector–Emitter Sustaining Voltage (1) (I_C = 30 mAdc, I_B = 0)	TIP100, TIP105	$V_{CEO(sus)}$	60	—	Vdc
	TIP101, TIP106		80	—	
	TIP102, TIP107		100	—	
Collector Cutoff Current (V_{CE} = 30 Vdc, I_B = 0)	TIP100, TIP105	I_{CEO}	—	50	μAdc
(V_{CE} = 40 Vdc, I_B = 0)	TIP101, TIP106		—	50	
(V_{CE} = 50 Vdc, I_B = 0)	TIP102, TIP107		—	50	
Collector Cuttoff Current (V_{CB} = 60 Vdc, I_E = 0)	TIP100, TIP105	I_{CBO}	—	50	μAdc
(V_{CB} = 80 Vdc, I_E = 0)	TIP101, TIP106		—	50	
(V_{CB} = 100 Vdc, I_E = 0)	TIP102, TIP107		—	50	
Emitter Cutoff Current (V_{BE} = 5.0 Vdc, I_C = 0)		I_{EBO}	—	8.0	mAdc
ON CHARACTERISTICS (1)					
DC Current Gain (I_C = 3.0 Adc, V_{CE} = 4.0 Vdc)		h_{FE}	1000	20,000	—
(I_C = 8.0 Adc, V_{CE} = 4.0 Vdc)			200	—	
Collector–Emitter Saturation Voltage (I_C = 3.0 Adc, I_B = 6.0 mAdc)		$V_{CE(sat)}$	—	2.0	Vdc
(I_C = 8.0 Adc, I_B = 80 mAdc)			—	2.5	
Base–Emitter On Voltage (I_C = 8.0 Adc, V_{CE} = 4.0 Vdc)		$V_{BE(on)}$	—	2.8	Vdc
DYNAMIC CHARACTERISTICS					
Small–Signal Current Gain (I_C = 3.0 Adc, V_{CE} = 4.0 Vdc, f = 1.0 MHz)		h_{fe}	4.0	—	—
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 0.1 MHz)	TIP105, TIP106, TIP107	C_{ob}	—	300	pF
	TIP100, TIP101, TIP102		—	200	

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

FIGURE -1 POWER DERATING



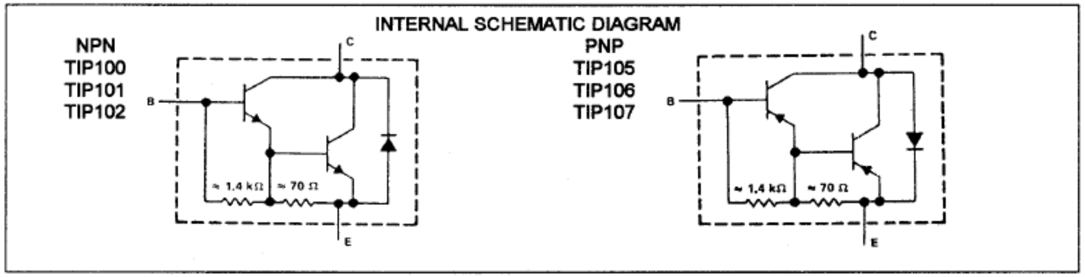
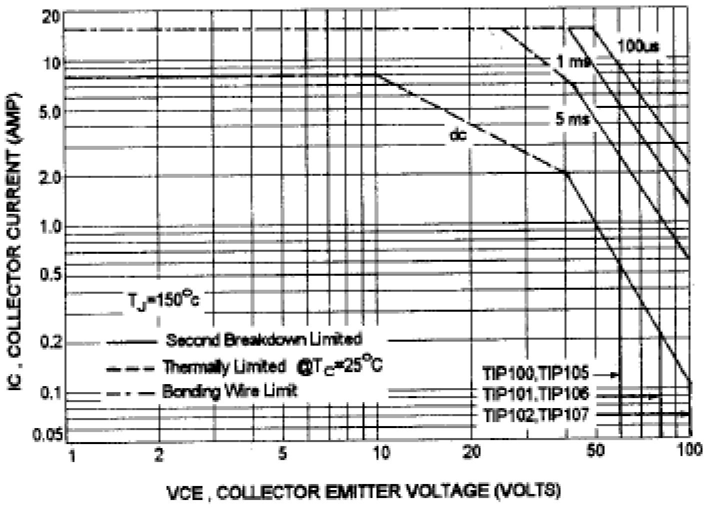


FIG-6 ACTIVE REGION SAFE OPERATING AREA



There are two limitation on the power handling ability of a transistor:average junction temperature and second breakdown safe operating area curves indicate I_C-V_{CE} limits of the transistor that must be observed for reliable operation i.e., the transistor must not be subjected to greater dissipation than curves indicate.

The data of FIG-6 is base on $T_{J(PK)}$=150 °C;T_C is variable depending on power level.second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(PK)} \leq 150$°C ,At high case temperatures,thermal limitation will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

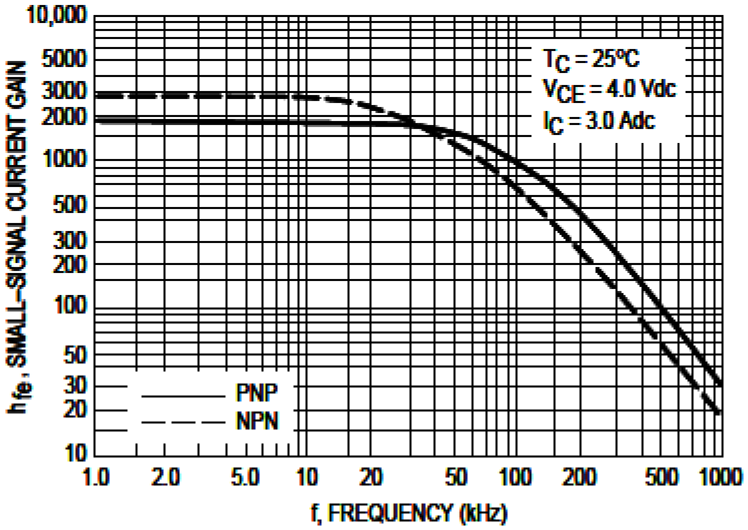


Figure 6. Small–Signal Current Gain

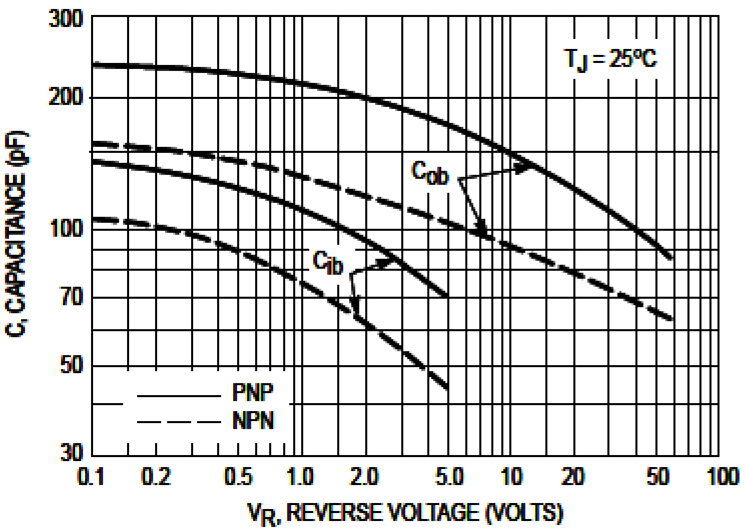
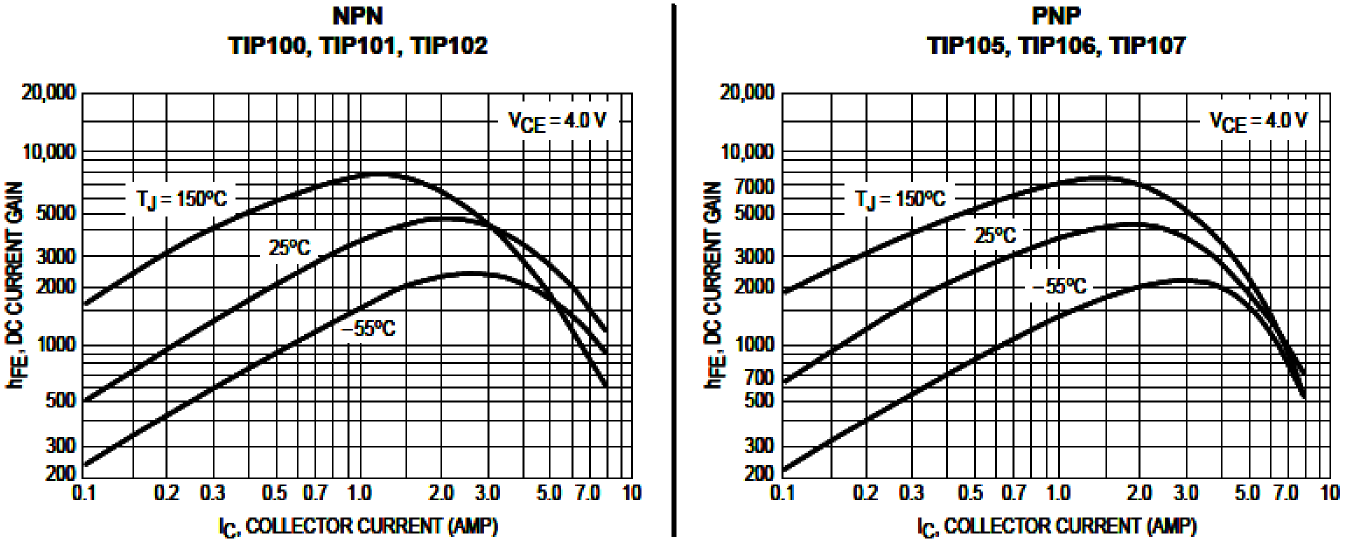


Figure 7. Capacitance


NPN
TIP100, TIP101, TIP102

PNP
TIP105, TIP106, TIP107

Figure 8. DC Current Gain

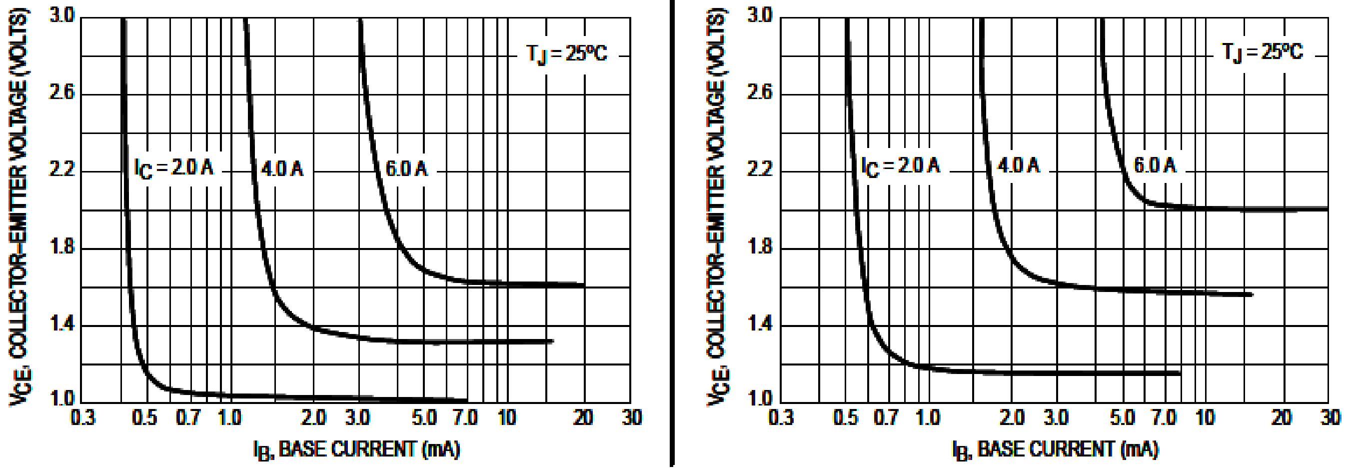


Figure 9. Collector Saturation Region

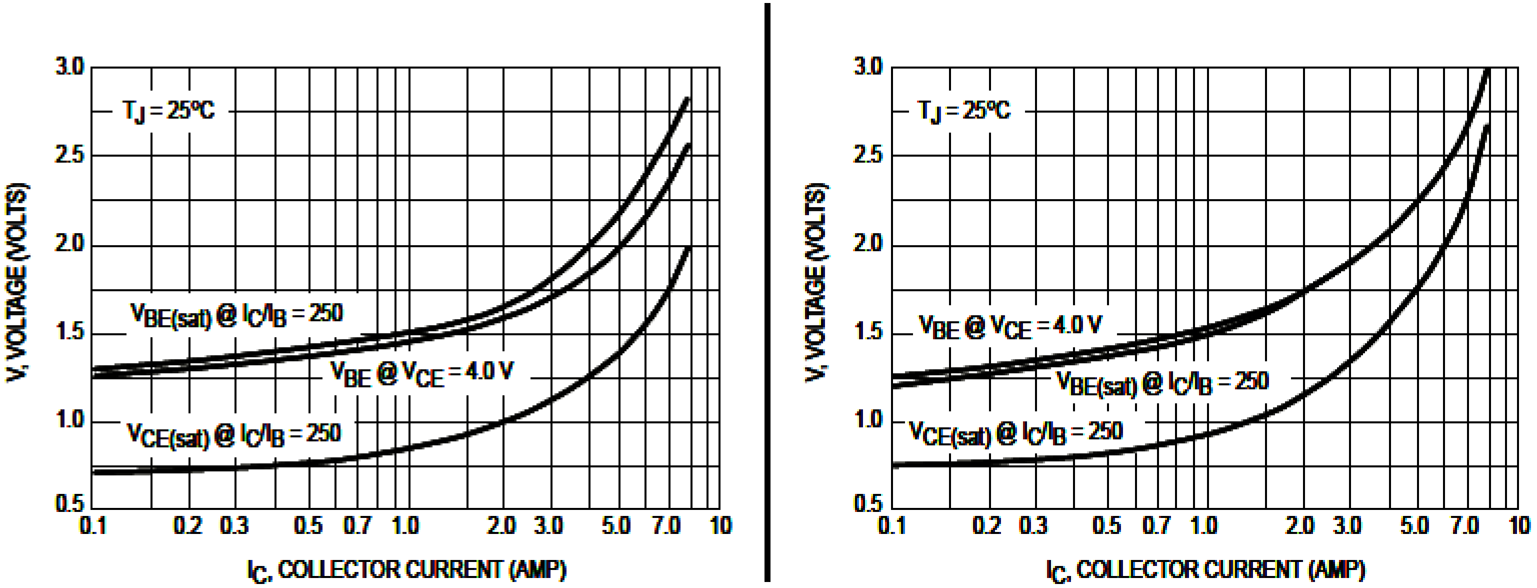
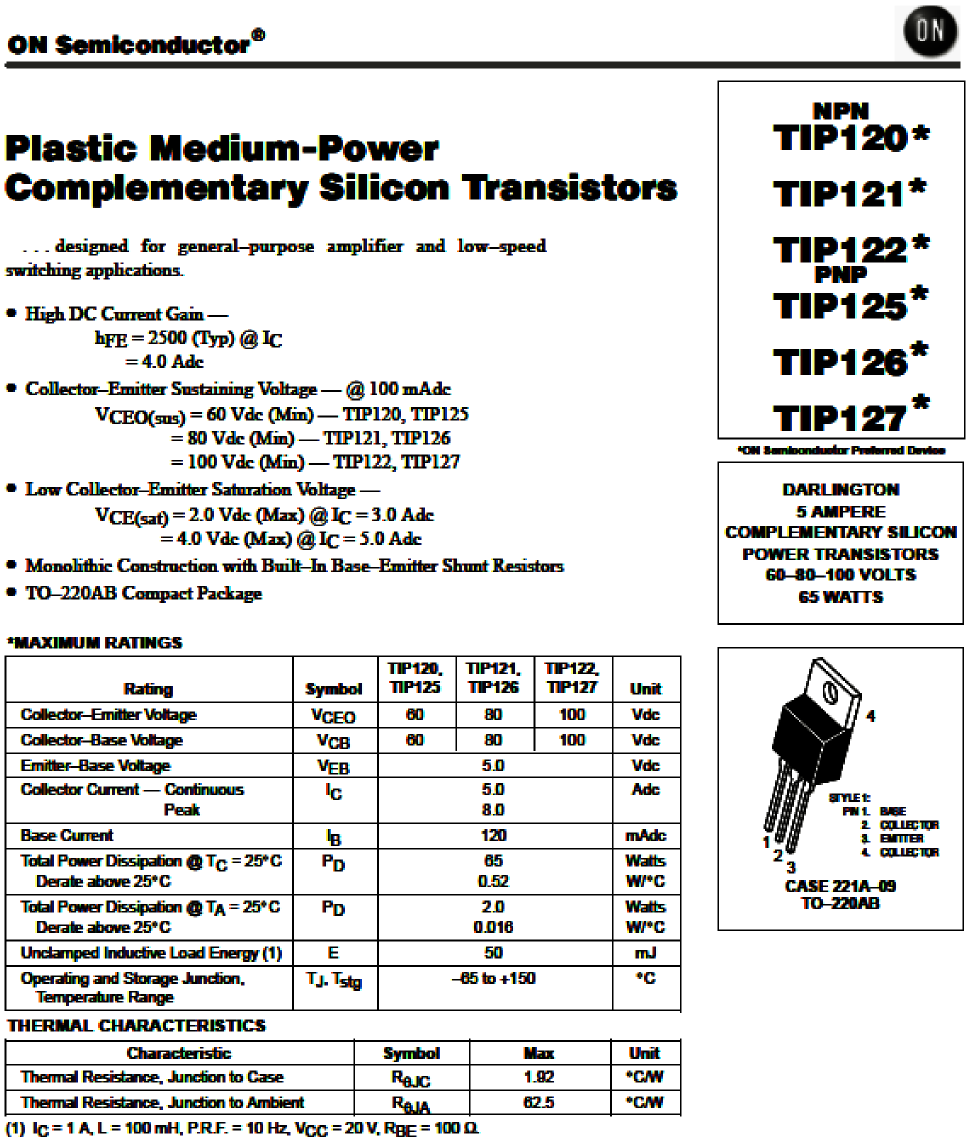


Figure 10. “On” Voltages

TIP120TIP121/TIP122/NPN TIP125TIP126/TIP127/PNP DARLINGTON 5A 65W



ON Semiconductor®

Plastic Medium-Power Complementary Silicon Transistors

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

- High DC Current Gain —
  $h_{FE} = 2500$ (Typ) @ I_C
  $= 4.0$ Adc
- Collector–Emitter Sustaining Voltage — @ 100 mAdc
  $V_{CEO(sus)} = 60$ Vdc (Min) — TIP120, TIP125
  $= 80$ Vdc (Min) — TIP121, TIP126
  $= 100$ Vdc (Min) — TIP122, TIP127
- Low Collector–Emitter Saturation Voltage —
  $V_{CE(sat)} = 2.0$ Vdc (Max) @ $I_C = 3.0$ Adc
  $= 4.0$ Vdc (Max) @ $I_C = 5.0$ Adc
- Monolithic Construction with Built–In Base–Emitter Shunt Resistors
- TO–220AB Compact Package

NPN
TIP120*
TIP121*
TIP122*
PNP
TIP125*
TIP126*
TIP127*

*ON Semiconductor Preferred Device

DARLINGTON
5 AMPERE
COMPLEMENTARY SILICON
POWER TRANSISTORS
60–80–100 VOLTS
65 WATTS

STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

CASE 221A–09
TO–220AB

***MAXIMUM RATINGS**

Rating	Symbol	TIP120, TIP125	TIP121, TIP126	TIP122, TIP127	Unit
Collector–Emitter Voltage	V_{CEO}	60	80	100	Vdc
Collector–Base Voltage	V_{CB}	60	80	100	Vdc
Emitter–Base Voltage	V_{EB}	5.0			Vdc
Collector Current — Continuous Peak	I_C	5.0 8.0			Adc
Base Current	I_B	120			mAdc
Total Power Dissipation @ $T_C = 25°C$ Derate above 25°C	P_D	65 0.52			Watts W/°C
Total Power Dissipation @ $T_A = 25°C$ Derate above 25°C	P_D	2.0 0.016			Watts W/°C
Unclamped Inductive Load Energy (1)	E	50			mJ
Operating and Storage Junction, Temperature Range	T_J, T_{stg}	–65 to +150			°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.92	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	62.5	°C/W

(1) $I_C = 1$ A, L = 100 mH, P.R.F. = 10 Hz, $V_{CC} = 20$ V, $R_{BE} = 100\ \Omega$.

TIP120 TIP121 TIP122 TIP125 TIP126 TIP127

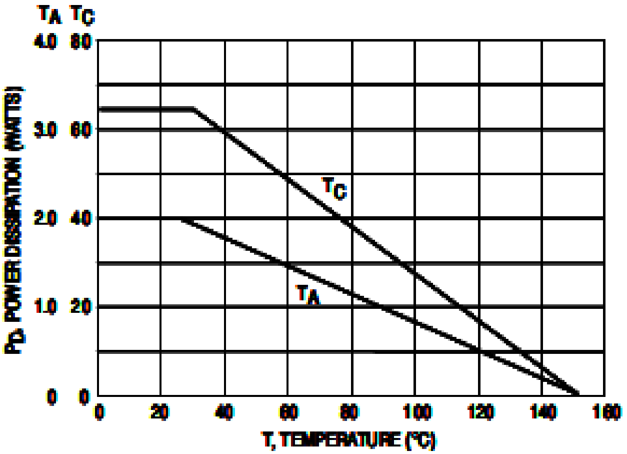


Figure 1. Power Derating

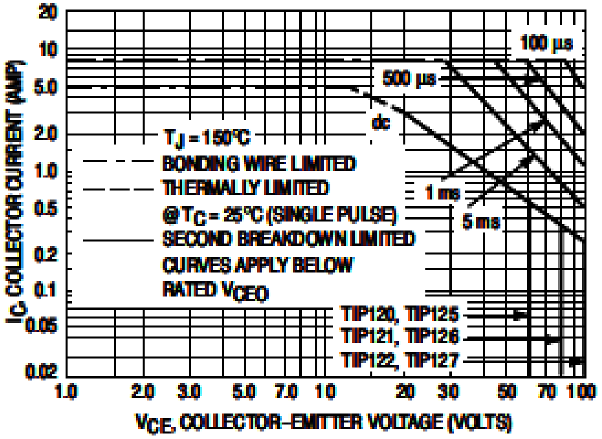


Figure 5. Active–Region Safe Operating Area

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate $I_C - V_{CE}$ limits of the transistor that must be observed for reliable operation, i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 5 is based on $T_{J(pk)} = 150°C$; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} < 150°C$. $T_{J(pk)}$ may be calculated from the data in Figure 4. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector–Emitter Sustaining Voltage (1)		$V_{CEO(sus)}$			Vdc
(I_C = 100 mAdc, I_B = 0)	TIP120, TIP125		60	—	
	TIP121, TIP126		80	—	
	TIP122, TIP127		100	—	
Collector Cutoff Current		I_{CEO}			mAdc
(V_{CE} = 30 Vdc, I_B = 0)	TIP120, TIP125		—	0.5	
(V_{CE} = 40 Vdc, I_B = 0)	TIP121, TIP126		—	0.5	
(V_{CE} = 50 Vdc, I_B = 0)	TIP122, TIP127		—	0.5	
Collector Cutoff Current		I_{CBO}			mAdc
(V_{CB} = 60 Vdc, I_E = 0)	TIP120, TIP125		—	0.2	
(V_{CB} = 80 Vdc, I_E = 0)	TIP121, TIP126		—	0.2	
(V_{CB} = 100 Vdc, I_E = 0)	TIP122, TIP127		—	0.2	
Emitter Cutoff Current (V_{BE} = 5.0 Vdc, I_C = 0)		I_{EBO}	—	2.0	mAdc
ON CHARACTERISTICS (1)					
DC Current Gain		h_{FE}			—
(I_C = 0.5 Adc, V_{CE} = 3.0 Vdc)			1000	—	
(I_C = 3.0 Adc, V_{CE} = 3.0 Vdc)			1000	—	
Collector–Emitter Saturation Voltage		$V_{CE(sat)}$			Vdc
(I_C = 3.0 Adc, I_B = 12 mAdc)			—	2.0	
(I_C = 5.0 Adc, I_B = 20 mAdc)			—	4.0	
Base–Emitter On Voltage (I_C = 3.0 Adc, V_{CE} = 3.0 Vdc)		$V_{BE(on)}$	—	2.5	Vdc
DYNAMIC CHARACTERISTICS					
Small–Signal Current Gain (I_C = 3.0 Adc, V_{CE} = 4.0 Vdc, f = 1.0 MHz)		h_{fe}	4.0	—	—
Output Capacitance		C_{ob}			pF
(V_{CB} = 10 Vdc, I_E = 0, f = 0.1 MHz	TIP125, TIP126, TIP127		—	300	
	TIP120, TIP121, TIP122		—	200	

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

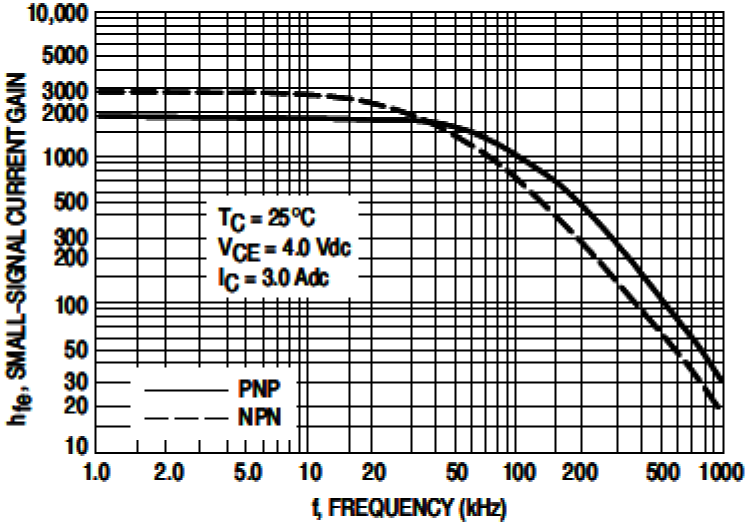


Figure 6. Small–Signal Current Gain

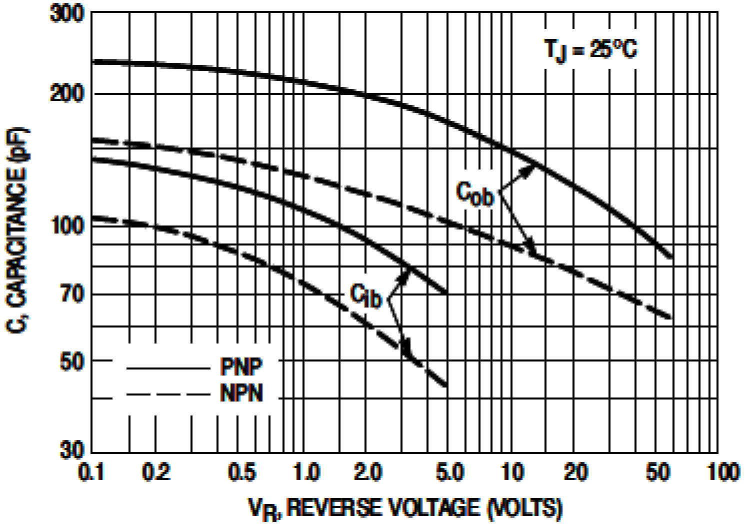


Figure 7. Capacitance

NPN
TIP120, TIP121, TIP122

PNP
TIP125, TIP126, TIP127

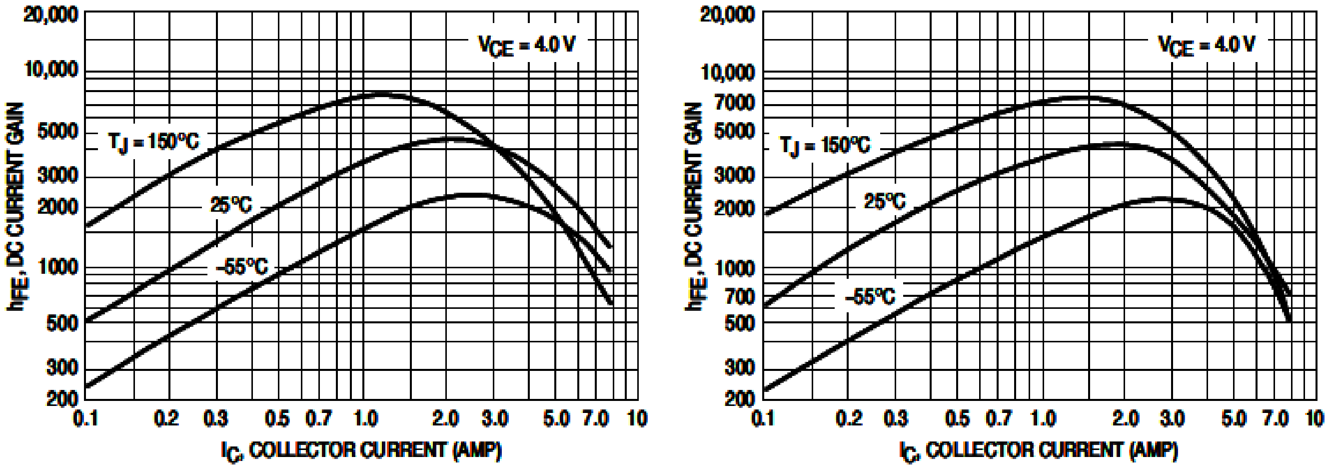


Figure 8. DC Current Gain

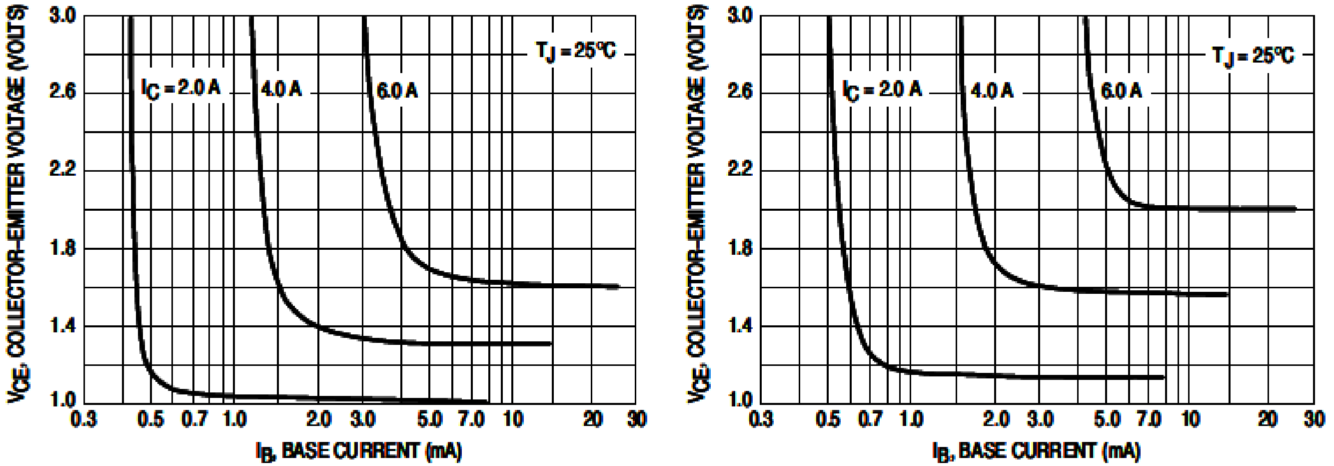


Figure 9. Collector Saturation Region

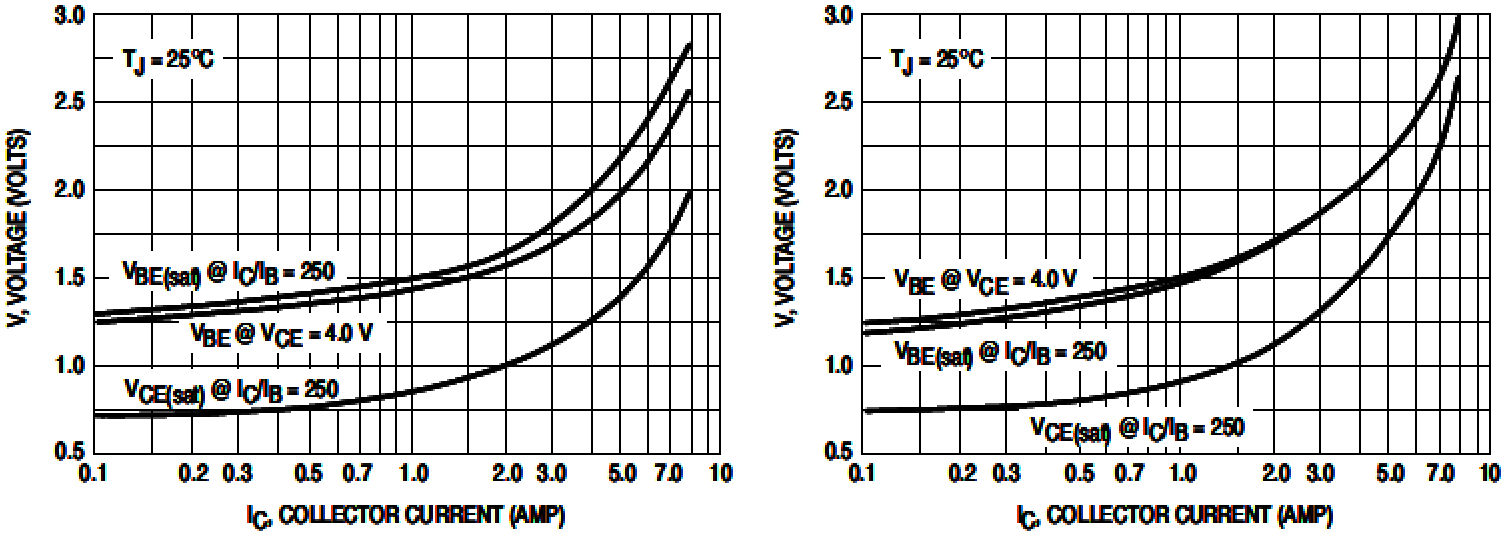


Figure 10. “On” Voltages

TIP140/141/142 NPN TIP 145/46/47 PNP DARLINGTON 10A

MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

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by TIP140/D

Darlington Complementary Silicon Power Transistors

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

- High DC Current Gain — Min h_{FE} = 1000 @ I_C = 5 A, V_{CE} = 4 V
- Collector–Emitter Sustaining Voltage — @ 30 mA
  $V_{CEO(sus)}$ = 60 Vdc (Min) — TIP140, TIP145
  80 Vdc (Min) — TIP141, TIP146
  100 Vdc (Min) — TIP142, TIP147
- Monolithic Construction with Built–In Base–Emitter Shunt Resistor

NPN
TIP140
TIP141*
TIP142*
PNP
TIP145
TIP146*
TIP147*

*Motorola Preferred Device

10 AMPERE
DARLINGTON
COMPLEMENTARY SILICON
POWER TRANSISTORS
60–100 VOLTS
125 WATTS

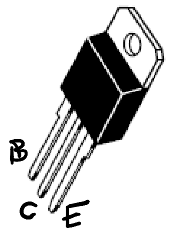
MAXIMUM RATINGS

Rating	Symbol	TIP140 TIP145	TIP141 TIP146	TIP142 TIP147	Unit
Collector–Emitter Voltage	V_{CEO}	60	80	100	Vdc
Collector–Base Voltage	V_{CB}	60	80	100	Vdc
Emitter–Base Voltage	V_{EB}	5.0			Vdc
Collector Current — Continuous Peak (1)	I_C	10 15			Adc
Base Current — Continuous	I_B	0.5			Adc
Total Device Dissipation @ T_C = 25°C	P_D	125			Watts
Operating and Storage Junction Temperature Range	T_J, T_{stg}	–65 to +150			°C

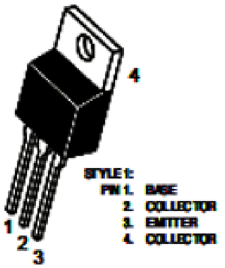
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	°C/W
Thermal Resistance, Case to Ambient	$R_{\theta JA}$	35.7	°C/W

(1) 5 ms, ≤ 10% Duty Cycle.

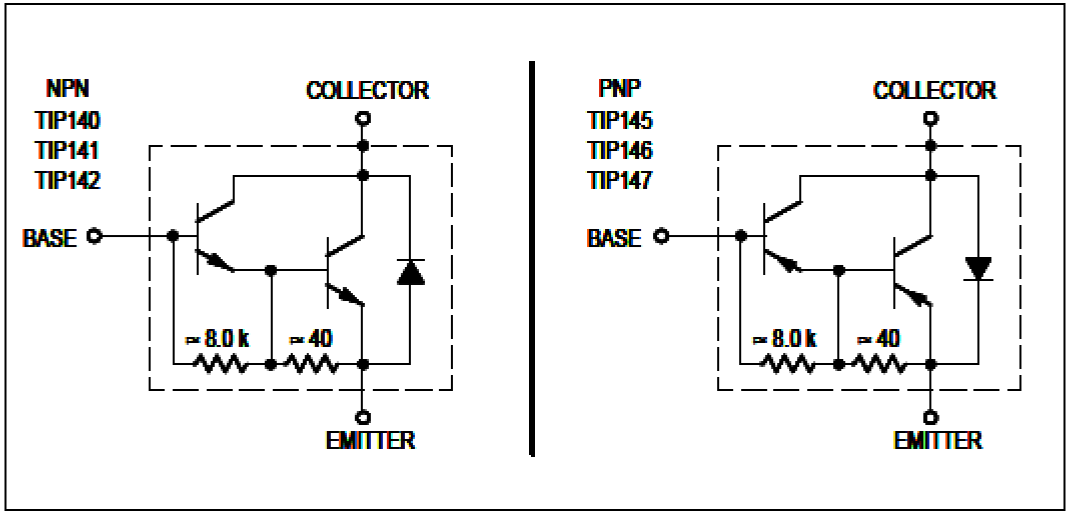


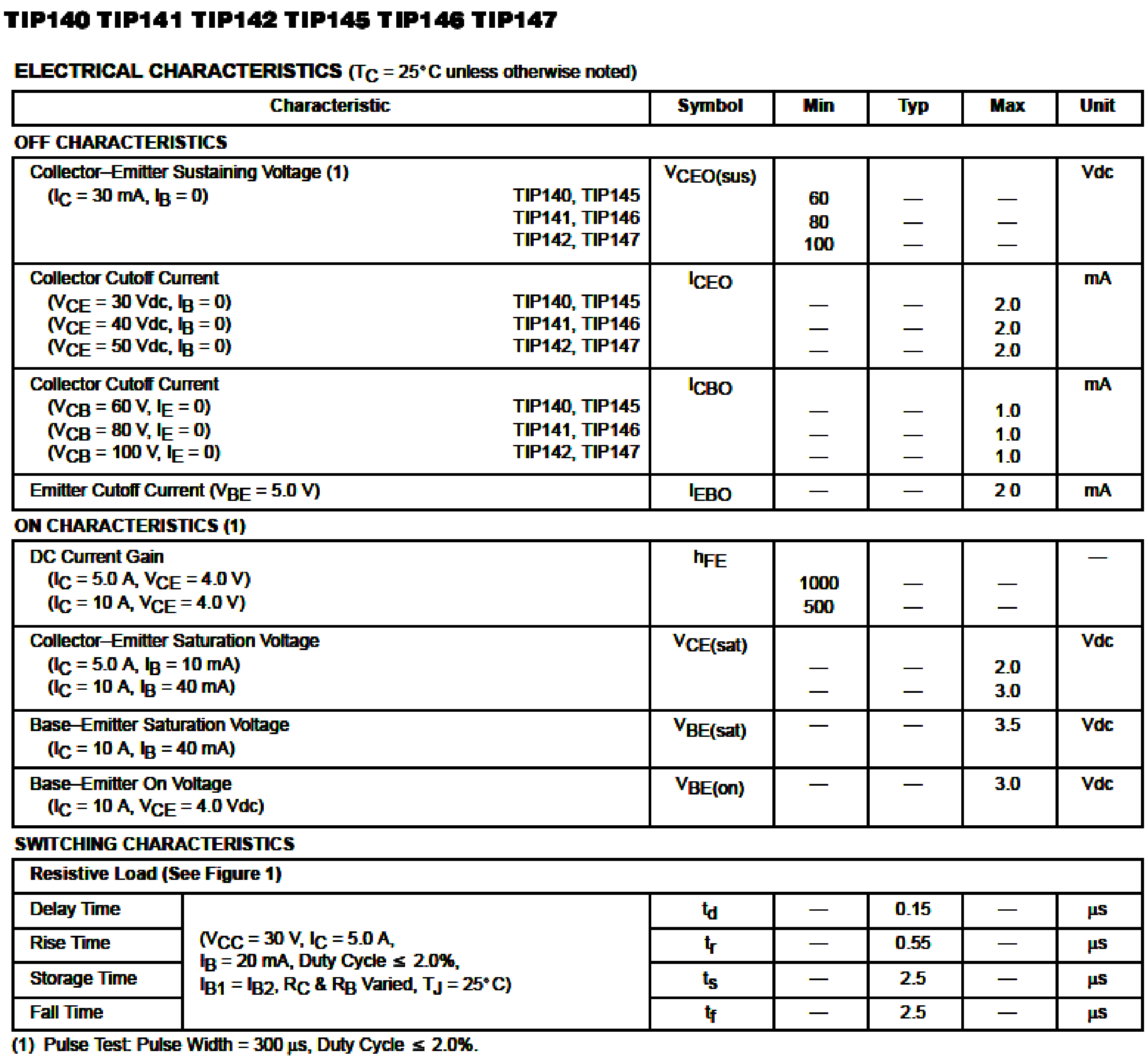
CASE 340D–01



CASE 221A–09
TO–220AB

DARLINGTON SCHEMATICS





TIP140 TIP141 TIP142 TIP145 TIP146 TIP147

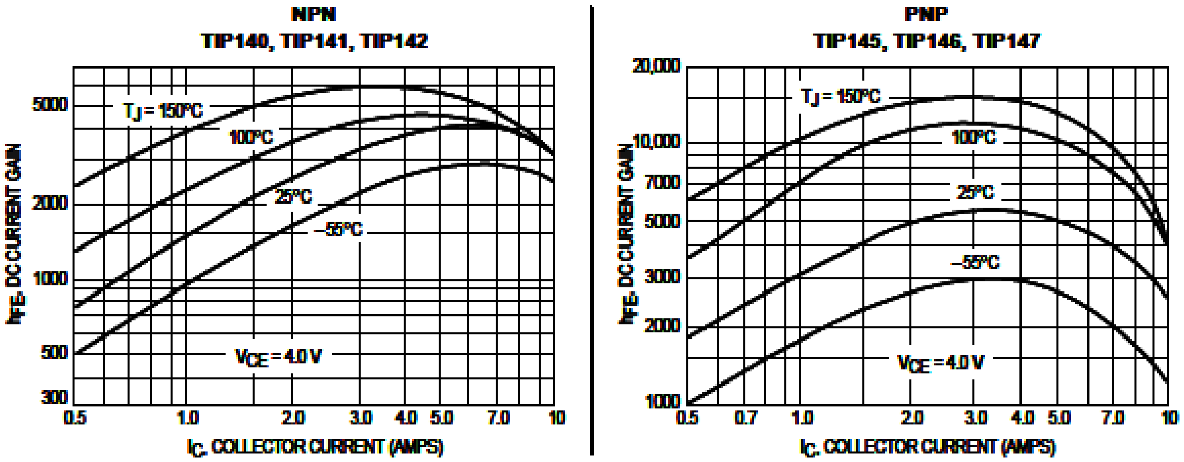
ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector–Emitter Sustaining Voltage (1) (I_C = 30 mA, I_B = 0) TIP140, TIP145 TIP141, TIP146 TIP142, TIP147	$V_{CEO(sus)}$	60 80 100	— — —	— — —	Vdc
Collector Cutoff Current (V_{CE} = 30 Vdc, I_B = 0) TIP140, TIP145 (V_{CE} = 40 Vdc, I_B = 0) TIP141, TIP146 (V_{CE} = 50 Vdc, I_B = 0) TIP142, TIP147	I_{CEO}	— — —	— — —	2.0 2.0 2.0	mA
Collector Cutoff Current (V_{CB} = 60 V, I_E = 0) TIP140, TIP145 (V_{CB} = 80 V, I_E = 0) TIP141, TIP146 (V_{CB} = 100 V, I_E = 0) TIP142, TIP147	I_{CBO}	— — —	— — —	1.0 1.0 1.0	mA
Emitter Cutoff Current (V_{BE} = 5.0 V)	I_{EBO}	—	—	2 0	mA
ON CHARACTERISTICS (1)					
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 (I_C = 10 A, V_{CE} = 4.0 Vdc)	$V_{BE(on)}$	—	—	3.0	Vdc
SWITCHING CHARACTERISTICS					
Resistive Load (See Figure 1)					
Delay Time (V_{CC} = 30 V, I_C = 5.0 A, I_B = 20 mA, Duty Cycle ≤ 2.0%, I_{B1} = I_{B2}, R_C & R_B Varied, T_J = 25°C)	t_d	—	0.15	—	µs
Rise Time	t_r	—	0.55	—	µs
Storage Time	t_s	—	2.5	—	µs
Fall Time	t_f	—	2.5	—	µs

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2.0%.

TIP140 TIP141 TIP142 TIP145 TIP146 TIP147

TYPICAL CHARACTERISTICS


NPN
TIP140, TIP141, TIP142

PNP
TIP145, TIP146, TIP147

Figure 3. DC Current Gain versus Collector Current

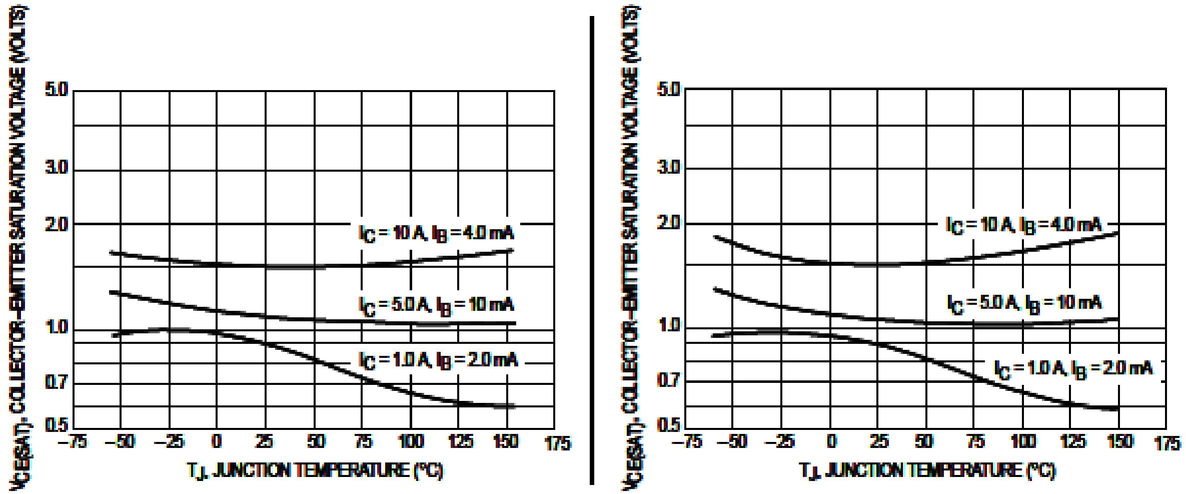


Figure 4. Collector−Emitter Saturation Voltage

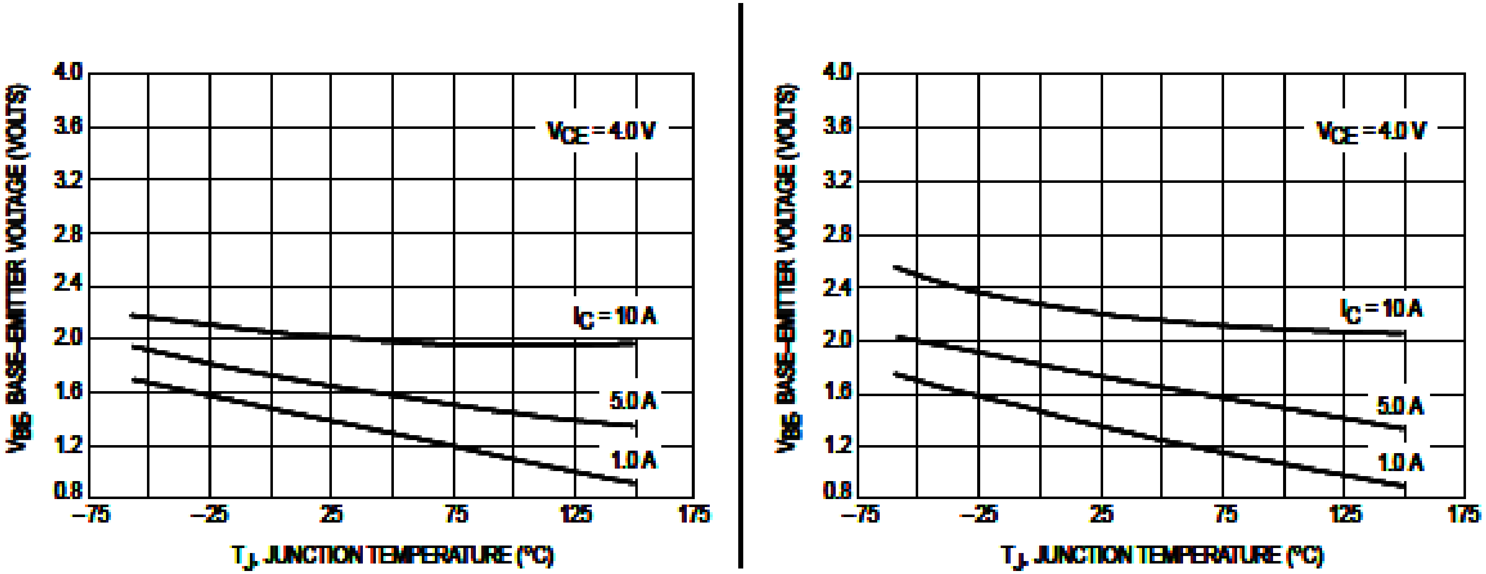


Figure 5. Base−Emitter Voltage

TIP140 TIP141 TIP142 TIP145 TIP146 TIP147

ACTIVE–REGION SAFE OPERATING AREA

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate I_C – V_{CE} limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 6 is based on $T_{J(pk)} = 150^\circ C$; T_C is variable depending on conditions. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

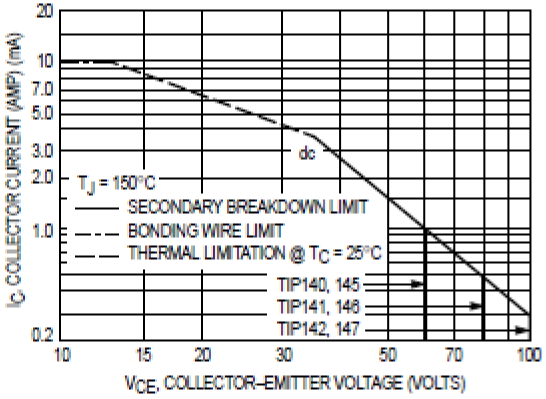


Figure 6. Active–Region Safe Operating Area

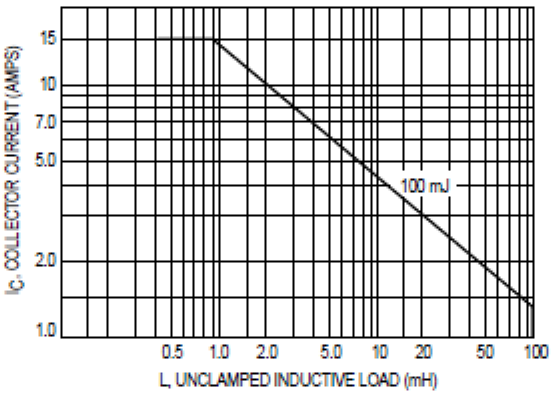
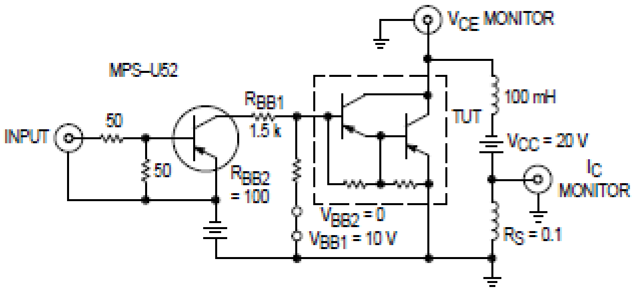
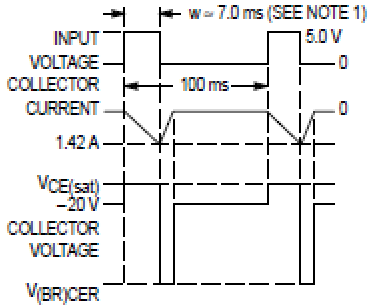


Figure 7. Unclamped Inductive Load



TEST CIRCUIT

NOTE 1: Input pulse width is increased until I_{CM} = 1.42 A.
NOTE 2: For NPN test circuit reverse polarities.



VOLTAGE AND CURRENT WAVEFORMS

Figure 8. Inductive Load

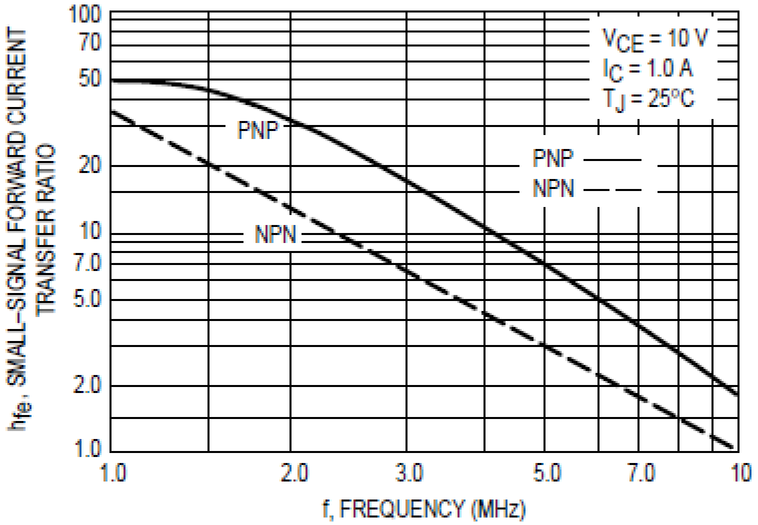


Figure 9. Magnitude of Common Emitter Small–Signal Short–Circuit Forward Current Transfer Ratio

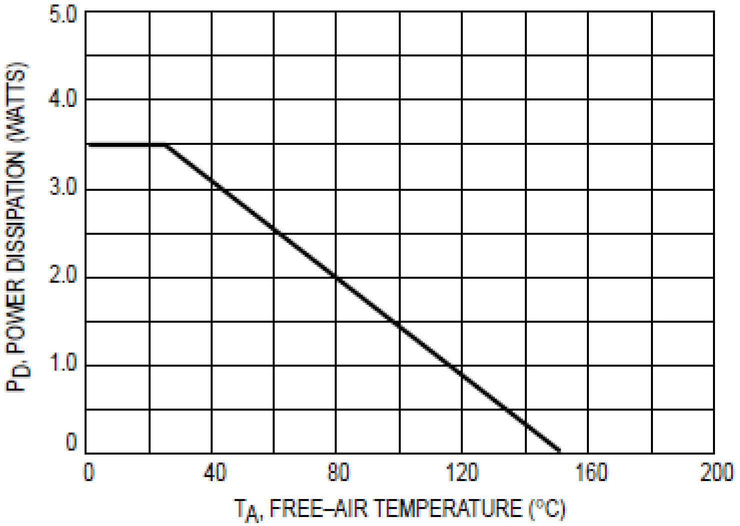


Figure 10. Free–Air Temperature Power Derating

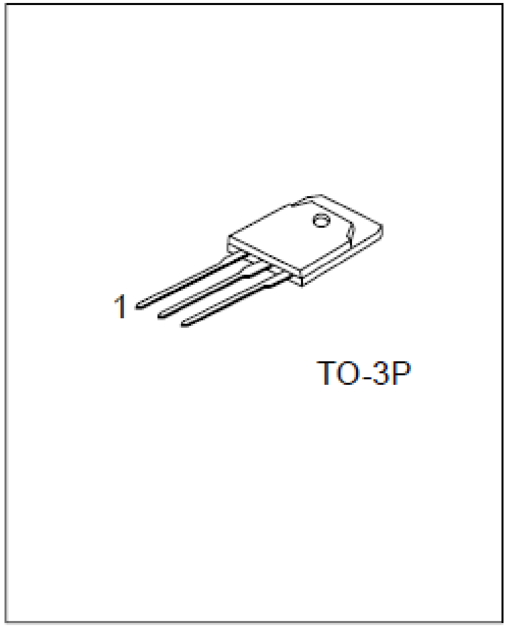
BU931 DARLINGTON NPN 12A 175W

UNISONIC TECHNOLOGIES CO., LTD

BU931

NPN SILICON TRANSISTOR

NPN POWER DARLINGTON

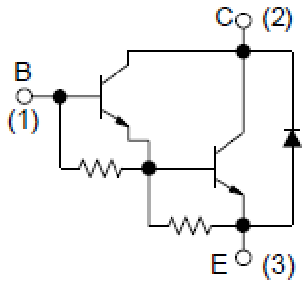


*Pb-free plating product number: BU931L

■ FEATURES

* High operating junction temperature
* High voltage ignition coil driver
* Very rugged bipolar technology

■ INTERNAL SCHEMATIC DIAGRAM



BU931

NPN SILICON TRANSISTOR

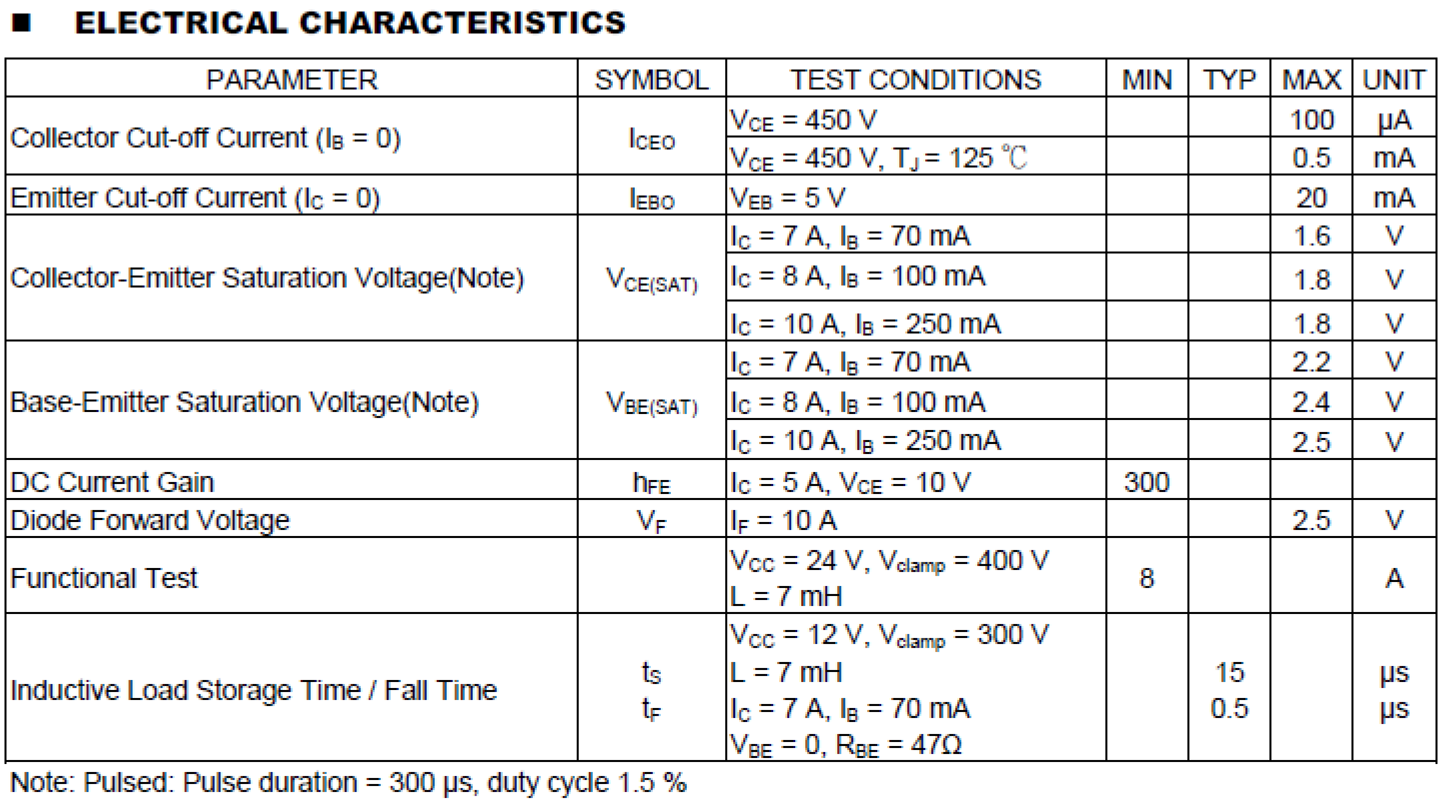
■ ABSOLUTE MAXIMUM RATINGS (Ta=25℃)

PARAMETER	SYMBOL	RATINGS	UNIT
Collector-Emitter Voltage (V_{BE} = 0)	V_{CES}	500	V
Collector-Emitter Voltage (I_B = 0)	V_{CEO}	400	V
Emitter-Base Voltage (I_C = 0)	V_{EBO}	5	V
Collector Current	I_C	15	A
Collector Peak Current	I_{CM}	30	A
Base Current	I_B	1	A
Base Peak Current	I_{BM}	5	A
Total Dissipation (Tc = 25 ℃)	P_D	175	W
Junction Temperature	T_J	+200	℃
Storage Temperature	T_{STG}	-65 ~ +200	℃

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ THERMAL DATA

PARAMETER	SYMBOL	RATING	UNIT
Thermal Resistance Junction-Case Max	θ_{JC}	1.1	℃/W



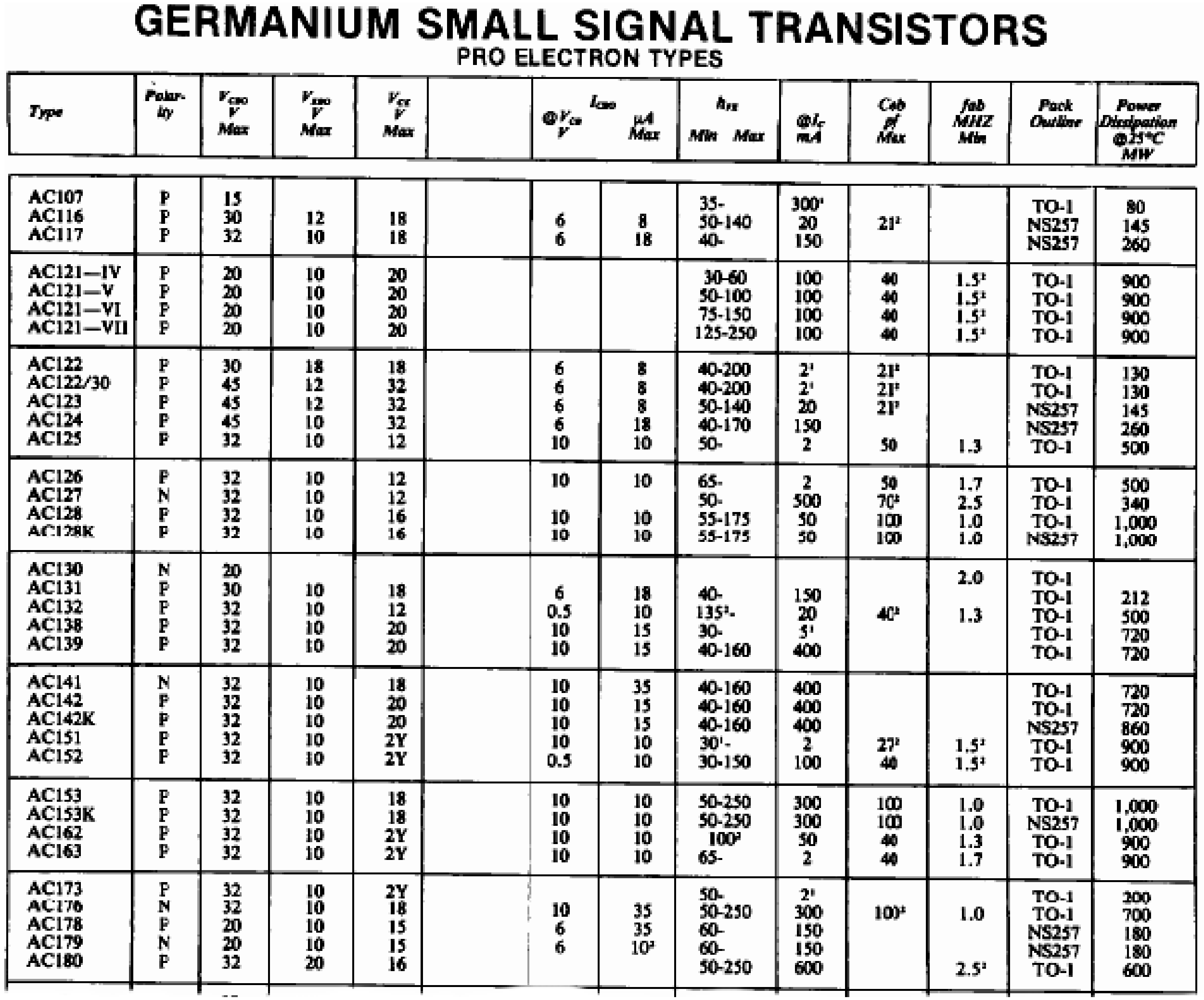
■ ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Collector Cut-off Current (I_B = 0)	I_{CEO}	V_{CE} = 450 V			100	µA
		V_{CE} = 450 V, T_J = 125 ℃			0.5	mA
Emitter Cut-off Current (I_C = 0)	I_{EBO}	V_{EB} = 5 V			20	mA
Collector-Emitter Saturation Voltage(Note)	$V_{CE(SAT)}$	I_C = 7 A, I_B = 70 mA			1.6	V
		I_C = 8 A, I_B = 100 mA			1.8	V
		I_C = 10 A, I_B = 250 mA			1.8	V
Base-Emitter Saturation Voltage(Note)	$V_{BE(SAT)}$	I_C = 7 A, I_B = 70 mA			2.2	V
		I_C = 8 A, I_B = 100 mA			2.4	V
		I_C = 10 A, I_B = 250 mA			2.5	V
DC Current Gain	h_{FE}	I_C = 5 A, V_{CE} = 10 V	300			
Diode Forward Voltage	V_F	I_F = 10 A			2.5	V
Functional Test		V_{CC} = 24 V, V_{clamp} = 400 V L = 7 mH	8			A
Inductive Load Storage Time / Fall Time	t_S t_F	V_{CC} = 12 V, V_{clamp} = 300 V L = 7 mH I_C = 7 A, I_B = 70 mA V_{BE} = 0, R_{BE} = 47Ω		15 0.5		µs µs

Note: Pulsed: Pulse duration = 300 µs, duty cycle 1.5 %

TRANSITORES DE GERMÂNIO.

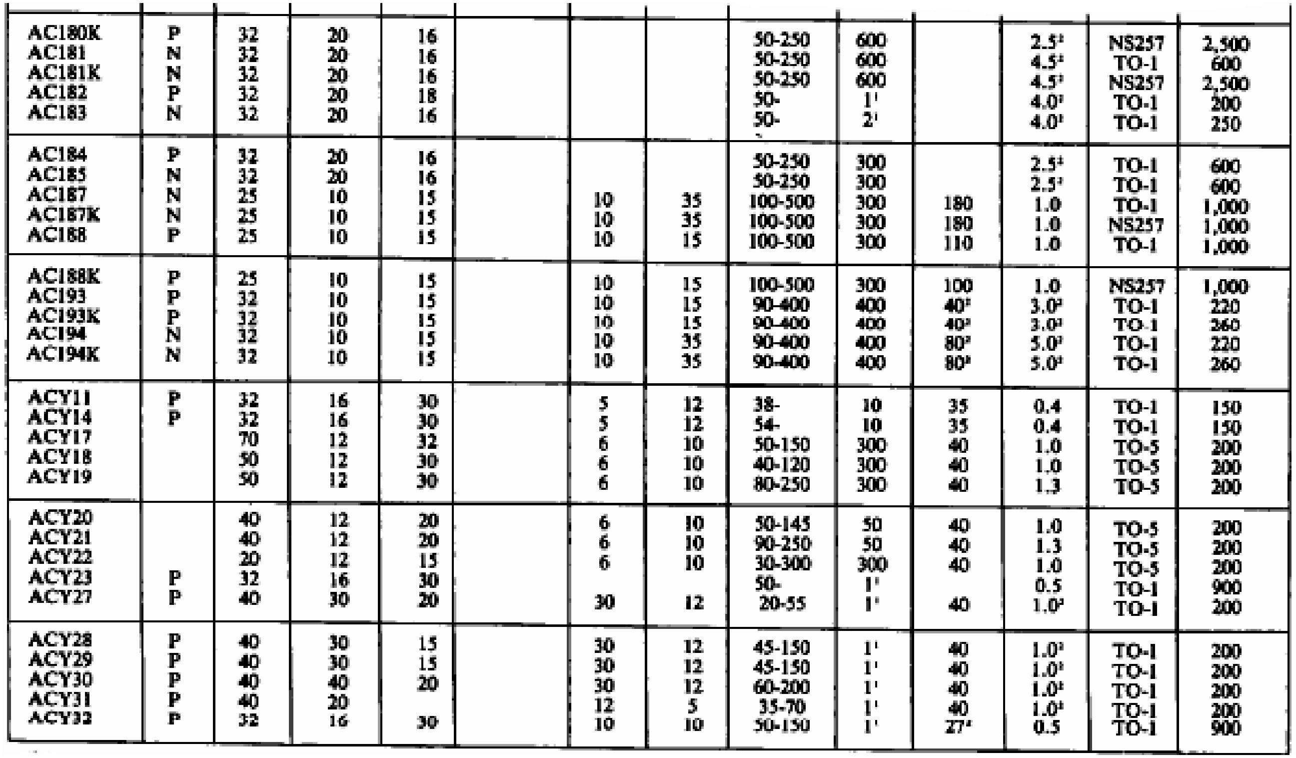
TABELA DE TRANSISTORES DE GERMÂNIO PARA PEQUNOS SINAIS



GERMANIUM SMALL SIGNAL TRANSISTORS

PRO ELECTRON TYPES

Type	Polar-ity	V_{CBO} V Max	V_{CEO} V Max	V_{CE} V Max		I_{CBO} @V_{CB} V	I_{CBO} µA Max	h_{FE} Min Max	@I_C mA	Cob pf Max	fab MHZ Min	Pack Outline	Power Dissipation @25°C MW
AC107	P	15						35-	300[1]			TO-1	80
AC116	P	30	12	18		6	8	50-140	20	21[2]		NS257	145
AC117	P	32	10	18		6	18	40-	150			NS257	260
AC121—IV	P	20	10	20				30-60	100	40	1.5[2]	TO-1	900
AC121—V	P	20	10	20				50-100	100	40	1.5[2]	TO-1	900
AC121—VI	P	20	10	20				75-150	100	40	1.5[2]	TO-1	900
AC121—VII	P	20	10	20				125-250	100	40	1.5[2]	TO-1	900
AC122	P	30	18	18		6	8	40-200	2[1]	21[2]		TO-1	130
AC122/30	P	45	12	32		6	8	40-200	2[1]	21[2]		TO-1	130
AC123	P	45	12	32		6	8	50-140	20	21[2]		NS257	145
AC124	P	45	10	32		6	18	40-170	150			NS257	260
AC125	P	32	10	12		10	10	50-	2	50	1.3	TO-1	500
AC126	P	32	10	12		10	10	65-	2	50	1.7	TO-1	500
AC127	N	32	10	12				50-	500	70[2]	2.5	TO-1	340
AC128	P	32	10	16		10	10	55-175	50	100	1.0	TO-1	1,000
AC128K	P	32	10	16		10	10	55-175	50	100	1.0	NS257	1,000
AC130	N	20									2.0	TO-1	
AC131	P	30	10	18		6	18	40-	150			TO-1	212
AC132	P	32	10	12		0.5	10	135[2]-	20	40[2]	1.3	TO-1	500
AC138	P	32	10	20		10	15	30-	5[1]			TO-1	720
AC139	P	32	10	20		10	15	40-160	400			TO-1	720
AC141	N	32	10	18		10	35	40-160	400			TO-1	720
AC142	P	32	10	20		10	15	40-160	400			TO-1	720
AC142K	P	32	10	20		10	15	40-160	400			NS257	860
AC151	P	32	10	2Y		10	10	30[1]-	2	27[2]	1.5[2]	TO-1	900
AC152	P	32	10	2Y		0.5	10	30-150	100	40	1.5[2]	TO-1	900
AC153	P	32	10	18		10	10	50-250	300	100	1.0	TO-1	1,000
AC153K	P	32	10	18		10	10	50-250	300	100	1.0	NS257	1,000
AC162	P	32	10	2Y		10	10	100[2]	50	40	1.3	TO-1	900
AC163	P	32	10	2Y		10	10	65-	2	40	1.7	TO-1	900
AC173	P	32	10	2Y				50-	2[1]			TO-1	200
AC176	N	32	10	18		10	35	50-250	300	100[2]	1.0	TO-1	700
AC178	P	20	10	15		6	35	60-	150			NS257	180
AC179	N	20	10	15		6	10[2]	60-	150			NS257	180
AC180	P	32	20	16				50-250	600		2.5[1]	TO-1	600

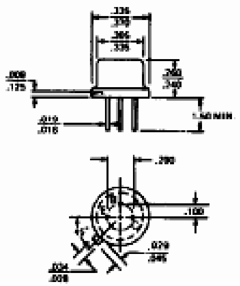


AC180K	P	32	20	16				50-250	600		2.5[2]	NS257	2,500
AC181	N	32	20	16				50-250	600		4.5[2]	TO-1	600
AC181K	N	32	20	16				50-250	600		4.5[3]	NS257	2,500
AC182	P	32	20	18				50-	1[1]		4.0[1]	TO-1	200
AC183	N	32	20	16				50-	2[1]		4.0[1]	TO-1	250
AC184	P	32	20	16				50-250	300		2.5[2]	TO-1	600
AC185	N	32	20	16				50-250	300		2.5[3]	TO-1	600
AC187	N	25	10	15		10	35	100-500	300	180	1.0	TO-1	1,000
AC187K	N	25	10	15		10	35	100-500	300	180	1.0	NS257	1,000
AC188	P	25	10	15		10	15	100-500	300	110	1.0	TO-1	1,000
AC188K	P	25	10	15		10	15	100-500	300	100	1.0	NS257	1,000
AC193	P	32	10	15		10	15	90-400	400	40[2]	3.0[2]	TO-1	220
AC193K	P	32	10	15		10	15	90-400	400	40[3]	3.0[3]	TO-1	260
AC194	N	32	10	15		10	35	90-400	400	80[2]	5.0[2]	TO-1	220
AC194K	N	32	10	15		10	35	90-400	400	80[4]	5.0[3]	TO-1	260
ACY11	P	32	16	30		5	12	38-	10	35	0.4	TO-1	150
ACY14	P	32	16	30		5	12	54-	10	35	0.4	TO-1	150
ACY17		70	12	32		6	10	50-150	300	40	1.0	TO-5	200
ACY18		50	12	30		6	10	40-120	300	40	1.0	TO-5	200
ACY19		50	12	30		6	10	80-250	300	40	1.3	TO-5	200
ACY20		40	12	20		6	10	50-145	50	40	1.0	TO-5	200
ACY21		40	12	20		6	10	90-250	50	40	1.3	TO-5	200
ACY22		20	12	15		6	10	30-300	300	40	1.0	TO-5	200
ACY23	P	32	16	30				50-	1[1]		0.5	TO-1	900
ACY27	P	40	30	20		30	12	20-55	1[1]	40	1.0[2]	TO-1	200
ACY28	P	40	30	15		30	12	45-150	1[1]	40	1.0[3]	TO-1	200
ACY29	P	40	30	15		30	12	45-150	1[1]	40	1.0[3]	TO-1	200
ACY30	P	40	40	20		30	12	60-200	1[1]	40	1.0[4]	TO-1	200
ACY31	P	40	20			12	5	35-70	1[1]	40	1.0[4]	TO-1	200
ACY32	P	32	16	30		10	10	50-150	1[1]	27[4]	0.5	TO-1	900

GERMANIUM POWER TRANSISTORS

CASE OUTLINE DRAWINGS & DIMENSIONS

TO-5



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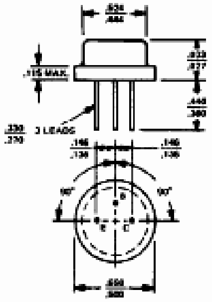

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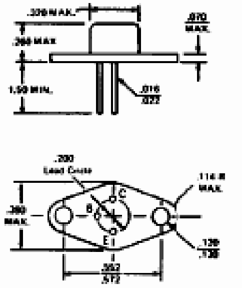

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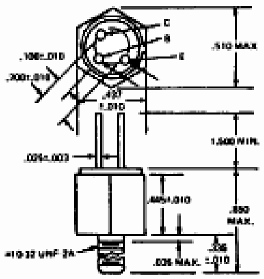

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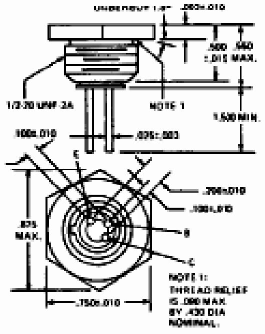

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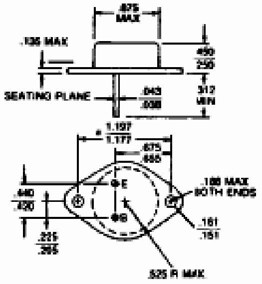
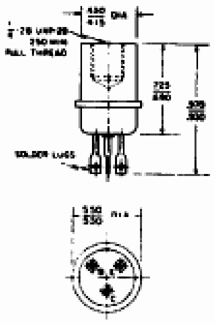


CASE OUTLINE DRAWINGS & DIMENSIONS

TO-13



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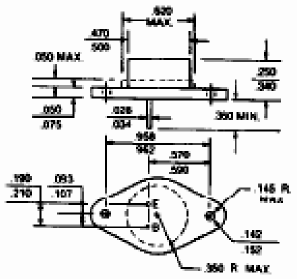
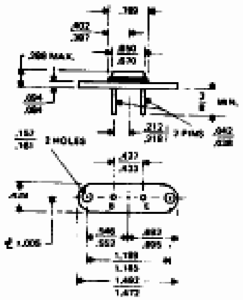
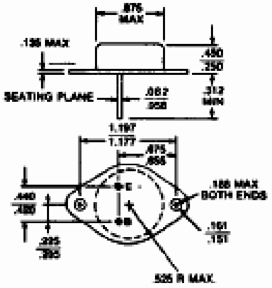


MS-7



MODIFIED TO-3
(60 mil pins)



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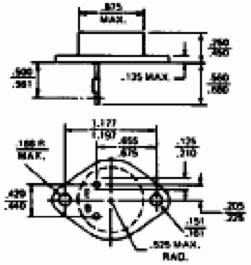

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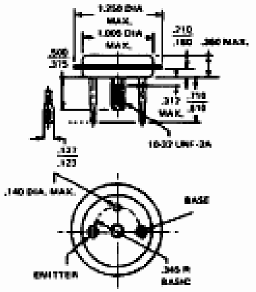
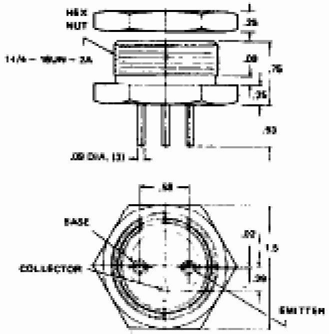


CASE OUTLINE DRAWINGS & DIMENSIONS

MT-22



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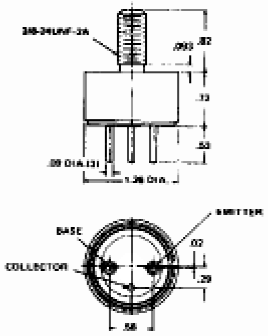
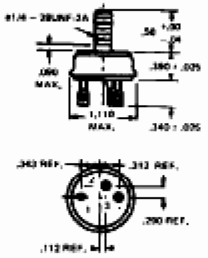


MT-7



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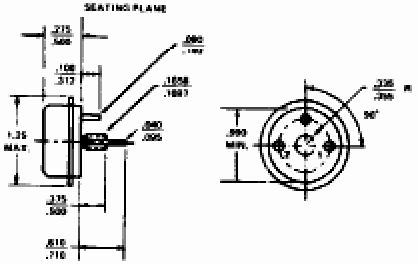
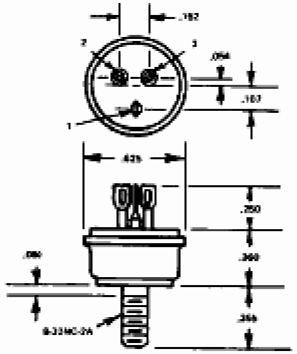


MT-36

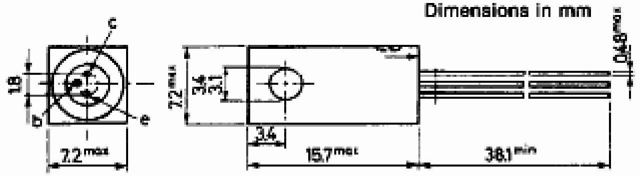


Germanium Power Devices Corporation

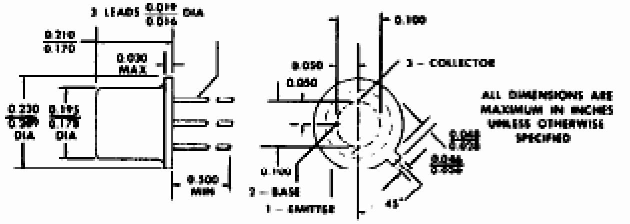
CASE OUTLINE DRAWINGS & DIMENSIONS

NS257

Dimensions in mm



TO-18

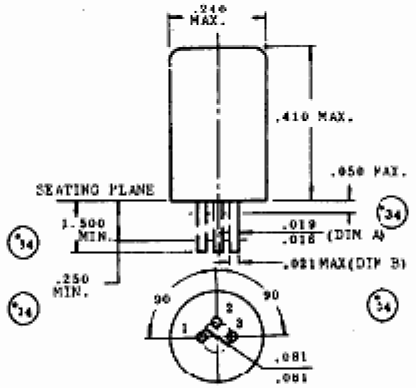


ALL DIMENSIONS ARE MAXIMUM IN INCHES UNLESS OTHERWISE SPECIFIED

THE COLLECTOR IS ELECTRICAL CONTACT WITH THE CASE.

ALL JEDEC TO-18 DIMENSIONS AND NOTES ARE APPLICABLE.

TO-1



LENDO CÓDIGOS E MARCAS EM TRANSISTORES

A maioria das indicações dos transistores segue um dos códigos a seguir: JEDEC, JIS ou Pro-Electron.

Para CI´s, aparece com números (Por ex. 741, 4001, 7400) entre o prefixo e o sufixo.

Joint Electron Device Engineering Council (JEDEC):

Estes números estão na forma de dígitos, letras e números sequenciais [sufixo]. A letra é sempre 'N', e o primeiro digito é 1 para diodos, 2 para transistores , 3 para dispositivos de 4 camadas e assim por diante. Mas 4N e 5N são reservados para acopladores óticos. Os números sequenciais começam em 100 até 9999.

Se presente o sufixo pode indicar várias coisas. Por exemplo 2N2222A é uma versão melhorada do 2N2222. Ele tem maior ganho, frequência, limites de tensão. Na dúvida sempre checar uma Data Sheet.

Exemplos: 1N914 (diode), 2N2222, 2N2222A, 2N904 (transistors).

NOTA: Quando uma versão metálica de um transistor JEDEC é refeita em encapsulamento plástico, muitas vezes é adicionado um número ou letra. Por exemplo o transistor PN2222A é uma versão em plástico do 2N2222A. (metálico)

Obs: Ao invés de 2N muitas vezes o fabricante usa a sua própria designação.

Japanese Industrial Standard (JIS):

Os números da parte tomam a forma: Digito, duas letras, numero sequencial (sufixo opcional)T

Digito 1 é para diodos 2 para transistores. A letra indica o tipo e a aplicação do dispositivo de acordo com o seguinte código:

Exemplo o transistor PN2222A é uma versão em plástico do 2N2222A. (metálico)

SA:	PNP transistor para HF	SB:	PNP AF transistor
SC:	NPN transistor para HF	SD:	NPN AF transistor
SE:	Diodos	SF	Thyristors
SG:	Gunn devices	SH:	UJT
SJ:	P-channel FET	SK:	N-channel FET
SM:	Triac	SQ	LED
SR	Rectifier	SS	Signal diodes
ST	Avalanche diodes	SV	Varicaps
SZ	Zener diodes		

O numero sequencial começa em 10 até 9999. O sufixo, opcional, indica a aprovação por várias organizações Japonesas. Como o código sempre começa com 2S, muitas vezes é omitido, por exemplo, um 2SC733 pode ser encontrado como C733.

Exemplos: 2SA1187, 2SB646, 2SC733.

Pro-Electron (European):

A parte do código é formado por duas letras e número sequencial.

A primeira letra indica o tipo de material: A = Ge B = Si C = GaAs R = Material composto

A segunda letra indica o tipo de dispositivo e aplicação:
A: diodo, RF
B: diodo,varactor
C: transistor, AF,pequeno sinal
D: transistor, AF, potência
E: diodo Tunnel
F: transistor, HF, pequeno sinal
K: Dispositivo de efeito Hall
L: Transistor, HF, potência
N: Opto-Acoplador
P: Dispositivo sensível á radiação
Q: Dispositivo que produz radiação
R: Tiristor, baixa potência
T: Tiristor, potência
U: Transistor, potencia, chaveamento
Y: Retificador
Z: diodo Zener ou regulador de tensão

A terceira letra indica se o dispositivo é usado em aplicação industrial ou comercial, é usualmente W, X, Y, ou Z.

Exemplos: BC108A, BAW68, BF239, BFY51.

Os prefixos mais comuns são:

MJ: Motorola potência, encapsulamento metálico
MJE: Motorola potência, encapsulamento plástico
MPS: Motorola baixa potência, encapsulamento plástico
MRF: Motorola HF, VHF transistor para microondas
RCA: dispositivo RCA
TIP: Texas Instruments (TI) transistor de potência , encapsulamento plástico
TIPL: TI transistor planar de potência
TIS: TI transistor de pequeno sinal (encapsulamento plástico)
ZT: Ferranti
ZTX: Ferranti

DIODO

DIODO RETIFICADOR

1N4001 4002 4003 4004 4004 4005 4006 4007 DIODO RETIFICADOR 1A

1N4001, 1N4002, 1N4003, 1N4004, 1N4005, 1N4006, 1N4007

Axial Lead Standard Recovery Rectifiers

This data sheet provides information on subminiature size, axial lead mounted rectifiers for general−purpose low−power applications.

Features

- Shipped in Plastic Bags, 1000 per bag
- Available Tape and Reeled, 5000 per reel, by adding a “RL” suffix to the part number
- Available in Fan−Fold Packaging, 3000 per box, by adding a “FF” suffix to the part number
- Pb−Free Packages are Available

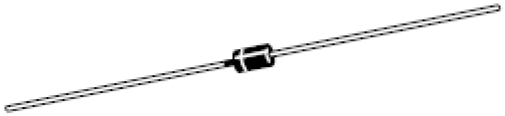
Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 0.4 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds, 1/16 in. from case
- Polarity: Cathode Indicated by Polarity Band

ON Semiconductor®

http://onsemi.com

LEAD MOUNTED RECTIFIERS
50−1000 VOLTS
DIFFUSED JUNCTION



CASE 59−10
AXIAL LEAD
PLASTIC

MAXIMUM RATINGS

Rating	Symbol	1N4001	1N4002	1N4003	1N4004	1N4005	1N4006	1N4007	Unit
†Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	800	1000	V
†Non–Repetitive Peak Reverse Voltage (halfwave, single phase, 60 Hz)	V_{RSM}	60	120	240	480	720	1000	1200	V
†RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	280	420	560	700	V
†Average Rectified Forward Current (single phase, resistive load, 60 Hz, T_A = 75°C)	I_O	1.0							A
†Non–Repetitive Peak Surge Current (surge applied at rated load conditions)	I_{FSM}	30 (for 1 cycle)							A
Operating and Storage Junction Temperature Range	T_J T_{stg}	–65 to +175							°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.
†Indicates JEDEC Registered Data

THERMAL CHARACTERISTICS

Rating	Symbol	Max	Unit
Maximum Thermal Resistance, Junction–to–Ambient	$R_{\theta JA}$	Note 1	°C/W

ELECTRICAL CHARACTERISTICS†

Rating	Symbol	Typ	Max	Unit
Maximum Instantaneous Forward Voltage Drop, (i_F = 1.0 Amp, T_J = 25°C)	v_F	0.93	1.1	V
Maximum Full–Cycle Average Forward Voltage Drop, (I_O = 1.0 Amp, T_L = 75°C, 1 inch leads)	$V_{F(AV)}$	–	0.8	V
Maximum Reverse Current (rated DC voltage) (T_J = 25°C) (T_J = 100°C)	I_R	 0.05 1.0	 10 50	μA
Maximum Full–Cycle Average Reverse Current, (I_O = 1.0 Amp, T_L = 75°C, 1 inch leads)	$I_{R(AV)}$	–	30	μA

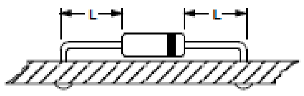
NOTE 1. – AMBIENT MOUNTING DATA

Data shown for thermal resistance, junction–to–ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

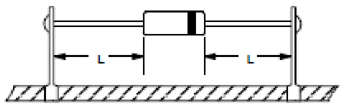
TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

Mounting Method		Lead Length, L			Units
		1/8	1/4	1/2	
1	$R_{\theta JA}$	52	65	72	°C/W
2		67	80	87	°C/W
3		50			°C/W

MOUNTING METHOD 1

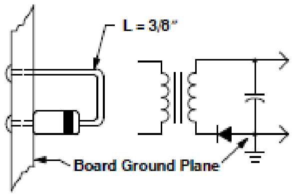


MOUNTING METHOD 2



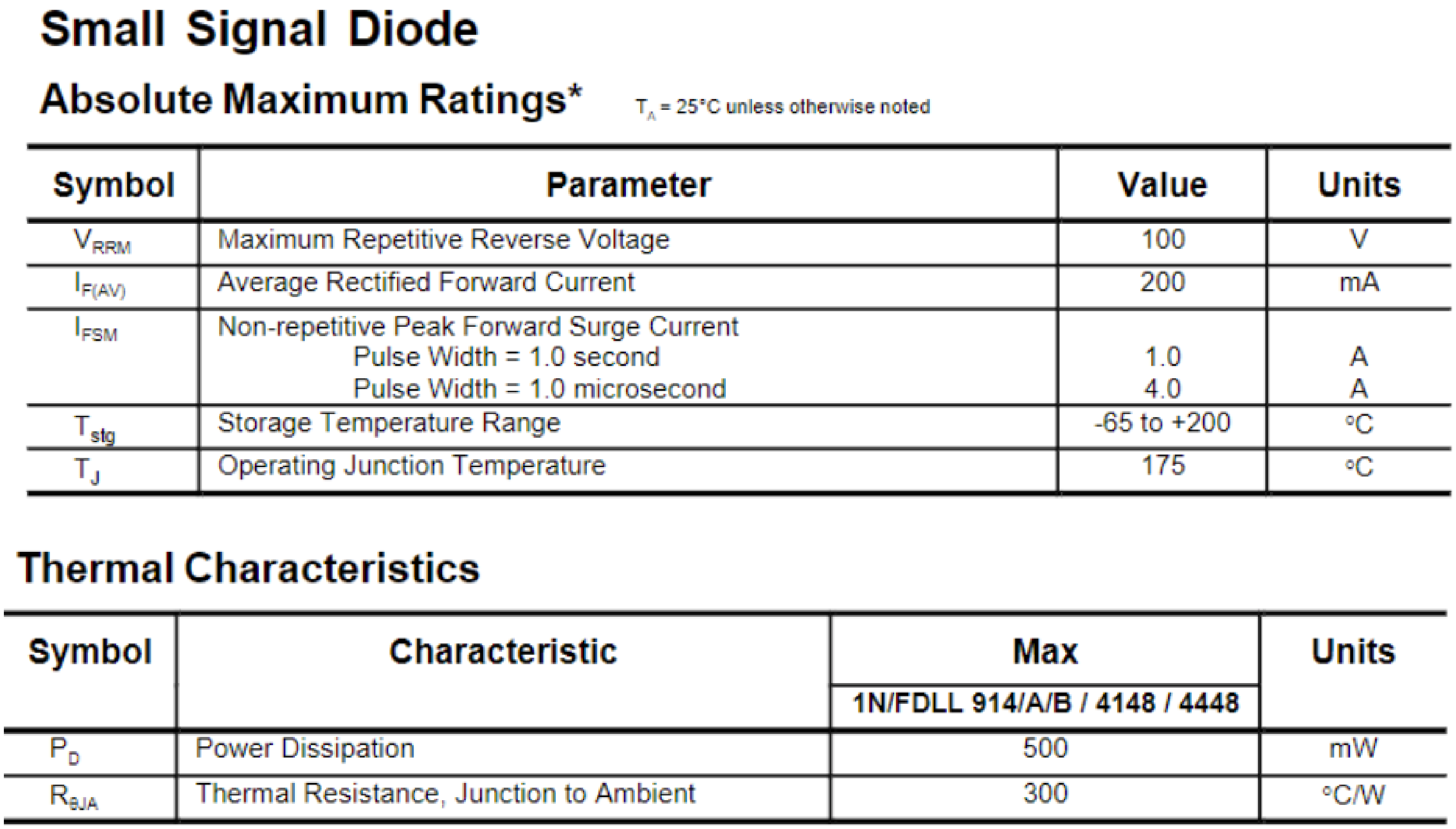
Vector Pin Mounting

MOUNTING METHOD 3



P.C. Board with
1–1/2″ X 1–1/2″ Copper Surface

1N 914 AB 916 A B 4148 4448 DIODO RÁPIDO DE USO GERAL 200MA



Small Signal Diode

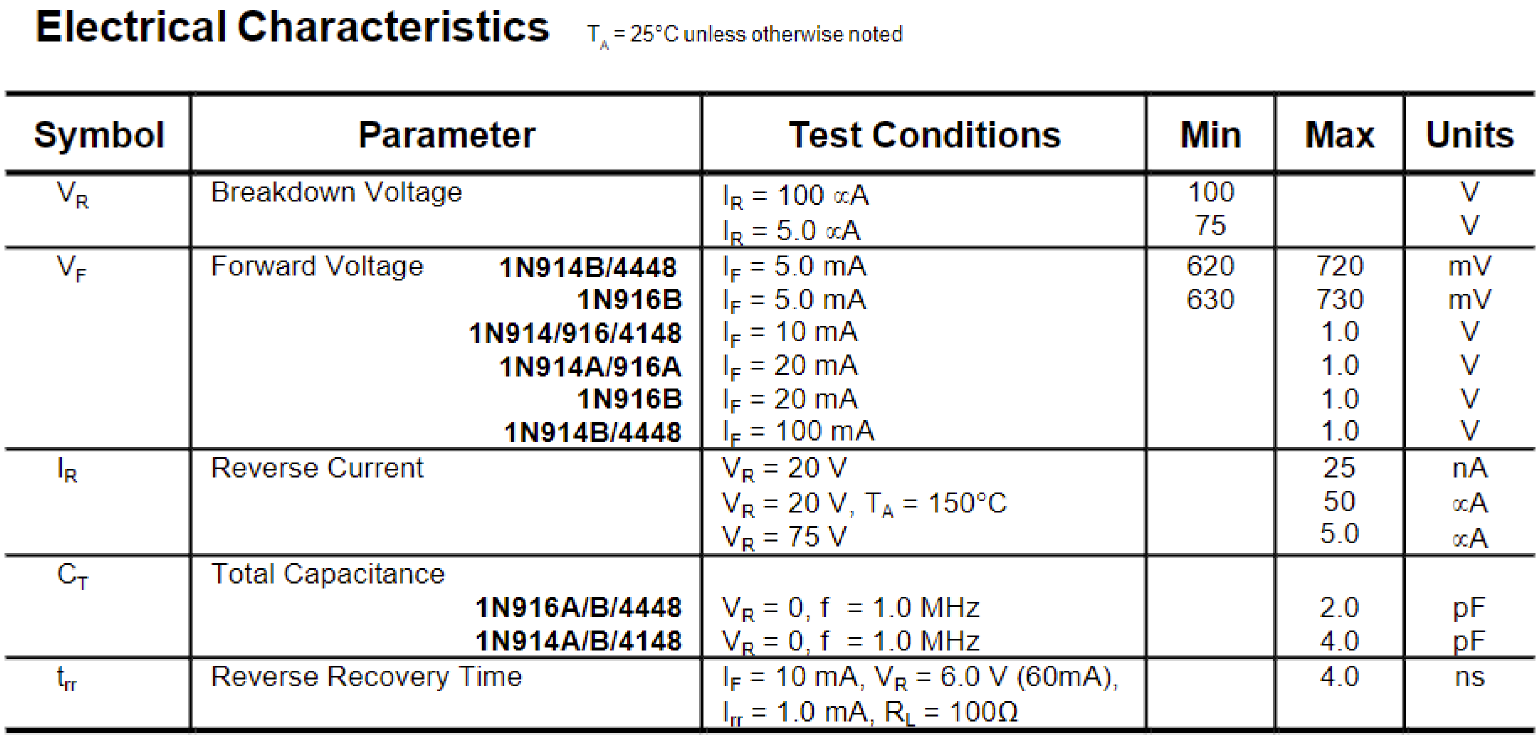
Absolute Maximum Ratings*

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

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



Electrical Characteristics

T_A = 25°C unless otherwise noted

Symbol	Parameter		Test Conditions	Min	Max	Units
V_R	Breakdown Voltage		I_R = 100 ∝A	100		V
			I_R = 5.0 ∝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	∝A
			V_R = 75 V		5.0	∝A
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 = 100Ω		4.0	ns

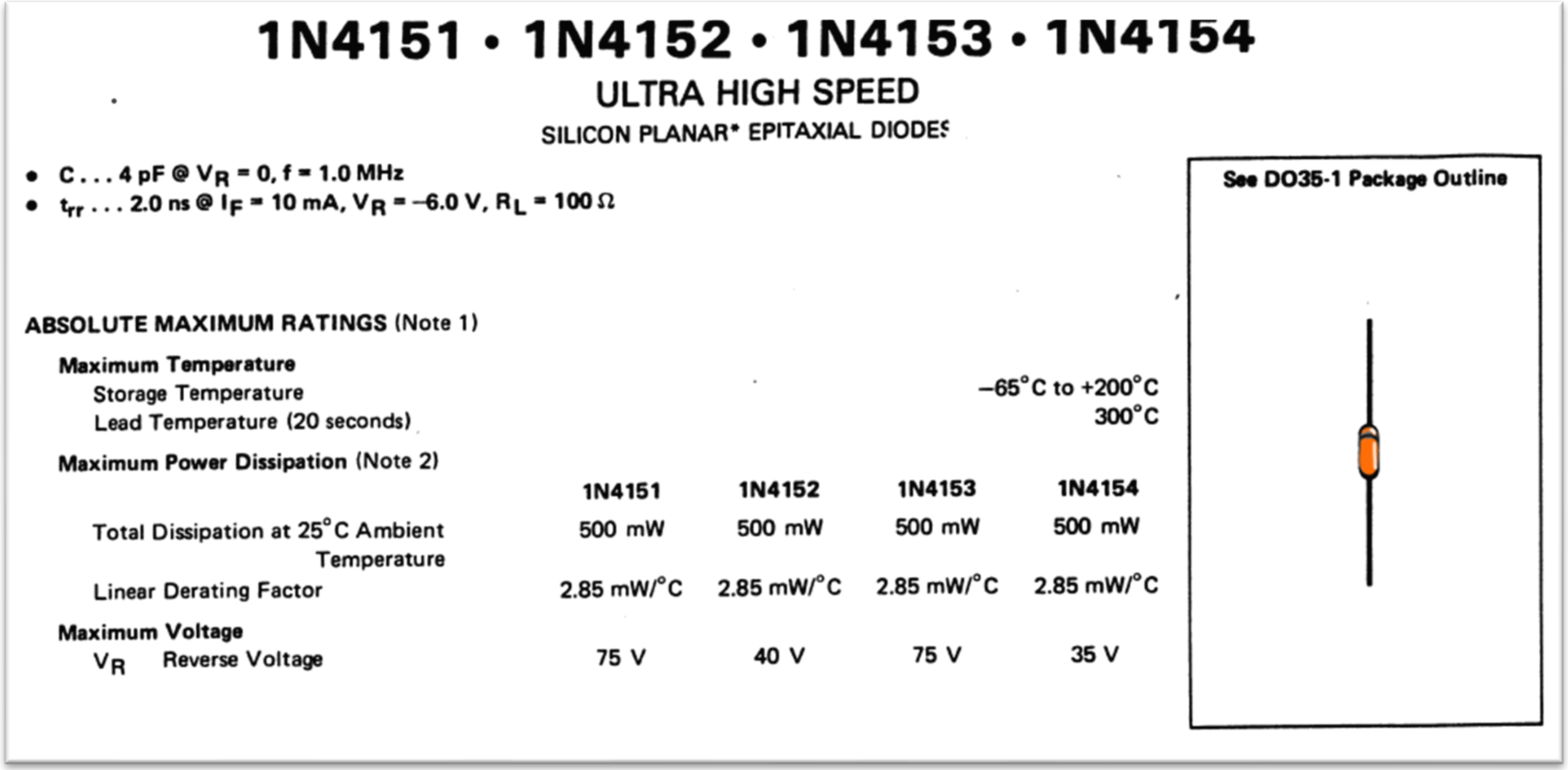
DIODO DE SINAL, DIODO DE GERMÂNIO 1N270/1N34/1N60

1N270: diodo germânio otimizado demodulador detector Vf=1,00V, Vr=100V, IF=40mA, Ir=100uA

1N34: diodo detector de RF Germânio bigode de gato

1N60: diodo detector de RF Germânio bigode de gato

DIODO 1N4151 52 53 54 ULTRA HIGH SPEED SILICON PLANAR EPITAXIAL DIODES



1N4151 • 1N4152 • 1N4153 • 1N4154

ULTRA HIGH SPEED

SILICON PLANAR* EPITAXIAL DIODES

- C . . . 4 pF @ $V_R = 0$, f = 1.0 MHz
- t_{rr} . . . 2.0 ns @ $I_F = 10$ mA, $V_R = -6.0$ V, $R_L = 100\ \Omega$

See DO35-1 Package Outline

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperature

Storage Temperature −65°C to +200°C

Lead Temperature (20 seconds) 300°C

Maximum Power Dissipation (Note 2)

	1N4151	1N4152	1N4153	1N4154
Total Dissipation at 25°C Ambient Temperature	500 mW	500 mW	500 mW	500 mW
Linear Derating Factor	2.85 mW/°C	2.85 mW/°C	2.85 mW/°C	2.85 mW/°C
Maximum Voltage				
V_R Reverse Voltage	75 V	40 V	75 V	35 V

Mais rápido que o 1N4148, mas menor corrente!

DIODO RF

DIODOS DE RF E BIGODE DE GATO 1N34/1N270/OA70/OA90/OA91/OA95

1N34: diodo de contato de germânio detector de RF Vr=30V, IF=50mA, Ir=2mA

1N60: diodo de contato de germânio detector de RF Vr=50V, IF=500mA, Ir=40uA

OA70: diodo germânio demodulador detector Vr 15V, IF=50mA

OA90: diodo germânio demodulador detector Vr 30V, IF=500mA, Vf=1,2V, Ir=80uA

OA91: diodo germânio demodulador detector Vr 115V, IF=500mA, Vf=1,02V, Ir=80uA

OA95: diodo germânio demodulador detector Vr 30V, IF=500mA, Vf=1,05V, Ir=30uA

O diodo bigode de gato é um diodo sem junção por contato.

O termo velocidade se refere a velocidade de comutação, a velocidade de trocar do estado ligado para desligado quando a polaridade inverte, observe no data sheet o tempo de comutação é o parâmetro Trr (reverse recovery time), conhecendo o tempo de recuperação você pode avaliar a frequência de trabalho simplesmente invertendo esse valor.

O parâmetro VF (Forward Voltage) indica a tensão da junção, ao redor de 0,7V indica um diodo de silício, ao redor de 0,3 indica um diodo de germânio.

Os diodos de junção possuem correntes reversas melhores, mas tensões diretas maiores.

Um diodo detector é usado em aplicações de rádio e TV, principalmente na etapa detectora de RF, esses são diodos de contato, são os melhores para trabalhar como detector.

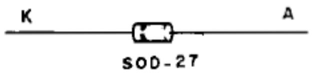
Esses diodos rápidos são selados e encapsulados em vidro e vem normalmente no encapsulamento DO-35

BA281 DIODO RF DETECTOR DE RF PHILIPS

BA281

Diodo detector de FM - Philips.

$V_R = 50$ V
$I_F = 200$ mA
Cd a ($V_R = 0$ V) < 1,2 pF
$V_F = 360 - 420$ mV (a 0,01 mA)



SILICON RATIO DETECTOR DIODE

Silicon planar epitaxial diode in DO-35 envelope, intended for use in ratio detector circuits. Due to small spreads of forward voltage at low currents and of junction capacitance, the diodes can be used as matched pairs.

QUICK REFERENCE DATA

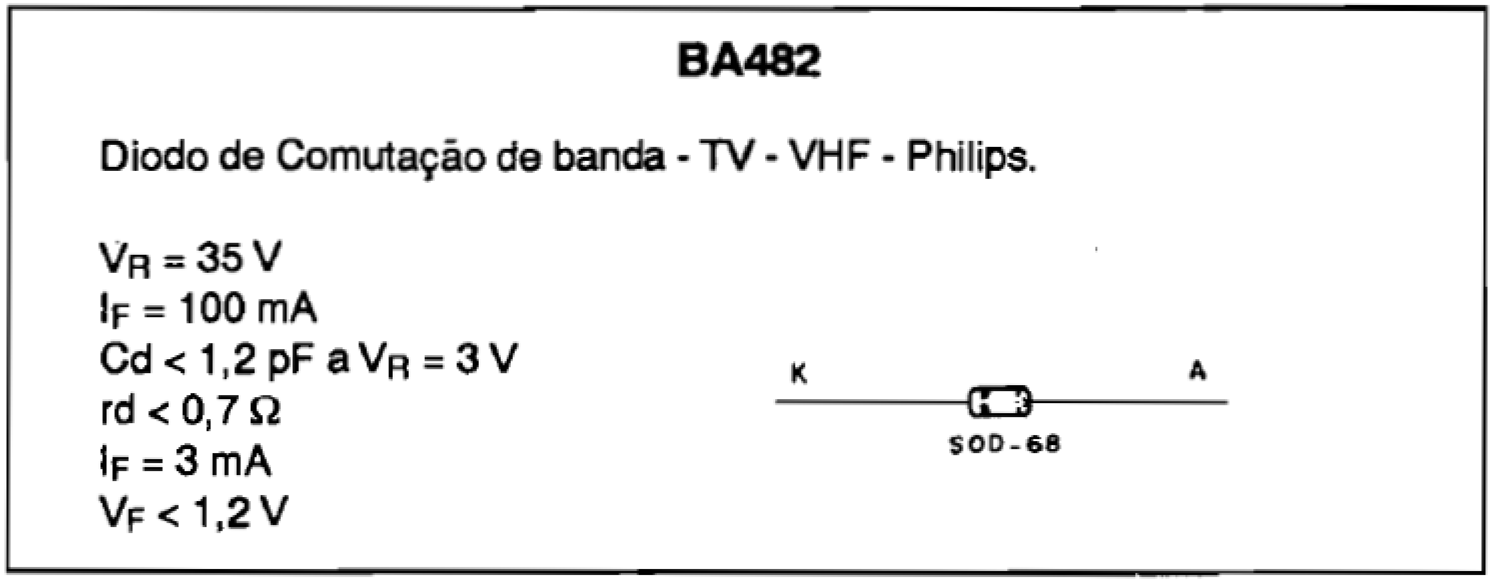
Continuous reverse voltage	V_R	max.	50	V
Forward current (d.c.)	I_F	max.	200	mA
Repetitive peak forward current	I_{FRM}	max.	450	mA
Forward voltage	V_F	360 to	420	mV
Diode capacitance	C_d	<	1,2	pF
Junction temperature	T_j	max.	200	°C

MECHANICAL DATA

Dimensions in mm

Fig. 1 DO-35 (SOD-27).

BA482 DIODO RF COMUTAÇÃO DE BANDA TV VHF PHILIPS E



BA482

Diodo de Comutação de banda - TV - VHF - Philips.

$V_R = 35\ V$
$I_F = 100\ mA$
$Cd < 1{,}2\ pF$ a $V_R = 3\ V$
$rd < 0{,}7\ \Omega$
$I_F = 3\ mA$
$V_F < 1{,}2\ V$

DIODO SCHOOTTKY DE VIDRO BAIXA POTÊNCIA

1N60/1N60P/BA317/BA318/BAT46

Um diodo schottky pequenos com encapsulamento de vidro são diodos que não tem junção, são diodos rápidos e baixas correntes reversas, são usados para chaveamento, são muito parecidos com os diodos bigode de gato, mas a são usados em aplicações de potência fontes chaveadas pequenas.

A tensão direta é muito baixa, da ordem de 0,3V.

1N60/1N60P:

Schottky de 80mW um dos mais populares. Diodo Schottky de baixa tensão reversa ao redor de 0,3V, tensão de trabalho 20V, corrente de trabalho de 150 mA podendo ser usado como detector. O diodo 1N60P é para corrente de trabalho de 500mA.

BA317/18:

Schoottky de 200 mA.

BAT46:

schottky de pequeno sinal de uso geral 100 mA.

DIODO RÁPIDO PARA FONTE CHAVEADA

TABELA SELEÇÃO DIODO RÁPIDO PARA FONTE CHAVEADA

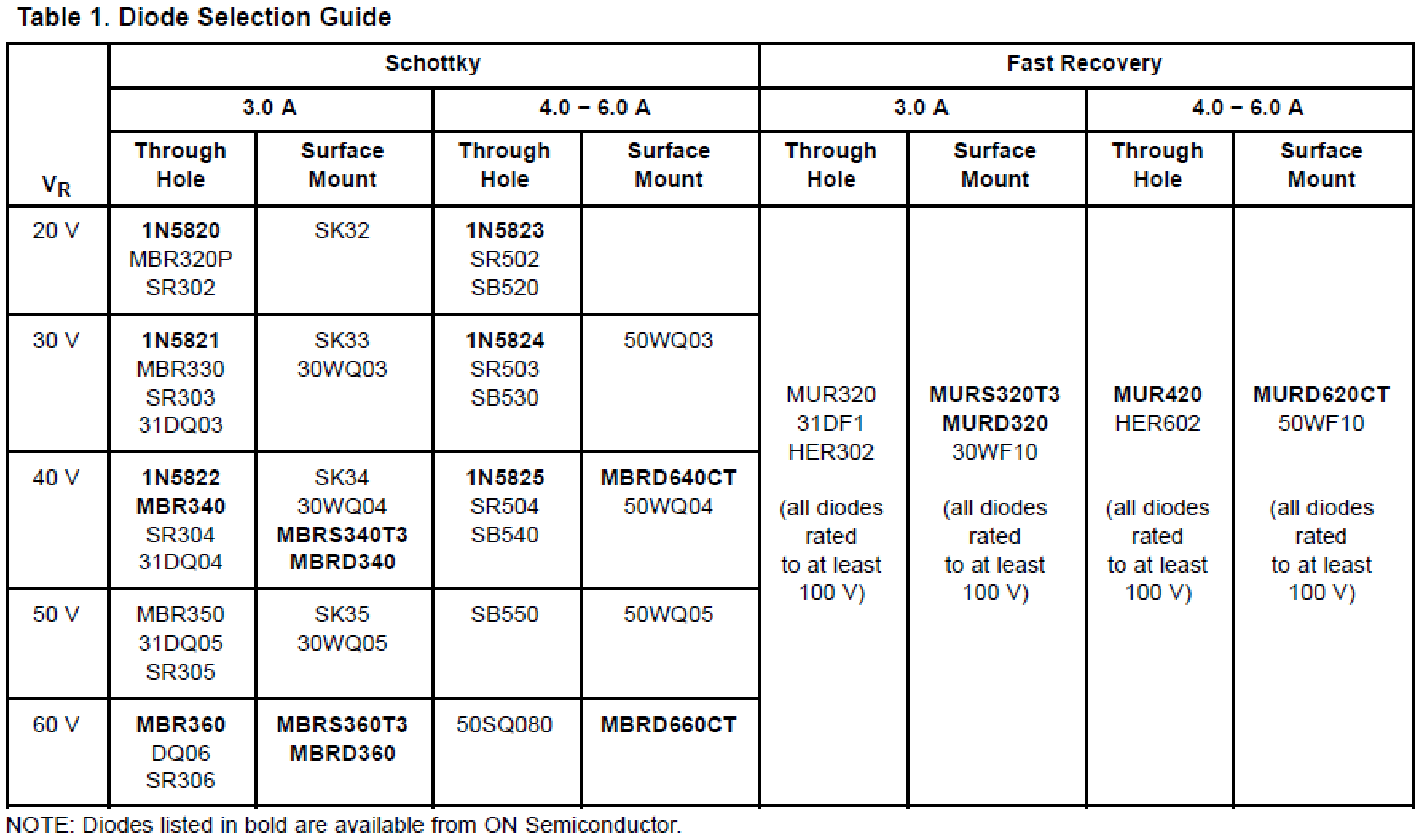


Table 1. Diode Selection Guide

	Schottky				Fast Recovery			
	3.0 A		4.0 – 6.0 A		3.0 A		4.0 – 6.0 A	
V_R	Through Hole	Surface Mount	Through Hole	Surface Mount	Through Hole	Surface Mount	Through Hole	Surface Mount
20 V	**1N5820** MBR320P SR302	SK32	**1N5823** SR502 SB520		MUR320 31DF1 HER302 (all diodes rated to at least 100 V)	**MURS320T3** **MURD320** 30WF10 (all diodes rated to at least 100 V)	**MUR420** HER602 (all diodes rated to at least 100 V)	**MURD620CT** 50WF10 (all diodes rated to at least 100 V)
30 V	**1N5821** MBR330 SR303 31DQ03	SK33 30WQ03	**1N5824** SR503 SB530	50WQ03				
40 V	**1N5822** **MBR340** SR304 31DQ04	SK34 30WQ04 **MBRS340T3** **MBRD340**	**1N5825** SR504 SB540	**MBRD640CT** 50WQ04				
50 V	MBR350 31DQ05 SR305	SK35 30WQ05	SB550	50WQ05				
60 V	**MBR360** DQ06 SR306	**MBRS360T3** **MBRD360**	50SQ080	**MBRD660CT**				

NOTE: Diodes listed in bold are available from ON Semiconductor.

Fonte: manual do LM2576

UF4001 - UF4007 (1A)

WTE
POWER SEMICONDUCTORS

UF4001 – UF4007

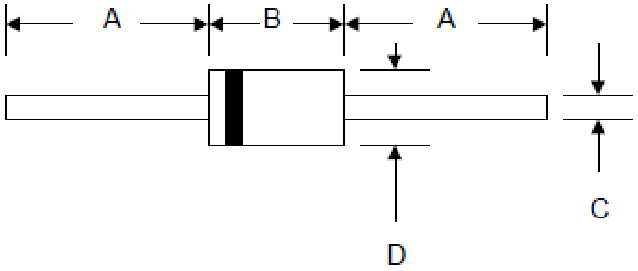
1.0A ULTRAFAST RECOVERY RECTIFIER

Features

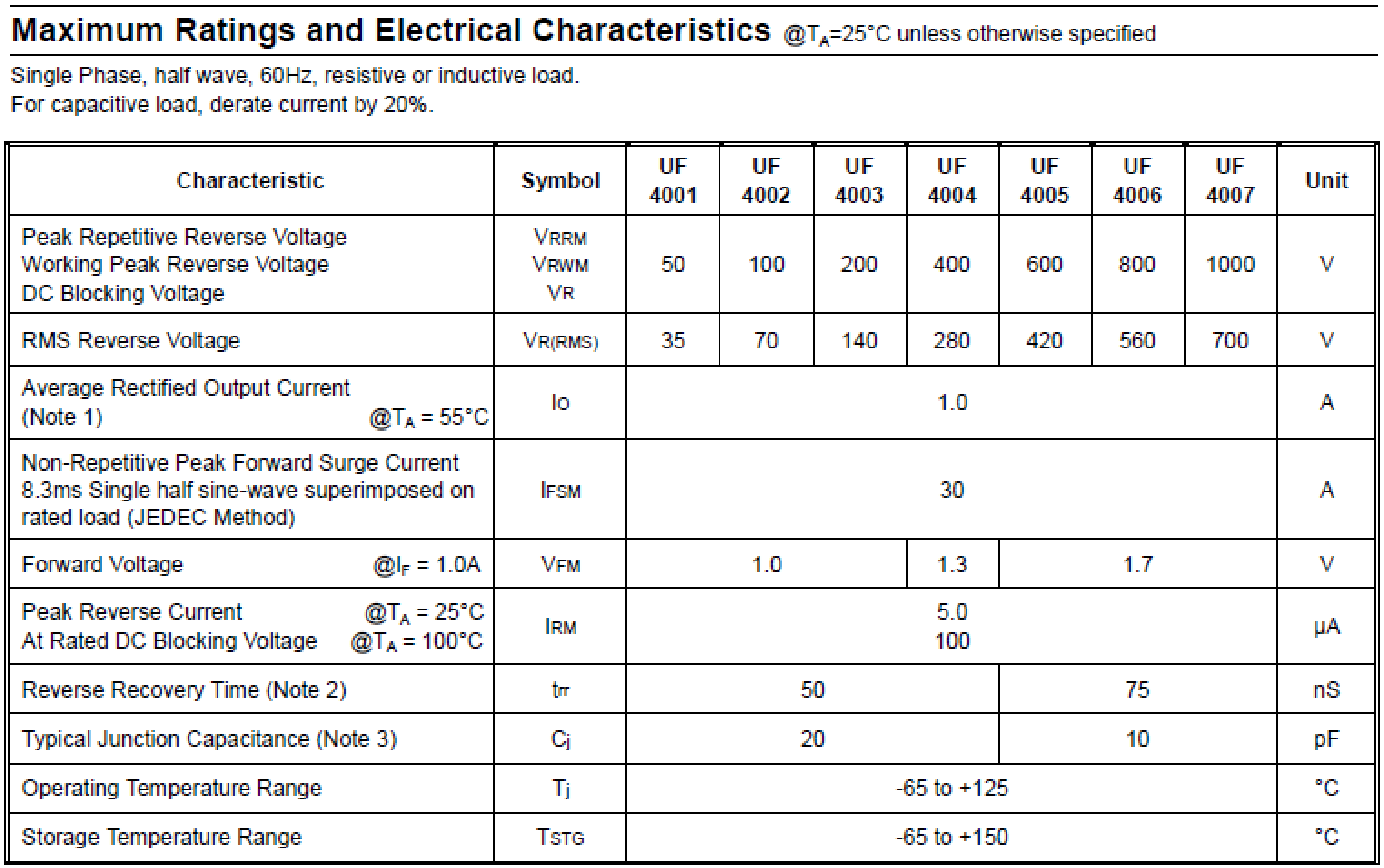
- Diffused Junction
- Low Forward Voltage Drop
- High Current Capability
- High Reliability
- High Surge Current Capability

Mechanical Data

- Case: Molded Plastic
- Terminals: Plated Leads Solderable per MIL-STD-202, Method 208
- Polarity: Cathode Band
- Weight: 0.34 grams (approx.)
- Mounting Position: Any
- Marking: Type Number



DO-41		
Dim	**Min**	**Max**
A	25.4	—
B	4.06	5.21
C	0.71	0.864
D	2.00	2.72
All Dimensions in mm		

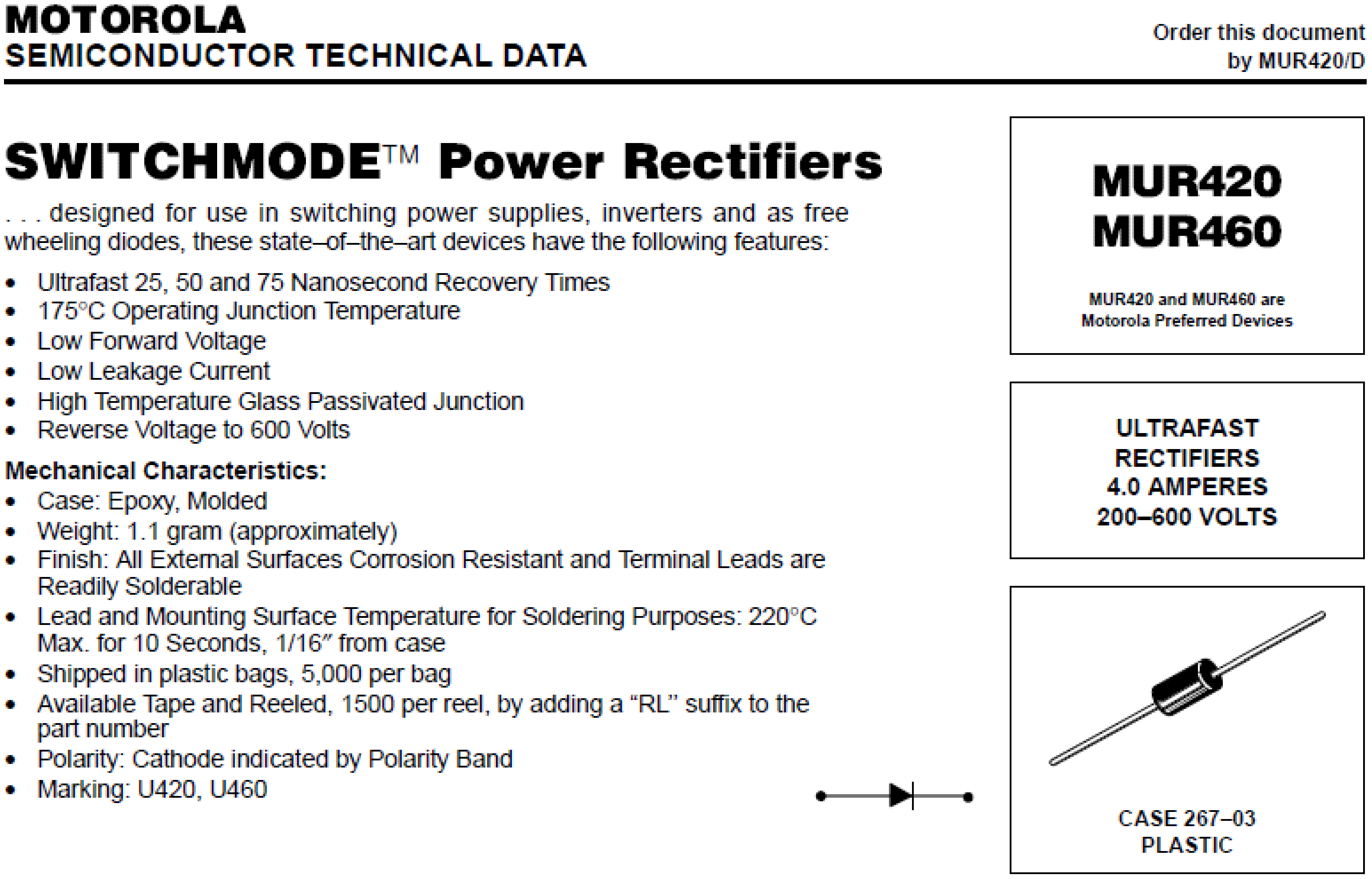


Maximum Ratings and Electrical Characteristics @T_A=25°C unless otherwise specified

Single Phase, half wave, 60Hz, resistive or inductive load.
For capacitive load, derate current by 20%.

Characteristic	Symbol	UF 4001	UF 4002	UF 4003	UF 4004	UF 4005	UF 4006	UF 4007	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	800	1000	V
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	280	420	560	700	V
Average Rectified Output Current (Note 1) @T_A = 55°C	I_O	1.0							A
Non-Repetitive Peak Forward Surge Current 8.3ms Single half sine-wave superimposed on rated load (JEDEC Method)	I_{FSM}	30							A
Forward Voltage @I_F = 1.0A	V_{FM}	1.0			1.3	1.7			V
Peak Reverse Current @T_A = 25°C At Rated DC Blocking Voltage @T_A = 100°C	I_{RM}	5.0 100							µA
Reverse Recovery Time (Note 2)	t_{rr}	50				75			nS
Typical Junction Capacitance (Note 3)	C_j	20				10			pF
Operating Temperature Range	T_j	-65 to +125							°C
Storage Temperature Range	T_{STG}	-65 to +150							°C

MUR 420 460 (6A)



MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

Order this document
by MUR420/D

SWITCHMODE™ Power Rectifiers

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state–of–the–art devices have the following features:

- Ultrafast 25, 50 and 75 Nanosecond Recovery Times
- 175°C Operating Junction Temperature
- Low Forward Voltage
- Low Leakage Current
- High Temperature Glass Passivated Junction
- Reverse Voltage to 600 Volts

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.1 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16″ from case
- Shipped in plastic bags, 5,000 per bag
- Available Tape and Reeled, 1500 per reel, by adding a "RL" suffix to the part number
- Polarity: Cathode indicated by Polarity Band
- Marking: U420, U460

MUR420
MUR460

MUR420 and MUR460 are
Motorola Preferred Devices

ULTRAFAST
RECTIFIERS
4.0 AMPERES
200–600 VOLTS

CASE 267–03
PLASTIC

MUR1510 - MUR1515 - MUR1520 - MUR1540 - MUR1560 (15A)

MUR1510, MUR1515, MUR1520, MUR1540, MUR1560

Preferred Devices

SWITCHMODE™ Power Rectifiers

These state−of−the−art devices are a series designed for use in switching power supplies, inverters and as free wheeling diodes.

Features

- Ultrafast 35 and 60 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- Popular TO−220 Package
- High Voltage Capability to 600 V
- Low Forward Drop
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating Specified @ Both Case and Ambient Temperatures
- Pb−Free Packages are Available*

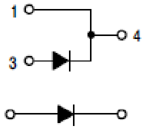
Mechanical Characteristics:

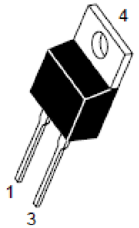
- Case: Epoxy, Molded
- Weight: 1.9 Grams (Approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds

ON Semiconductor®

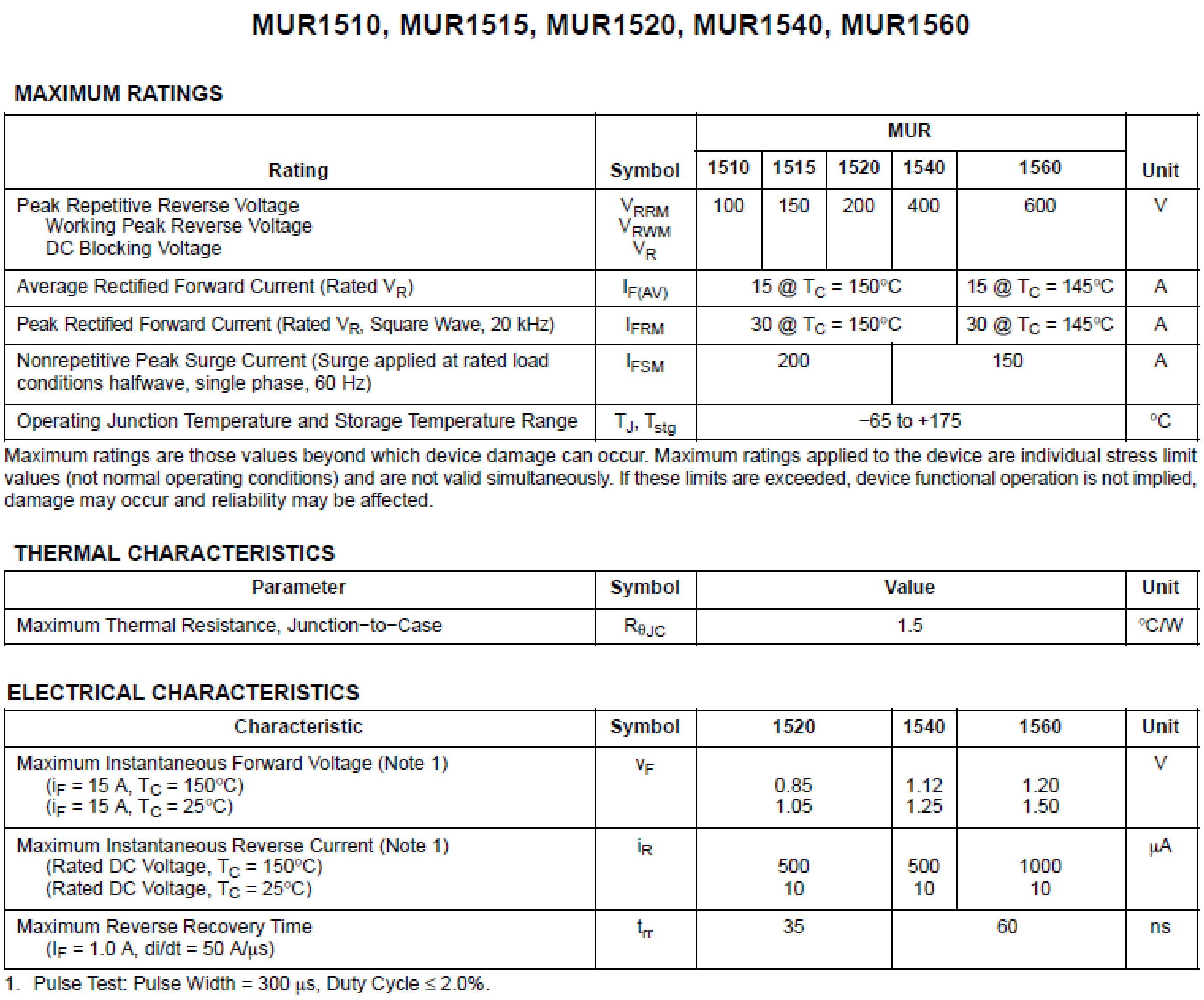
http://onsemi.com

ULTRAFAST RECTIFIERS
15 AMPERES, 100−600 VOLTS





TO−220AC
CASE 221B
PLASTIC



MUR1510, MUR1515, MUR1520, MUR1540, MUR1560

MAXIMUM RATINGS

		MUR					
Rating	Symbol	1510	1515	1520	1540	1560	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	100	150	200	400	600	V
Average Rectified Forward Current (Rated V_R)	$I_{F(AV)}$	15 @ T_C = 150°C				15 @ T_C = 145°C	A
Peak Rectified Forward Current (Rated V_R, Square Wave, 20 kHz)	I_{FRM}	30 @ T_C = 150°C				30 @ T_C = 145°C	A
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	200		150			A
Operating Junction Temperature and Storage Temperature Range	T_J, T_{stg}	−65 to +175					°C

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

THERMAL CHARACTERISTICS

Parameter	Symbol	Value	Unit
Maximum Thermal Resistance, Junction−to−Case	$R_{\theta JC}$	1.5	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	1520	1540	1560	Unit
Maximum Instantaneous Forward Voltage (Note 1) (i_F = 15 A, T_C = 150°C) (i_F = 15 A, T_C = 25°C)	v_F	 0.85 1.05	 1.12 1.25	 1.20 1.50	V
Maximum Instantaneous Reverse Current (Note 1) (Rated DC Voltage, T_C = 150°C) (Rated DC Voltage, T_C = 25°C)	i_R	 500 10	 500 10	 1000 10	μA
Maximum Reverse Recovery Time (I_F = 1.0 A, di/dt = 50 A/μs)	t_{rr}	35	60		ns

1. Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

MUR840 - MUR860 - RURP840 – RURP (8A)

FAIRCHILD SEMICONDUCTOR®

MUR840, MUR860, RURP840, RURP860

Data Sheet **January 2002**

8A, 400V - 600V Ultrafast Diodes

The MUR840, MUR860, RURP840 and RURP860 are low forward voltage drop ultrafast recovery rectifiers ($t_{rr} < 60ns$). They use a glass-passivated ion-implanted, epitaxial construction.

These devices are intended for use as output rectifiers and flywheel diodes in a variety of high-frequency pulse-width modulated switching regulators. Their low stored charge and attendant fast reverse-recovery behavior minimize electrical noise generation and in many circuits markedly reduce the turn-on dissipation of the associated power switching transistors.

Formerly developmental type TA09616.

Ordering Information

PART NUMBER	PACKAGE	BRAND
MUR840	TO-220AC	MUR840
RURP840	TO-220AC	RURP840
MUR860	TO-220AC	MUR860
RURP860	TO-220AC	RURP860

NOTE: When ordering, use the entire part number.

Symbol

Features

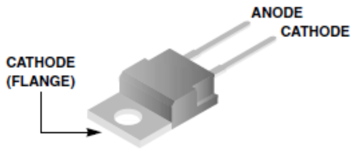
- Ultrafast with Soft Recovery . . . . <60ns
- Operating Temperature. . . . . 175°C
- Reverse Voltage 600V
- Avalanche Energy Rated
- Planar Construction

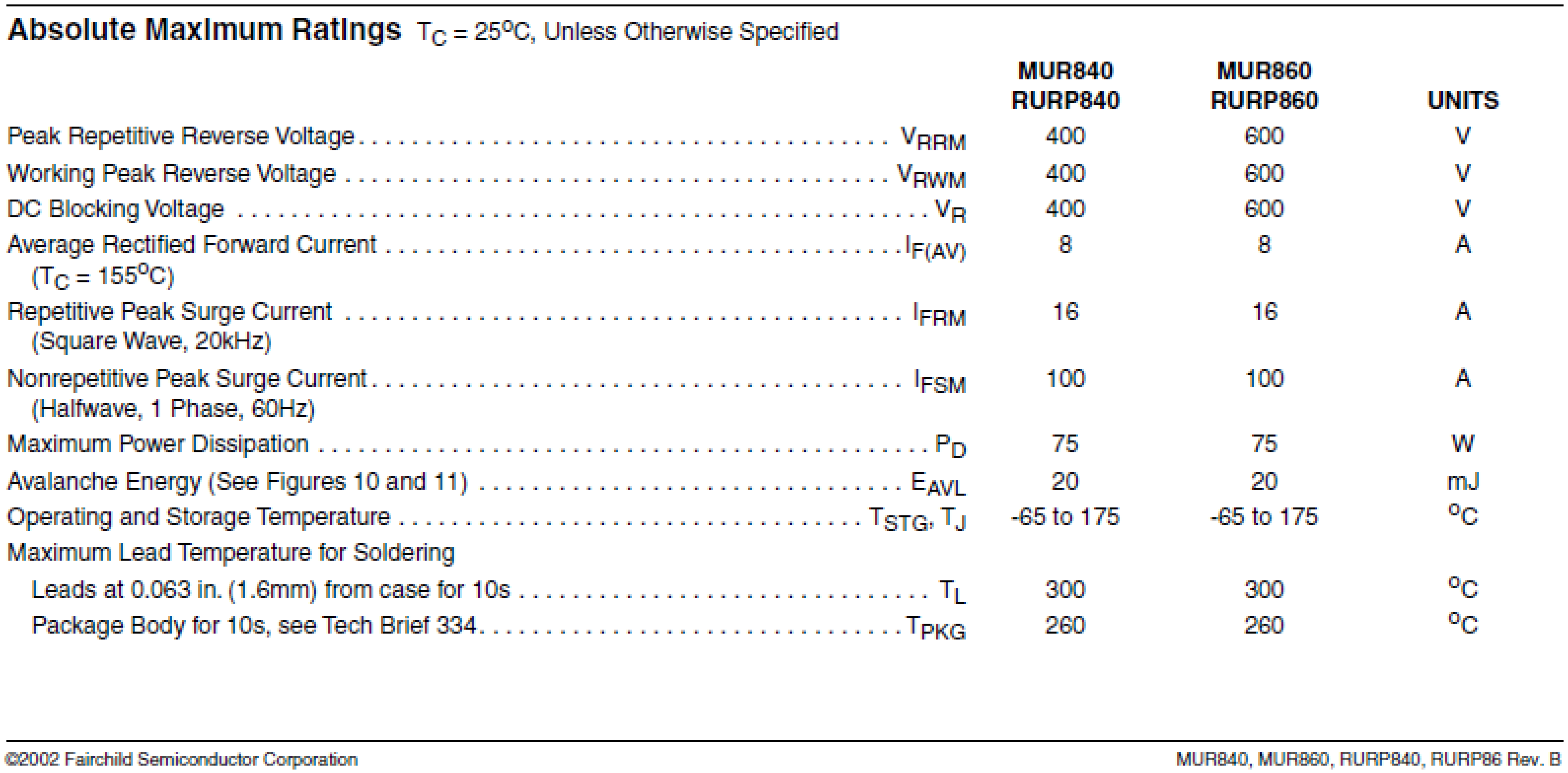
Applications

- Switching Power Supplies
- Power Switching Circuits
- General Purpose

Packaging

JEDEC TO-220AC





Absolute Maximum Ratings $T_C = 25^oC$, Unless Otherwise Specified

		MUR840 RURP840	MUR860 RURP860	UNITS
Peak Repetitive Reverse Voltage	V_{RRM}	400	600	V
Working Peak Reverse Voltage	V_{RWM}	400	600	V
DC Blocking Voltage	V_R	400	600	V
Average Rectified Forward Current ($T_C = 155^oC$)	$I_{F(AV)}$	8	8	A
Repetitive Peak Surge Current (Square Wave, 20kHz)	I_{FRM}	16	16	A
Nonrepetitive Peak Surge Current (Halfwave, 1 Phase, 60Hz)	I_{FSM}	100	100	A
Maximum Power Dissipation	P_D	75	75	W
Avalanche Energy (See Figures 10 and 11)	E_{AVL}	20	20	mJ
Operating and Storage Temperature	T_{STG}, T_J	-65 to 175	-65 to 175	^oC
Maximum Lead Temperature for Soldering				
Leads at 0.063 in. (1.6mm) from case for 10s	T_L	300	300	^oC
Package Body for 10s, see Tech Brief 334	T_{PKG}	260	260	^oC

MUR840, MUR860, RURP840, RURP86 Rev. B

1N5817 1N5818 1N5819 SCHOTTKY 1A 20/30/40V

MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

Order this document
by 1N5817/D

Axial Lead Rectifiers

. . . employing the Schottky Barrier principle in a large area metal–to–silicon power diode. State–of–the–art geometry features chrome barrier metal, epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low–voltage, high–frequency inverters, free wheeling diodes, and polarity protection diodes.

- Extremely Low v_F
- Low Stored Charge, Majority Carrier Conduction
- Low Power Loss/High Efficiency

Mechanical Characteristics

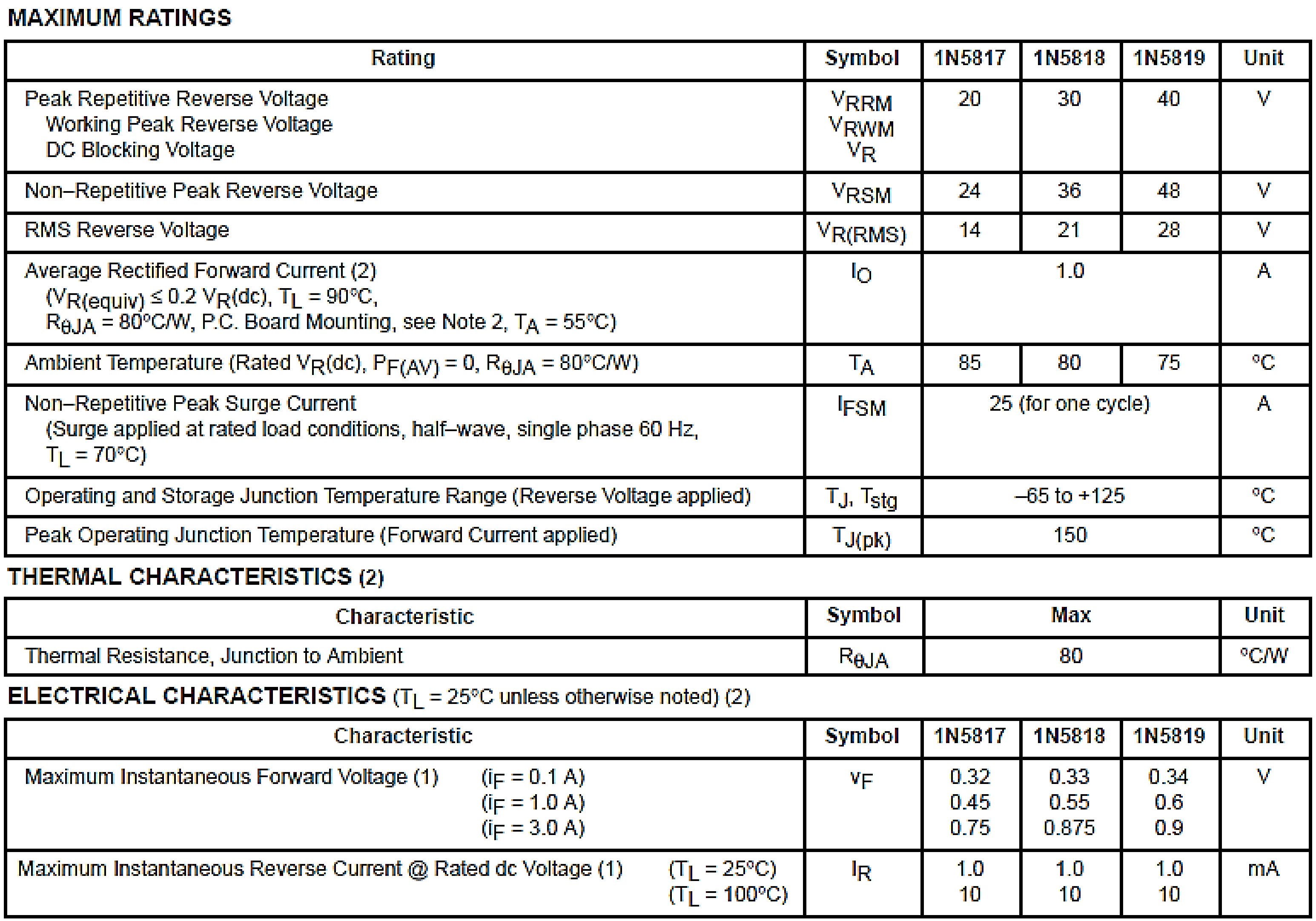
- Case: Epoxy, Molded
- Weight: 0.4 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16″ from case
- Shipped in plastic bags, 1000 per bag.
- Available Tape and Reeled, 5000 per reel, by adding a “RL” suffix to the part number
- Polarity: Cathode Indicated by Polarity Band
- Marking: 1N5817, 1N5818, 1N5819

1N5817
1N5818
1N5819

1N5817 and 1N5819 are
Motorola Preferred Devices

SCHOTTKY BARRIER
RECTIFIERS
1 AMPERE
20, 30 and 40 VOLTS

CASE 59–04



MAXIMUM RATINGS

Rating	Symbol	1N5817	1N5818	1N5819	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	30	40	V
Non–Repetitive Peak Reverse Voltage	V_{RSM}	24	36	48	V
RMS Reverse Voltage	$V_{R(RMS)}$	14	21	28	V
Average Rectified Forward Current (2) ($V_{R(equiv)} \leq 0.2\ V_R(dc)$, $T_L = 90°C$, $R_{\theta JA} = 80°C/W$, P.C. Board Mounting, see Note 2, $T_A = 55°C$)	I_O	1.0			A
Ambient Temperature (Rated $V_R(dc)$, $P_{F(AV)} = 0$, $R_{\theta JA} = 80°C/W$)	T_A	85	80	75	°C
Non–Repetitive Peak Surge Current (Surge applied at rated load conditions, half–wave, single phase 60 Hz, $T_L = 70°C$)	I_{FSM}	25 (for one cycle)			A
Operating and Storage Junction Temperature Range (Reverse Voltage applied)	T_J, T_{stg}	–65 to +125			°C
Peak Operating Junction Temperature (Forward Current applied)	$T_{J(pk)}$	150			°C

THERMAL CHARACTERISTICS (2)

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	80	°C/W

ELECTRICAL CHARACTERISTICS ($T_L = 25°C$ unless otherwise noted) (2)

Characteristic		Symbol	1N5817	1N5818	1N5819	Unit
Maximum Instantaneous Forward Voltage (1)	($i_F = 0.1$ A) ($i_F = 1.0$ A) ($i_F = 3.0$ A)	v_F	0.32 0.45 0.75	0.33 0.55 0.875	0.34 0.6 0.9	V
Maximum Instantaneous Reverse Current @ Rated dc Voltage (1)	($T_L = 25°C$) ($T_L = 100°C$)	I_R	1.0 10	1.0 10	1.0 10	mA

1N5820 1N5821 1N5822 SCHOTTKY 3A 20/30/40V

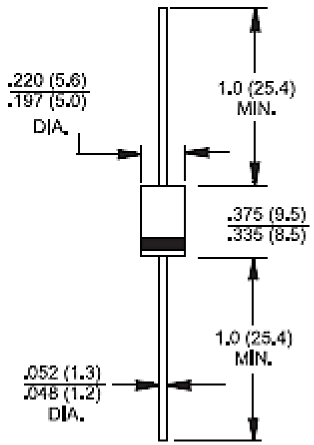
TAIWAN SEMICONDUCTOR

RoHS
COMPLIANCE

1N5820 - 1N5822

3.0 AMPS. Schottky Barrier Rectifiers

DO-201AD



Dimensions in inches and (millimeters)

Features

- Low power loss, high efficiency.
- High current capability, Low VF.
- High reliability
- High surge current capability.
- Epitaxial construction.
- Guard-ring for transient protection.
- For use in low voltage, high frequency inventor, free wheeling, and polarity protection application.

Mechanical Data

- Cases: DO-201AD molded plastic
- Epoxy: UL 94V-0 rate flame retardant
- Lead: Pure tin plated, lead free, solderable per MIL-STD-202, Method 208 guaranteed
- Polarity: Color band denotes cathode end
- High temperature soldering guaranteed: 260°C/10 seconds/.375",(9.5mm) lead lengths at 5 lbs., (2.3kg) tension
- Weight: 1.10 grams

DIODO DUPLO F12C 12A (CATOPDO COMUM F12A (ANODO COMUM) /F12D (DUPLO)

Pb Free Plating Product

F12C20C thru F12C60C

RoHS

12.0 Ampere Common Cathode Fast Recovery Rectifier Diode

Feature

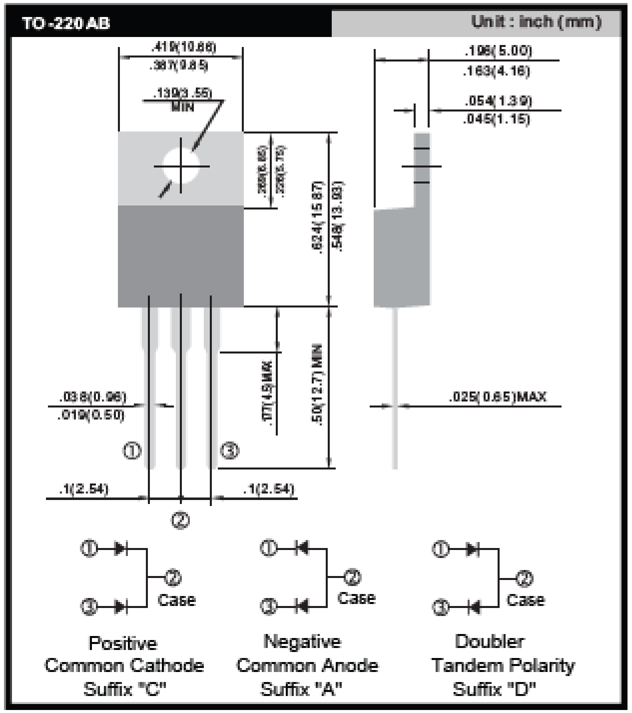
- ✶ Fast switching for high efficiency
- ✶ Low forward voltage drop
- ✶ High current capability
- ✶ Low reverse leakage current
- ✶ High surge current capability

Application

- ✶ Automotive Environment(Inverters/Converters)
- ✶ Plating Power Supply,Adaptor,SMPS and UPS
- ✶ Car Audio Amplifiers and Sound Device System

Mechanical Data

- ✶ Case:TO-220AB Heatsink
- ✶ Epoxy: UL 94V-0 rate flame retardant
- ✶ Terminals: Solderable per MIL-STD-202 method 208
- ✶ Polarity: As marked on diode body
- ✶ Mounting position: Any
- ✶ Weight: 2.2 gram approximately



MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Rating at 25°C ambient temperature unless otherwise specified.
Single phase, half wave, 60Hz, resistive or inductive load.
For capacitive load, derate current by 20%.

	SYMBOL	**F12C20C** **F12C20A** **F12C20D**	**F12C40C** **F12C40A** **F12C40D**	**F12C60C** **F12C60A** **F12C60D**	UNIT
Maximum Recurrent Peak Reverse Voltage	V_{RRM}	200	400	600	V
Maximum RMS Voltage	V_{RMS}	140	280	420	V
Maximum DC Blocking Voltage	V_{DC}	200	400	600	V
Maximum Average Forward Rectified Current T_C=100°C	$I_{F(AV)}$	12.0			A
Peak Forward Surge Current, 8.3ms single Half sine-wave superimposed on rated load (JEDEC method)	I_{FSM}	100			A
Maximum Instantaneous Forward Voltage @ 6.0 A	V_F	0.98	1.3	1.7	V
Maximum DC Reverse Current @T_J=25°C At Rated DC Blocking Voltage @T_J=125°C	I_R	10.0 250			uA uA
Maximum Reverse Recovery Time (Note 1)	T_{rr}	35			nS
Typical junction Capacitance (Note 2)	C_J	65			pF
Typical Thermal Resistance (Note 3)	$R_{θJC}$	2.2			°CW
Operating Junction and Storage Temperature Range	T_J, T_{STG}	-55 to +150			°C

NOTES : (1) Reverse recovery test conditions I_F = 0.5A, I_R = 1.0A, Irr = 0.25A.
(2) Measured at 1.0 MHz and applied reverse voltage of 4.0 Volts DC.
(3) Thermal Resistance junction to case.

DIODO PARA CORRENTES MAIORES QUE 1A

DIODO 1N5404 1N5407 1N5408 (3A) 400V/700V/1000V

1N5404-SI-D 400V 3A

1N5407-SI-D 700V 3A

1N5408-SI-D 1000V 3A

(a corrente dos 1N54 é 3A o que muda é a tensão)

DIODO 6A10 10A10

6A10 SI-D 1000V 6A

10A10 SI-D 1000V 10A

DIODO ZENER

DIODO ZENER 1N TABELA

TABELA DE DIODOS DE REFERÊNCIA - ZENER

Tipo	Vz	/W	Tipo	Vz	/W	Tipo	Vz	/W	Tipo	Vz	/W
1N746	3,3	/0,4W	1N5221	2,4	/0,5W	1N4728	3,3	/1W	1N5333	3,3	/5W
1N747	3,6	/0,4W	1N5222	2,5	/0,5W	1N4729	3,6	/1W	1N5334	3,6	/5W
1N748	3,9	/0,4W	1N5223	2,7	/0,5W	1N4730	3,9	/1W	1N5335	3,9	/5W
1N749	4,3	/0,4W	1N5224	2,8	/0,5W	1N4731	4,3	/1W	1N5336	4,3	/5W
1N750	4,7	/0,4W	1N5225	3,0	/0,5W	1N4732	4,7	/1W	1N5337	4,7	/5W
1N751	5,1	/0,4W	1N5226	3,3	/0,5W	1N4733	5,1	/1W	1N5338	5,1	/5W
1N752	5,6	/0,4W	1N5227	3,6	/0,5W	1N4734	5,6	/1W	1N5339	5,6	/5W
1N753	6,2	/0,4W	1N5228	3,9	/0,5W	1N4735	6,2	/1W	1N5340	6,0	/5W
1N754	6,8	/0,4W	1N5229	4,3	/0,5W	1N4736	6,8	/1W	1N5341	6,2	/5W
1N755	7,5	/0,4W	1N5230	4,7	/0,5W	1N4737	7,5	/1W	1N5342	6,8	/5W
1N756	8,2	/0,4W	1N5231	5,1	/0,5W	1N4738	8,2	/1W	1N5343	7,5	/5W
1N757	9,1	/0,4W	1N5232	5,6	/0,5W	1N4739	9,1	/1W	1N5344	8,2	/5W
1N758	10	/0,4W	1N5234	6,2	/0,5W	1N4740	10	/1W	1N5345	8,7	/5W
1N759	12	/0,4W	1N5235	6,8	/0,5W	1N4742	12	/1W	1N5346	9,1	/5W
1N957	6,8	/0,4W	1N5236	7,5	/0,5W	1N4743	13	/1W	1N5347	10	/5W
1N958	7,5	/0,4W	1N5237	8,2	/0,5W	1N4744	15	/1W	1N5348	11	/5W
1N959	8,2	/0,4W	1N5239	9,1	/0,5W	1N4745	16	/1W	1N5349	12	/5W
1N960	9,1	/0,4W	1N5240	10	/0,5W	1N4746	18	/1W	1N5350	13	/5W
1N961	10	/0,4W	1N5242	12	/0,5W	1N4747	20	/1W	1N5351	14	/5W
1N962	11	/0,4W	1N5245	15	/0,5W	1N4748	22	/1W	1N5352	15	/5W
1N963	12	/0,4W	1N5246	16	/0,5W	1N4749	24	/1W	1N5353	16	/5W
1N964	13	/0,4W	1N5248	18	/0,5W	1N4750	27	/1W	1N5354	17	/5W
1N965	15	/0,4W	1N5250	20	/0,5W	1N4751	30	/1W	1N5355	18	/5W
1N966	16	/0,4W	1N5251	22	/0,5W	1N4752	33	/1W	1N5356	19	/5W
1N967	18	/0,4W	1N5252	24	/0,5W	1N4753	36	/1W	1N5357	20	/5W
1N968	20	/0,4W	1N5254	27	/0,5W	1N4754	39	/1W	1N5358	22	/5W

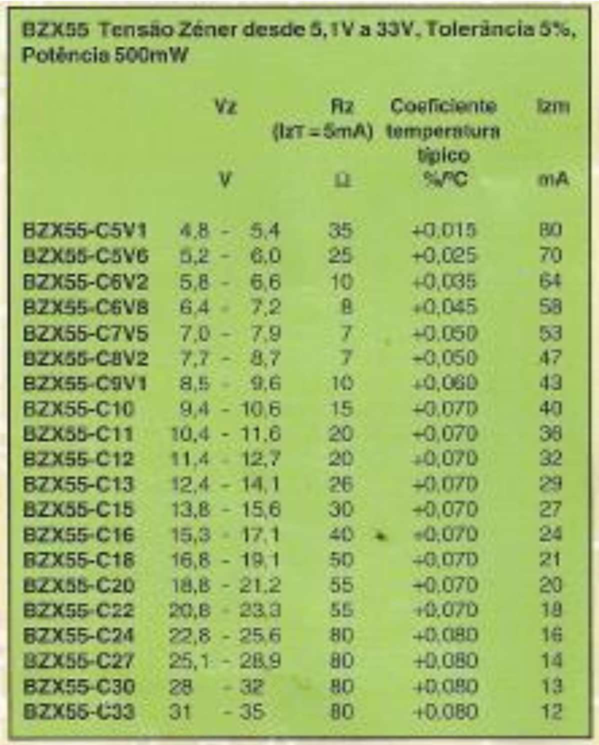
1N969 22 /0,4W
1N970 24 /0,4W
1N971 27 /0,4W
1N972 30 /0,4W
1N973 33 /0,4W
1N974 36 /0,4W
1N975 39 /0,4W
1N976 43 /0,4W
1N977 47 /0,4W
1N978 51 /0,4W
1N979 56 /0,4W
1N980 62 /0,4W
1N981 68 /0,4W
1N982 75 /0,4W
1N983 82 /0,4W
1N984 91 /0,4W
1N985 100 /0,4W
1N986 110 /0,4W
1N987 120 /0,4W
1N988 130 /0,4W
1N989 150 /0,4W
1N990 160 /0,4W
1N991 180 /0,4W
1N992 200 /0,4W

1N5256 30 /0,5W
1N5257 33 /0,5W
1N5258 36 /0,5W
1N5259 39 /0,5W
1N5260 43 /0,5W
1N5261 47 /0,5W
1N5262 51 /0,5W
1N5263 56 /0,5W
1N5265 62 /0,5W
1N5266 68 /0,5W
1N5267 75 /0,5W
1N5268 82 /0,5W
1N5270 91 /0,5W
1N5271 100 /0,5W

1N4755 43 /1W
1N4756 47 /1W
1N4757 51 /1W
1N4758 56 /1W
1N4759 62 /1W
1N4760 68 /1W
1N4761 75 /1W
1N4762 82 /1W
1N4763 91 /1W
1N4764 100 /1W

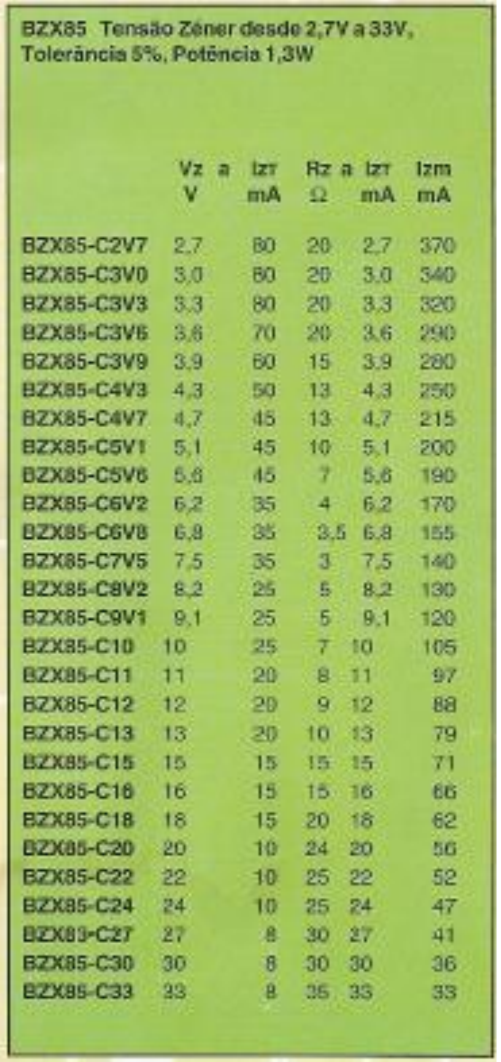
1N5359 24 /5W
1N5361 27 /5W
1N5362 28 /5W
1N5363 30 /5W
1N5364 33 /5W
1N5365 36 /5W
1N5366 39 /5W
1N5367 43 /5W
1N5368 47 /5W
1N5369 51 /5W
1N5370 56 /5W
1N5371 60 /5W
1N5372 62 /5W
1N5373 68 /5W
1N5374 75 /5W

DIODO ZENER BZX TABELA DE SELEÇÃO



BZX55 Tensão Zéner desde 5,1V a 33V, Tolerância 5%, Potência 500mW

	Vz	Rz (IzT = 5mA)	Coeficiente temperatura típico	Izm
	V	Ω	%/°C	mA
BZX55-C5V1	4,8 - 5,4	35	+0,015	80
BZX55-C5V6	5,2 - 6,0	25	+0,025	70
BZX55-C6V2	5,8 - 6,6	10	+0,035	64
BZX55-C6V8	6,4 - 7,2	8	+0,045	58
BZX55-C7V5	7,0 - 7,9	7	+0,050	53
BZX55-C8V2	7,7 - 8,7	7	+0,050	47
BZX55-C9V1	8,5 - 9,6	10	+0,060	43
BZX55-C10	9,4 - 10,6	15	+0,070	40
BZX55-C11	10,4 - 11,6	20	+0,070	36
BZX55-C12	11,4 - 12,7	20	+0,070	32
BZX55-C13	12,4 - 14,1	26	+0,070	29
BZX55-C15	13,8 - 15,6	30	+0,070	27
BZX55-C16	15,3 - 17,1	40	+0,070	24
BZX55-C18	16,8 - 19,1	50	+0,070	21
BZX55-C20	18,8 - 21,2	55	+0,070	20
BZX55-C22	20,8 - 23,3	55	+0,070	18
BZX55-C24	22,8 - 25,6	80	+0,080	16
BZX55-C27	25,1 - 28,9	80	+0,080	14
BZX55-C30	28 - 32	80	+0,080	13
BZX55-C33	31 - 35	80	+0,080	12



BZX85 Tensão Zéner desde 2,7V a 33V, Tolerância 5%, Potência 1,3W

	Vz a	IzT	Rz a	IzT	Izm
	V	mA	Ω	mA	mA
BZX85-C2V7	2,7	80	20	2,7	370
BZX85-C3V0	3,0	80	20	3,0	340
BZX85-C3V3	3,3	80	20	3,3	320
BZX85-C3V6	3,6	70	20	3,6	290
BZX85-C3V9	3,9	60	15	3,9	280
BZX85-C4V3	4,3	50	13	4,3	250
BZX85-C4V7	4,7	45	13	4,7	215
BZX85-C5V1	5,1	45	10	5,1	200
BZX85-C5V6	5,6	45	7	5,6	190
BZX85-C6V2	6,2	35	4	6,2	170
BZX85-C6V8	6,8	35	3,5	6,8	155
BZX85-C7V5	7,5	35	3	7,5	140
BZX85-C8V2	8,2	25	5	8,2	130
BZX85-C9V1	9,1	25	5	9,1	120
BZX85-C10	10	25	7	10	105
BZX85-C11	11	20	8	11	97
BZX85-C12	12	20	9	12	88
BZX85-C13	13	20	10	13	79
BZX85-C15	15	15	15	15	71
BZX85-C16	16	15	15	16	66
BZX85-C18	18	15	20	18	62
BZX85-C20	20	10	24	20	56
BZX85-C22	22	10	25	22	52
BZX85-C24	24	10	25	24	47
BZX83-C27	27	8	30	27	41
BZX85-C30	30	8	30	30	36
BZX85-C33	33	8	35	33	33

RESUMO DOS DIODOS ZENERES 1N E UZ258.

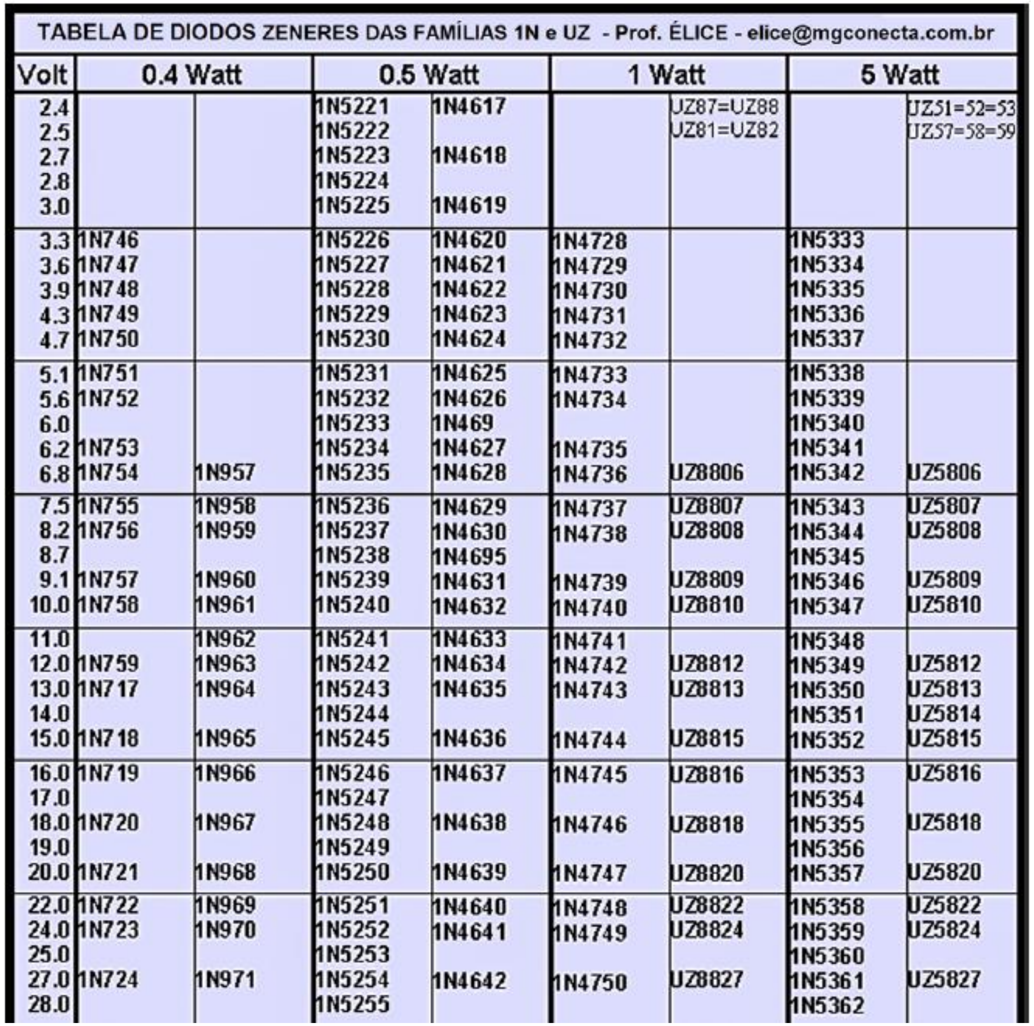


TABELA DE DIODOS ZENERES DAS FAMÍLIAS 1N e UZ - Prof. ÉLICE - elice@mgconecta.com.br

Volt	0.4 Watt		0.5 Watt		1 Watt		5 Watt	
2.4			1N5221	1N4617		UZ87=UZ88		UZ51=52=53
2.5			1N5222			UZ81=UZ82		UZ57=58=59
2.7			1N5223	1N4618				
2.8			1N5224					
3.0			1N5225	1N4619				
3.3	1N746		1N5226	1N4620	1N4728		1N5333	
3.6	1N747		1N5227	1N4621	1N4729		1N5334	
3.9	1N748		1N5228	1N4622	1N4730		1N5335	
4.3	1N749		1N5229	1N4623	1N4731		1N5336	
4.7	1N750		1N5230	1N4624	1N4732		1N5337	
5.1	1N751		1N5231	1N4625	1N4733		1N5338	
5.6	1N752		1N5232	1N4626	1N4734		1N5339	
6.0			1N5233	1N469			1N5340	
6.2	1N753		1N5234	1N4627	1N4735		1N5341	
6.8	1N754	1N957	1N5235	1N4628	1N4736	UZ8806	1N5342	UZ5806
7.5	1N755	1N958	1N5236	1N4629	1N4737	UZ8807	1N5343	UZ5807
8.2	1N756	1N959	1N5237	1N4630	1N4738	UZ8808	1N5344	UZ5808
8.7			1N5238	1N4695			1N5345	
9.1	1N757	1N960	1N5239	1N4631	1N4739	UZ8809	1N5346	UZ5809
10.0	1N758	1N961	1N5240	1N4632	1N4740	UZ8810	1N5347	UZ5810
11.0		1N962	1N5241	1N4633	1N4741		1N5348	
12.0	1N759	1N963	1N5242	1N4634	1N4742	UZ8812	1N5349	UZ5812
13.0	1N717	1N964	1N5243	1N4635	1N4743	UZ8813	1N5350	UZ5813
14.0			1N5244				1N5351	UZ5814
15.0	1N718	1N965	1N5245	1N4636	1N4744	UZ8815	1N5352	UZ5815
16.0	1N719	1N966	1N5246	1N4637	1N4745	UZ8816	1N5353	UZ5816
17.0			1N5247				1N5354	
18.0	1N720	1N967	1N5248	1N4638	1N4746	UZ8818	1N5355	UZ5818
19.0			1N5249				1N5356	
20.0	1N721	1N968	1N5250	1N4639	1N4747	UZ8820	1N5357	UZ5820
22.0	1N722	1N969	1N5251	1N4640	1N4748	UZ8822	1N5358	UZ5822
24.0	1N723	1N970	1N5252	1N4641	1N4749	UZ8824	1N5359	UZ5824
25.0			1N5253				1N5360	
27.0	1N724	1N971	1N5254	1N4642	1N4750	UZ8827	1N5361	UZ5827
28.0			1N5255				1N5362	

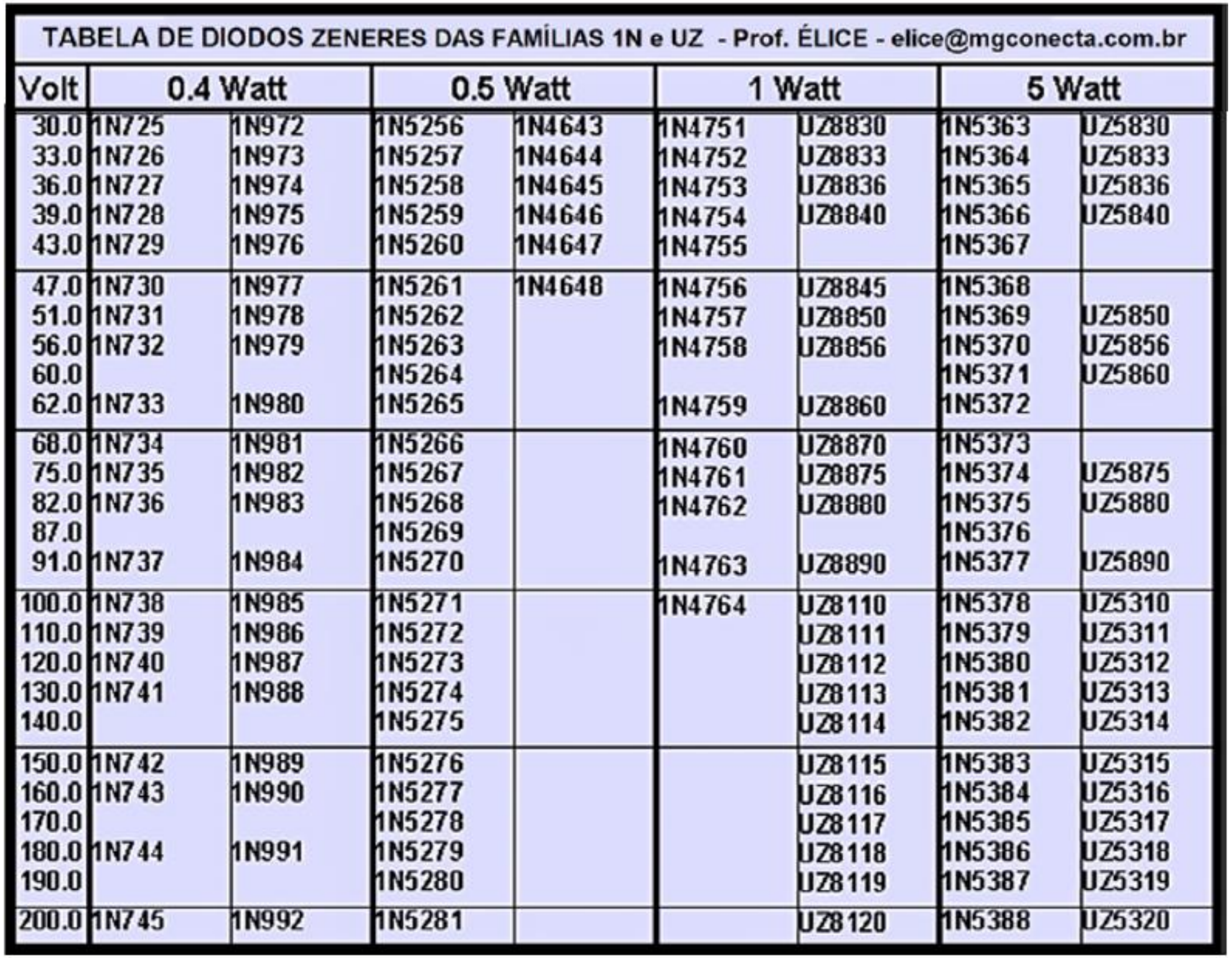


TABELA DE DIODOS ZENERES DAS FAMÍLIAS 1N e UZ - Prof. ÉLICE - elice@mgconecta.com.br

Volt	0.4 Watt		0.5 Watt		1 Watt		5 Watt	
30.0	1N725	1N972	1N5256	1N4643	1N4751	UZ8830	1N5363	UZ5830
33.0	1N726	1N973	1N5257	1N4644	1N4752	UZ8833	1N5364	UZ5833
36.0	1N727	1N974	1N5258	1N4645	1N4753	UZ8836	1N5365	UZ5836
39.0	1N728	1N975	1N5259	1N4646	1N4754	UZ8840	1N5366	UZ5840
43.0	1N729	1N976	1N5260	1N4647	1N4755		1N5367	
47.0	1N730	1N977	1N5261	1N4648	1N4756	UZ8845	1N5368	
51.0	1N731	1N978	1N5262		1N4757	UZ8850	1N5369	UZ5850
56.0	1N732	1N979	1N5263		1N4758	UZ8856	1N5370	UZ5856
60.0			1N5264				1N5371	UZ5860
62.0	1N733	1N980	1N5265		1N4759	UZ8860	1N5372	
68.0	1N734	1N981	1N5266		1N4760	UZ8870	1N5373	
75.0	1N735	1N982	1N5267		1N4761	UZ8875	1N5374	UZ5875
82.0	1N736	1N983	1N5268		1N4762	UZ8880	1N5375	UZ5880
87.0			1N5269				1N5376	
91.0	1N737	1N984	1N5270		1N4763	UZ8890	1N5377	UZ5890
100.0	1N738	1N985	1N5271		1N4764	UZ8110	1N5378	UZ5310
110.0	1N739	1N986	1N5272			UZ8111	1N5379	UZ5311
120.0	1N740	1N987	1N5273			UZ8112	1N5380	UZ5312
130.0	1N741	1N988	1N5274			UZ8113	1N5381	UZ5313
140.0			1N5275			UZ8114	1N5382	UZ5314
150.0	1N742	1N989	1N5276			UZ8115	1N5383	UZ5315
160.0	1N743	1N990	1N5277			UZ8116	1N5384	UZ5316
170.0			1N5278			UZ8117	1N5385	UZ5317
180.0	1N744	1N991	1N5279			UZ8118	1N5386	UZ5318
190.0			1N5280			UZ8119	1N5387	UZ5319
200.0	1N745	1N992	1N5281			UZ8120	1N5388	UZ5320

DIODO VARICAP

DIODO VARICAP BB TABELA DE SELEÇÃO BB119/204/405/809/909

Nº	Tipo	ENCAPS.	V_R (V)	I_F (mA)	C_d (pF)	a V_R (V)	C_{d1}/C_{d2}	a V_{R1}/V_{R2} (V/V)	rD (Ω)	Aplicações típicas
31	BB119	SOD-27	15	200	20-25	4	>1,3	4/10	<15	CAF em rádio e TV
32	BB204B	SOT-54	30	100	37-42	3	2,5-2,8	3/30	<0,4	Rádio FM
33	BB204G	SOT-54	30	100	34-39	3	2,5-2,8	3/30	<0,4	Rádio FM
34	BB405B	SOD-68A	30	20	<18	1	>7,6	1/28	<0,75	Televisão UHF
35	BB809	SOD-68A	28	20	39-46	1	8-10	1/28	<0,6	Televisão VHF
36	BB909A	SOD-68	32	20	>31	1	12-15	1/28	<0,9	Televisão VHF
37	BB909B	SOD-68	32	20	>33,5	1	12-15	1/28	<0,9	Televisão VHF

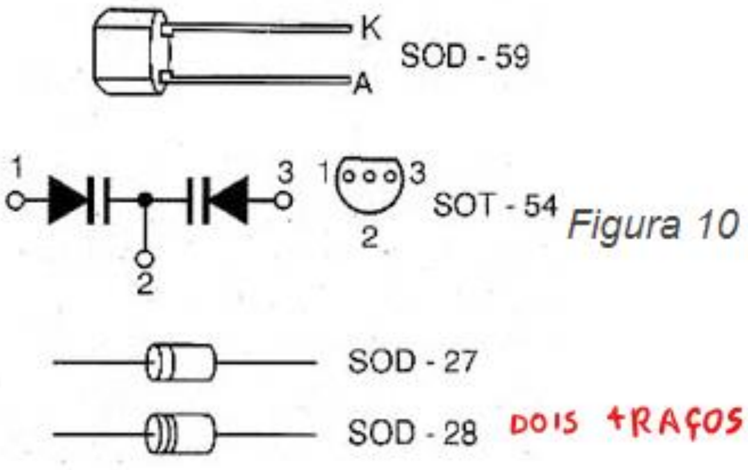
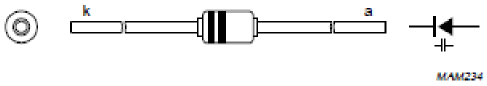


Figura 10

DOIS TRAÇOS

BB910

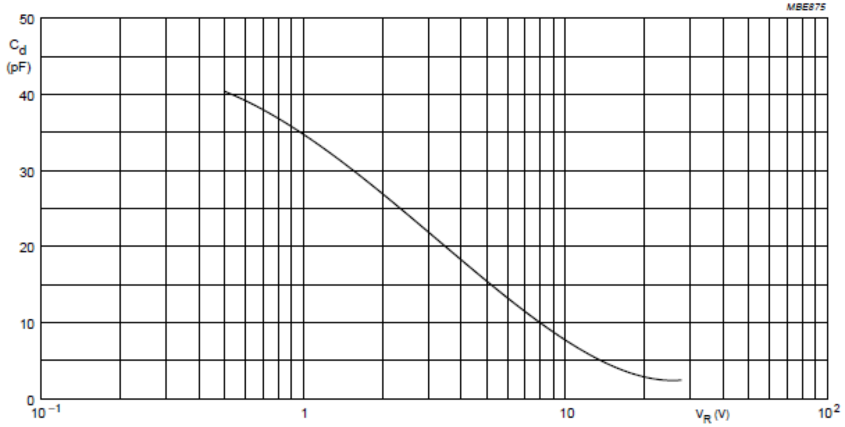


Cathode side indicated by a red band on a black body.
Additional green band.

Fig.1 Simplified outline (SOD68; DO-34) and symbol.

C_d	diode capacitance	V_R = 0.5 V; f = 1 MHz; see Figs 2 and 4	38	–	–	pF
		V_R = 28 V; f = 1 MHz; see Figs 2 and 4	2.3	–	2.7	pF

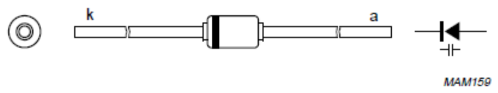
GRAPHICAL DATA



f = 1 MHz; T_j = 25 °C.

Fig.2 Diode capacitance as a function of reverse voltage; typical values.

BB809

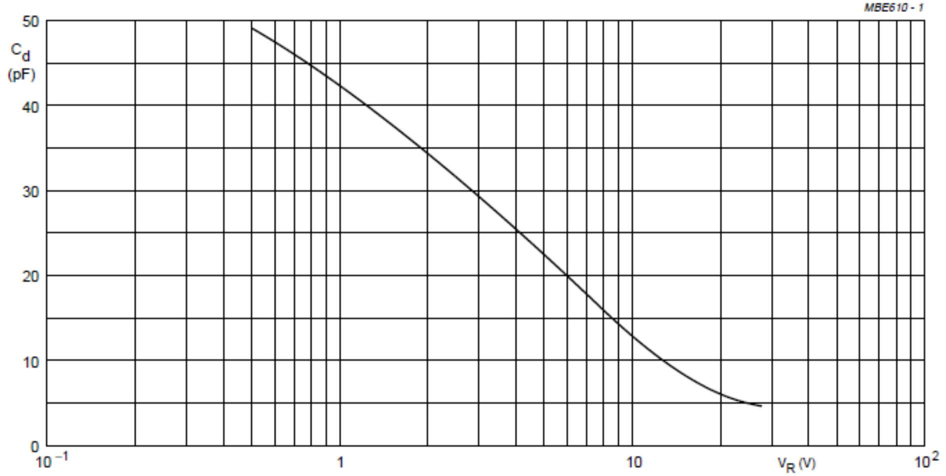


Cathode side indicated by a yellow band on a black body.

Fig.1 Simplified outline (SOD68; DO-34) and symbol.

r_s	diode series resistance	f = 200 MHz; note 1	–	–	0.6	Ω
C_d	diode capacitance	V_R = 1 V; f = 1 MHz; see Figs 2 and 4	39	–	46	pF
		V_R = 28 V; f = 1 MHz; see Figs 2 and 4	4	–	5	pF

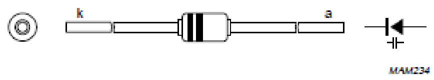
GRAPHICAL DATA



f = 1 MHz; T_j = 25 °C.

Fig.2 Diode capacitance as a function of reverse voltage; typical values.

BB909A/ BB909B

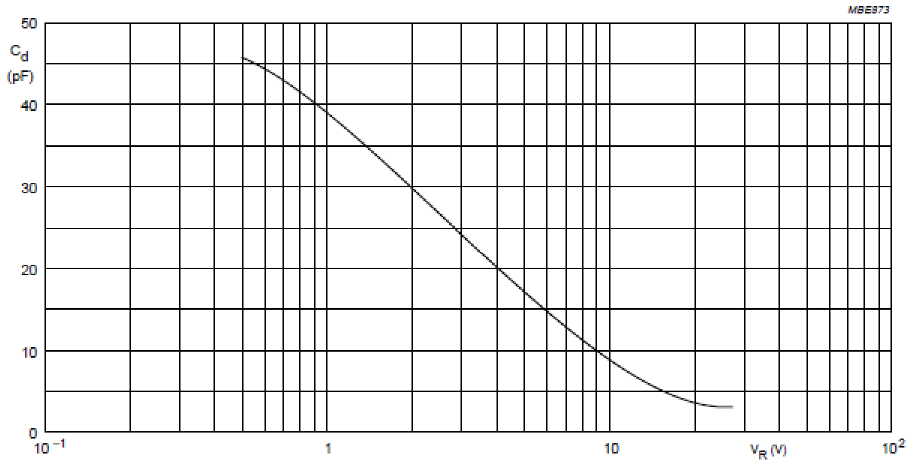


Cathode side indicated by a green band on a black body (BB909A and BB909B).
Additional red band (BB909A only).

Fig.1 Simplified outline (SOD68; DO-34) and symbol.

r_s	diode series resistance	f = 100 MHz; note 1	–	–	0.9	Ω
C_d	diode capacitance	see Figs 2 and 4				
	BB909A	V_R = 1 V; f = 1 MHz	31	–	–	pF
		V_R = 3 V; f = 1 MHz	–	23	–	pF
		V_R = 28 V; f = 1 MHz	2.6	–	3	pF
	BB909B	V_R = 1 V; f = 1 MHz	33.5	–	–	pF
		V_R = 3 V; f = 1 MHz	–	25	–	pF
		V_R = 28 V; f = 1 MHz	2.8	–	3.2	pF

GRAPHICAL DATA



f = 1 MHz; T_j = 25 °C.

Fig.2 Diode capacitance as a function of reverse voltage; typical values.

BB204B/BB204G

PIN	DESCRIPTION
1	anode (a1)
2	common cathode
3	anode (a2)

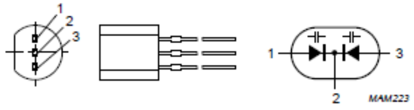
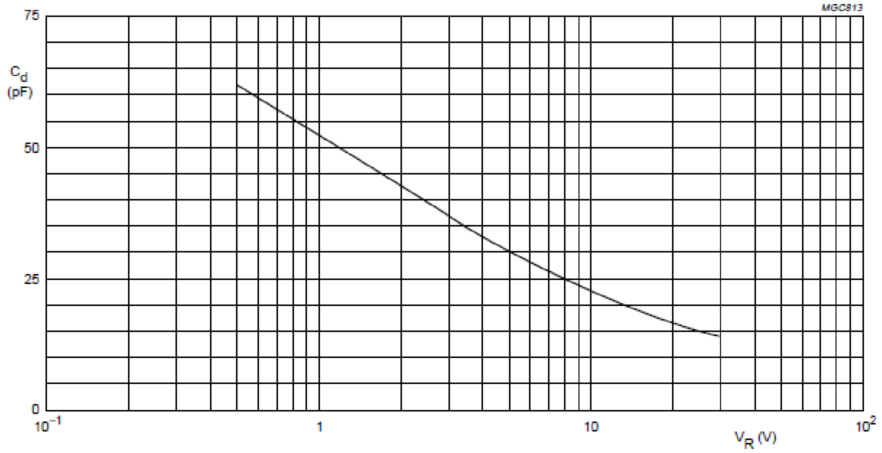


Fig.1 Simplified outline (TO-92 variant) and symbol.

r_s	diode series resistance	f = 100 MHz; note 1	–	0.2	0.4	Ω
C_d	diode capacitance	see Figs 2 and 4				
	BB204B	V_R = 3 V; f = 1 MHz	37	–	42	pF
		V_R = 8 V; f = 1 MHz	24	–	29	pF
		V_R = 30 V; f = 1 MHz	–	14	–	pF
	BB204G	V_R = 3 V; f = 1 MHz	34	–	39	pF
		V_R = 8 V; f = 1 MHz	22	–	27	pF
		V_R = 30 V; f = 1 MHz	–	14	–	pF

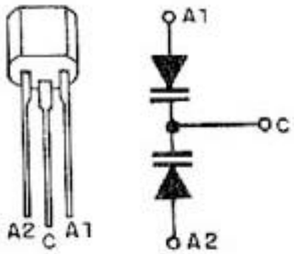
GRAPHICAL DATA



f = 1 MHz.

Fig.2 Diode capacitance as a function of reverse voltage; typical values.

BB204/ BB304



① $\frac{C_D 2V}{C_D 8V}$

	BB204	BB304	
C_D	14	42 a 47,5	pF
Para U_N	30	2	V
$\frac{C_D 3V}{C_D 30V}$	2,4 a 2,8	1,65 a 1,75 ①	
r_s	0,2	0,2	Ω
Para C_D	38	38	pF

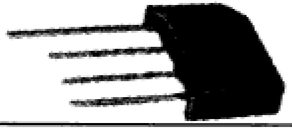
PONTES RETIFICADORAS

KPC200 ATÉ KBPC210 PONTE RETIFICADORA 2A

JGD

KBP200 THRU KBP210

SINGLE PHASE 2.0 AMPS. SILICON BRIDGE RECTIFIERS

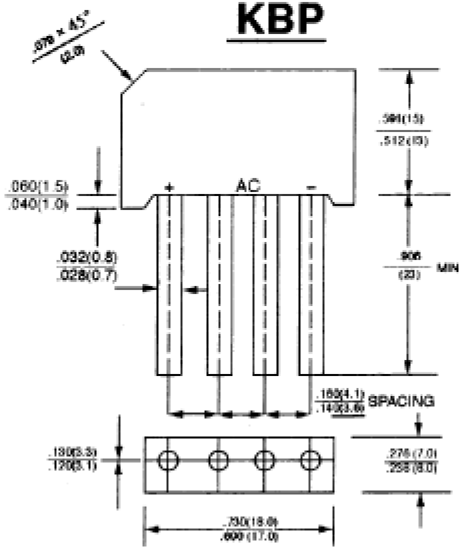


VOLTAGE RANGE
50 to 1000 Volts
CURRENT
2.0 Amperes

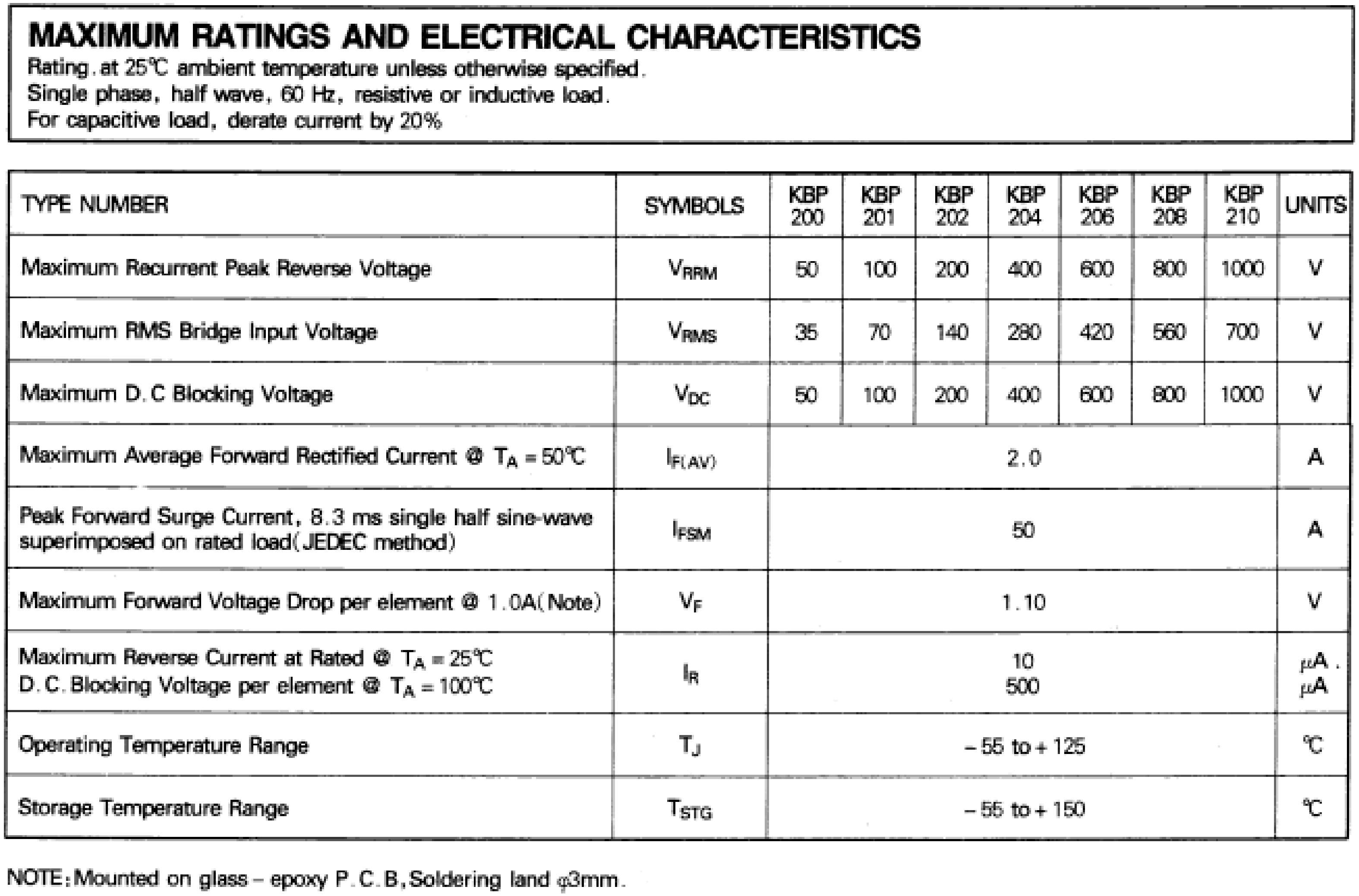
FEATURES

- * Ideal for printed circuit board
- * High Surge Current Capability
- * Reliable low cost construction
- * Small size, simple installation

KBP



Dimensions in inches and (millimeters)



MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Rating at 25℃ ambient temperature unless otherwise specified.
Single phase, half wave, 60 Hz, resistive or inductive load.
For capacitive load, derate current by 20%

TYPE NUMBER	SYMBOLS	KBP 200	KBP 201	KBP 202	KBP 204	KBP 206	KBP 208	KBP 210	UNITS
Maximum Recurrent Peak Reverse Voltage	V_{RRM}	50	100	200	400	600	800	1000	V
Maximum RMS Bridge Input Voltage	V_{RMS}	35	70	140	280	420	560	700	V
Maximum D.C Blocking Voltage	V_{DC}	50	100	200	400	600	800	1000	V
Maximum Average Forward Rectified Current @ $T_A = 50℃$	$I_{F(AV)}$	2.0							A
Peak Forward Surge Current, 8.3 ms single half sine-wave superimposed on rated load (JEDEC method)	I_{FSM}	50							A
Maximum Forward Voltage Drop per element @ 1.0A (Note)	V_F	1.10							V
Maximum Reverse Current at Rated @ $T_A = 25℃$ D.C. Blocking Voltage per element @ $T_A = 100℃$	I_R	10 500							µA µA
Operating Temperature Range	T_J	−55 to +125							℃
Storage Temperature Range	T_{STG}	−55 to +150							℃

NOTE: Mounted on glass-epoxy P.C.B, Soldering land φ3mm.

FIG.1-MAXIMUM NON – REPETITIVE PEAK FORWARD SURGE CURRENT – PER ELEMENT

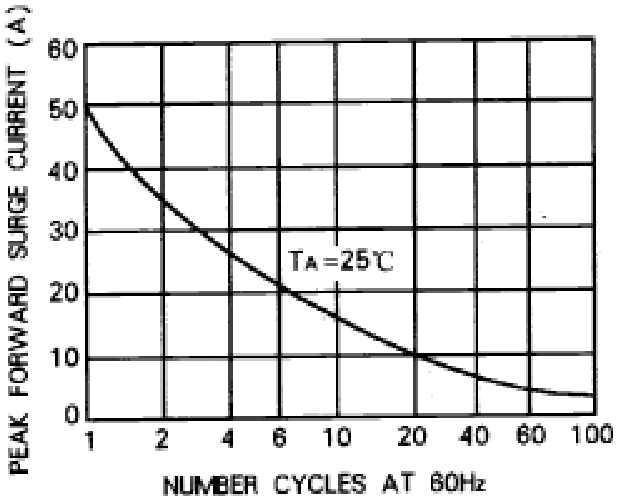


FIG.2-TYPICAL FORWARD OUTPUT CURRENT DERATING CURVE

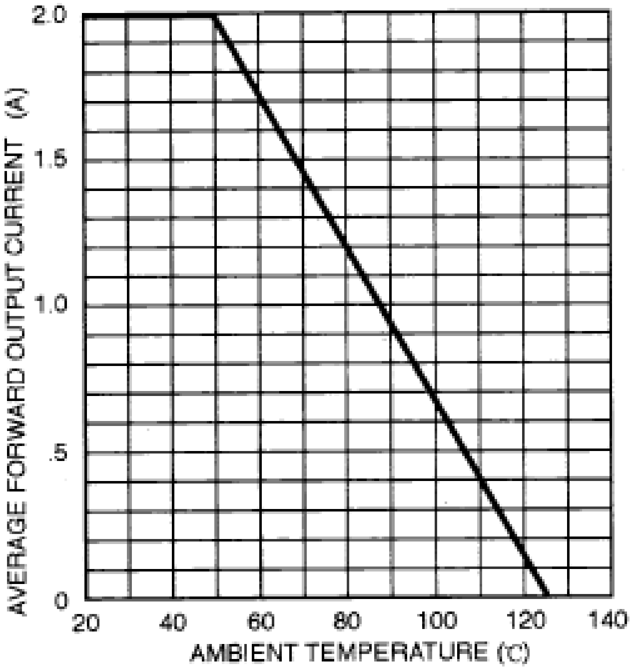


FIG.3-TYPICAL INSTANTANEOUS FORWARD CHARACTERISTICS – PER ELEMENT

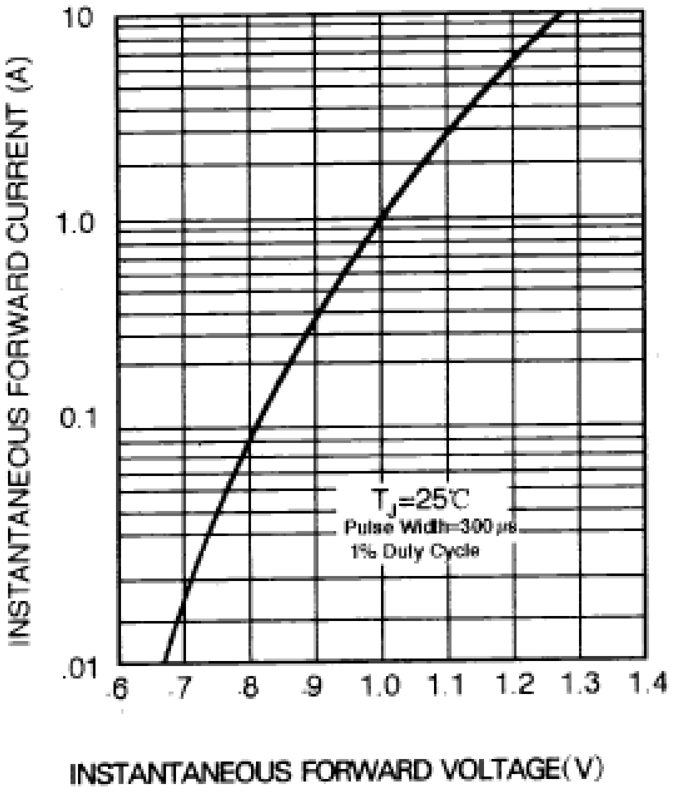
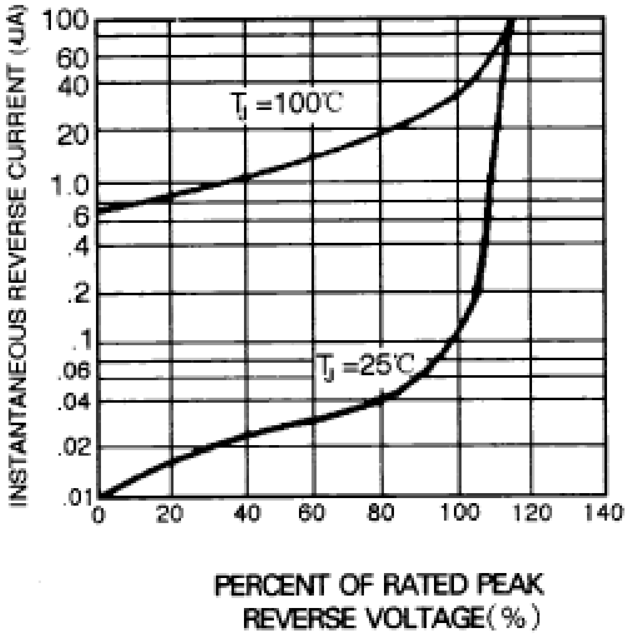


FIG.4-TYPICAL REVERSE CHARACTERISTICS PER ELEMENT



KBPC15 KBPC25 KBPC35 / W SERIE

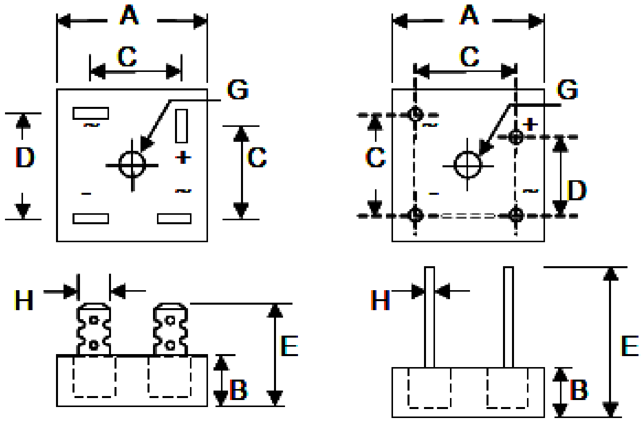
WTE
POWER SEMICONDUCTORS

KBPC15, 25, 35/W SERIES

15, 25, 35A HIGH CURRENT BRIDGE RECTIFIE

Features

- Diffused Junction
- Low Reverse Leakage Current
- Low Power Loss, High Efficiency
- Electrically Isolated Metal Case for Maximum Heat Dissipation
- Case to Terminal Isolation Voltage 2500V
- UL Recognized File # E157705



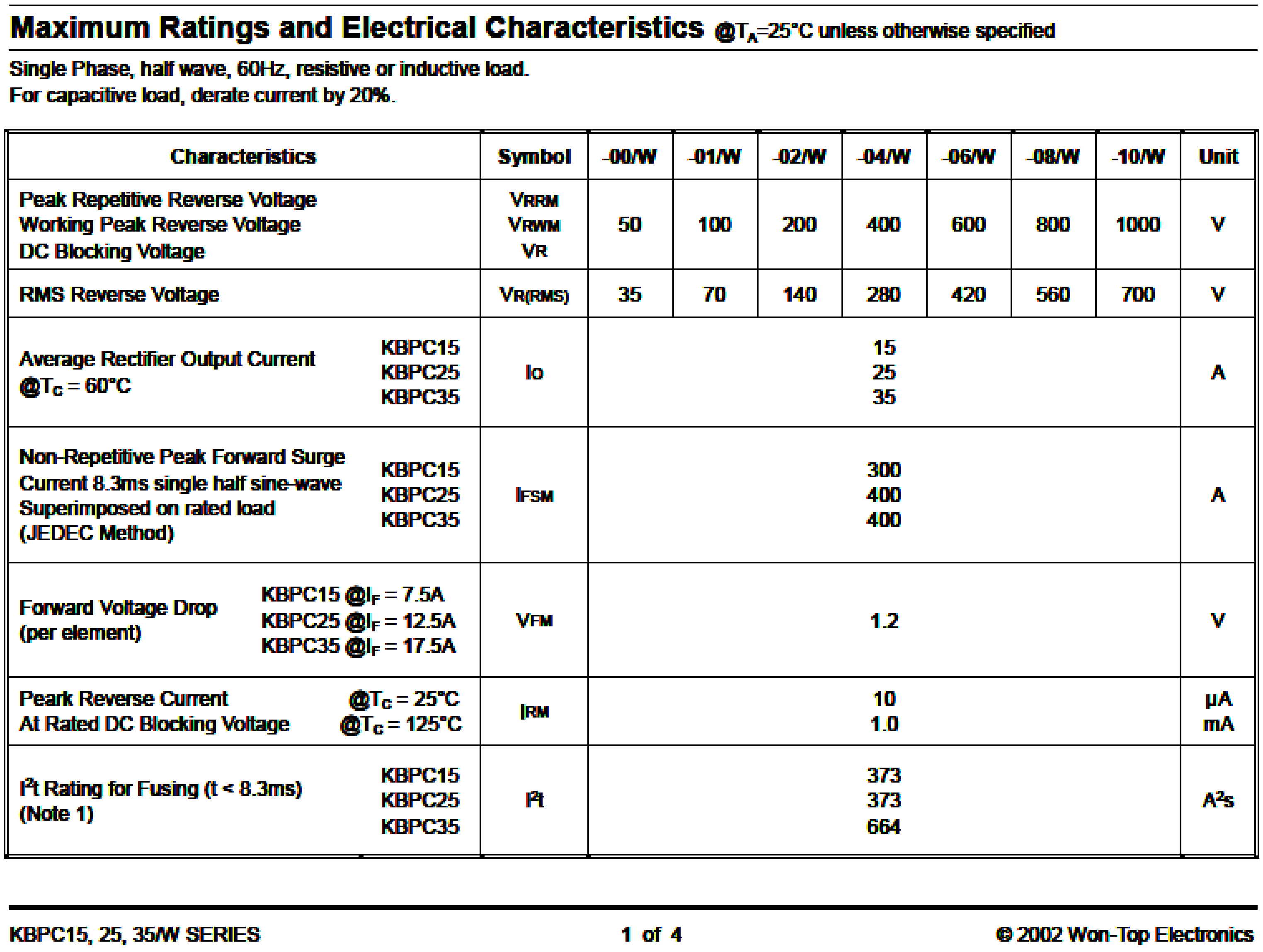
KBPC **KBPC-W**

Mechanical Data

- Case: Metal Case with Electrically Isolated Epoxy
- Terminals: Plated Leads Solderable per MIL-STD-202, Method 208
- Polarity: Symbols Marked on Case
- Mounting: Through Hole for #10 Screw
- Weight: KBPC 31.6 grams (approx.)
  KBPC-W 28.5 grams (approx.)
- Marking: Type Number

"W" Suffix Designates Wire Leads
No Suffix Designates Faston Terminals

	KBPC		KBPC-W	
Dim	**Min**	**Max**	**Min**	**Max**
A	28.40	28.70	28.40	28.70
B	10.97	11.23	10.97	11.23
C	15.70	16.70	17.10	19.10
D	17.50	18.50	10.90	11.90
E	22.86	25.40	30.50	—
G	Hole for #10 screw, 5.08Ø Nominal			
H	6.35 Typical		0.97Ø	1.07Ø
All Dimension in mm				



Maximum Ratings and Electrical Characteristics @T_A=25°C unless otherwise specified

Single Phase, half wave, 60Hz, resistive or inductive load.
For capacitive load, derate current by 20%.

Characteristics		Symbol	-00/W	-01/W	-02/W	-04/W	-06/W	-08/W	-10/W	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	50	100	200	400	600	800	1000	V
RMS Reverse Voltage		$V_{R(RMS)}$	35	70	140	280	420	560	700	V
Average Rectifier Output Current @T_C = 60°C	KBPC15 KBPC25 KBPC35	Io	15 25 35							A
Non-Repetitive Peak Forward Surge Current 8.3ms single half sine-wave Superimposed on rated load (JEDEC Method)	KBPC15 KBPC25 KBPC35	I_{FSM}	300 400 400							A
Forward Voltage Drop (per element)	KBPC15 @I_F = 7.5A KBPC25 @I_F = 12.5A KBPC35 @I_F = 17.5A	V_{FM}	1.2							V
Peark Reverse Current At Rated DC Blocking Voltage	@T_C = 25°C @T_C = 125°C	I_{RM}	10 1.0							µA mA
I^2t Rating for Fusing (t < 8.3ms) (Note 1)	KBPC15 KBPC25 KBPC35	I^2t	373 373 664							A^2s

Maximum Ratings and Electrical Characteristics @T_A=25°C unless otherwise specified

Typical Junction Capacitance (per element) (Note 2)	C_j	300	pF
Typical Thermal Resistance Junction to Case (per element) (Note 3) KBPC15 KBPC25 KBPC35	$R_{\theta JC}$	6.3 3.8 2.7	K/W
RMS Isolation Voltage from Case to Lead	V_{ISO}	2500	V
Operating and Storage Temperature Range	T_j, T_{STG}	-65 to +150	°C

*** Glass passivated forms are available upon request.**

Note: 1. Measured at non-repetitive, for t > 1ms and < 8.3ms.
2. Measured at 1.0 MHz and applied reverse voltage of 4.0V D.C.
3. Thermal resistance junction to case mounted on heatsink.

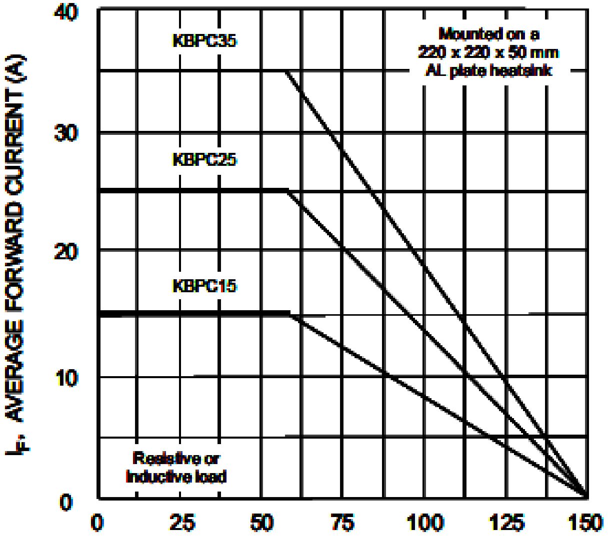


Fig. 1 Forward. Current Derating Curve

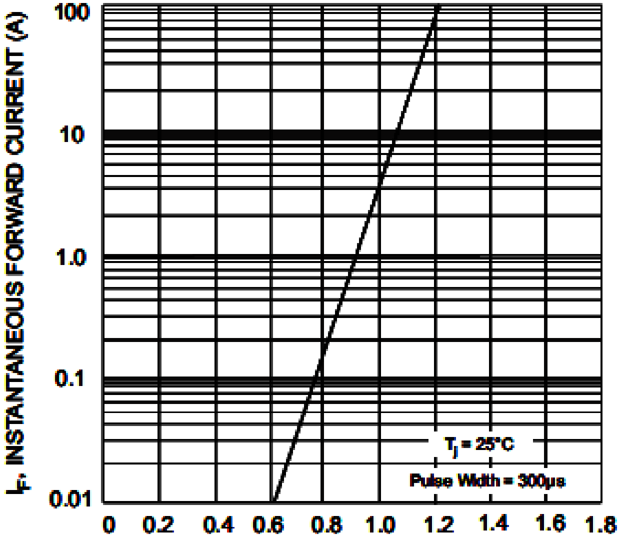


Fig. 2 Typical Forward Characteristics (per element)

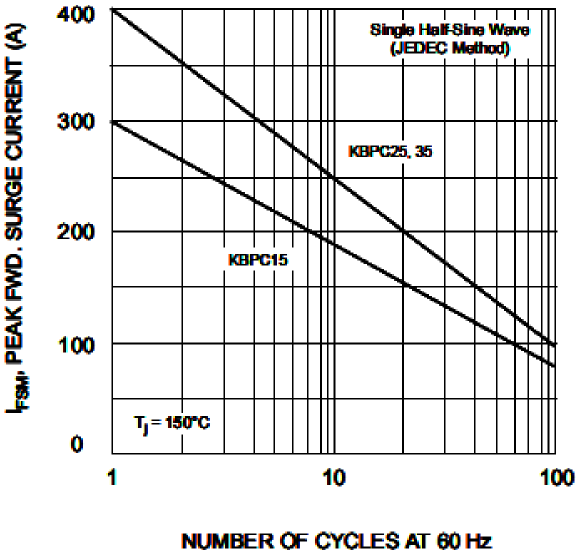


Fig. 3 Max Non-Repetitive Surge Current

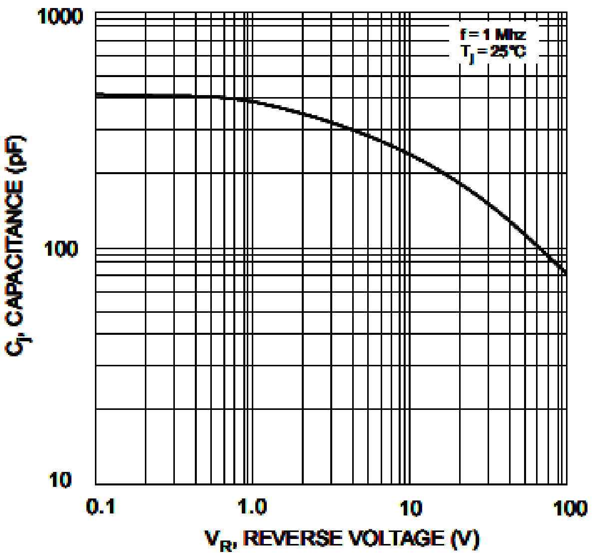


Fig. 4 Typical Junction Capacitance (per element)

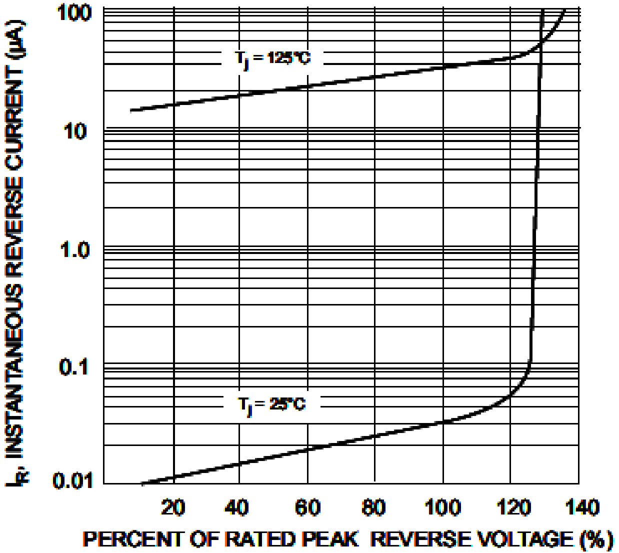


Fig. 5 Typical Reverse Characteristics (per element)

KBP005/01/02/03/04/06/08 PONTE RETIFICADORA 2A

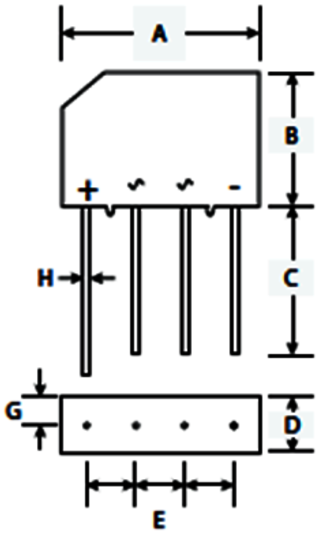
DEC

KBP005 THRU KBP10

CURRENT 2.0 Amperes
VOLTAGE 50 to 1000 Volts

Features

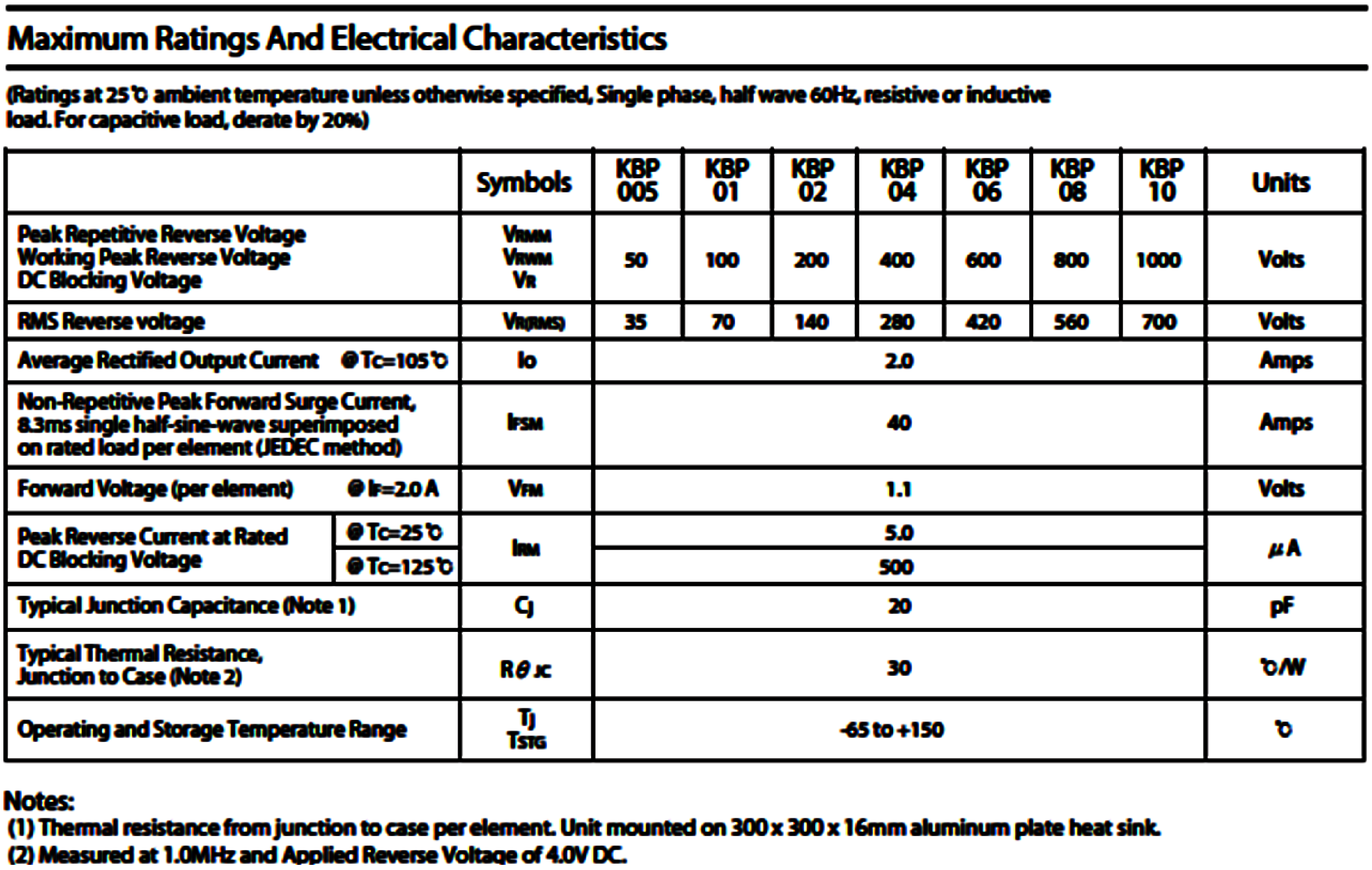
- Glass Passivated Die Construction
- High Case Dielectric Strength of 1500VRMS
- Low Reverse Leakage Current
- Surge Overload Rating to 40A Peak
- Ideal for Printed Circuit Board Applications
- Plastic Material - UL Flammability Classification 94V-0



KBP		
Dim	Min	Max
A	14.00	15.00
B	10.50	11.50
C	15.00	—
D	4.70	5.00
E	3.50	4.00
G	2.30	2.50
H	0.70 Typical	
All Dimensions in mm		

Mechanical Data

- Case: Molded Plastic
- Terminals: Plated Leads, Solderable per MIL-STD-202, Method 208
- Polarity: As Marked on Body
- Approx. Weight: 1.52 grams
- Mounting Position: Any
- Marking: Type Number



Maximum Ratings And Electrical Characteristics

(Ratings at 25℃ ambient temperature unless otherwise specified, Single phase, half wave 60Hz, resistive or inductive load. For capacitive load, derate by 20%)

		Symbols	KBP 005	KBP 01	KBP 02	KBP 04	KBP 06	KBP 08	KBP 10	Units
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	50	100	200	400	600	800	1000	Volts
RMS Reverse voltage		$V_{R(RMS)}$	35	70	140	280	420	560	700	Volts
Average Rectified Output Current	@Tc=105℃	I_O	2.0							Amps
Non-Repetitive Peak Forward Surge Current, 8.3ms single half-sine-wave superimposed on rated load per element (JEDEC method)		I_{FSM}	40							Amps
Forward Voltage (per element)	@I_F=2.0 A	V_{FM}	1.1							Volts
Peak Reverse Current at Rated DC Blocking Voltage	@Tc=25℃	I_{RM}	5.0							µA
	@Tc=125℃		500							
Typical Junction Capacitance (Note 1)		C_J	20							pF
Typical Thermal Resistance, Junction to Case (Note 2)		$R\theta_{JC}$	30							℃/W
Operating and Storage Temperature Range		T_J T_{STG}	-65 to +150							℃

Notes:

(1) Thermal resistance from junction to case per element. Unit mounted on 300 x 300 x 1.6mm aluminum plate heat sink.

(2) Measured at 1.0MHz and Applied Reverse Voltage of 4.0V DC.

KBU800/ KBU801/ KBU802/ KBU804/ KBU806/ KBU808/ KBU810 PONTE RETIFICADORA 8A

WTE
POWER SEMICONDUCTORS

KBU800 – KBU810

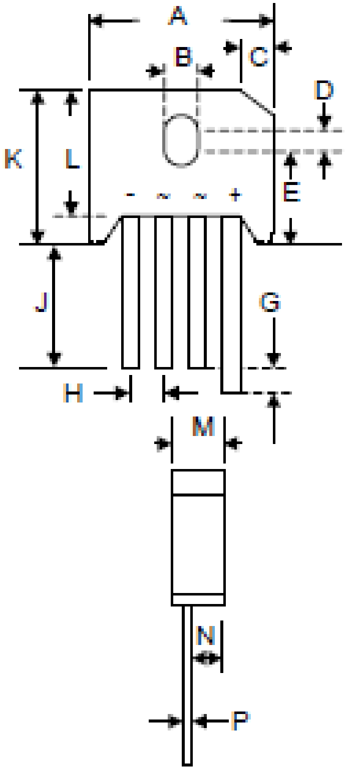
8.0A BRIDGE RECTIFIER

Features

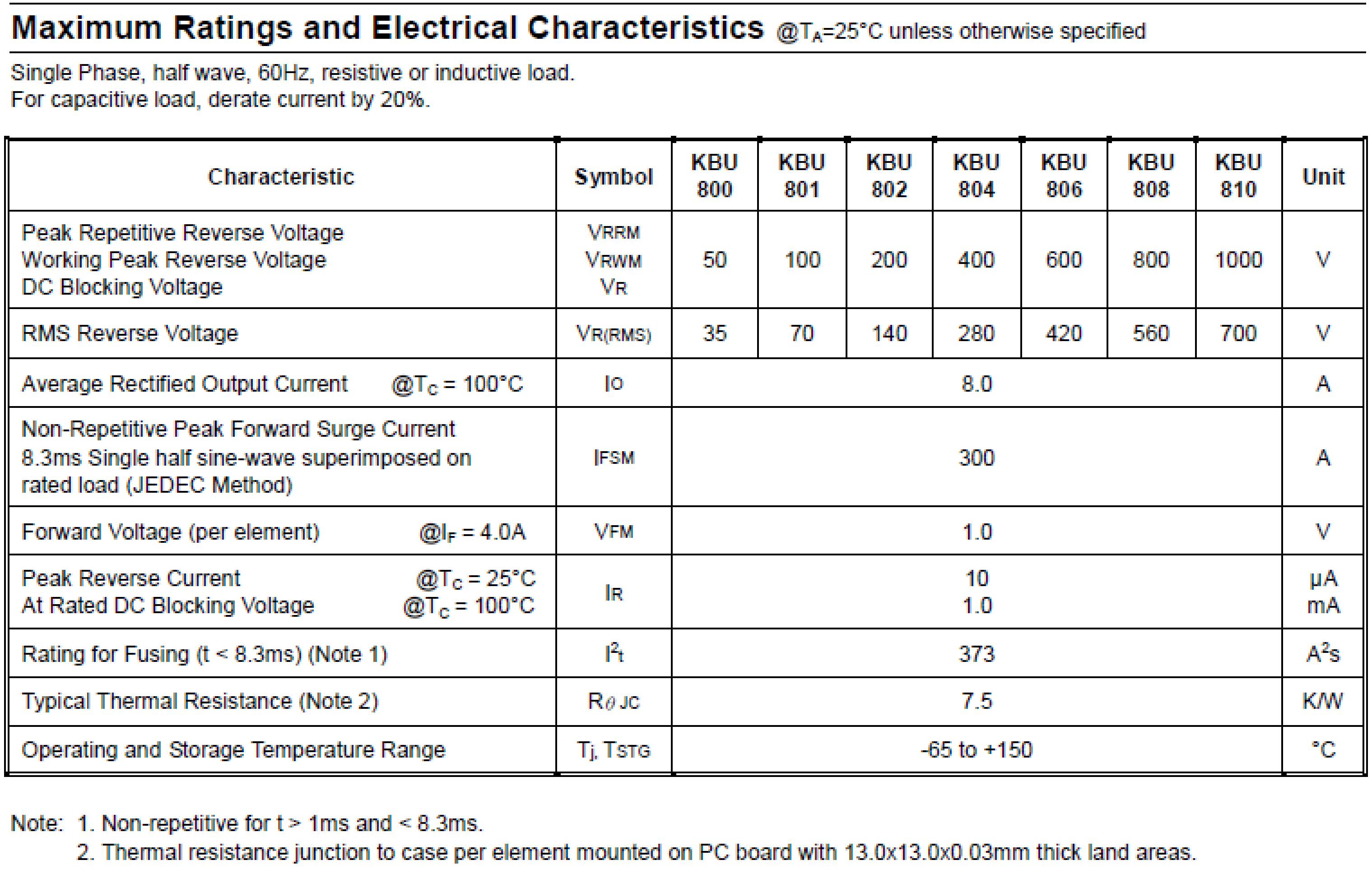
- Diffused Junction
- Low Forward Voltage Drop
- High Current Capability
- High Reliability
- High Surge Current Capability
- Ideal for Printed Circuit Boards
- UL Recognized File # E157705

Mechanical Data

- Case: Molded Plastic
- Terminals: Plated Leads Solderable per MIL-STD-202, Method 208
- Polarity: As Marked on Body
- Weight: 8.0 grams (approx.)
- Mounting Position: Any
- Marking: Type Number



KBU		
Dim	**Min**	**Max**
A	22.70	23.70
B	3.80	4.10
C	4.20	4.70
D	1.70	2.20
E	10.30	11.30
G	4.50	6.80
H	4.60	5.60
J	25.40	—
K	—	19.30
L	16.80	17.80
M	6.60	7.10
N	4.70	5.20
P	1.20	1.30
All Dimensions in mm		



Maximum Ratings and Electrical Characteristics @T_A=25°C unless otherwise specified

Single Phase, half wave, 60Hz, resistive or inductive load.
For capacitive load, derate current by 20%.

Characteristic	Symbol	KBU 800	KBU 801	KBU 802	KBU 804	KBU 806	KBU 808	KBU 810	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	800	1000	V
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	280	420	560	700	V
Average Rectified Output Current @T_C = 100°C	I_O	8.0							A
Non-Repetitive Peak Forward Surge Current 8.3ms Single half sine-wave superimposed on rated load (JEDEC Method)	I_{FSM}	300							A
Forward Voltage (per element) @I_F = 4.0A	V_{FM}	1.0							V
Peak Reverse Current @T_C = 25°C At Rated DC Blocking Voltage @T_C = 100°C	I_R	10 1.0							µA mA
Rating for Fusing (t < 8.3ms) (Note 1)	I^2t	373							A^2s
Typical Thermal Resistance (Note 2)	$R_{\theta JC}$	7.5							K/W
Operating and Storage Temperature Range	T_j, T_{STG}	-65 to +150							°C

Note: 1. Non-repetitive for t > 1ms and < 8.3ms.
2. Thermal resistance junction to case per element mounted on PC board with 13.0x13.0x0.03mm thick land areas.

KBU1000 -KBU101 PONTE RETIFICADORA 10A

WTE
POWER SEMICONDUCTORS

KBU1000 – KBU1010

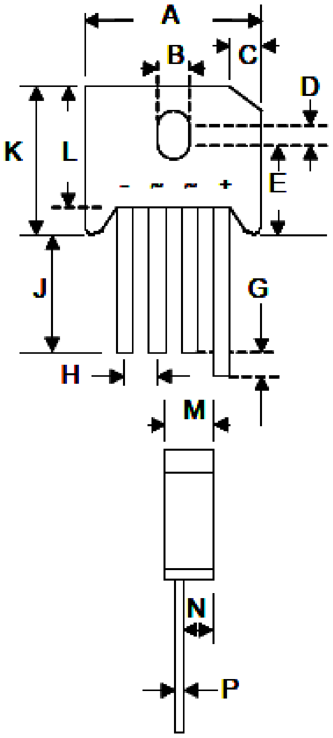
10A BRIDGE RECTIFIER

Features

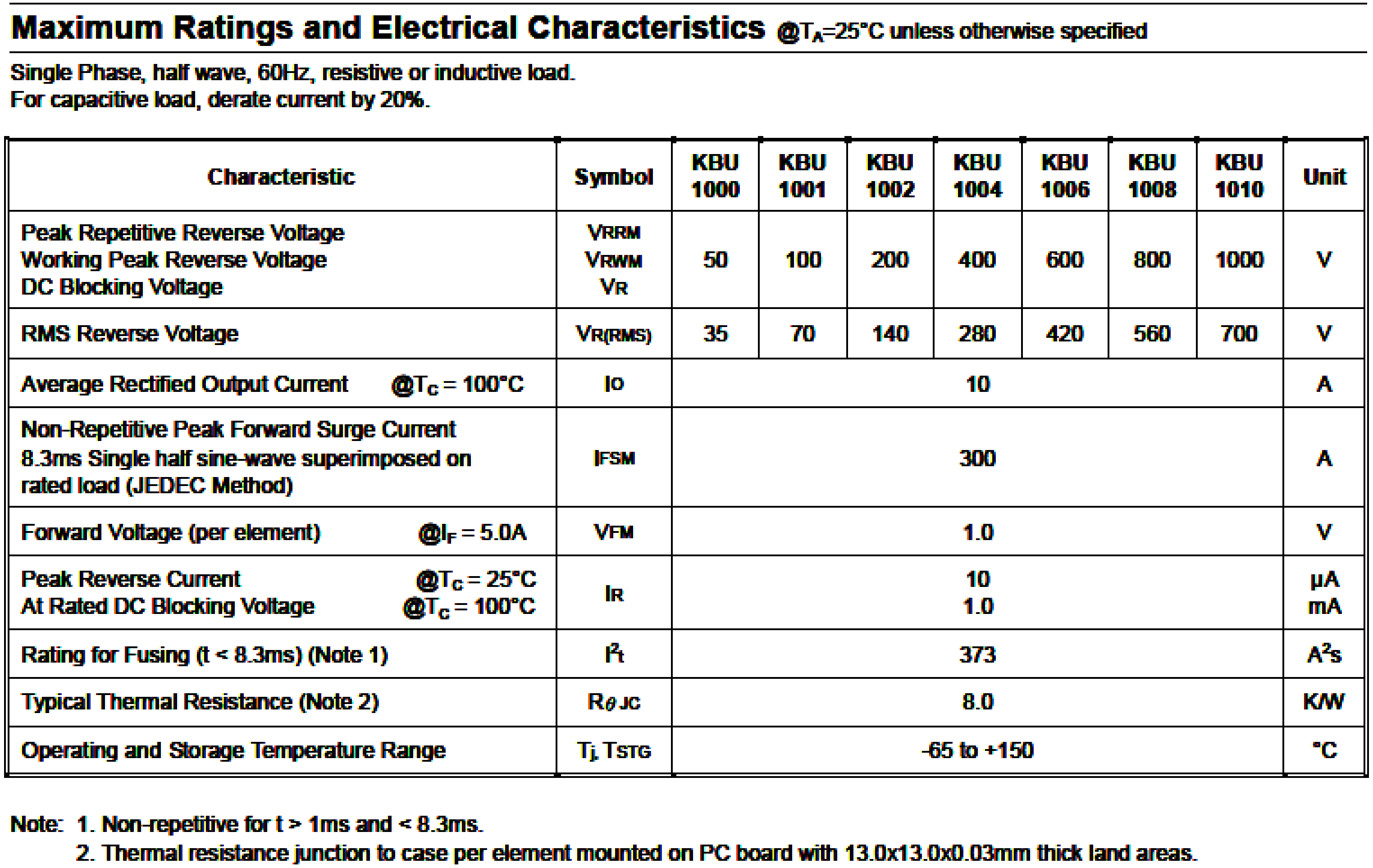
- Diffused Junction
- Low Forward Voltage Drop
- High Current Capability
- High Reliability
- High Surge Current Capability
- Ideal for Printed Circuit Boards

Mechanical Data

- Case: Molded Plastic
- Terminals: Plated Leads Solderable per MIL-STD-202, Method 208
- Polarity: As Marked on Body
- Weight: 8.0 grams (approx.)
- Mounting Position: Any
- Marking: Type Number



KBU		
Dim	**Min**	**Max**
A	22.70	23.70
B	3.80	4.10
C	4.20	4.70
D	1.70	2.20
E	10.30	11.30
G	4.50	6.80
H	4.60	5.60
J	25.40	—
K	—	19.30
L	16.80	17.80
M	6.60	7.10
N	4.70	5.20
P	1.20	1.30
All Dimensions in mm		



Maximum Ratings and Electrical Characteristics @T_A=25°C unless otherwise specified

Single Phase, half wave, 60Hz, resistive or inductive load.
For capacitive load, derate current by 20%.

Characteristic	Symbol	KBU 1000	KBU 1001	KBU 1002	KBU 1004	KBU 1006	KBU 1008	KBU 1010	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	800	1000	V
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	280	420	560	700	V
Average Rectified Output Current @T_C = 100°C	I_O	10							A
Non-Repetitive Peak Forward Surge Current 8.3ms Single half sine-wave superimposed on rated load (JEDEC Method)	I_{FSM}	300							A
Forward Voltage (per element) @I_F = 5.0A	V_{FM}	1.0							V
Peak Reverse Current @T_C = 25°C At Rated DC Blocking Voltage @T_C = 100°C	I_R	10 1.0							µA mA
Rating for Fusing (t < 8.3ms) (Note 1)	I^2t	373							A^2s
Typical Thermal Resistance (Note 2)	$R_{\theta JC}$	8.0							K/W
Operating and Storage Temperature Range	T_j, T_{STG}	-65 to +150							°C

Note: 1. Non-repetitive for t > 1ms and < 8.3ms.
2. Thermal resistance junction to case per element mounted on PC board with 13.0x13.0x0.03mm thick land areas.

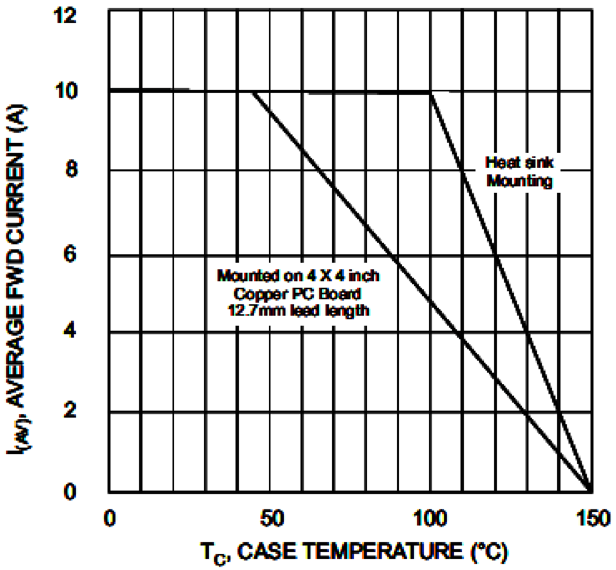


Fig. 1 Forward Current Derating Curve

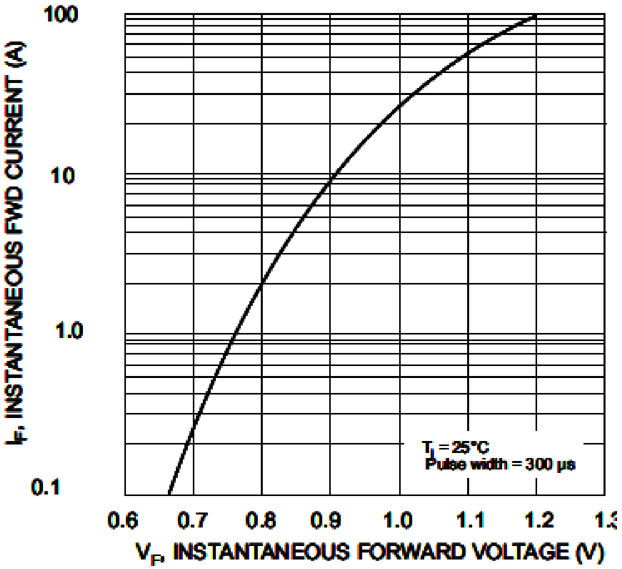


Fig. 2 Typical Forward Characteristics, per element

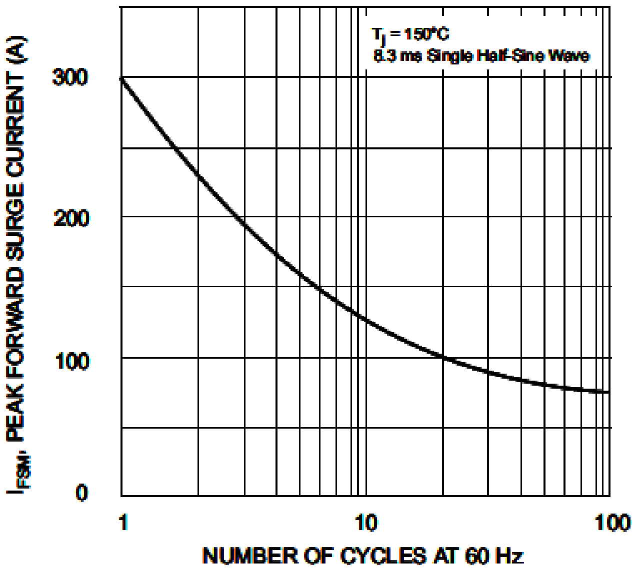


Fig. 3 Max Non-Repetitive Peak Fwd Surge Current

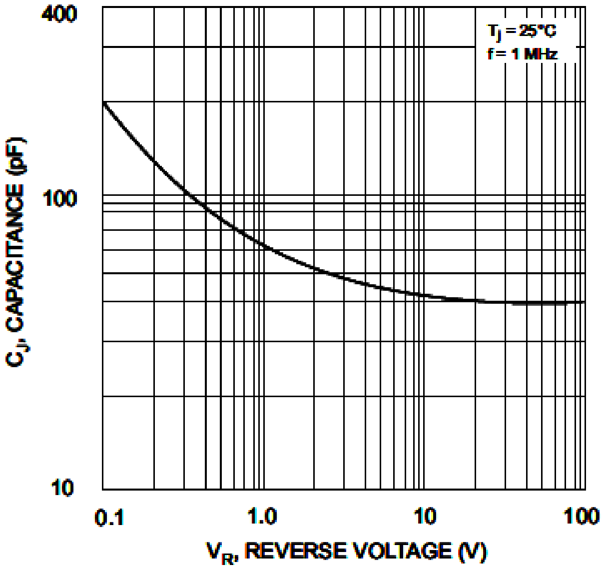


Fig. 4 Typical Junction Capacitance per element

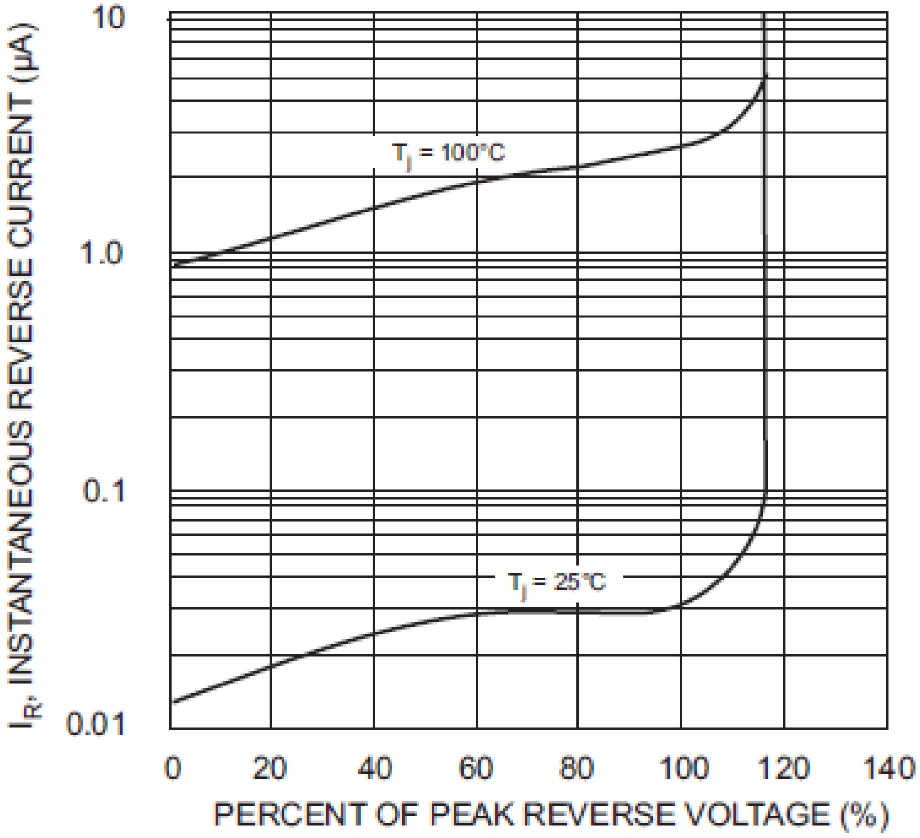


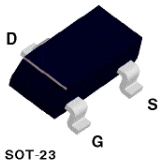
Fig. 5 Typical Reverse Characteristics

MOSFET

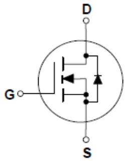
2N7000/2N7002 MOSFET N BAIXA POTÊNCIA 200MA BAIXO VGS .

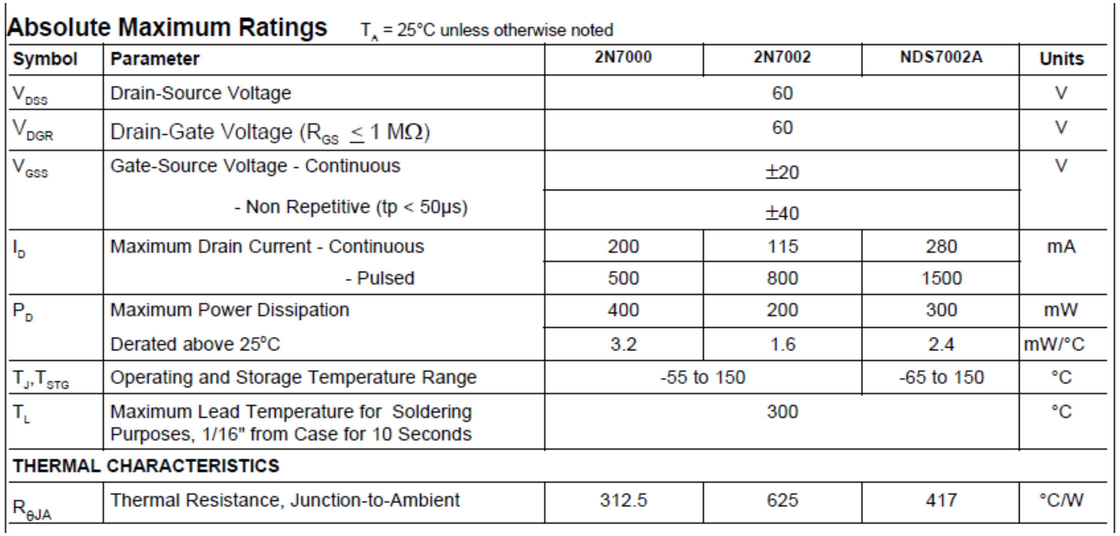
MOSFET prático para usar em baixas potências, mas tem a vantagem de ter baixo vgs

TO-92
2N7000



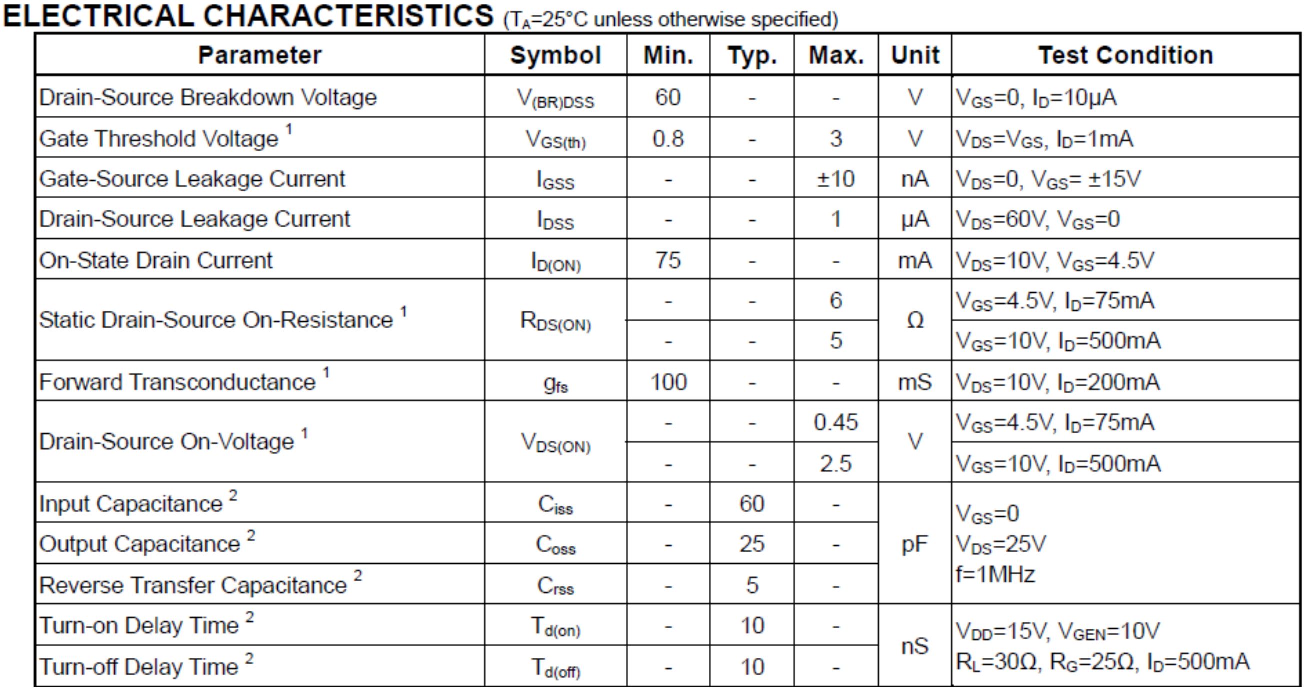
SOT-23
(TO-236AB)
2N7002/NDS7002A





Absolute Maximum Ratings T_A = 25°C unless otherwise noted

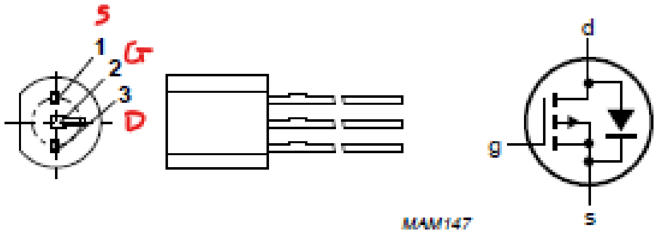
Symbol	Parameter	2N7000	2N7002	NDS7002A	Units
V_{DSS}	Drain-Source Voltage	60			V
V_{DGR}	Drain-Gate Voltage ($R_{GS} \leq 1$ MΩ)	60			V
V_{GSS}	Gate-Source Voltage - Continuous	±20			V
	- Non Repetitive (tp < 50μs)	±40			
I_D	Maximum Drain Current - Continuous	200	115	280	mA
	- Pulsed	500	800	1500	
P_D	Maximum Power Dissipation	400	200	300	mW
	Derated above 25°C	3.2	1.6	2.4	mW/°C
T_J,T_{STG}	Operating and Storage Temperature Range	-55 to 150		-65 to 150	°C
T_L	Maximum Lead Temperature for Soldering Purposes, 1/16" from Case for 10 Seconds	300			°C
THERMAL CHARACTERISTICS					
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	312.5	625	417	°C/W



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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	60	-	-	V	V_{GS}=0, I_D=10μA
Gate Threshold Voltage [1]	$V_{GS(th)}$	0.8	-	3	V	V_{DS}=V_{GS}, I_D=1mA
Gate-Source Leakage Current	I_{GSS}	-	-	±10	nA	V_{DS}=0, V_{GS}= ±15V
Drain-Source Leakage Current	I_{DSS}	-	-	1	μA	V_{DS}=60V, V_{GS}=0
On-State Drain Current	$I_{D(ON)}$	75	-	-	mA	V_{DS}=10V, V_{GS}=4.5V
Static Drain-Source On-Resistance [1]	$R_{DS(ON)}$	-	-	6	Ω	V_{GS}=4.5V, I_D=75mA
		-	-	5		V_{GS}=10V, I_D=500mA
Forward Transconductance [1]	g_{fs}	100	-	-	mS	V_{DS}=10V, I_D=200mA
Drain-Source On-Voltage [1]	$V_{DS(ON)}$	-	-	0.45	V	V_{GS}=4.5V, I_D=75mA
		-	-	2.5		V_{GS}=10V, I_D=500mA
Input Capacitance [2]	C_{iss}	-	60	-	pF	V_{GS}=0 V_{DS}=25V f=1MHz
Output Capacitance [2]	C_{oss}	-	25	-		
Reverse Transfer Capacitance [2]	C_{rss}	-	5	-		
Turn-on Delay Time [2]	$T_{d(on)}$	-	10	-	nS	V_{DD}=15V, V_{GEN}=10V R_L=30Ω, R_G=25Ω, I_D=500mA
Turn-off Delay Time [2]	$T_{d(off)}$	-	10	-		

BS250 P MOSFET 250MA



QUICK REFERENCE DATA

Drain-source voltage	$-V_{DS}$	max.	45	V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	20	V
Drain current (DC)	$-I_D$	max.	0.25	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	0.83	W
Drain-source ON-resistance $-I_D$ = 200 mA; $-V_{GS}$ = 10 V	$R_{DS(on)}$	typ. max.	9 14	Ω Ω
Transfer admittance $-I_D$ = 200 mA; $-V_{DS}$ = 15 V	$\lvert Y_{fs} \rvert$	typ.	125	mS

IRF510 MOSFET CANAL N 5,6A 100V RDS 0,540 OHM

intersil

IRF510

Data Sheet **November 1999** **File Number 1573.4**

5.6A, 100V, 0.540 Ohm, N-Channel Power MOSFET

This N-Channel enhancement mode silicon gate power field effect transistor is an advanced power MOSFET designed, tested, and guaranteed to withstand a specified level of energy in the breakdown avalanche mode of operation. All of these power MOSFETs are designed for applications such as switching regulators, switching convertors, motor drivers, relay drivers, and drivers for high power bipolar switching transistors requiring high speed and low gate drive power. These types can be operated directly from integrated circuits.

Formerly developmental type TA17441.

Ordering Information

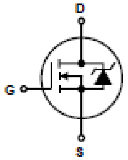
PART NUMBER	PACKAGE	BRAND
IRF510	TO-220AB	IRF510

NOTE: When ordering, include the entire part number.

Features

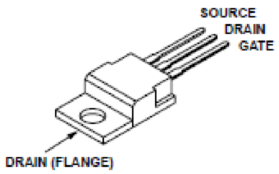
- 5.6A, 100V
- $r_{DS(ON)} = 0.540\Omega$
- Single Pulse Avalanche Energy Rated
- SOA is Power Dissipation Limited
- Nanosecond Switching Speeds
- Linear Transfer Characteristics
- High Input Impedance
- Related Literature
    - TB334 "Guidelines for Soldering Surface Mount Components to PC Boards"

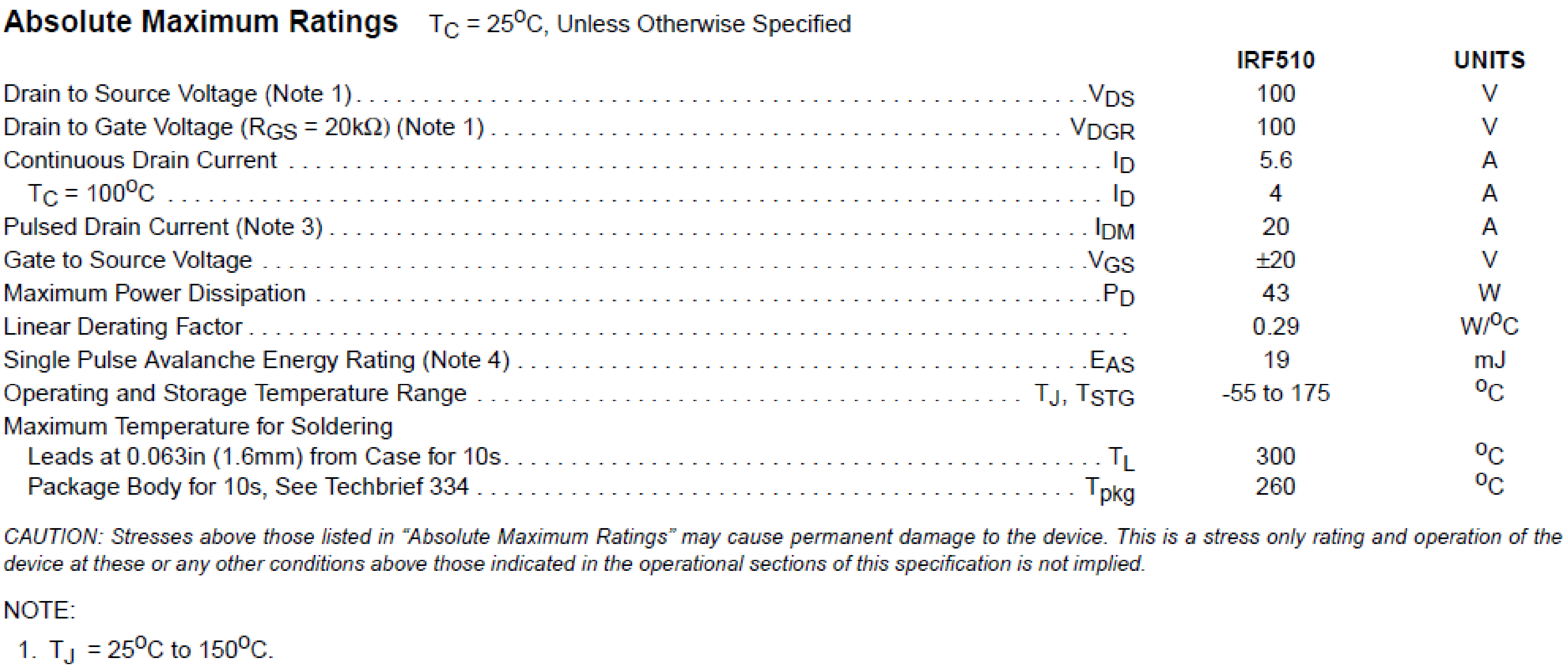
Symbol



Packaging

JEDEC TO-220AB





Absolute Maximum Ratings $T_C = 25^oC$, Unless Otherwise Specified

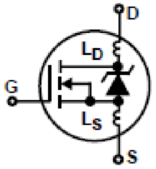
		IRF510	UNITS
Drain to Source Voltage (Note 1)	V_{DS}	100	V
Drain to Gate Voltage ($R_{GS} = 20k\Omega$) (Note 1)	V_{DGR}	100	V
Continuous Drain Current	I_D	5.6	A
$T_C = 100^oC$	I_D	4	A
Pulsed Drain Current (Note 3)	I_{DM}	20	A
Gate to Source Voltage	V_{GS}	±20	V
Maximum Power Dissipation	P_D	43	W
Linear Derating Factor		0.29	$W/^oC$
Single Pulse Avalanche Energy Rating (Note 4)	E_{AS}	19	mJ
Operating and Storage Temperature Range	T_J, T_{STG}	-55 to 175	^oC
Maximum Temperature for Soldering			
Leads at 0.063in (1.6mm) from Case for 10s	T_L	300	^oC
Package Body for 10s, See Techbrief 334	T_{pkg}	260	^oC

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

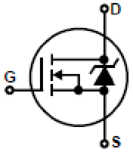
NOTE:

1. $T_J = 25^oC$ to 150^oC.

Electrical Specifications $T_C = 25^oC$, Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Drain to Source Breakdown Voltage	BV_{DSS}	$V_{GS} = 0V$, $I_D = 250\mu A$, (Figure 10)	100	-	-	V
Gate to Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}$, $I_D = 250\mu A$	2.0	-	4.0	V
Zero-Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 95V$, $V_{GS} = 0V$	-	-	25	µA
		$V_{DS} = 0.8 \times$ Rated BV_{DSS}, $V_{GS} = 0V$, $T_J = 150^oC$	-	-	250	µA
On-State Drain Current (Note 2)	$I_{D(ON)}$	$V_{DS} > I_{D(ON)} \times r_{DS(ON)MAX}$, $V_{GS} = 10V$ (Figure 7)	5.6	-	-	A
Gate to Source Leakage Current	I_{GSS}	$V_{GS} = \pm 20V$	-	-	±100	nA
Drain to Source On Resistance (Note 2)	$r_{DS(ON)}$	$V_{GS} = 10V$, $I_D = 3.4A$ (Figures 8, 9)	-	0.4	0.54	Ω
Forward Transconductance (Note 2)	g_{fs}	$V_{GS} = 50V$, $I_D = 3.4A$ (Figure 12)	1.3	2.0	-	S
Turn-On Delay Time	$t_{d(ON)}$	$I_D \approx 5.6A$, $R_{GS} = 24\Omega$, $V_{DD} = 50V$, $R_L = 9\Omega$, $V_{DD} = 50V$, $V_{GS} = 10V$ MOSFET switching times are essentially independent of operating temperature	-	8	12	ns
Rise Time	t_r		-	25	63	ns
Turn-Off Delay Time	$t_{d(OFF)}$		-	15	7	ns
Fall Time	t_f		-	12	59	ns
Total Gate Charge (Gate to Source + Gate to Drain)	$Q_{g(TOT)}$	$V_{GS} = 10V$, $I_D = 5.6A$, $V_{DS} = 0.8 \times$ Rated BV_{DSS}, $I_{G(REF)} = 1.5mA$ (Figure 14) Gate charge is essentially independent of operating temperature.	-	5.0	30	nC
Gate to Source Charge	Q_{gs}		-	2.0	-	nC
Gate to Drain "Miller" Charge	Q_{gd}		-	3.0	-	nC
Input Capacitance	C_{ISS}	$V_{GS} = 0V$, $V_{DS} = 25V$, f = 1.0MHz (Figure 11)	-	135	-	pF
Output Capacitance	C_{OSS}		-	80	-	pF
Reverse-Transfer Capacitance	C_{RSS}		-	20	-	pF
Internal Drain Inductance	L_D	Measured From the Contact Screw On Tab To Center of Die Modified MOSFET Symbol Showing the Internal Devices Inductances 	-	3.5	-	nH
		Measured From the Drain Lead, 6mm (0.25in) From Package to Center of Die	-	4.5	-	nH
Internal Source Inductance	L_S	Measured From The Source Lead, 6mm (0.25in) From Header to Source Bonding Pad	-	7.5	-	nH
Junction to Case	$R_{\theta JC}$		-	-	3.5	$^oC/W$
Junction to Ambient	$R_{\theta JA}$	Free air operation	-	-	80	$^oC/W$

Source to Drain Diode Specifications

PARAMETER	SYMBOL	Test Conditions	MIN	TYP	MAX	UNITS
Continuous Source to Drain Current	I_{SD}	Modified MOSFET Symbol Showing the Integral Reverse P-N Junction Diode  	-	-	5.6	A
Pulse Source to Drain Current (Note 3)	I_{SDM}		-	-	20	A
Source to Drain Diode Voltage (Note 2)	V_{SD}	$T_J = 25^oC$, $I_{SD} = 5.6A$, $V_{GS} = 0V$ (Figure 13)	-	-	2.5	V
Reverse Recovery Time	t_{rr}	$T_J = 25^oC$, $I_{SD} = 5.6A$, $dI_{SD}/d_t = 100A/\mu s$	4.6	96	200	ns
Reverse Recovered Charge	Q_{RR}	$T_J = 25^oC$, $I_{SD} = 5.6A$, $dI_{SD}/d_t = 100A/\mu s$	0.17	0.4	0.83	μC

NOTES:

2. Pulse test: pulse width ≤ 300μs, duty cycle ≤ 2%.
3. Repetitive rating: pulse width limited by max junction temperature. See Transient Thermal Impedance curve (Figure 3).
4. $V_{DD} = 25V$, start $T_J = 25^oC$, $L = 910\mu H$, $R_G = 25\Omega$, peak $I_{AS} = 5.6A$.

Typical Performance Curves Unless Otherwise Specified

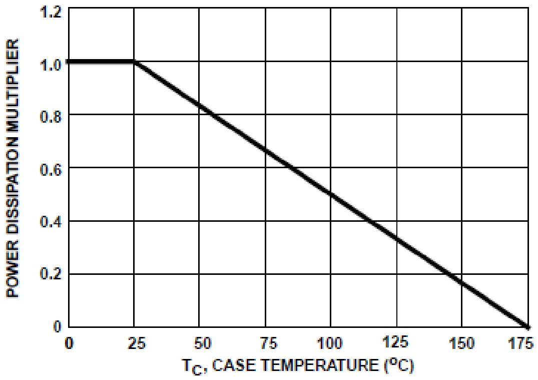


FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE

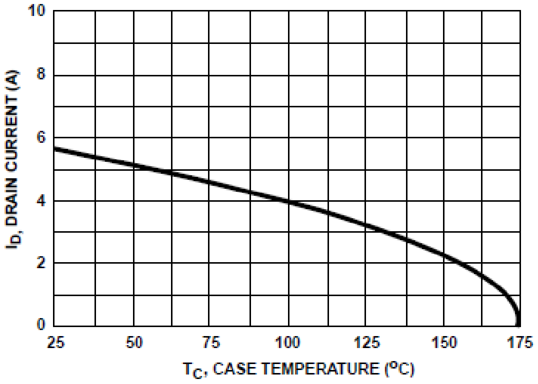
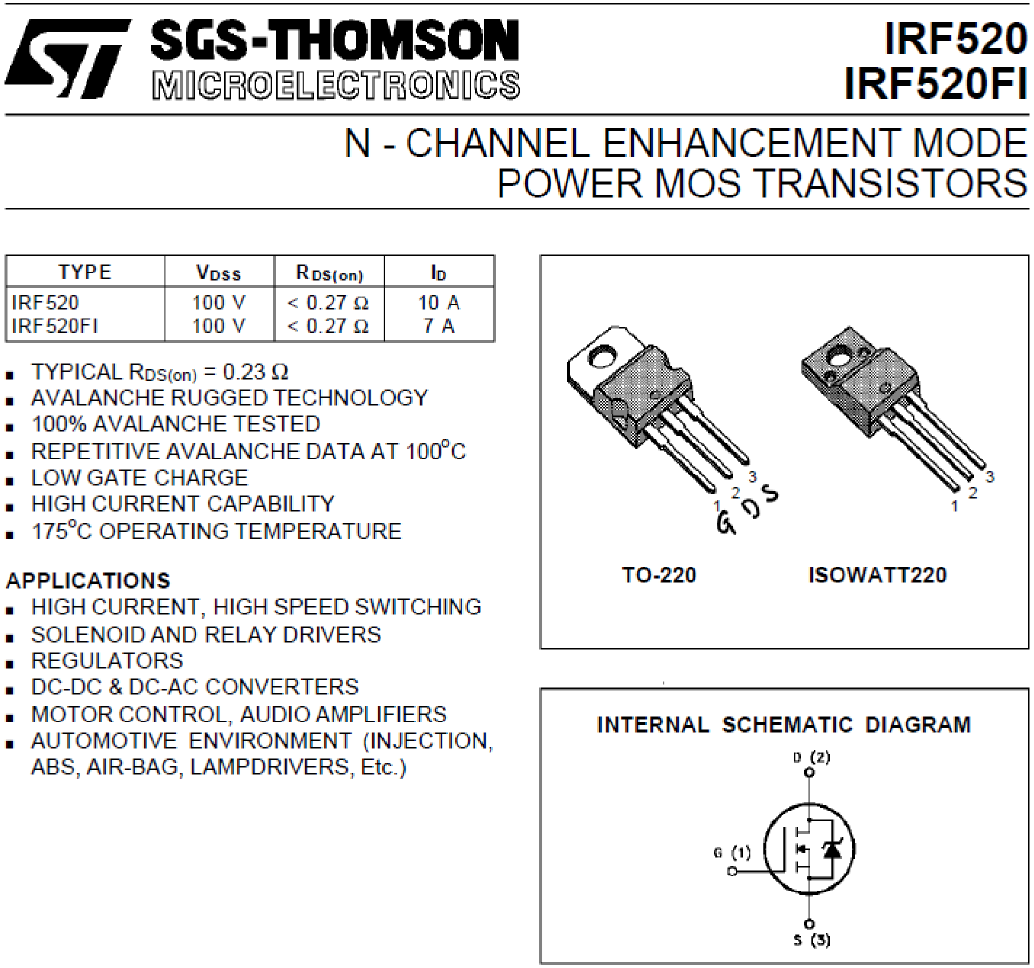


FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

IR520 MOSFET CANAL N 10A 100V RDS 0,270OHM



SGS-THOMSON
MICROELECTRONICS

IRF520
IRF520FI

N - CHANNEL ENHANCEMENT MODE POWER MOS TRANSISTORS

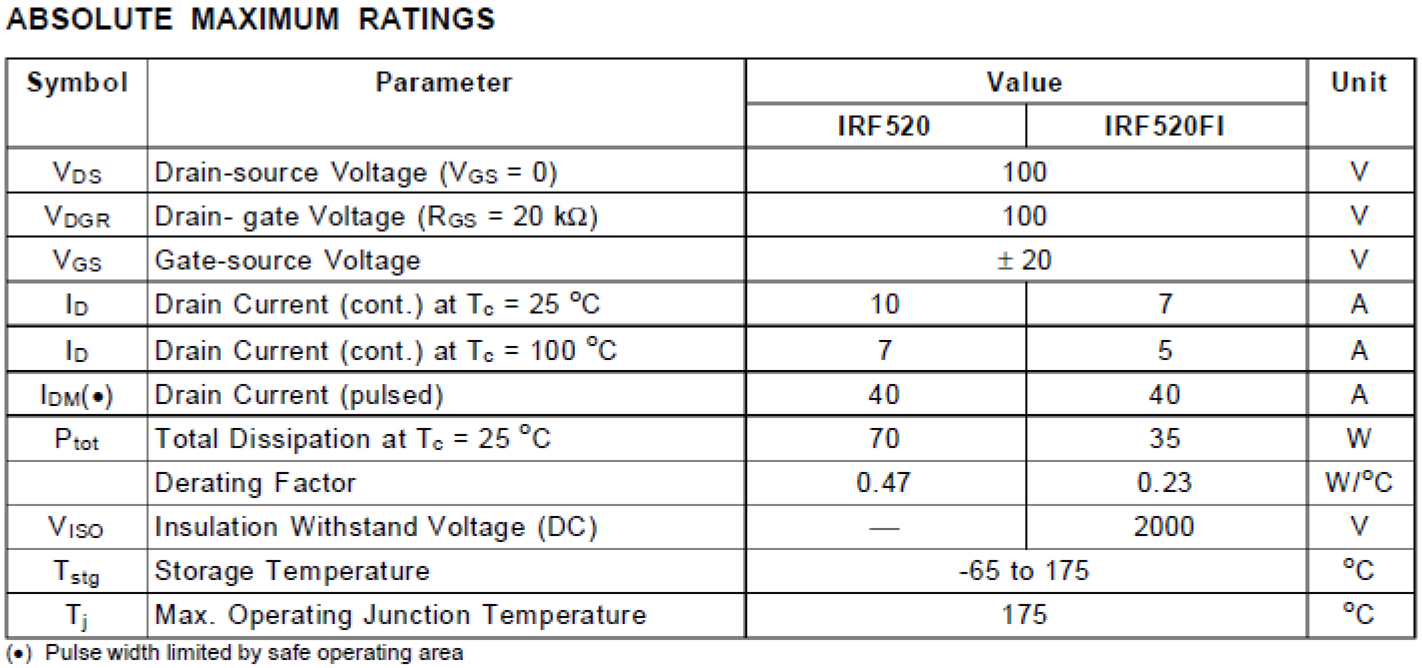
TYPE	V_{DSS}	$R_{DS(on)}$	I_D
IRF520	100 V	< 0.27 Ω	10 A
IRF520FI	100 V	< 0.27 Ω	7 A

- TYPICAL $R_{DS(on)}$ = 0.23 Ω
- AVALANCHE RUGGED TECHNOLOGY
- 100% AVALANCHE TESTED
- REPETITIVE AVALANCHE DATA AT 100°C
- LOW GATE CHARGE
- HIGH CURRENT CAPABILITY
- 175°C OPERATING TEMPERATURE

APPLICATIONS
- HIGH CURRENT, HIGH SPEED SWITCHING
- SOLENOID AND RELAY DRIVERS
- REGULATORS
- DC-DC & DC-AC CONVERTERS
- MOTOR CONTROL, AUDIO AMPLIFIERS
- AUTOMOTIVE ENVIRONMENT (INJECTION, ABS, AIR-BAG, LAMPDRIVERS, Etc.)

TO-220 ISOWATT220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		IRF520	IRF520FI	
V_{DS}	Drain-source Voltage (V_{GS} = 0)	100		V
V_{DGR}	Drain- gate Voltage (R_{GS} = 20 kΩ)	100		V
V_{GS}	Gate-source Voltage	± 20		V
I_D	Drain Current (cont.) at T_c = 25 °C	10	7	A
I_D	Drain Current (cont.) at T_c = 100 °C	7	5	A
I_{DM}(•)	Drain Current (pulsed)	40	40	A
P_{tot}	Total Dissipation at T_c = 25 °C	70	35	W
	Derating Factor	0.47	0.23	W/°C
V_{ISO}	Insulation Withstand Voltage (DC)	—	2000	V
T_{stg}	Storage Temperature	-65 to 175		°C
T_j	Max. Operating Junction Temperature	175		°C

(•) Pulse width limited by safe operating area

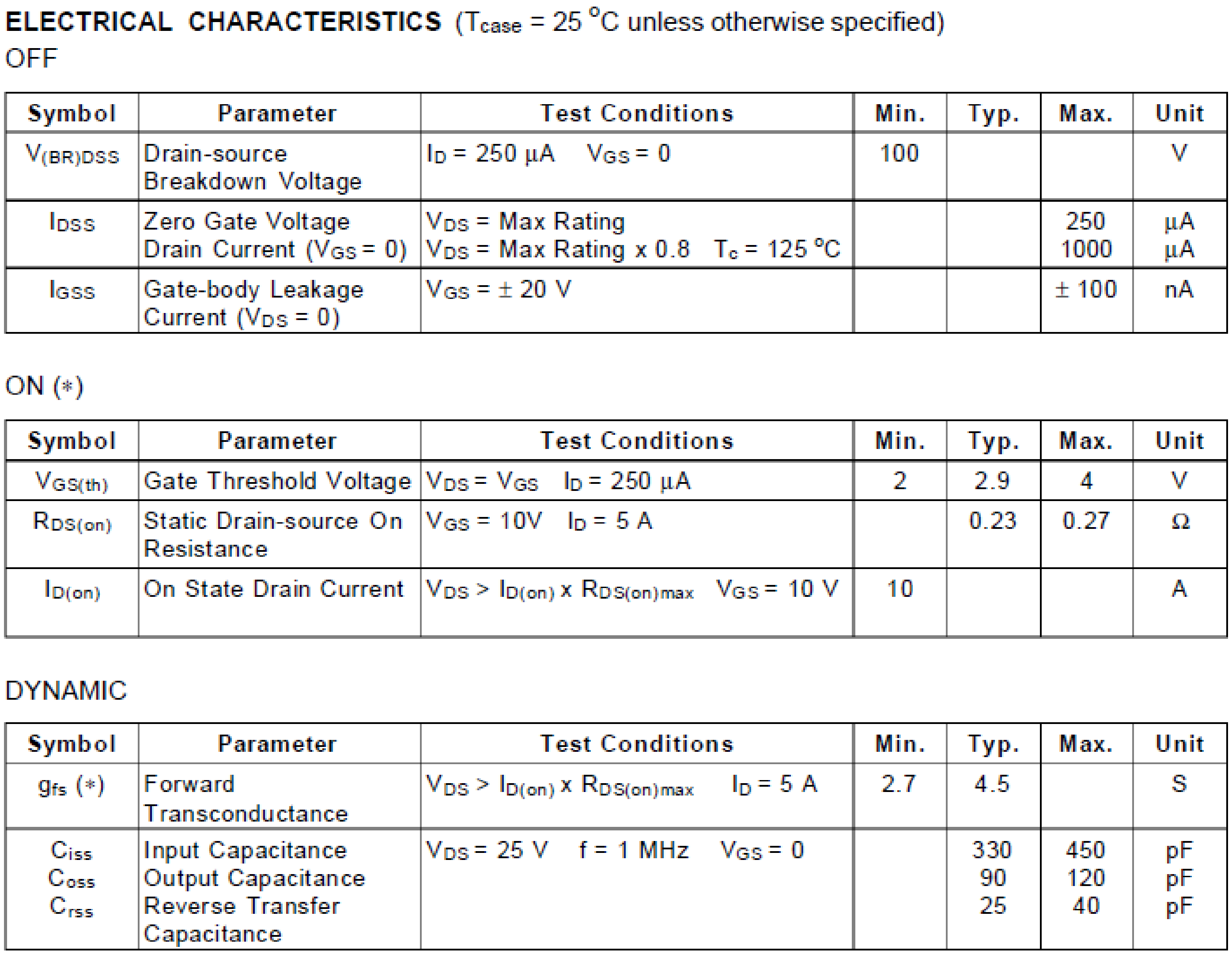
IRF520/FI

THERMAL DATA

		TO-220	ISOWATT220	
$R_{thj-case}$	Thermal Resistance Junction-case Max	2.14	4.29	°C/W
$R_{thj-amb}$	Thermal Resistance Junction-ambient Max	62.5		°C/W
R_{thc-s}	Thermal Resistance Case-sink Typ	0.5		°C/W
T_l	Maximum Lead Temperature For Soldering Purpose	300		°C

AVALANCHE CHARACTERISTICS

Symbol	Parameter	Max Value	Unit
I_{AR}	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T_j max, $\delta < 1\%$)	10	A
E_{AS}	Single Pulse Avalanche Energy (starting $T_j = 25\ ^oC$, $I_D = I_{AR}$, $V_{DD} = 25$ V)	36	mJ
E_{AR}	Repetitive Avalanche Energy (pulse width limited by T_j max, $\delta < 1\%$)	9	mJ
I_{AR}	Avalanche Current, Repetitive or Not-Repetitive ($T_c = 100\ ^oC$, pulse width limited by T_j max, $\delta < 1\%$)	7	A



ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown Voltage	I_D = 250 µA V_{GS} = 0	100			V
I_{DSS}	Zero Gate Voltage Drain Current (V_{GS} = 0)	V_{DS} = Max Rating V_{DS} = Max Rating x 0.8 T_c = 125 °C			250 1000	µA µA
I_{GSS}	Gate-body Leakage Current (V_{DS} = 0)	V_{GS} = ± 20 V			± 100	nA

ON (*)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS} I_D = 250 µA	2	2.9	4	V
$R_{DS(on)}$	Static Drain-source On Resistance	V_{GS} = 10V I_D = 5 A		0.23	0.27	Ω
$I_{D(on)}$	On State Drain Current	$V_{DS} > I_{D(on)} \times R_{DS(on)max}$ V_{GS} = 10 V	10			A

DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} (*)	Forward Transconductance	$V_{DS} > I_{D(on)} \times R_{DS(on)max}$ I_D = 5 A	2.7	4.5		S
C_{iss} C_{oss} C_{rss}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	V_{DS} = 25 V f = 1 MHz V_{GS} = 0		330 90 25	450 120 40	pF pF pF

ELECTRICAL CHARACTERISTICS (continued)

SWITCHING RESISTIVE LOAD

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on Time	V_{DD} = 50 V I_D = 5 A R_{GS} = 4.7 Ω V_{GS} = 10 V (see test circuit)		10	15	ns
t_r	Rise Time			50	75	ns
$t_{d(off)}$	Turn-off Delay Time			25	40	ns
t_f	Fall Time			20	30	ns
Q_g	Total Gate Charge	I_D = 10 A V_{GS} = 10 V V_{DD} = Max Rating x 0.8 (see test circuit)		15	25	nC
Q_{gs}	Gate-Source Charge			7		nC
Q_{gd}	Gate-Drain Charge			4		nC

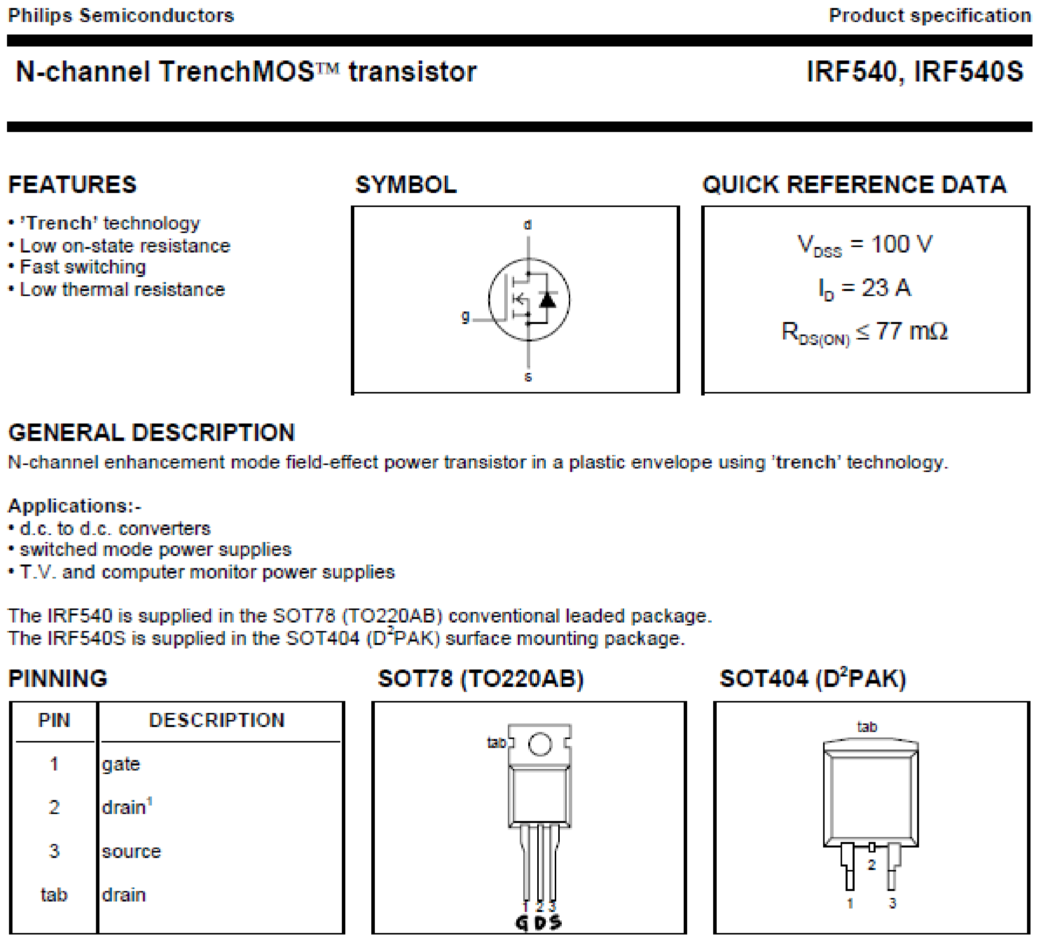
SOURCE DRAIN DIODE

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain Current				10	A
I_{SDM}(•)	Source-drain Current (pulsed)				40	A
V_{SD} (∗)	Forward On Voltage	I_{SD} = 10 A V_{GS} = 0			1.6	V
t_{rr}	Reverse Recovery Time	I_{SD} = 10 A di/dt = 100 A/µs V_{DD} = 20 V T_j = 150 °C		80		ns
Q_{rr}	Reverse Recovery Charge			0.22		µC

(∗) Pulsed: Pulse duration = 300 µs, duty cycle 1.5 %

(•) Pulse width limited by safe operating area

IRF540 MOSFET CANAL N 23A 100V RDS 0,077 OHM



Philips Semiconductors **Product specification**

N-channel TrenchMOS™ transistor IRF540, IRF540S

FEATURES

- 'Trench' technology
- Low on-state resistance
- Fast switching
- Low thermal resistance

SYMBOL

QUICK REFERENCE DATA

V_{DSS} = 100 V

I_D = 23 A

$R_{DS(ON)} \leq 77$ mΩ

GENERAL DESCRIPTION

N-channel enhancement mode field-effect power transistor in a plastic envelope using 'trench' technology.

Applications:-
- d.c. to d.c. converters
- switched mode power supplies
- T.V. and computer monitor power supplies

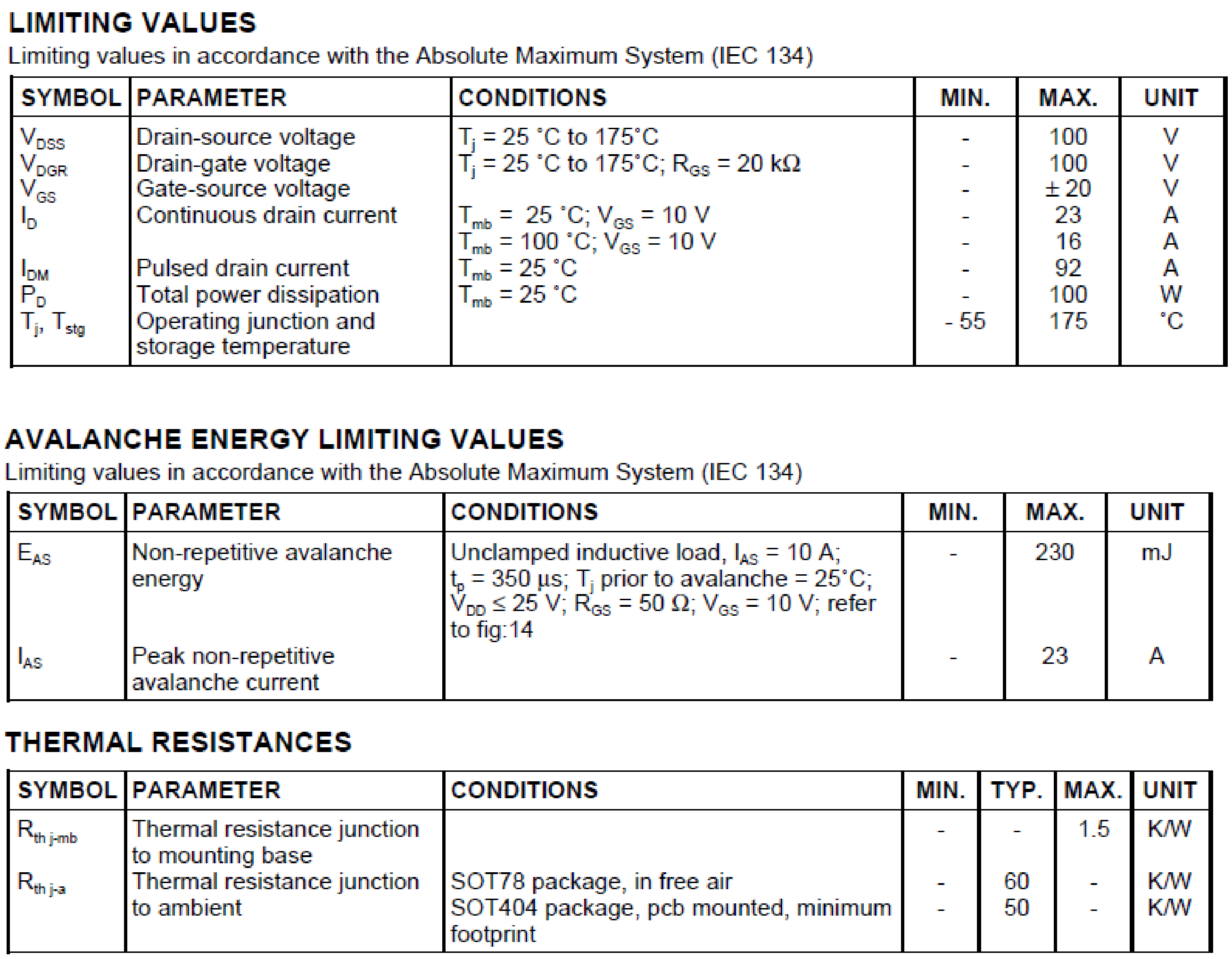
The IRF540 is supplied in the SOT78 (TO220AB) conventional leaded package.
The IRF540S is supplied in the SOT404 (D^2PAK) surface mounting package.

PINNING

PIN	DESCRIPTION
1	gate
2	drain[1]
3	source
tab	drain

SOT78 (TO220AB)

SOT404 (D^2PAK)



LIMITING VALUES

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DSS}	Drain-source voltage	T_j = 25 ˚C to 175˚C	-	100	V
V_{DGR}	Drain-gate voltage	T_j = 25 ˚C to 175˚C; R_{GS} = 20 kΩ	-	100	V
V_{GS}	Gate-source voltage		-	± 20	V
I_D	Continuous drain current	T_{mb} = 25 ˚C; V_{GS} = 10 V	-	23	A
		T_{mb} = 100 ˚C; V_{GS} = 10 V	-	16	A
I_{DM}	Pulsed drain current	T_{mb} = 25 ˚C	-	92	A
P_D	Total power dissipation	T_{mb} = 25 ˚C	-	100	W
T_j, T_{stg}	Operating junction and storage temperature		- 55	175	˚C

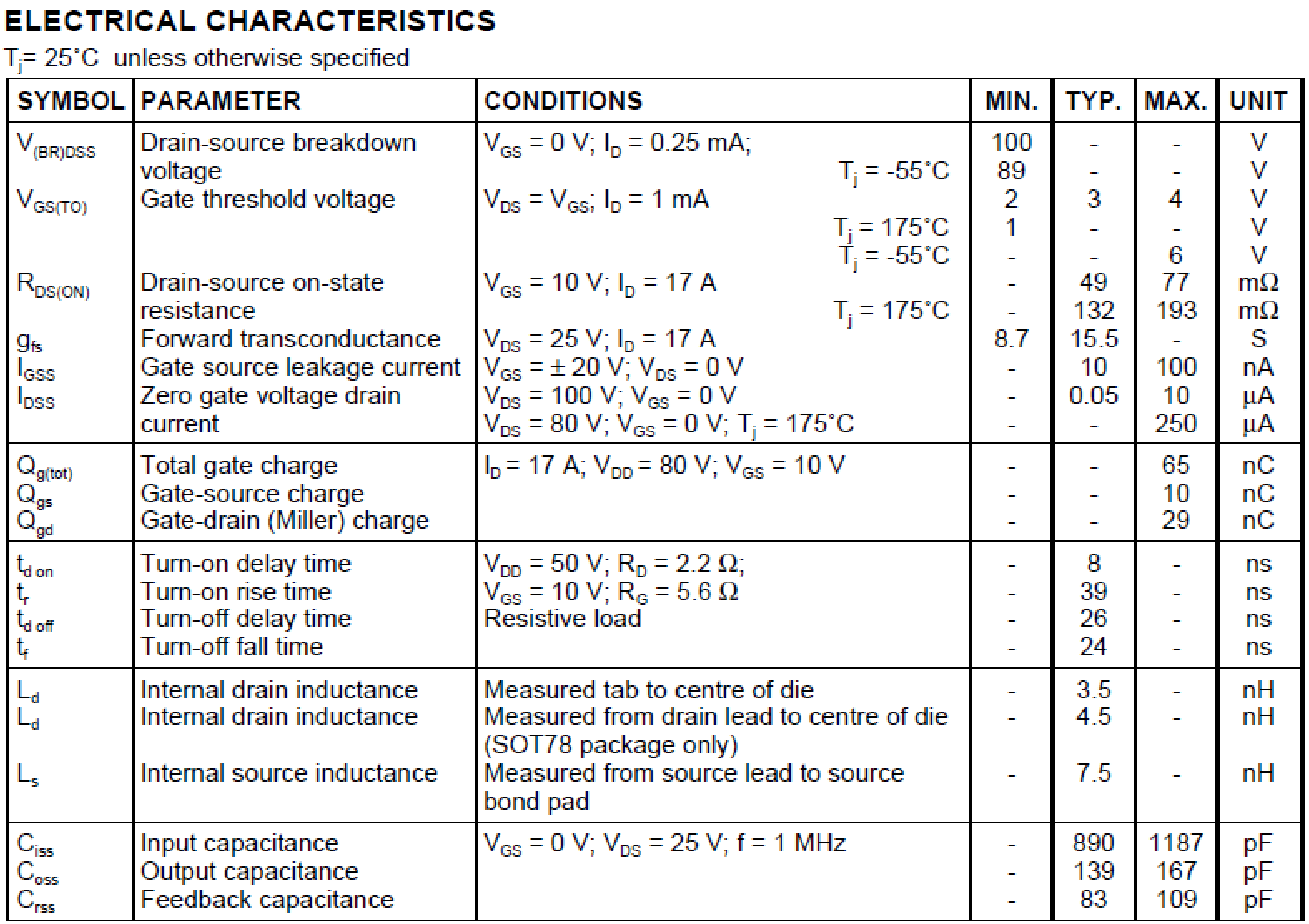
AVALANCHE ENERGY LIMITING VALUES

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
E_{AS}	Non-repetitive avalanche energy	Unclamped inductive load, I_{AS} = 10 A; t_p = 350 µs; T_j prior to avalanche = 25˚C; $V_{DD} \leq$ 25 V; R_{GS} = 50 Ω; V_{GS} = 10 V; refer to fig:14	-	230	mJ
I_{AS}	Peak non-repetitive avalanche current		-	23	A

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$R_{th\ j\text{-}mb}$	Thermal resistance junction to mounting base		-	-	1.5	K/W
$R_{th\ j\text{-}a}$	Thermal resistance junction to ambient	SOT78 package, in free air	-	60	-	K/W
		SOT404 package, pcb mounted, minimum footprint	-	50	-	K/W

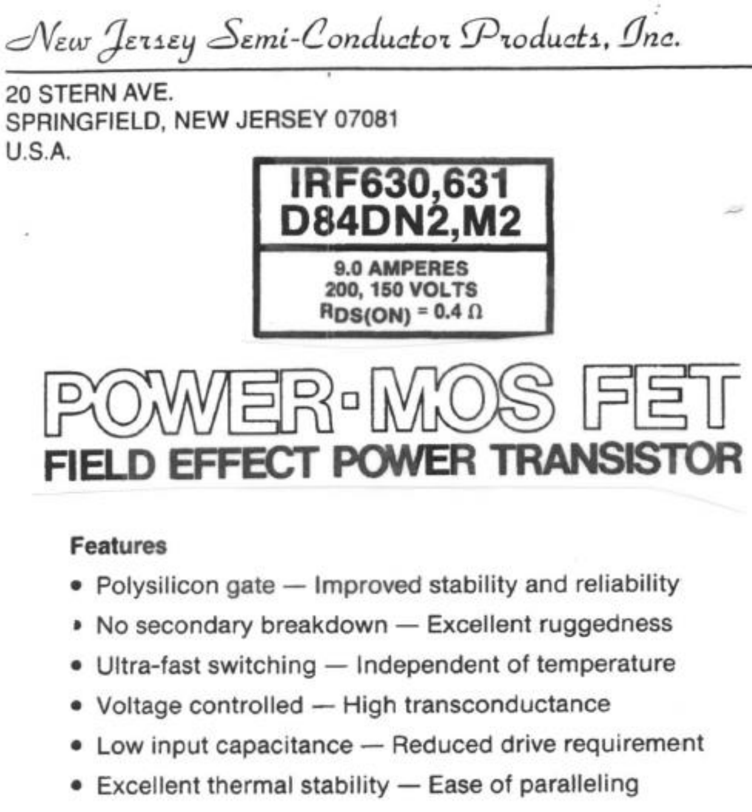


ELECTRICAL CHARACTERISTICS

T_j= 25°C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V; I_D = 0.25 mA;	100	-	-	V
		T_j = -55°C	89	-	-	V
$V_{GS(TO)}$	Gate threshold voltage	V_{DS} = V_{GS}; I_D = 1 mA	2	3	4	V
		T_j = 175°C	1	-	-	V
		T_j = -55°C	-	-	6	V
$R_{DS(ON)}$	Drain-source on-state resistance	V_{GS} = 10 V; I_D = 17 A	-	49	77	mΩ
		T_j = 175°C	-	132	193	mΩ
g_{fs}	Forward transconductance	V_{DS} = 25 V; I_D = 17 A	8.7	15.5	-	S
I_{GSS}	Gate source leakage current	V_{GS} = ± 20 V; V_{DS} = 0 V	-	10	100	nA
I_{DSS}	Zero gate voltage drain current	V_{DS} = 100 V; V_{GS} = 0 V	-	0.05	10	µA
		V_{DS} = 80 V; V_{GS} = 0 V; T_j = 175°C	-	-	250	µA
$Q_{g(tot)}$	Total gate charge	I_D = 17 A; V_{DD} = 80 V; V_{GS} = 10 V	-	-	65	nC
Q_{gs}	Gate-source charge		-	-	10	nC
Q_{gd}	Gate-drain (Miller) charge		-	-	29	nC
$t_{d\ on}$	Turn-on delay time	V_{DD} = 50 V; R_D = 2.2 Ω;	-	8	-	ns
t_r	Turn-on rise time	V_{GS} = 10 V; R_G = 5.6 Ω	-	39	-	ns
$t_{d\ off}$	Turn-off delay time	Resistive load	-	26	-	ns
t_f	Turn-off fall time		-	24	-	ns
L_d	Internal drain inductance	Measured tab to centre of die	-	3.5	-	nH
L_d	Internal drain inductance	Measured from drain lead to centre of die (SOT78 package only)	-	4.5	-	nH
L_s	Internal source inductance	Measured from source lead to source bond pad	-	7.5	-	nH
C_{iss}	Input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz	-	890	1187	pF
C_{oss}	Output capacitance		-	139	167	pF
C_{rss}	Feedback capacitance		-	83	109	pF

IRF630 9A 200V RDS 0,34 OHM



New Jersey Semi-Conductor Products, Inc.

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**IRF630,631
D84DN2,M2**

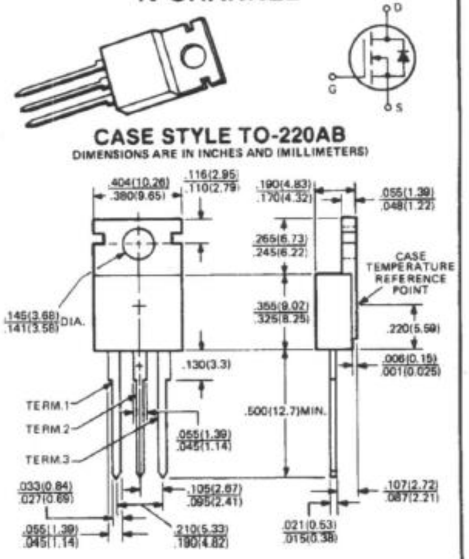
**9.0 AMPERES
200, 150 VOLTS
$R_{DS(ON)} = 0.4\ \Omega$**

POWER-MOS FET
FIELD EFFECT POWER TRANSISTOR

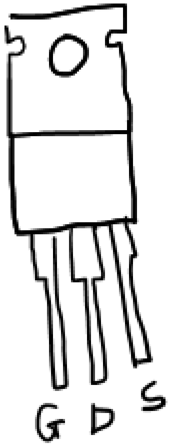
Features

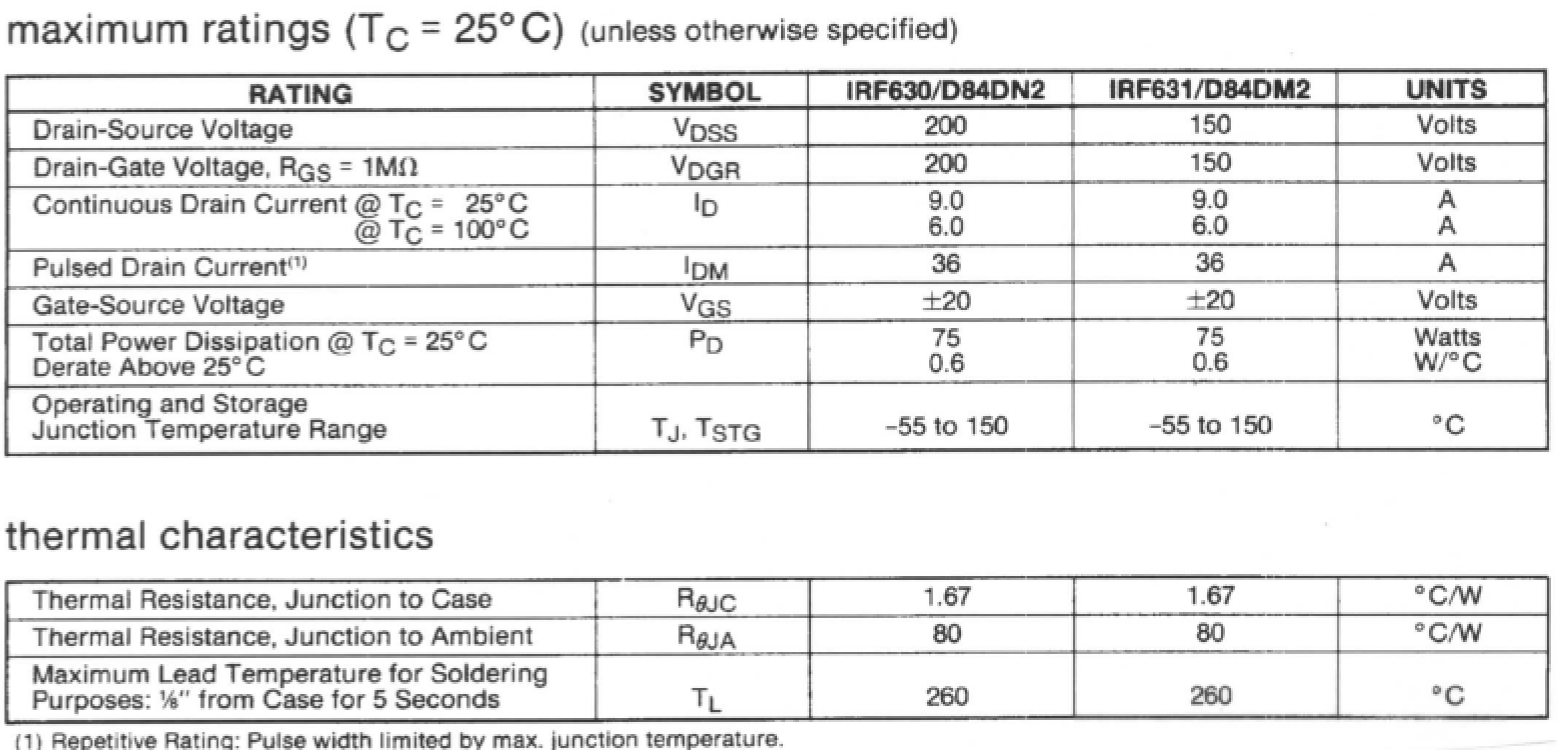
- Polysilicon gate — Improved stability and reliability
- No secondary breakdown — Excellent ruggedness
- Ultra-fast switching — Independent of temperature
- Voltage controlled — High transconductance
- Low input capacitance — Reduced drive requirement
- Excellent thermal stability — Ease of paralleling

N-CHANNEL



UNIT	TYPE	TERM.1	TERM.2	TERM.3	TAB
POWER MOS FET	TO-220-AB	GATE	DRAIN	SOURCE	DRAIN





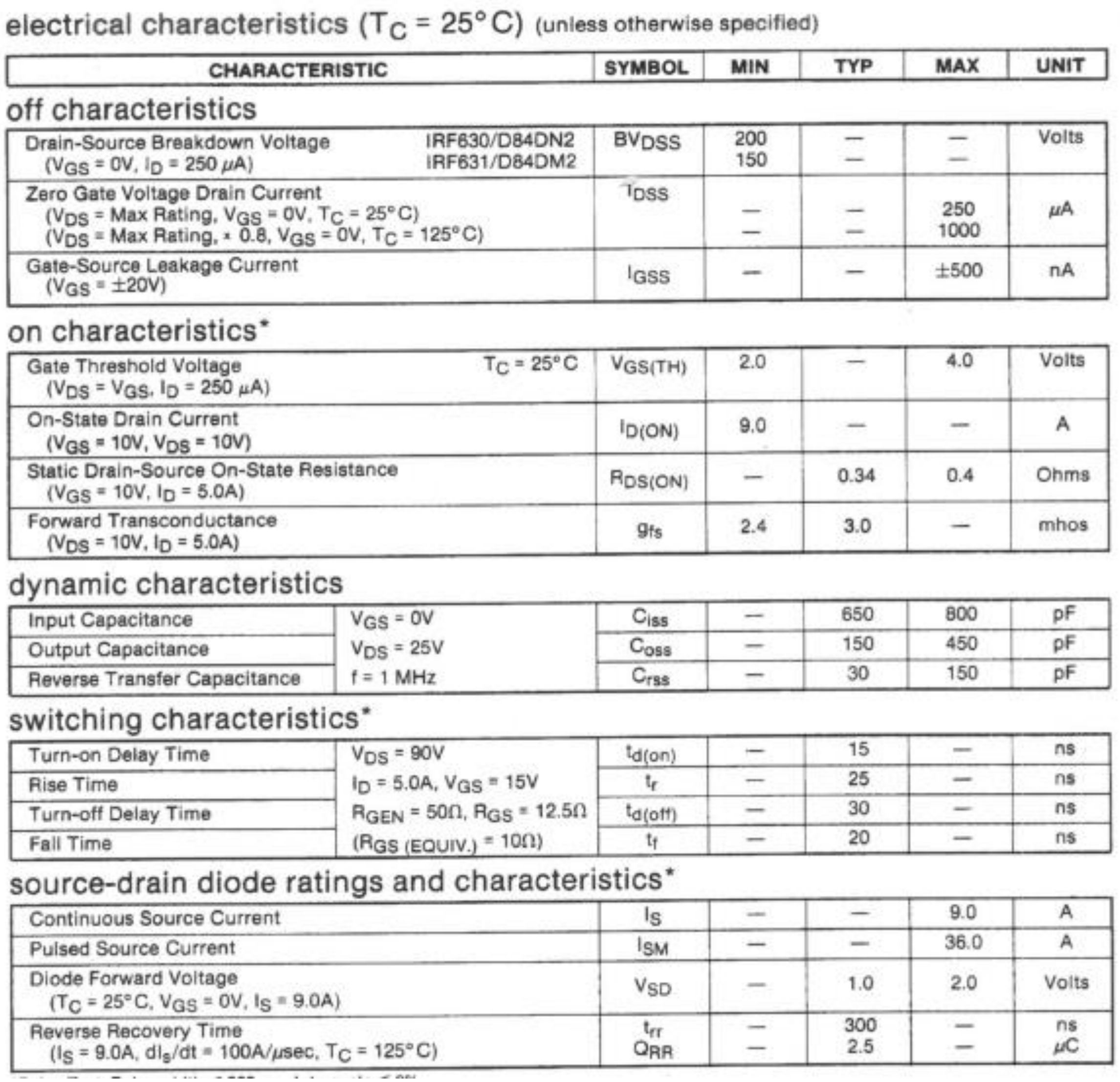
maximum ratings (T_C = 25° C) (unless otherwise specified)

RATING	SYMBOL	IRF630/D84DN2	IRF631/D84DM2	UNITS
Drain-Source Voltage	V_{DSS}	200	150	Volts
Drain-Gate Voltage, R_{GS} = 1MΩ	V_{DGR}	200	150	Volts
Continuous Drain Current @ T_C = 25°C @ T_C = 100°C	I_D	9.0 6.0	9.0 6.0	A A
Pulsed Drain Current⁽¹⁾	I_{DM}	36	36	A
Gate-Source Voltage	V_{GS}	±20	±20	Volts
Total Power Dissipation @ T_C = 25° C Derate Above 25° C	P_D	75 0.6	75 0.6	Watts W/° C
Operating and Storage Junction Temperature Range	T_J, T_{STG}	-55 to 150	-55 to 150	°C

thermal characteristics

Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.67	1.67	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	80	80	°C/W
Maximum Lead Temperature for Soldering Purposes: ⅛" from Case for 5 Seconds	T_L	260	260	°C

(1) Repetitive Rating: Pulse width limited by max. junction temperature.



electrical characteristics ($T_C = 25°C$) (unless otherwise specified)

CHARACTERISTIC		SYMBOL	MIN	TYP	MAX	UNIT
off characteristics						
Drain-Source Breakdown Voltage ($V_{GS} = 0V$, $I_D = 250\ \mu A$)	IRF630/D84DN2 IRF631/D84DM2	BV_{DSS}	200 150	— —	— —	Volts
Zero Gate Voltage Drain Current (V_{DS} = Max Rating, $V_{GS} = 0V$, $T_C = 25°C$) (V_{DS} = Max Rating, × 0.8, $V_{GS} = 0V$, $T_C = 125°C$)		I_{DSS}	— —	— —	250 1000	μA
Gate-Source Leakage Current ($V_{GS} = \pm 20V$)		I_{GSS}	—	—	±500	nA
on characteristics*						
Gate Threshold Voltage ($V_{DS} = V_{GS}$, $I_D = 250\ \mu A$)	$T_C = 25°C$	$V_{GS(TH)}$	2.0	—	4.0	Volts
On-State Drain Current ($V_{GS} = 10V$, $V_{DS} = 10V$)		$I_{D(ON)}$	9.0	—	—	A
Static Drain-Source On-State Resistance ($V_{GS} = 10V$, $I_D = 5.0A$)		$R_{DS(ON)}$	—	0.34	0.4	Ohms
Forward Transconductance ($V_{DS} = 10V$, $I_D = 5.0A$)		g_{fs}	2.4	3.0	—	mhos
dynamic characteristics						
Input Capacitance	$V_{GS} = 0V$	C_{iss}	—	650	800	pF
Output Capacitance	$V_{DS} = 25V$	C_{oss}	—	150	450	pF
Reverse Transfer Capacitance	f = 1 MHz	C_{rss}	—	30	150	pF
switching characteristics*						
Turn-on Delay Time	$V_{DS} = 90V$	$t_{d(on)}$	—	15	—	ns
Rise Time	$I_D = 5.0A$, $V_{GS} = 15V$	t_r	—	25	—	ns
Turn-off Delay Time	$R_{GEN} = 50\Omega$, $R_{GS} = 12.5\Omega$	$t_{d(off)}$	—	30	—	ns
Fall Time	($R_{GS\ (EQUIV.)} = 10\Omega$)	t_f	—	20	—	ns
source-drain diode ratings and characteristics*						
Continuous Source Current		I_S	—	—	9.0	A
Pulsed Source Current		I_{SM}	—	—	36.0	A
Diode Forward Voltage ($T_C = 25°C$, $V_{GS} = 0V$, $I_S = 9.0A$)		V_{SD}	—	1.0	2.0	Volts
Reverse Recovery Time ($I_S = 9.0A$, $dI_s/dt = 100A/\mu sec$, $T_C = 125°C$)		t_{rr} Q_{RR}	— —	300 2.5	— —	ns μC

IRF640 MOSFET CANAL N 200V 18A RDS 0,165 OHM VGS 10V

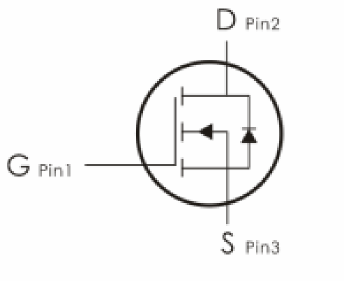
DOINGTER

IRF640

Description:

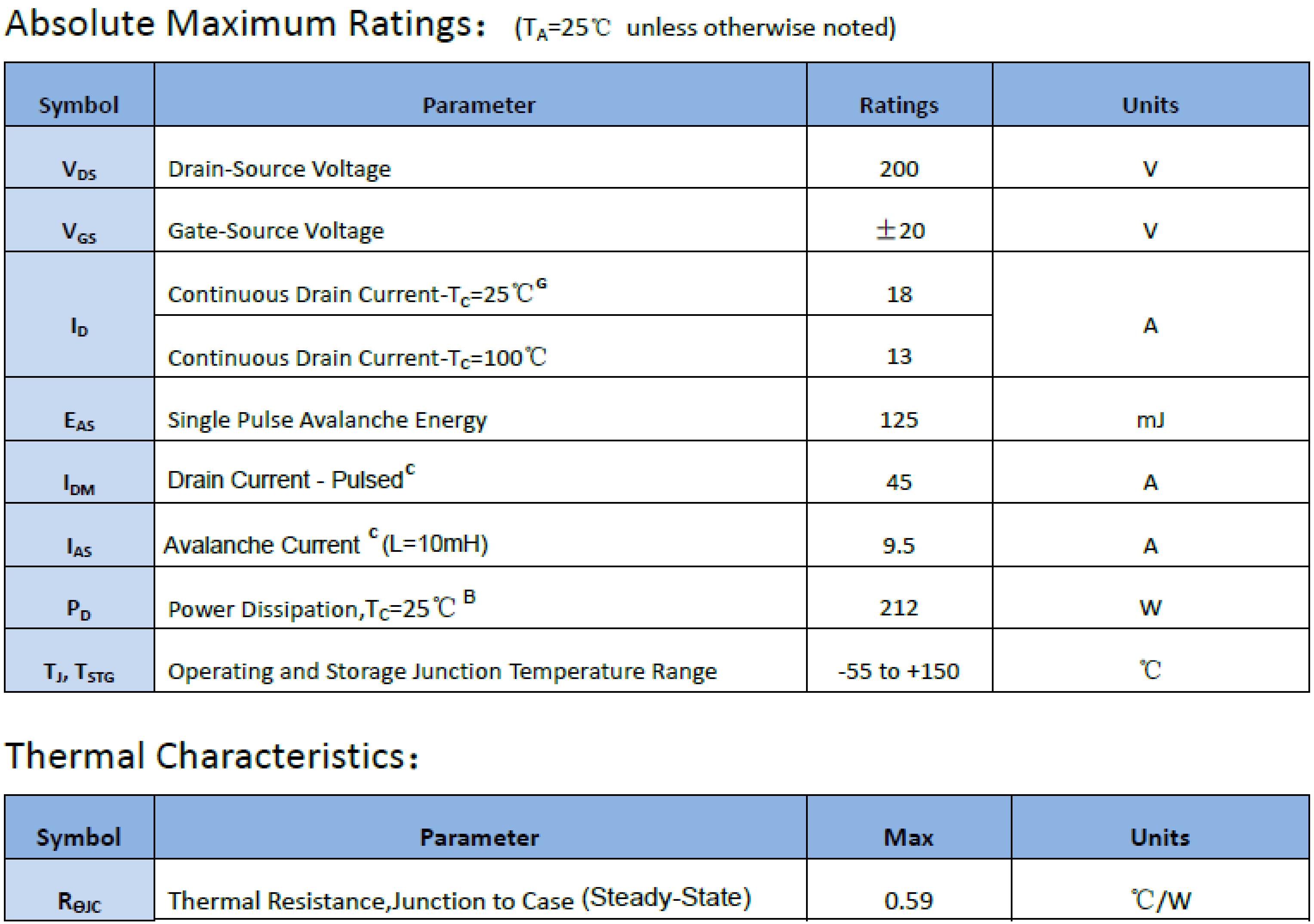
This N-Channel MOSFET uses advanced trench technology and design to provide excellent $R_{DS(on)}$ with low gate charge.

It can be used in a wide variety of applications.



Features:

1) V_{DS}=200V,I_D=18A,$R_{DS(ON)}$<165mΩ @V_{GS}=10V
2) Low gate charge.
3) Green device available.
4) Advanced high cell denity trench technology for ultra low $R_{DS(ON)}$.
5) Excellent package for good heat dissipation.



Absolute Maximum Ratings: (T_A=25℃ unless otherwise noted)

Symbol	Parameter	Ratings	Units
V_{DS}	Drain-Source Voltage	200	V
V_{GS}	Gate-Source Voltage	±20	V
I_D	Continuous Drain Current-T_C=25℃[G]	18	A
	Continuous Drain Current-T_C=100℃	13	
E_{AS}	Single Pulse Avalanche Energy	125	mJ
I_{DM}	Drain Current - Pulsed[C]	45	A
I_{AS}	Avalanche Current [C] (L=10mH)	9.5	A
P_D	Power Dissipation,T_C=25℃ [B]	212	W
T_J, T_{STG}	Operating and Storage Junction Temperature Range	-55 to +150	℃

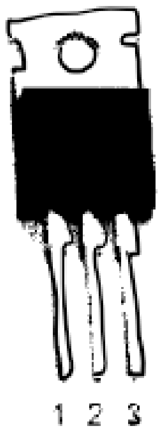
Thermal Characteristics:

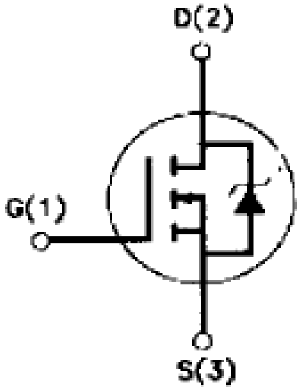
Symbol	Parameter	Max	Units
$R_{\theta JC}$	Thermal Resistance,Junction to Case (Steady-State)	0.59	℃/W

Electrical Characteristics： (T_A=25℃ unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Off Characteristics						
BV_{DSS}	Drain-Sourtce Breakdown Voltage	V_{GS}=0V,I_D=250 μ A	200	---	---	V
I_{DSS}	Zero Gate Voltage Drain Current	V_{GS}=0V, V_{DS}=200V	---	---	1	μ A
I_{GSS}	Gate-Source Leakage Current	V_{GS}=±20V, V_{DS}=0A	---	---	±100	nA
On Characteristics						
$V_{GS(th)}$	GATE-Source Threshold Voltage	V_{GS}=V_{DS}, I_D=250 μ A	1	---	3	V
$R_{DS(ON)}$	Drain-Source On Resistance	V_{GS}=10V,I_D=1A	---	120	165	m Ω
		V_{GS}=4.5 V,I_D=1A	---	150	180	m Ω
Dynamic Characteristics						
R_g	Gate resistance	V_{DS}=0V, V_{GS}=0V, f=1MHz	---	6.5	----	Ω
C_{iss}	Input Capacitance	V_{DS}=25V, V_{GS}=0V, f=1MHz	---	800	---	pF
C_{oss}	Output Capacitance		---	100	---	
C_{rss}	Reverse Transfer Capacitance		---	60	---	
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{GS}=10V ,V_{DS}=100V, R_L=5.5Ω,R_{GEN}=3Ω	---	8	---	ns
t_r	Rise Time		---	10	---	ns
$t_{d(off)}$	Turn-Off Delay Time		---	30	---	ns
t_f	Fall Time		---	4	---	ns
Q_g	Total Gate Charge	V_{GS}=10V, V_{DS}=100V, I_D=18A	---	27	40	nC
Q_{gs}	Gate-Source Charge		---	7	---	nC
Q_{gd}	Gate-Drain "Miller" Charge		---	3	---	nC
Drain-Source Diode Characteristics						

IRF840 MOSFET CANAL N 8A 500V 0,85 OHM





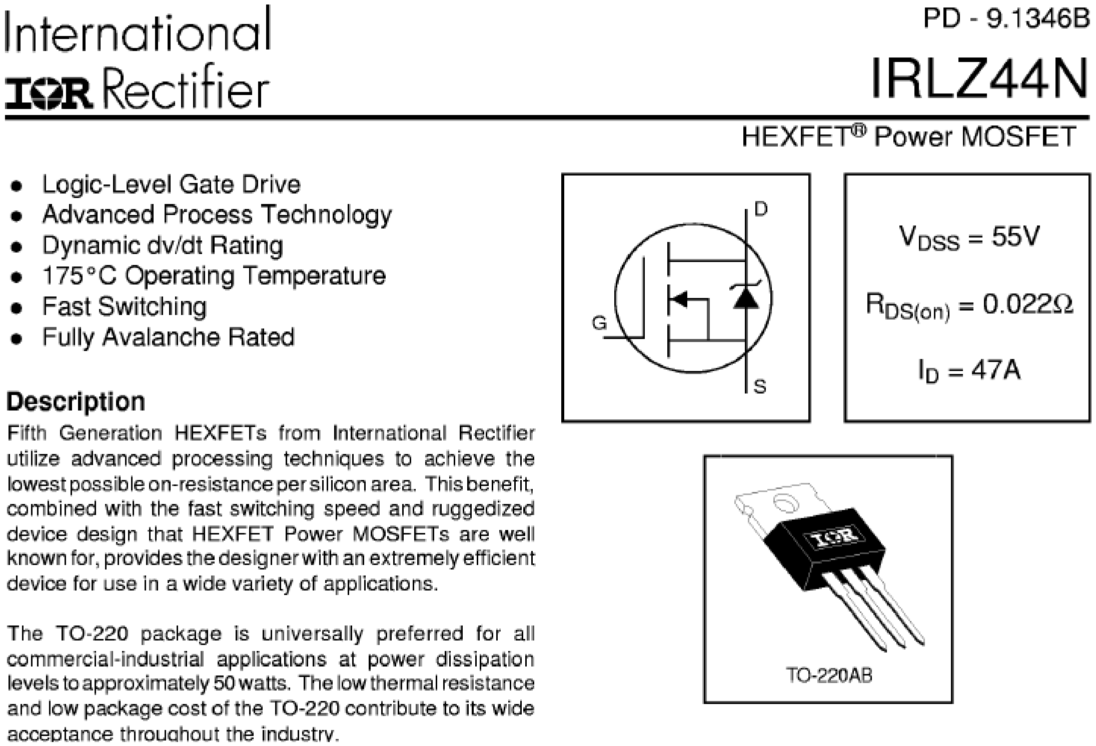
PIN 1.Gate
2.Drain
3.Source
TO-220C package

SYMBOL	PARAMETER	VALUE	UNIT
V_{DSS}	Drain-Source Voltage	500	V
V_{GS}	Gate-Source Voltage-Continuous	±20	V
I_D	Drain Current-Continuous	8	A
I_{DM}	Drain Current-Single Plused	32	A
P_D	Total Dissipation @T_C=25℃	125	W
T_j	Max. Operating Junction Temperature	150	℃
T_{stg}	Storage Temperature	-55~150	℃

• THERMAL CHARACTERISTICS

SYMBOL	PARAMETER
$R_{th\ j\text{-}c}$	Thermal Resistance,Junc ion to
$R_{th\ j\text{-}a}$	Thermal Resistance,Junc ion to

IRLZ44 47A 47A BAIXA TENSÃO DE GATE



International
IOR Rectifier

PD - 9.1346B

IRLZ44N

HEXFET® Power MOSFET

- Logic-Level Gate Drive
- Advanced Process Technology
- Dynamic dv/dt Rating
- 175°C Operating Temperature
- Fast Switching
- Fully Avalanche Rated

$V_{DSS} = 55V$

$R_{DS(on)} = 0.022\Omega$

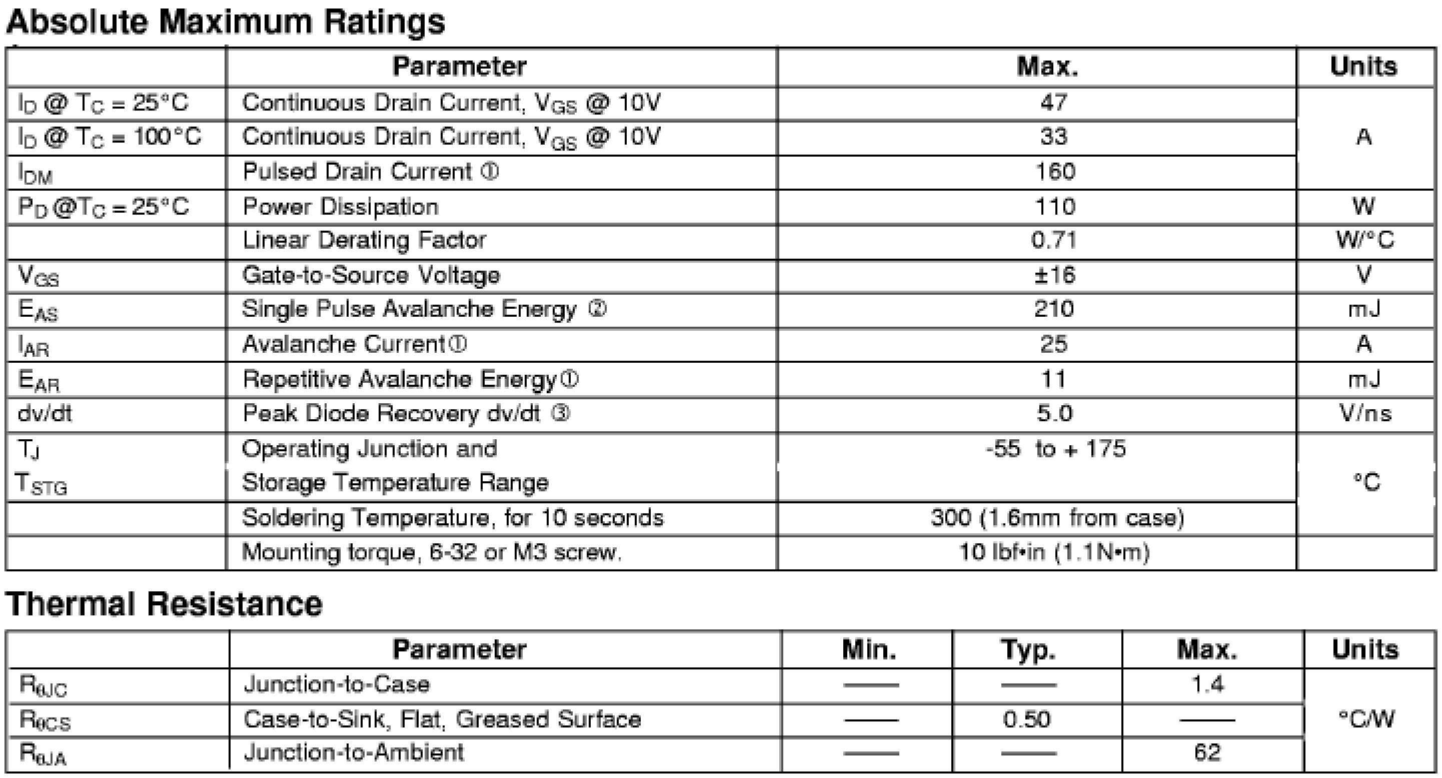
$I_D = 47A$

TO-220AB

Description

Fifth Generation HEXFETs from International Rectifier utilize advanced processing techniques to achieve the lowest possible on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design that HEXFET Power MOSFETs are well known for, provides the designer with an extremely efficient device for use in a wide variety of applications.

The TO-220 package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 watts. The low thermal resistance and low package cost of the TO-220 contribute to its wide acceptance throughout the industry.

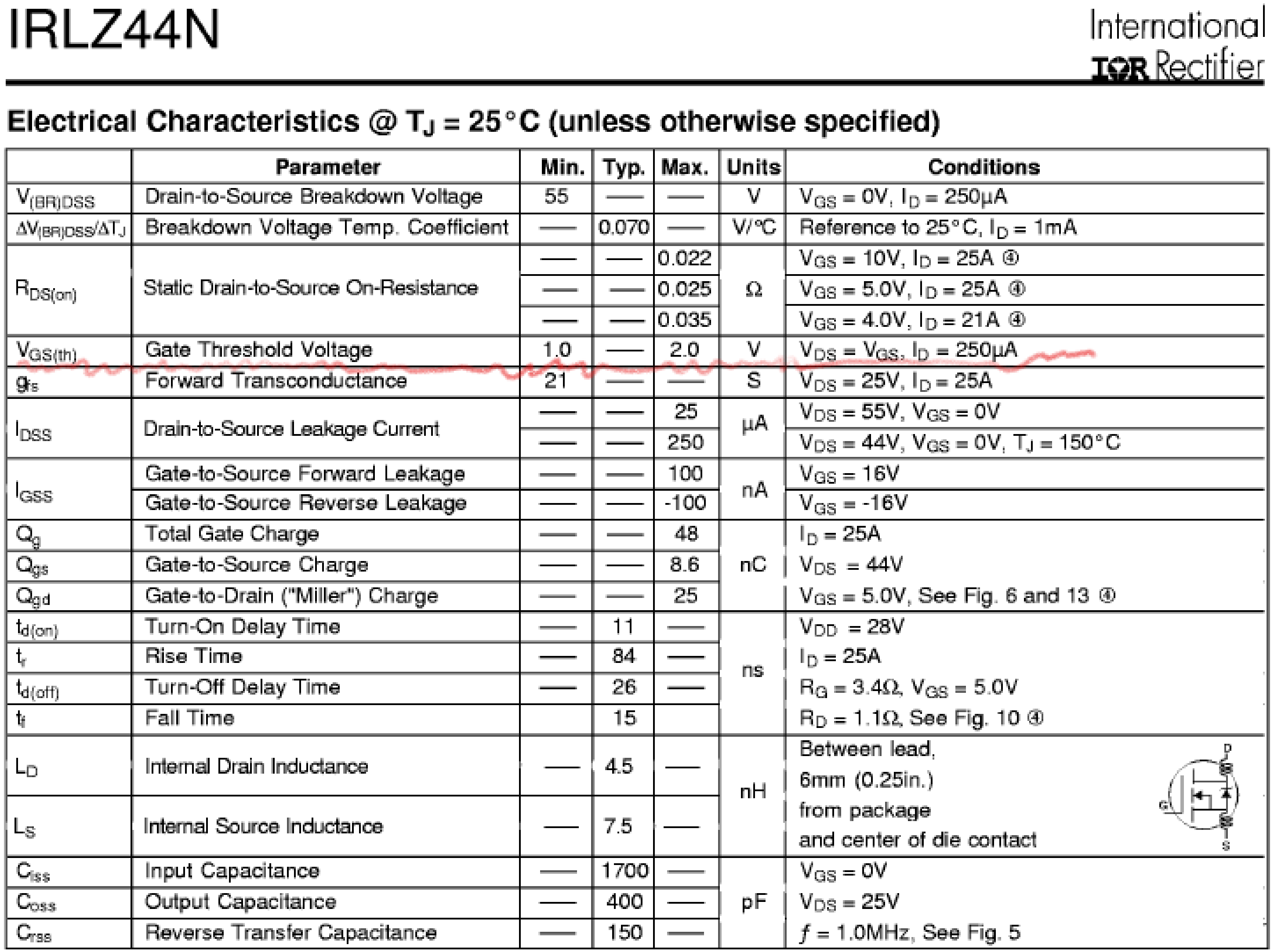


Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V	47	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V	33	
I_{DM}	Pulsed Drain Current ①	160	
P_D @T_C = 25°C	Power Dissipation	110	W
	Linear Derating Factor	0.71	W/°C
V_{GS}	Gate-to-Source Voltage	±16	V
E_{AS}	Single Pulse Avalanche Energy ②	210	mJ
I_{AR}	Avalanche Current①	25	A
E_{AR}	Repetitive Avalanche Energy①	11	mJ
dv/dt	Peak Diode Recovery dv/dt ③	5.0	V/ns
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 175	°C
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	
	Mounting torque, 6-32 or M3 screw.	10 lbf•in (1.1N•m)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	——	——	1.4	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	——	0.50	——	
$R_{\theta JA}$	Junction-to-Ambient	——	——	62	

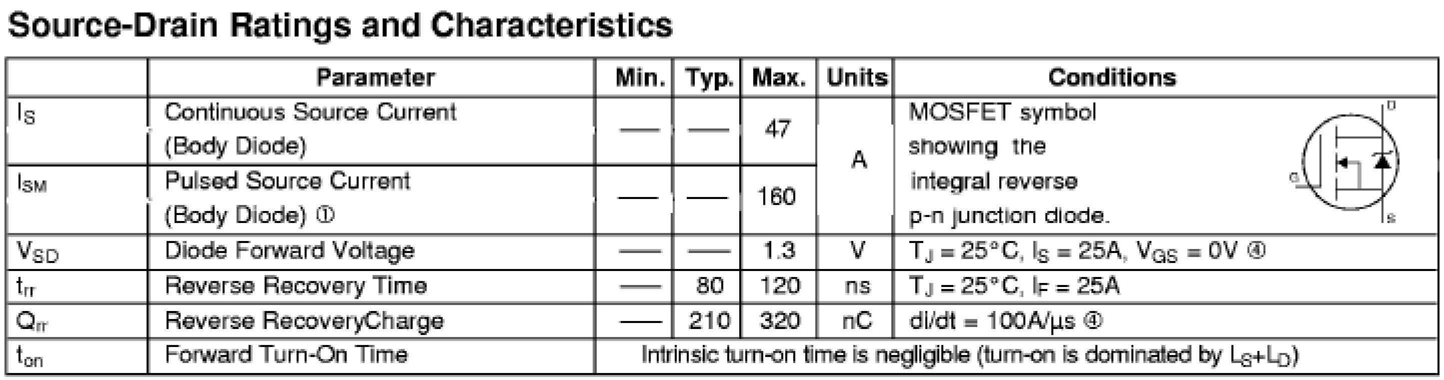


IRLZ44N

International
IOR Rectifier

Electrical Characteristics @ $T_J = 25°C$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	55	—	—	V	$V_{GS} = 0V$, $I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.070	—	V/°C	Reference to 25°C, $I_D = 1mA$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	0.022	Ω	$V_{GS} = 10V$, $I_D = 25A$ ④
		—	—	0.025		$V_{GS} = 5.0V$, $I_D = 25A$ ④
		—	—	0.035		$V_{GS} = 4.0V$, $I_D = 21A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	1.0	—	2.0	V	$V_{DS} = V_{GS}$, $I_D = 250\mu A$
g_{fs}	Forward Transconductance	21	—	—	S	$V_{DS} = 25V$, $I_D = 25A$
I_{DSS}	Drain-to-Source Leakage Current	—	—	25	μA	$V_{DS} = 55V$, $V_{GS} = 0V$
		—	—	250		$V_{DS} = 44V$, $V_{GS} = 0V$, $T_J = 150°C$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 16V$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -16V$
Q_g	Total Gate Charge	—	—	48	nC	$I_D = 25A$
Q_{gs}	Gate-to-Source Charge	—	—	8.6		$V_{DS} = 44V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	25		$V_{GS} = 5.0V$, See Fig. 6 and 13 ④
$t_{d(on)}$	Turn-On Delay Time	—	11	—	ns	$V_{DD} = 28V$
t_r	Rise Time	—	84	—		$I_D = 25A$
$t_{d(off)}$	Turn-Off Delay Time	—	26	—		$R_G = 3.4\Omega$, $V_{GS} = 5.0V$
t_f	Fall Time		15			$R_D = 1.1\Omega$, See Fig. 10 ④
L_D	Internal Drain Inductance	—	4.5	—	nH	Between lead, 6mm (0.25in.) from package and center of die contact
L_S	Internal Source Inductance	—	7.5	—		
C_{iss}	Input Capacitance	—	1700	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	400	—		$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	—	150	—		$f = 1.0MHz$, See Fig. 5



Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	47	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	160		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25°C$, $I_S = 25A$, $V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	80	120	ns	$T_J = 25°C$, $I_F = 25A$
Q_{rr}	Reverse RecoveryCharge	—	210	320	nC	di/dt = 100A/µs ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by L_S+L_D)				

IRFZ44N CNAL N BAIXÍSSIMO RDS 0,022OHM BAIXA TENSÃO 55V ALTA CORRENTE 49 A ISOLAÇÃO 2KV

Philips Semiconductors **Product specification**

N-channel enhancement mode TrenchMOS^{TM} transistor **IRFZ44N**

GENERAL DESCRIPTION

N-channel enhancement mode standard level field-effect power transistor in a plastic envelope using '**trench**' technology. The device features very low on-state resistance and has integral zener diodes giving ESD protection up to 2kV. It is intended for use in switched mode power supplies and general purpose switching applications.

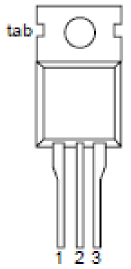
QUICK REFERENCE DATA

SYMBOL	PARAMETER	MAX.	UNIT
V_{DS}	Drain-source voltage	55	V
I_D	Drain current (DC)	49	A
P_{tot}	Total power dissipation	110	W
T_j	Junction temperature	175	˚C
$R_{DS(ON)}$	Drain-source on-state resistance V_{GS} = 10 V	22	mΩ

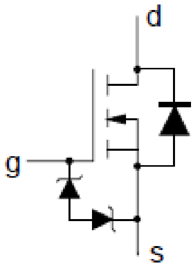
PINNING - TO220AB

PIN	DESCRIPTION
1	gate
2	drain
3	source
tab	drain

PIN CONFIGURATION



SYMBOL



LIMITING VALUES

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	Drain-source voltage	-	-	55	V
V_{DGR}	Drain-gate voltage	R_{GS} = 20 kΩ	-	55	V
$\pm V_{GS}$	Gate-source voltage	-	-	20	V
I_D	Drain current (DC)	T_{mb} = 25 °C	-	49	A
I_D	Drain current (DC)	T_{mb} = 100 °C	-	35	A
I_{DM}	Drain current (pulse peak value)	T_{mb} = 25 °C	-	160	A
P_{tot}	Total power dissipation	T_{mb} = 25 °C	-	110	W
T_{stg}, T_j	Storage & operating temperature	-	- 55	175	°C

ESD LIMITING VALUE

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_C	Electrostatic discharge capacitor voltage, all pins	Human body model (100 pF, 1.5 kΩ)	-	2	kV

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}mb}$	Thermal resistance junction to mounting base	-	-	1.4	K/W
$R_{th\ j\text{-}a}$	Thermal resistance junction to ambient	in free air	60	-	K/W

STATIC CHARACTERISTICS

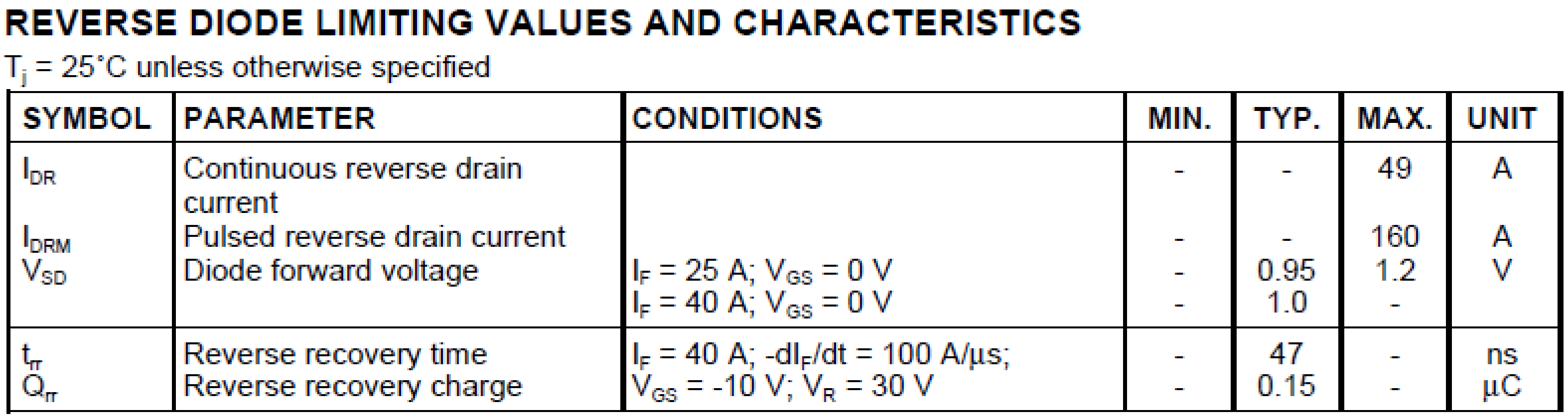
T_j = 25°C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V; I_D = 0.25 mA;	55	-	-	V
		T_j = -55°C	50	-	-	V
$V_{GS(TO)}$	Gate threshold voltage	V_{DS} = V_{GS}; I_D = 1 mA	2.0	3.0	4.0	V
		T_j = 175°C	1.0	-	-	V
		T_j = -55°C	-	-	4.4	
I_{DSS}	Zero gate voltage drain current	V_{DS} = 55 V; V_{GS} = 0 V;	-	0.05	10	µA
		T_j = 175°C	-	-	500	µA
I_{GSS}	Gate source leakage current	V_{GS} = ±10 V; V_{DS} = 0 V	-	0.04	1	µA
		T_j = 175°C	-	-	20	µA
$\pm V_{(BR)GSS}$	Gate source breakdown voltage	I_G = ±1 mA;	16	-	-	V
$R_{DS(ON)}$	Drain-source on-state resistance	V_{GS} = 10 V; I_D = 25 A	-	15	22	mΩ
		T_j = 175°C	-	-	42	mΩ

DYNAMIC CHARACTERISTICS

T_{mb} = 25°C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
g_{fs}	Forward transconductance	V_{DS} = 25 V; I_D = 25 A	6	-	-	S
C_{iss}	Input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz	-	1350	1800	pF
C_{oss}	Output capacitance		-	330	400	pF
C_{rss}	Feedback capacitance		-	155	215	pF
Q_g	Total gate charge	V_{DD} = 44 V; I_D = 50 A; V_{GS} = 10 V	-	-	62	nC
Q_{gs}	Gate-cource charge		-	-	15	nC
Q_{gd}	Gate-drain (miller) charge		-	-	26	nC
$t_{d\ on}$	Turn-on delay time	V_{DD} = 30 V; I_D = 25 A;	-	18	26	ns
t_r	Turn-on rise time	V_{GS} = 10 V; R_G = 10 Ω	-	50	75	ns
$t_{d\ off}$	Turn-off delay time	Resistive load	-	40	50	ns
t_f	Turn-off fall time		-	30	40	ns
L_d	Internal drain inductance	Measured from contact screw on tab to centre of die	-	3.5	-	nH
L_d	Internal drain inductance	Measured from drain lead 6 mm from package to centre of die	-	4.5	-	nH
L_s	Internal source inductance	Measured from source lead 6 mm from package to source bond pad	-	7.5	-	nH



REVERSE DIODE LIMITING VALUES AND CHARACTERISTICS

T_j = 25˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{DR}	Continuous reverse drain current		-	-	49	A
I_{DRM}	Pulsed reverse drain current		-	-	160	A
V_{SD}	Diode forward voltage	I_F = 25 A; V_{GS} = 0 V	-	0.95	1.2	V
		I_F = 40 A; V_{GS} = 0 V	-	1.0	-	
t_{rr}	Reverse recovery time	I_F = 40 A; $-dI_F/dt$ = 100 A/µs;	-	47	-	ns
Q_{rr}	Reverse recovery charge	V_{GS} = -10 V; V_R = 30 V	-	0.15	-	µC

GT40T 40A 1500V PARA ALTAS POTENCIAS

TOSHIBA GT40T101

TOSHIBA INSULATED GATE BIPOLAR TRANSISTOR SILICON N CHANNEL MOS TYPE

GT40T101

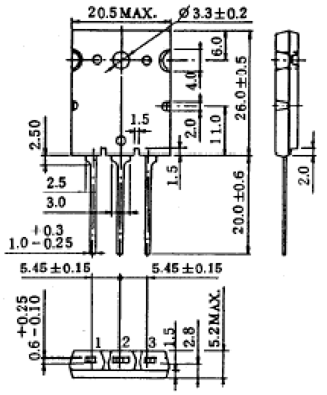
HIGH POWER SWITCHING APPLICATIONS.

- Enhancement-Mode
- High Speed : $t_f = 0.4\mu s$ (Max.) ($I_C = 40A$)
- Low Saturation : $V_{CE\,(sat)} = 5.0V$ (Max.) ($I_C = 40A$)

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Collector-Emitter Voltage		V_{CES}	1500	V
Gate-Emitter Voltage		V_{GES}	±25	V
Collector Current	DC	I_C	40	A
Collector Current	1ms	I_{CP}	80	A
Collector Power Dissipation	(Tc = 25°C)	P_C	200	W
Junction Temperature		T_j	150	°C
Storage Temperature Range		T_{stg}	−55~150	°C

Unit in mm

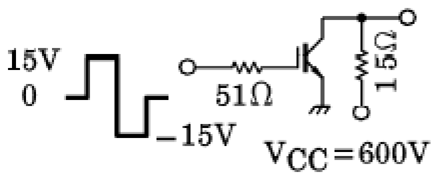


1. GATE
2. COLLECTOR (HEAT SINK)
3. EMITTER

JEDEC	—
EIAJ	—
TOSHIBA	2-21F2C

Weight : 9.75g

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current		I_{GES}	$V_{GE} = \pm 25V$, $V_{CE} = 0$	—	—	±500	nA
Collector Cut-off Current		I_{CES}	$V_{CE} = 1500V$, $V_{GE} = 0$	—	—	1.0	mA
Gate-Emitter Cut-off Voltage		$V_{GE\,(OFF)}$	$I_C = 40mA$, $V_{CE} = 5V$	3.0	—	6.0	V
Collector-Emitter Saturation Voltage		$V_{CE\,(sat)}$	$I_C = 40A$, $V_{GE} = 15V$	—	4.0	5.0	V
Input Capacitance		C_{ies}	$V_{CE} = 10V$, $V_{GE} = 0$, $f = 1MHz$	—	3600	—	pF
Switching Time	Rise Time	t_r		—	0.6	1.0	μs
	Turn-on Time	t_{on}		—	0.7	1.1	
	Fall Time	t_f		—	0.2	0.4	
	Turn-off Time	t_{off}		—	0.5	1.0	
Thermal Resistance		$R_{th\,(j\text{-}c)}$	—	—	—	0.625	°C / W

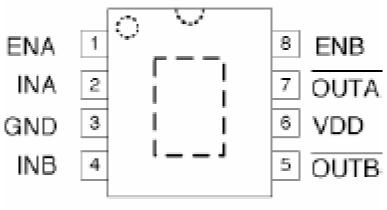
DRIVER MOSFET IGBT.

MIC4223/MIC4224/MIC4225 DRIVER SIMPLES

MIC4223/MIC4224/MIC4225

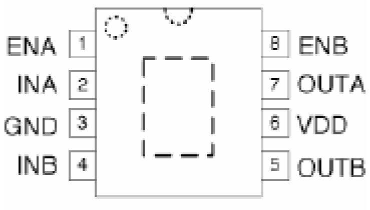
Dual 4A, 4.5V to 18V, 15ns Switch Time, Low-Side MOSFET Drivers with Enable

MIC4223



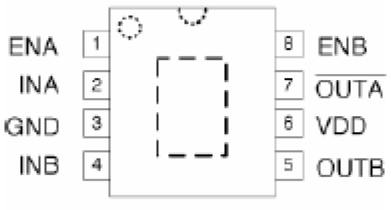
Dual Inverting

MIC4224



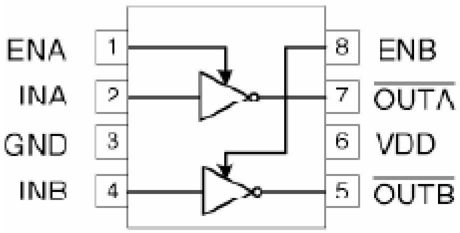
Dual Non-Inverting

MIC4225



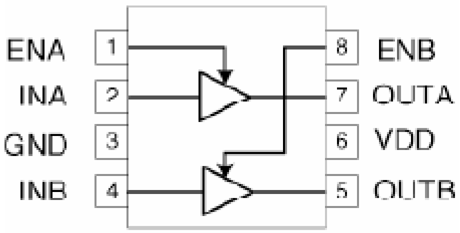
Inverting + Non-Inverting

MIC4223



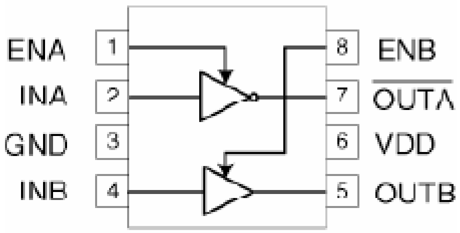
Dual Inverting

MIC4224



Dual Non-Inverting

MIC4225



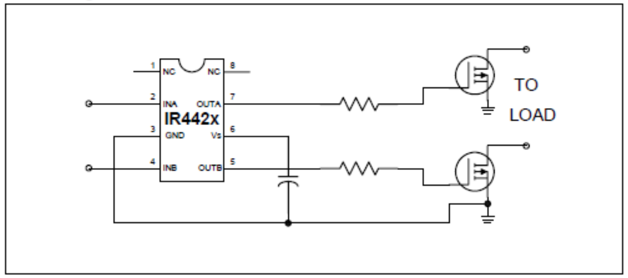
Inverting + Non-Inverting

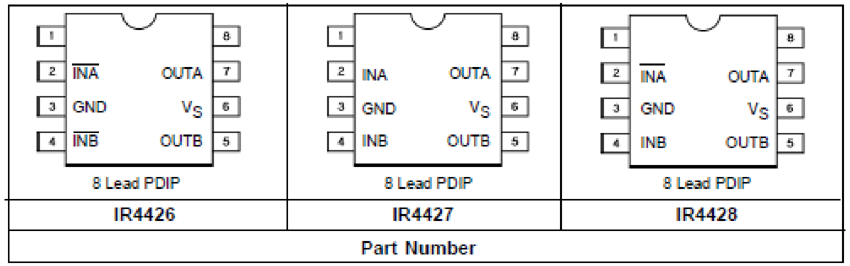
IR4426/IR4427/IR4448 DRIVER SIMPLES COM DUAS UNIDADES

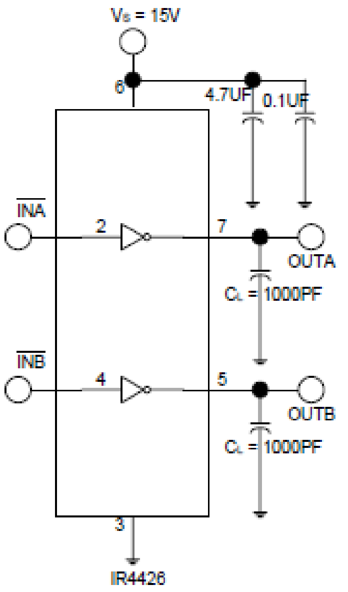
DUAL LOW SIDE DRIVER

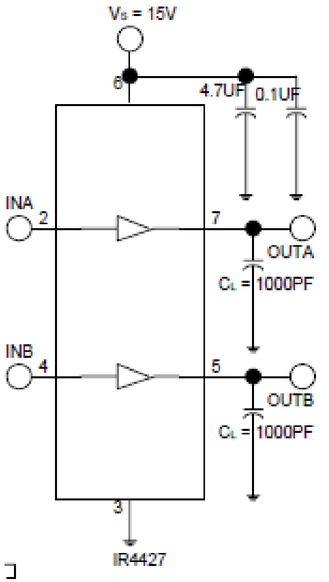
Product Summary

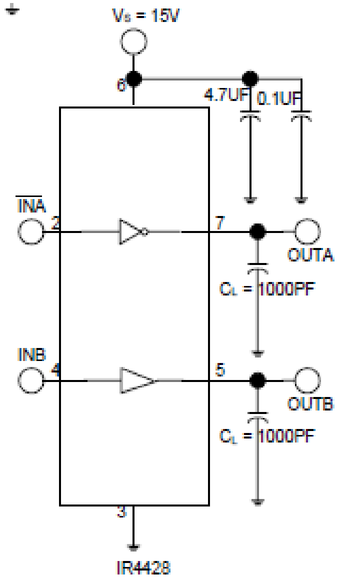
I_O+/-	1.5A / 1.5A
V_{OUT}	6V - 20V
$t_{on/off}$ (typ.)	85 & 65 ns





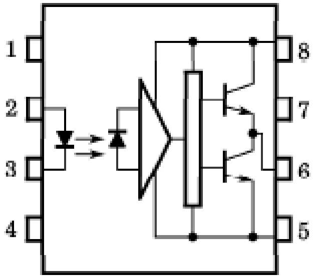




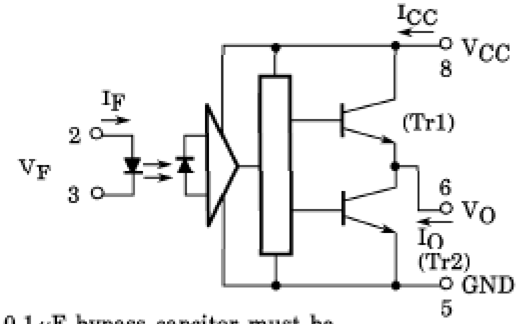


TLP251 OPTO DRIVER SIMPLES OPTOACOPLADO

PIN CONFIGURATION (TOP VIEW)



1 : N.C.
2 : ANODE
3 : CATHODE
4 : N.C.
5 : GND
6 : V_O (OUTPUT)
7 : N.C.
8 : V_{CC}



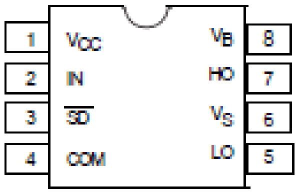
A 0.1μF bypass capcitor must be connected between pin 8 and 5 (See Note 5).

TRUTH TABLE

		Tr1	Tr2
Input LED	ON	ON	OFF
	OFF	OFF	ON

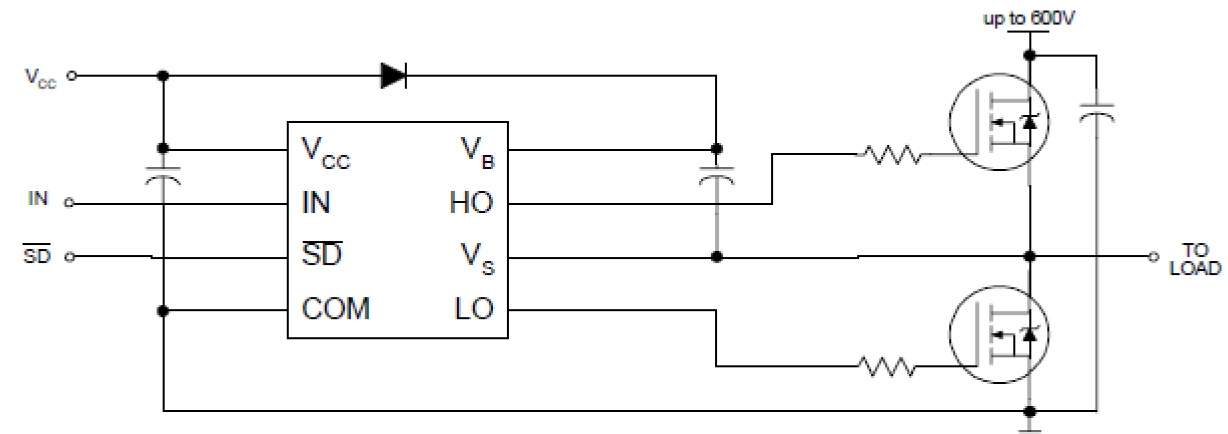
IR2104 DRIVER DUPLO COM BOOTSTRAPE ENTRADAS IN/SD

V_{OFFSET}	600V max.
I_O+/-	130 mA / 270 mA
V_{OUT}	10 - 20V
$t_{on/off}$ (typ.)	680 & 150 ns
Deadtime (typ.)	520 ns



8 Lead PDIP

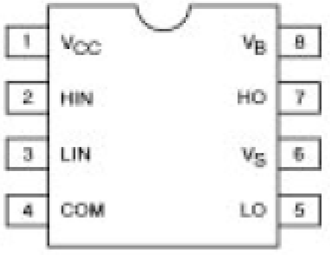
IR2104



(Refer to Lead Assignment for correct pin configuration) This/These diagram(s) show electrical connections only. Please refer to our Application Notes and DesignTips for proper circuit board layout.

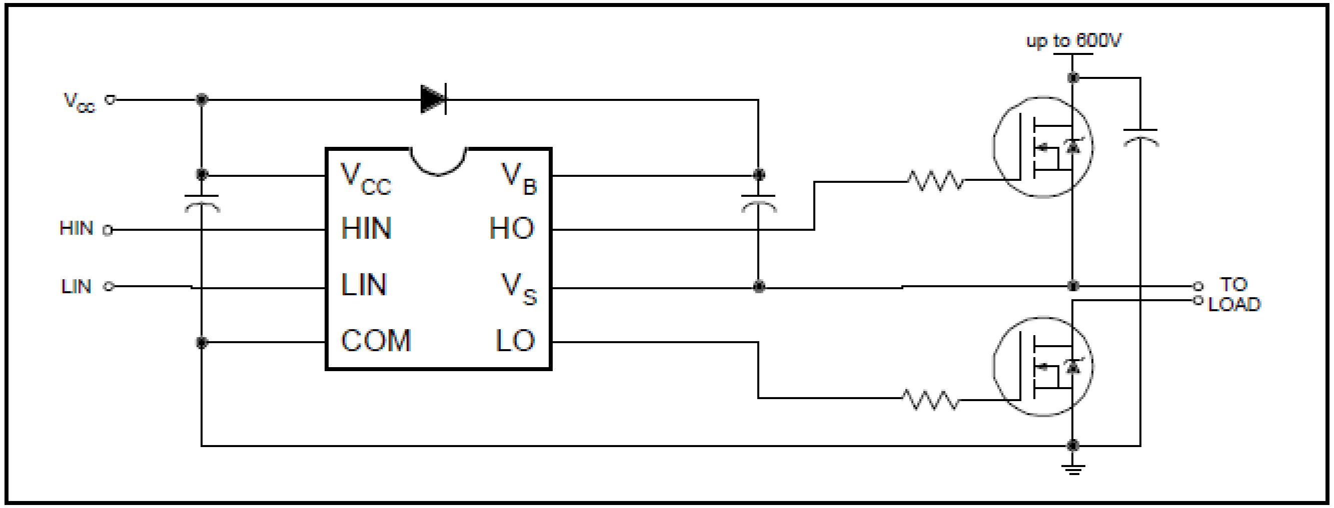
IR2101 DRIVER DUPLO COM BOOTSTRAPE ENTRADAS HIN LIN

V_{OFFSET}	600V max.
I_O+/-	100 mA / 210 mA
V_{OUT}	10 - 20V
$t_{on/off}$ (typ.)	130 & 90 ns
Delay Matching	30 ns



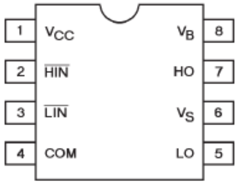
8 Lead DIP

IR2101



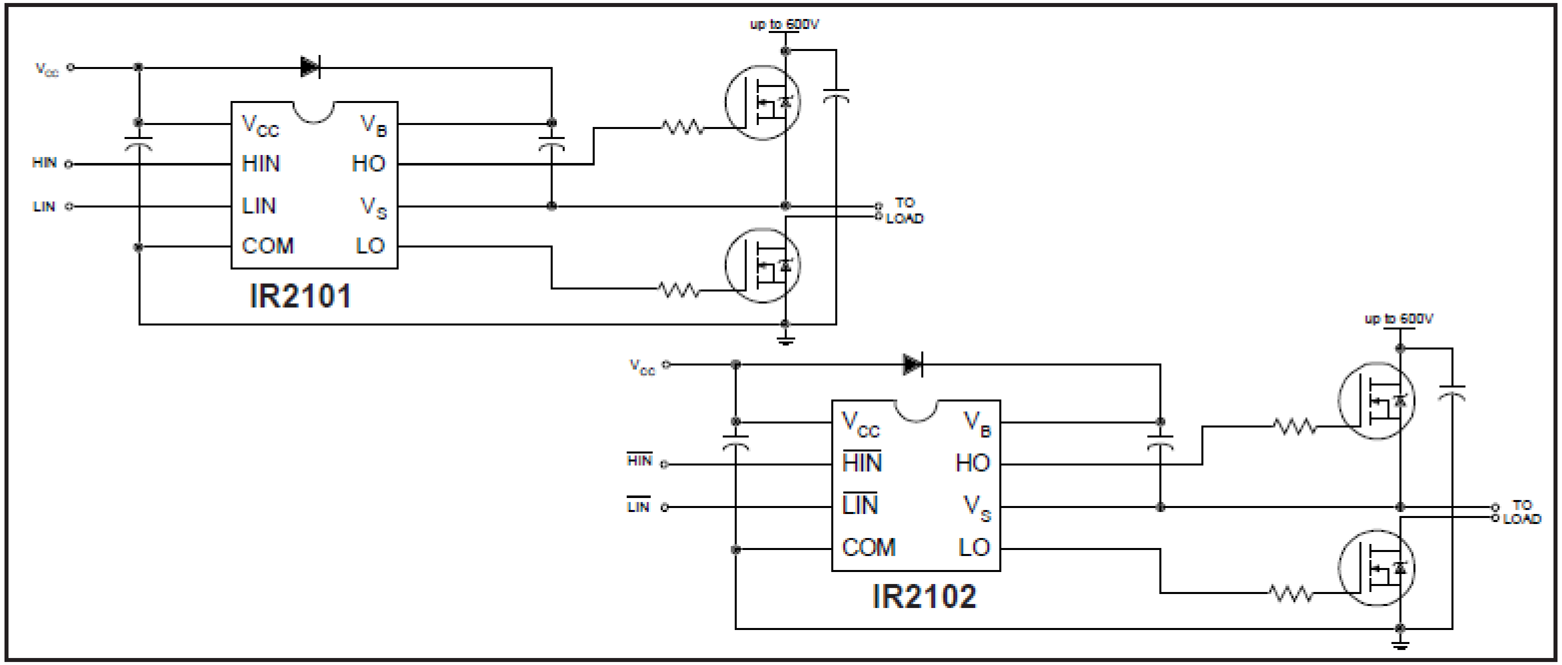
IR2102 DRIVER DUPLO COM BOOTSTRAPE ENTRADAS HIN/LIN INVERTIDAS

VOFFSET	600V max.
IO+/-	130 mA / 270 mA
VOUT	10 - 20V
ton/off (typ.)	160 & 150 ns
Delay Matching	50 ns

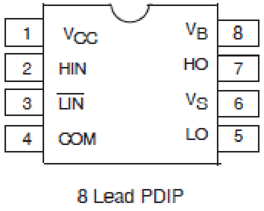


8 Lead PDIP

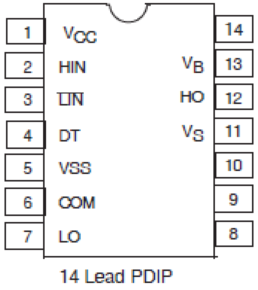
IR2102



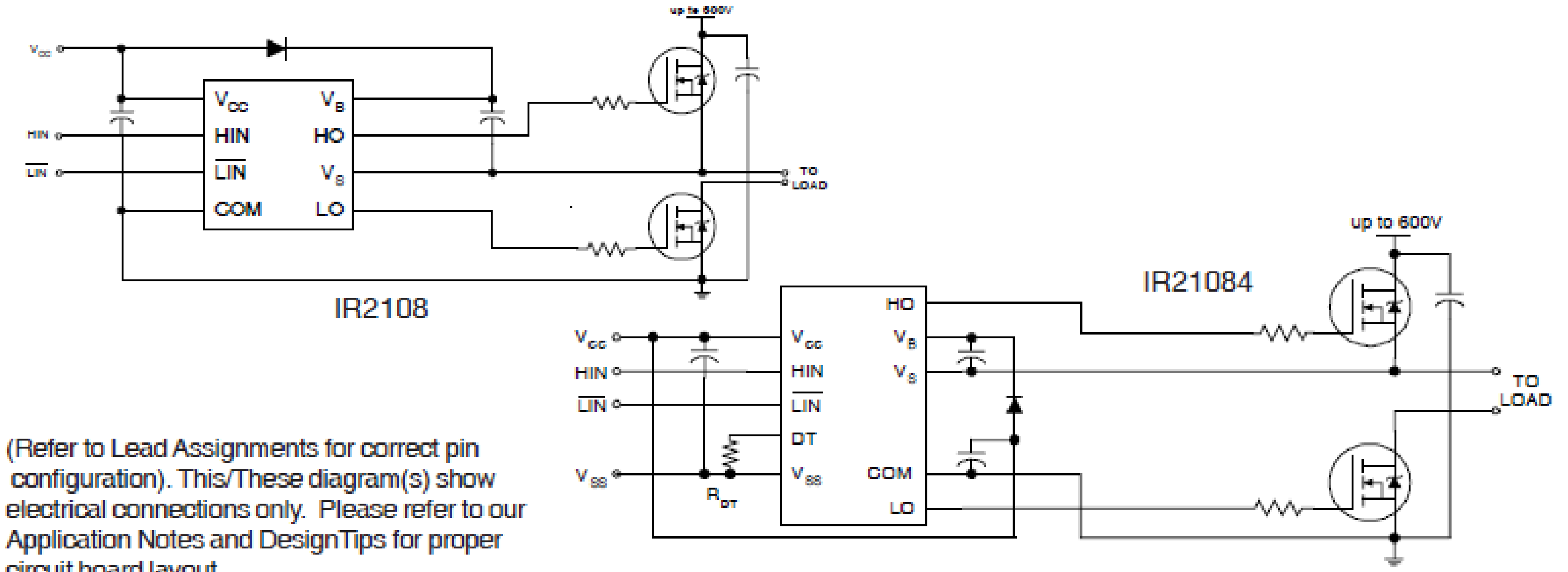
IR2108/IR21084 DRIVER DUPLO COM BOOTSTRAPE COM DEAD TIME ENTRADAS HIN/LIN O 1084 INVERTIDA



IR2108



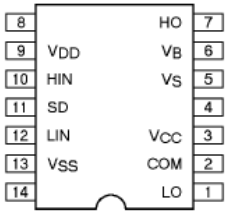
IR21084



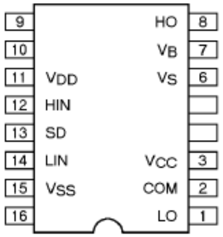
(Refer to Lead Assignments for correct pin configuration). This/These diagram(s) show electrical connections only. Please refer to our Application Notes and DesignTips for proper circuit board layout.

IR2110/IR2113 DRIVER DUPLO COM BOOTSTRAPEENTRADAS HIN/LIN/SD TERRAS SEPARADOS O MAIS USADO

V_{OFFSET} (IR2110)	500V max.
(IR2113)	600V max.
Io+/-	2A / 2A
V_{OUT}	10 - 20V
$t_{on/off}$ (typ.)	120 & 94 ns
Delay Matching (IR2110)	10 ns max.
(IR2113)	20ns max.

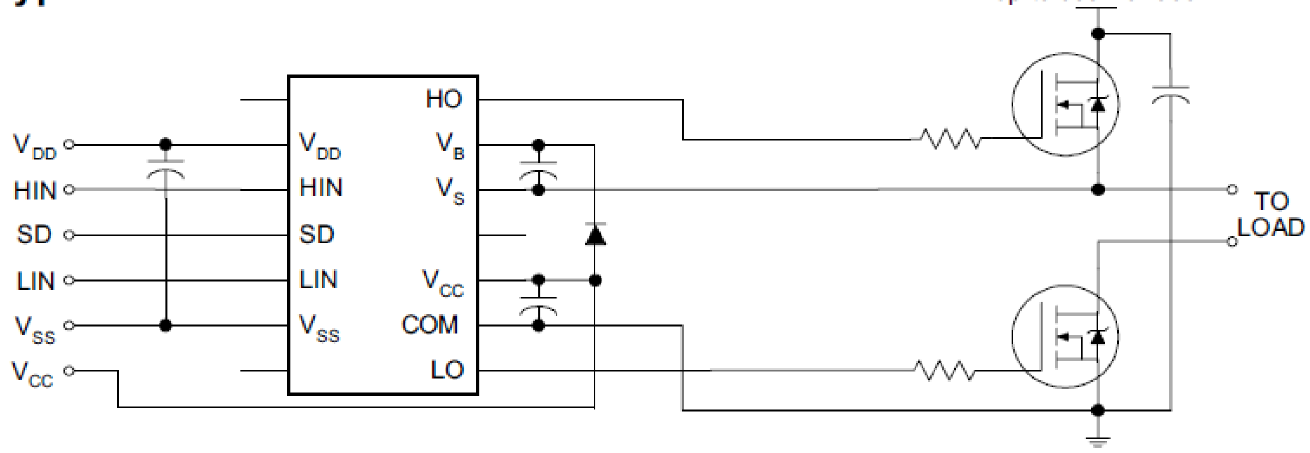


14 Lead PDIP
IR2110/IR2113



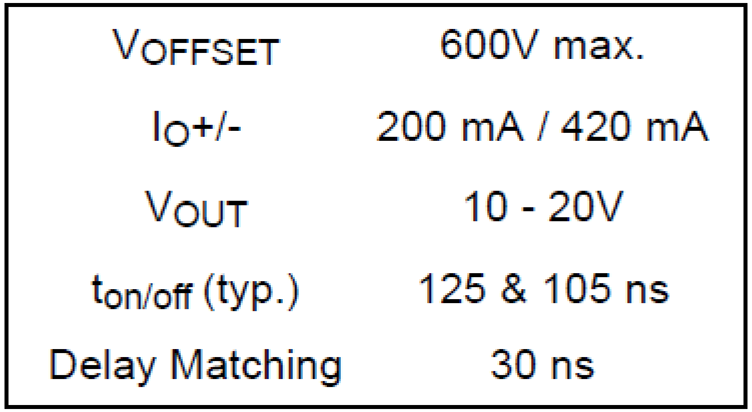
16 Lead SOIC (Wide Body)
IR2110S/IR2113S

Typical Connection

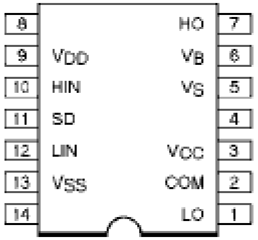


(Refer to Lead Assignments for correct pin configuration). This/These diagram(s) show electrical connections only. Please refer to our Application Notes and DesignTips for proper circuit board layout.

IR2112 DRIVER DUPLO COM BOOTSTRAPE SIMILAR AO 2110 MAS COM BAIXA CORRENTE DE GATE

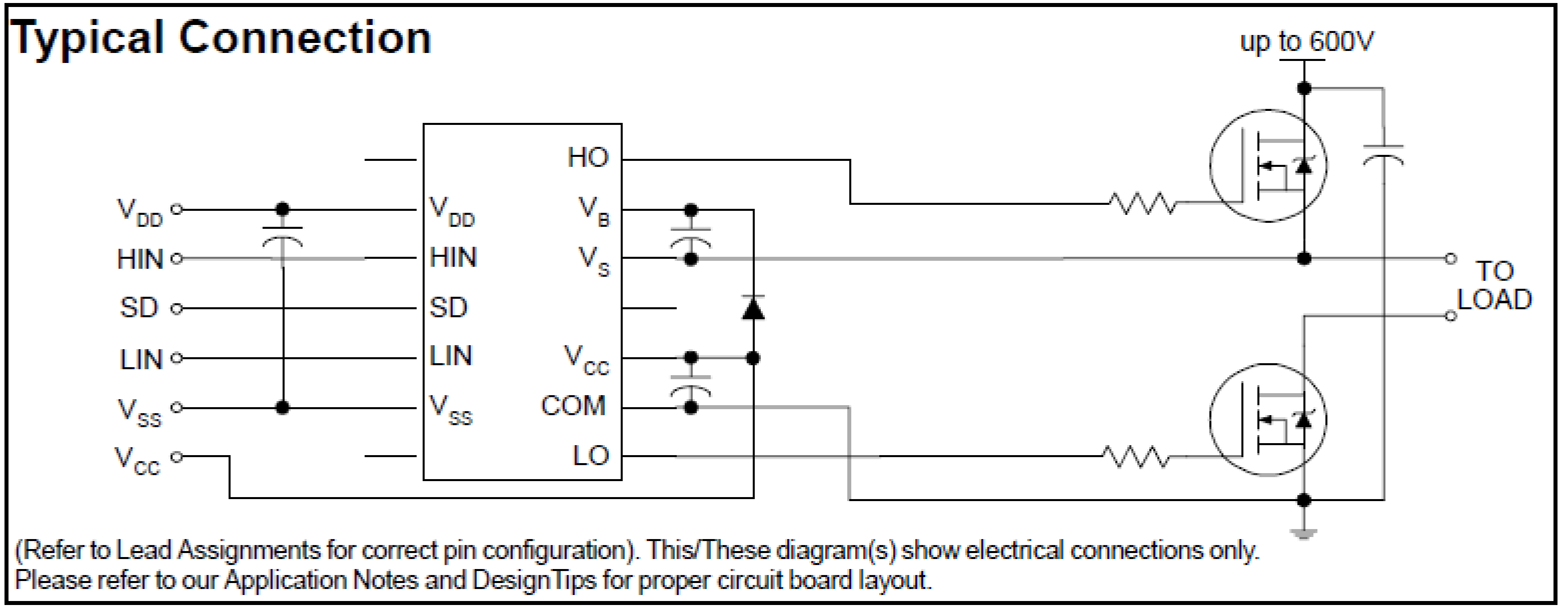


V_{OFFSET}	600V max.
I_O+/-	200 mA / 420 mA
V_{OUT}	10 - 20V
$t_{on/off}$ (typ.)	125 & 105 ns
Delay Matching	30 ns



14 Lead DIP

IR2112

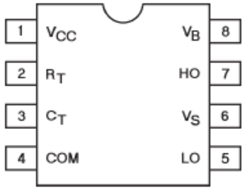


Typical Connection

(Refer to Lead Assignments for correct pin configuration). This/These diagram(s) show electrical connections only. Please refer to our Application Notes and DesignTips for proper circuit board layout.

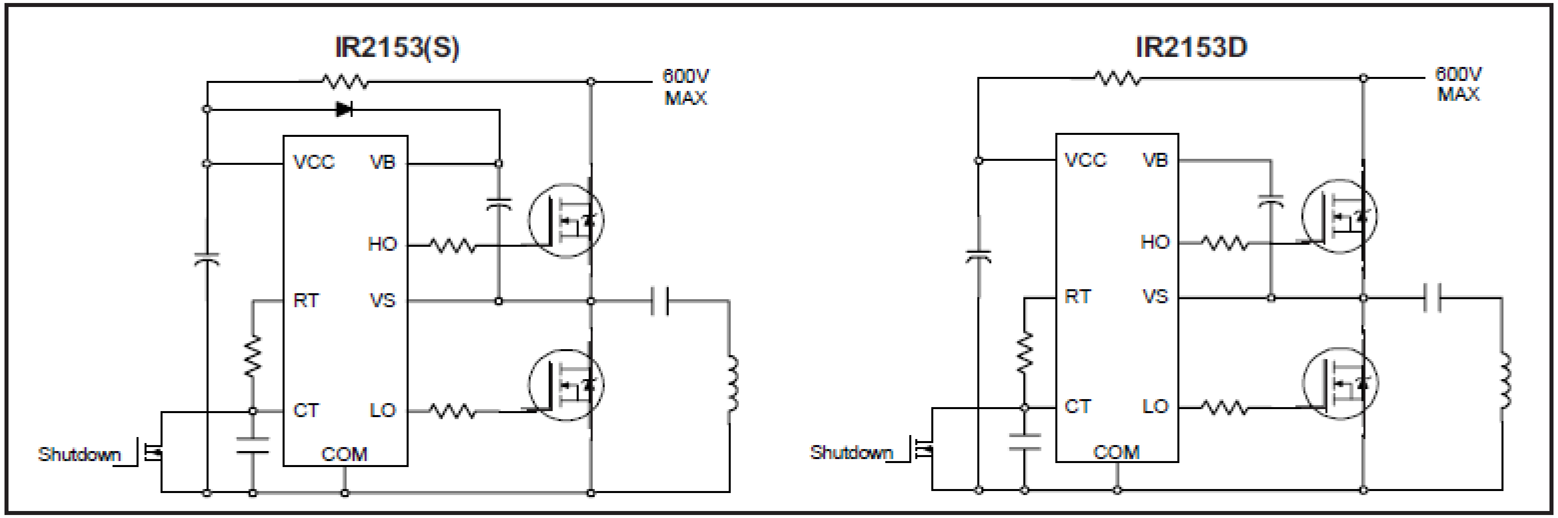
IR2153 DRIVER DUPLO COM BOOTSTRAPE SELF OSCILATION MELHORADO DO 2155

V_{OFFSET}	600V max.
Duty Cycle	50%
T_r/T_p	80/40ns
V_{clamp}	15.6V
Deadtime (typ.)	1.2 µs



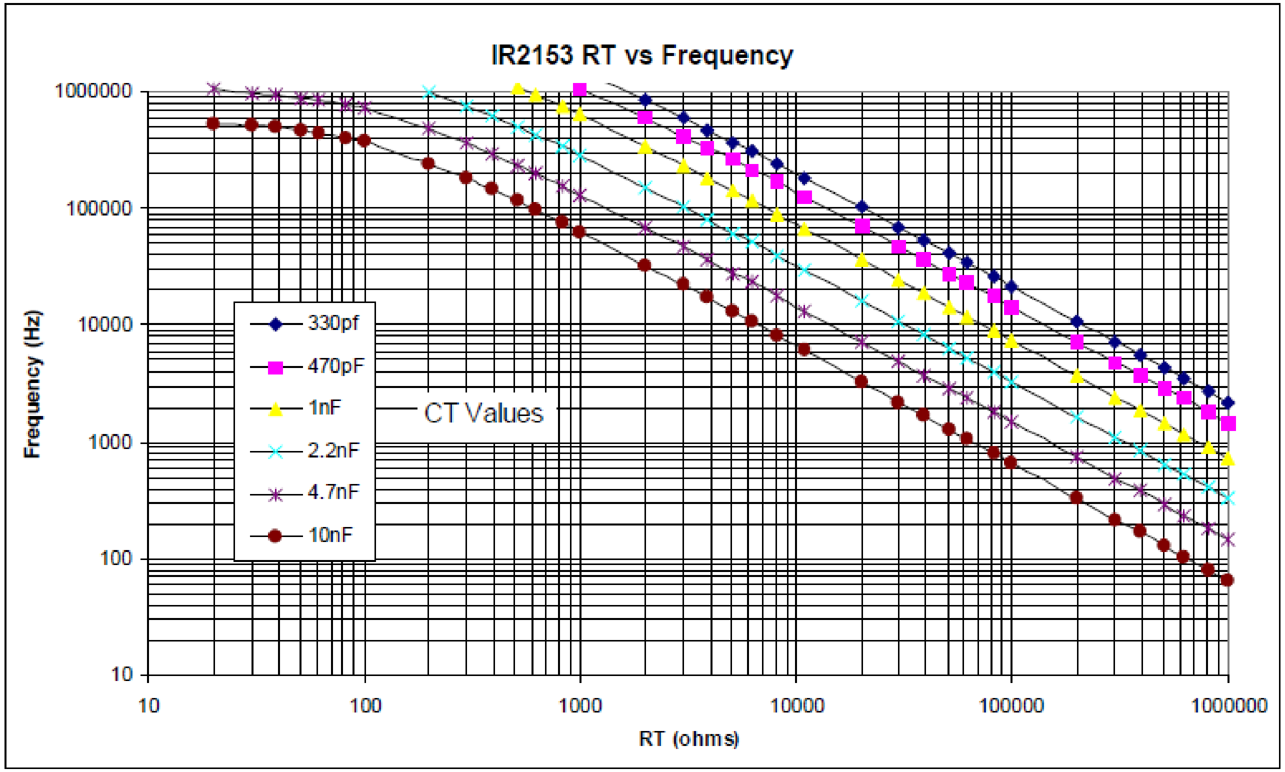
8 Lead PDIP

IR2153D



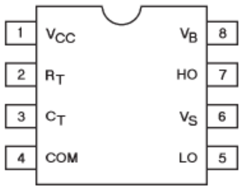
Recommended Component Values

Symbol	Component	Min.	Max.	Units
R_T	Timing resistor value	10	—	kΩ
C_T	C_T pin capacitor value	330	—	pF



IR2155 DRIVER DUPLO COM BOOTSTRAPE SELF OSCILATION ANTIGO AGORA USAR O IR2153

V_{OFFSET}	600V max.
Duty Cycle	50%
I_O+/-	210 mA / 420 mA
V_{OUT}	10 - 20V
Deadtime (typ.)	1.2 µs

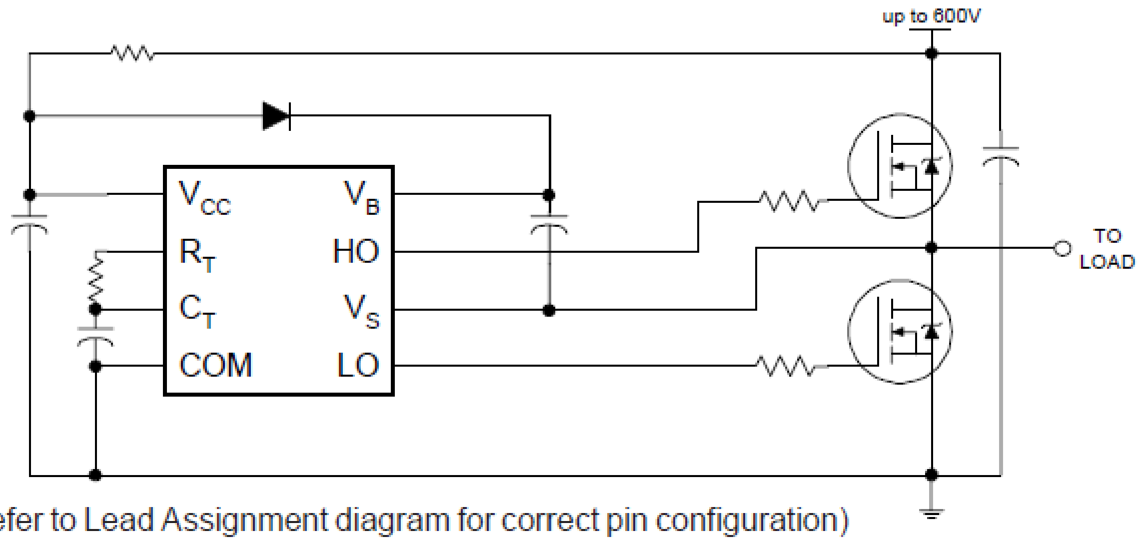


8 Lead DIP

IR2155

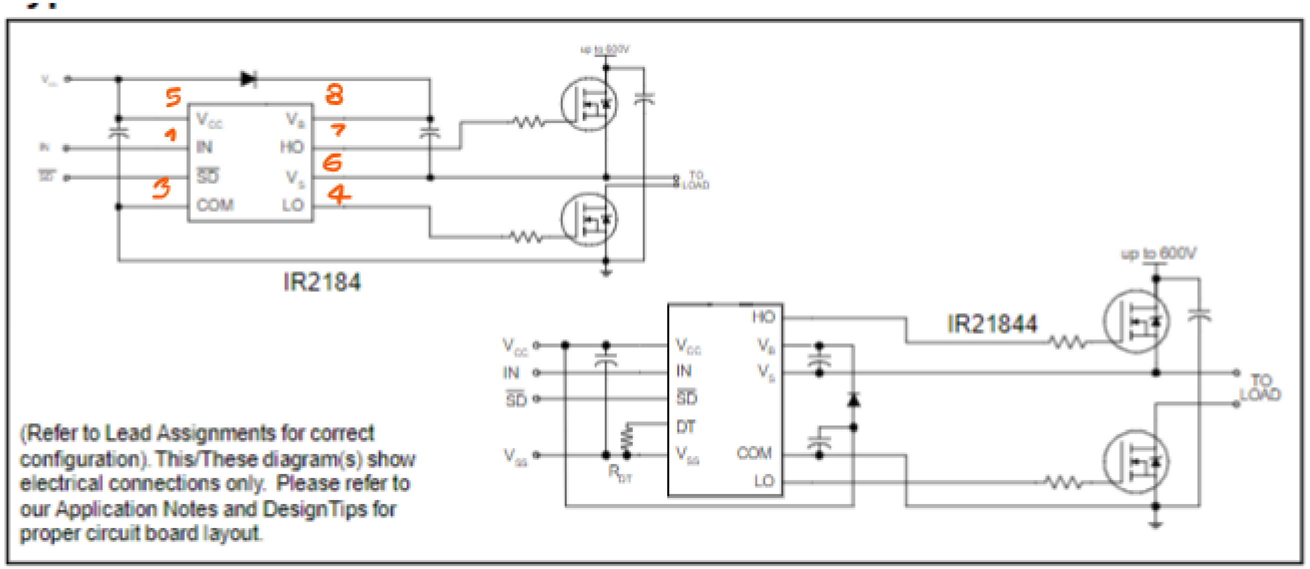
- Programmable oscillator frequency

$$f = \frac{1}{1.4 \times (R_T + 150\Omega) \times C_T}$$



(Refer to Lead Assignment diagram for correct pin configuration)

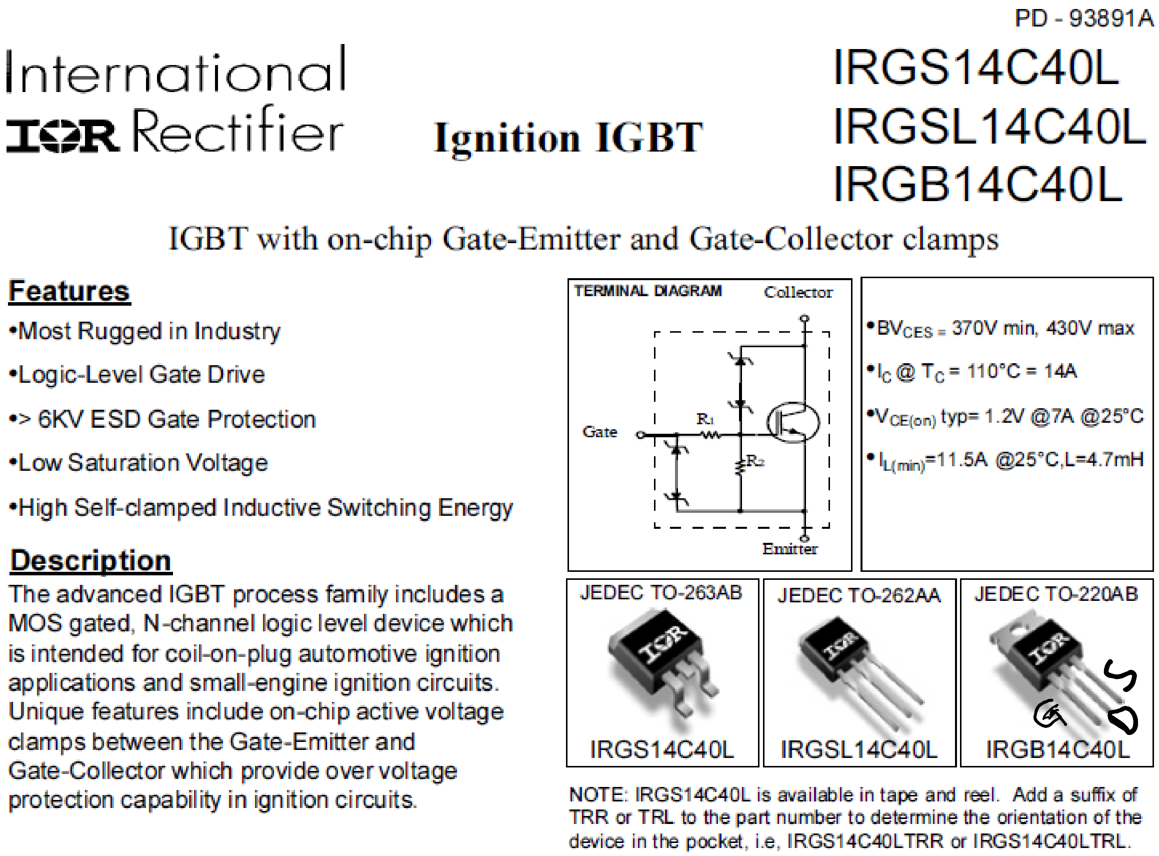
IR2184



(Refer to Lead Assignments for correct configuration). This/These diagram(s) show electrical connections only. Please refer to our Application Notes and DesignTips for proper circuit board layout.

IGBT

DRIVER IRGB14C40L IRGSL14C40L IRGS14C40L IGNITION IGBT 14A



PD - 93891A

International
IOR Rectifier

Ignition IGBT

IRGS14C40L
IRGSL14C40L
IRGB14C40L

IGBT with on-chip Gate-Emitter and Gate-Collector clamps

Features

- Most Rugged in Industry
- Logic-Level Gate Drive
- > 6KV ESD Gate Protection
- Low Saturation Voltage
- High Self-clamped Inductive Switching Energy

Description

The advanced IGBT process family includes a MOS gated, N-channel logic level device which is intended for coil-on-plug automotive ignition applications and small-engine ignition circuits. Unique features include on-chip active voltage clamps between the Gate-Emitter and Gate-Collector which provide over voltage protection capability in ignition circuits.

TERMINAL DIAGRAM

- BV_{CES} = 370V min, 430V max
- I_C @ T_C = 110°C = 14A
- $V_{CE(on)}$ typ= 1.2V @7A @25°C
- $I_{L(min)}$=11.5A @25°C,L=4.7mH

JEDEC TO-263AB	JEDEC TO-262AA	JEDEC TO-220AB
IRGS14C40L	IRGSL14C40L	IRGB14C40L

NOTE: IRGS14C40L is available in tape and reel. Add a suffix of TRR or TRL to the part number to determine the orientation of the device in the pocket, i.e, IRGS14C40LTRR or IRGS14C40LTRL.

Absolute Maximum Ratings

	Parameter	Max	Unit	Condition
V_{CES}	Collector-to-Emitter Voltage	Clamped	V	R_G = 1K ohm
I_C @ T_C = 25°C	Continuous Collector Current	20	A	V_{GE} = 5V
I_C @ T_C = 110°C	Continuous Collector Current	14	A	V_{GE} = 5V
I_G	Continuous Gate Current	1	mA	
I_{Gp}	Peak Gate Current	10	mA	t_{PK} = 1ms, f = 100Hz
V_{GE}	Gate-to-Emitter Voltage	Clamped	V	
P_D @ T_C = 25°C	Maximum Power Dissipation	125	W	
P_D @ T = 110°C	Maximum Power Dissipation	54	W	
T_J	Operating Junction and	- 40 to 175	°C	
T_{STG}	Storage Temperature Range	- 40 to 175	°C	
V_{ESD}	Electrostatic Voltage	6	KV	C = 100pF, R = 1.5K ohm
I_L	Self-clamped Inductive Switching Current	11.5	A	L = 4.7mH, T = 25°C

Thermal Resistance

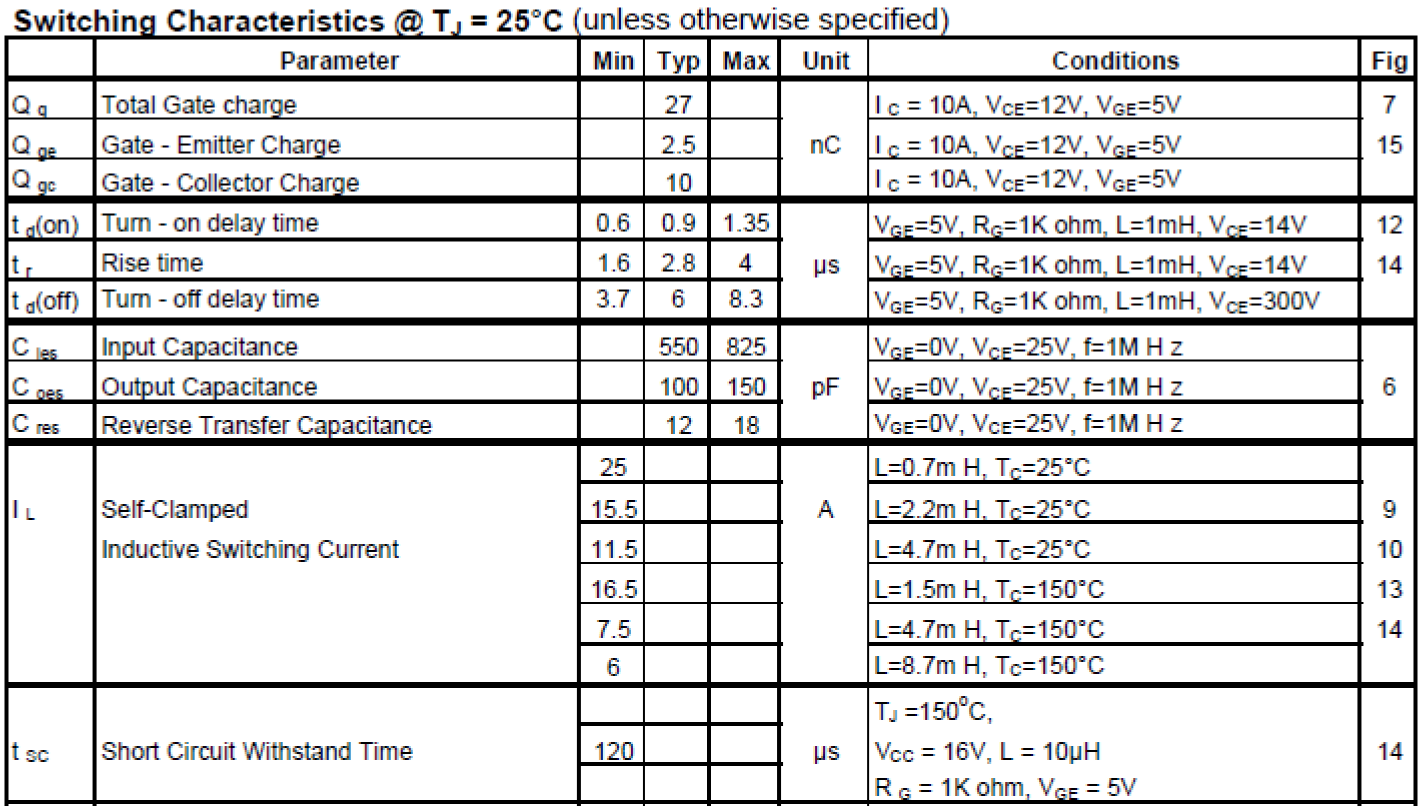
	Parameter	Min	Typ	Max	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case			1.2	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient			40	
	(PCB Mounted, Steady State)				
$Z_{\theta JC}$	Transient Thermal Impedance, Juction-to-Case (Fig.11)				

Off-State Electrical Charasteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min	Typ	Max	Unit	Conditions	Fig
BV_{CES}	Collector-to-Emitter Breakdown Voltage	370	400	430	V	R_G = 1K ohm, I_C=7A, V_{GE} = 0V	
BV_{GES}	Gate-to-Emitter Breakdown Voltage	10	12		V	I_G=2m A	
I_{CES}	Collector-to-Emitter Leakage Current			15	µA	R_G=1K ohm, V_{CE} = 250V	
				100	µA	R_G=1K ohm, V_{CE} = 250V, T_J =150°C	
BV_{CER}	Emitter-to-Collector Breakdown Voltage	24	28		V	I_C = -10m A	
R_1	Gate Series Resistance		75		ohm		
R_2	Gate-to-Emitter Resistance	10	20	30	K ohm		

On-State Electrical Charasteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min	Typ	Max	Unit	Conditions	Fig
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage		1.2	1.40	V	I_C = 7A, V_{GE} = 4.5V	
			1.35	1.55		I_C = 10A, V_{GE} = 4.5V	1
			1.35	1.55		I_C = 10A, V_{GE} = 4.5V, T_C= -40°C	2
			1.5	1.7		I_C = 14A, V_{GE} = 5.0V, T_C= -40°C	4
			1.55	1.75		I_C = 14A, V_{GE} = 5.0V	
			1.6	1.8		I_C = 14A, V_{GE} = 5.0V, T_C=150°C	
$V_{GE(th)}$	Gate Threshold Voltage	1.3	1.8	2.2	V	V_{CE} = V_{GE}, I_C = 1 m A, T_C=25°C	3, 5
		0.75		1.8		V_{CE} = V_{GE}, I_C = 1 m A, T_C=150°C	8
g_{fs}	Transconductance	10	15	19	S	V_{CE} = 25V, I_C = 10A, T_C=25°C	
I_C	Collector Current	20			A	V_{CE} = 10V, V_{GE} = 4.5V	



Switching Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min	Typ	Max	Unit	Conditions	Fig
Q_g	Total Gate charge		27		nC	I_C = 10A, V_{CE}=12V, V_{GE}=5V	7
Q_{ge}	Gate - Emitter Charge		2.5			I_C = 10A, V_{CE}=12V, V_{GE}=5V	15
Q_{gc}	Gate - Collector Charge		10			I_C = 10A, V_{CE}=12V, V_{GE}=5V	
t_d(on)	Turn - on delay time	0.6	0.9	1.35	µs	V_{GE}=5V, R_G=1K ohm, L=1mH, V_{CE}=14V	12
t_r	Rise time	1.6	2.8	4		V_{GE}=5V, R_G=1K ohm, L=1mH, V_{CE}=14V	14
t_d(off)	Turn - off delay time	3.7	6	8.3		V_{GE}=5V, R_G=1K ohm, L=1mH, V_{CE}=300V	
C_{ies}	Input Capacitance		550	825	pF	V_{GE}=0V, V_{CE}=25V, f=1M H z	6
C_{oes}	Output Capacitance		100	150		V_{GE}=0V, V_{CE}=25V, f=1M H z	
C_{res}	Reverse Transfer Capacitance		12	18		V_{GE}=0V, V_{CE}=25V, f=1M H z	
I_L	Self-Clamped Inductive Switching Current	25			A	L=0.7m H, T_C=25°C	
		15.5				L=2.2m H, T_C=25°C	9
		11.5				L=4.7m H, T_C=25°C	10
		16.5				L=1.5m H, T_C=150°C	13
		7.5				L=4.7m H, T_C=150°C	14
		6				L=8.7m H, T_C=150°C	
t_{SC}	Short Circuit Withstand Time	120			µs	T_J =150°C, V_{CC} = 16V, L = 10µH R_G = 1K ohm, V_{GE} = 5V	14

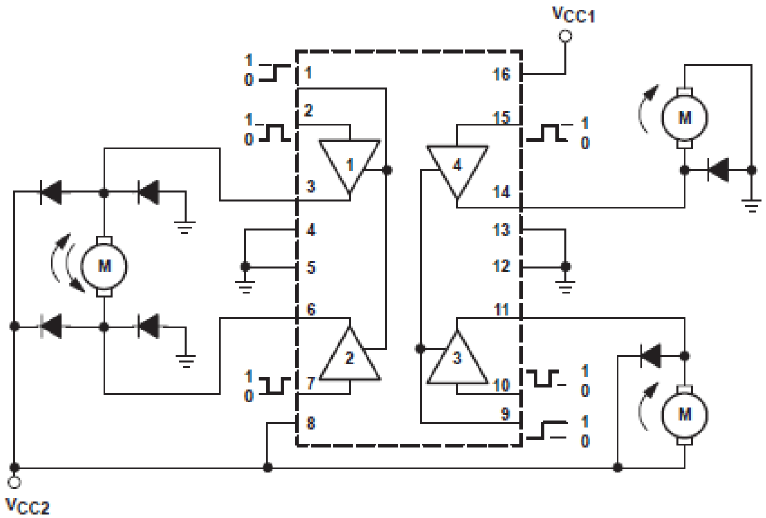
DRIVER FULL BRIDGE L297 STEP MOTTOR CONTROLLER

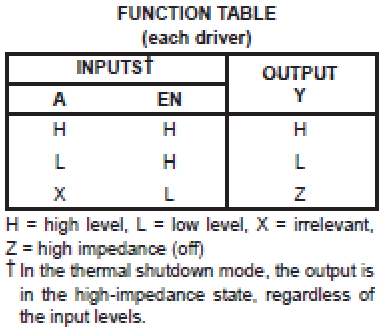
L298N 4A 48 V

L293 1A 4,5 a 36V

L298 Step motor controller para operar junto com o L298

L293 4,5 A 36 V 1A 2A DE PICO 4 AMP

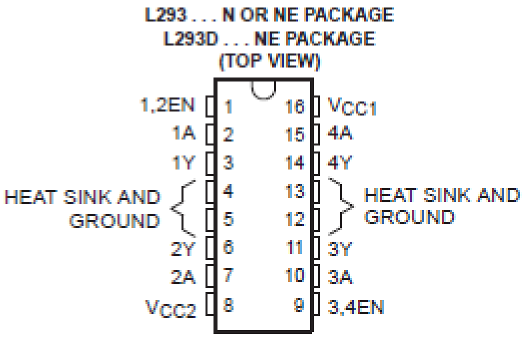




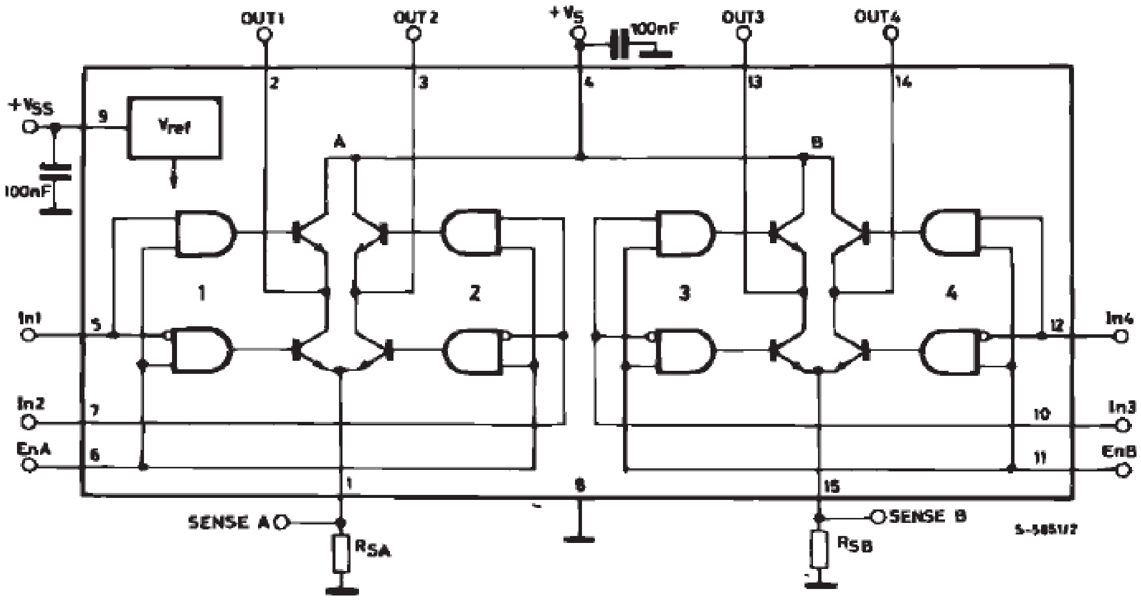
FUNCTION TABLE
(each driver)

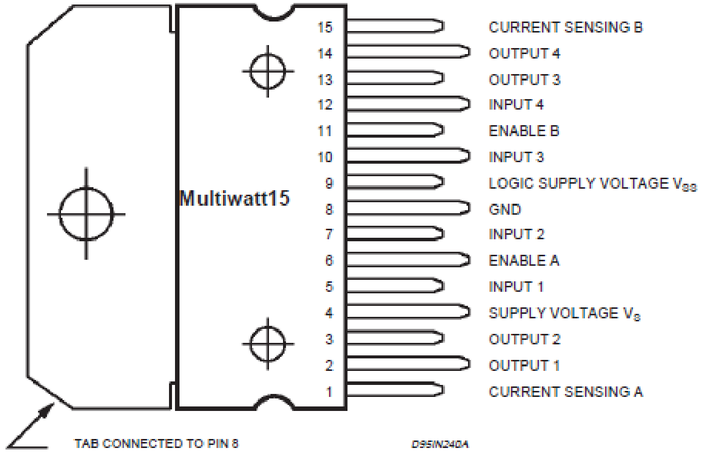
INPUTS†		OUTPUT
A	EN	Y
H	H	H
L	H	L
X	L	Z

H = high level, L = low level, X = irrelevant,
Z = high impedance (off)
† In the thermal shutdown mode, the output is in the high-impedance state, regardless of the input levels.



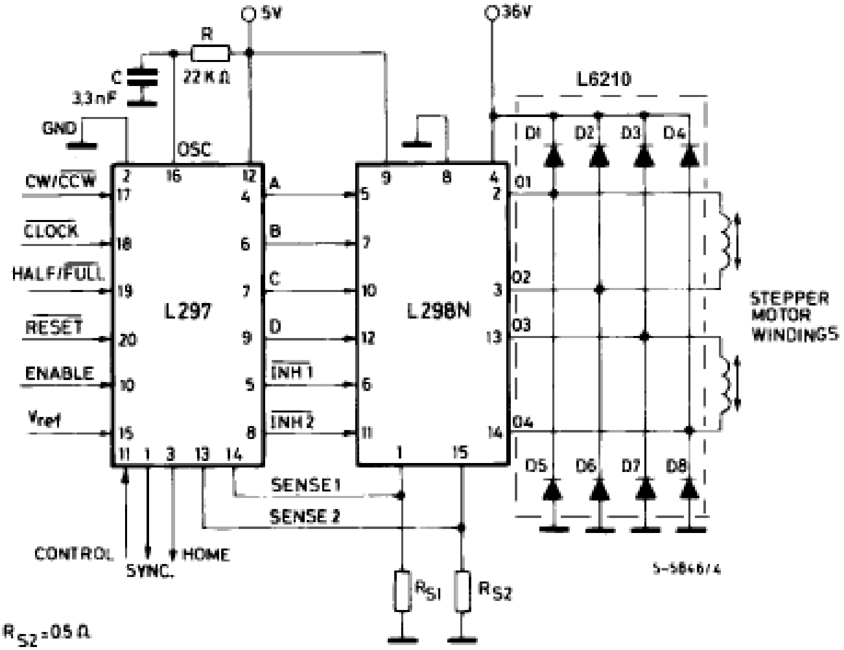
L298 40V 4A EM PONTE





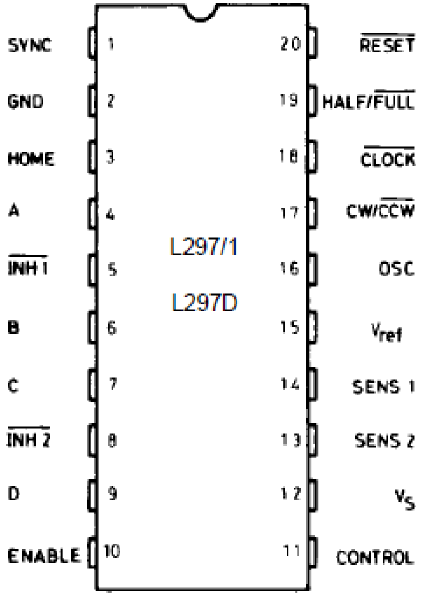
297 STEP MOTOR CONTROLLER

TWO PHASE BIPOLAR STEPPER MOTOR CONTROL CIRCUIT

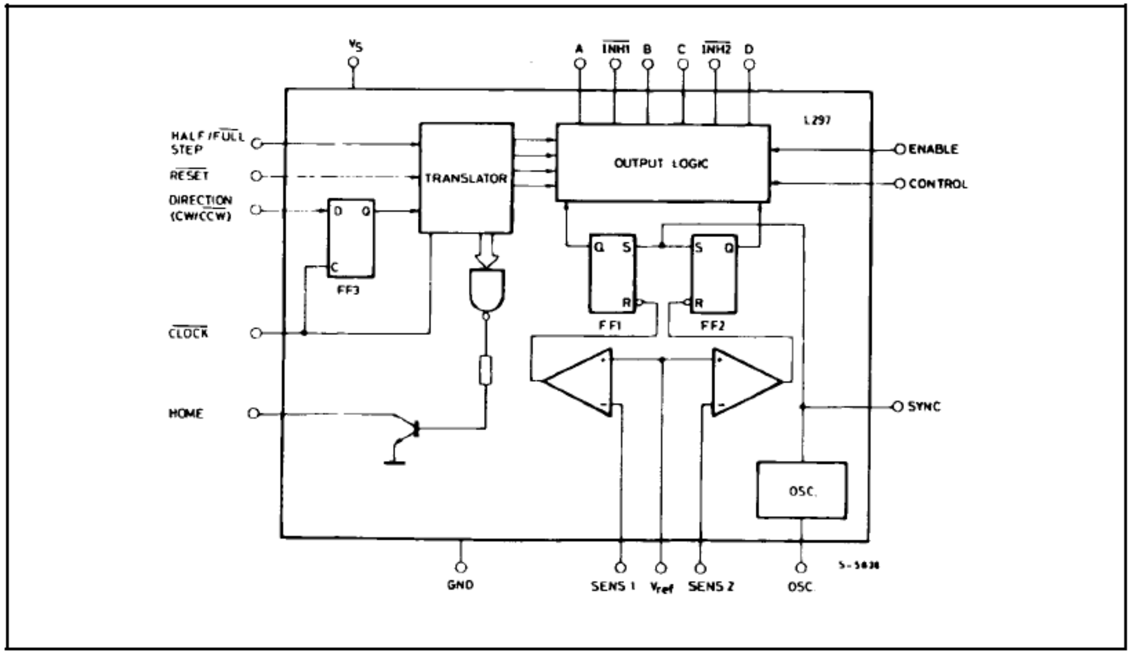


$R_{S1}R_{S2}$=05 Ω

D1 to D8 = 2A FAST DIODES

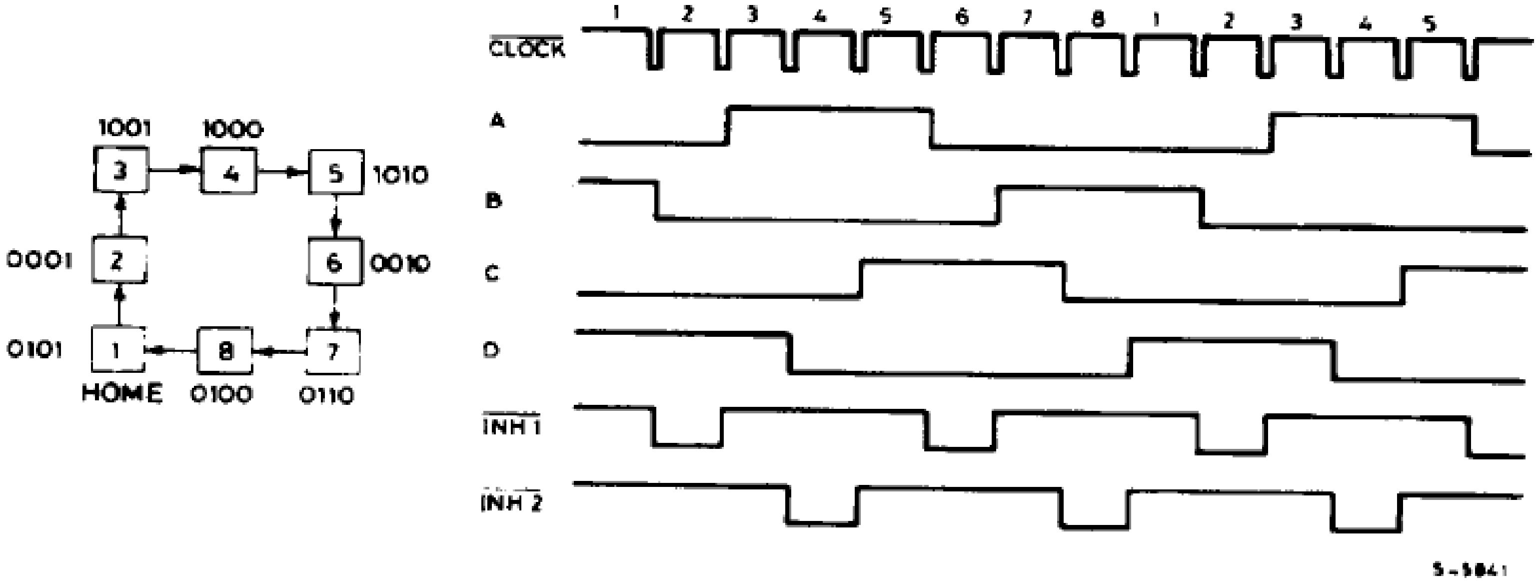


BLOCK DIAGRAM (L297/1 - L297D)



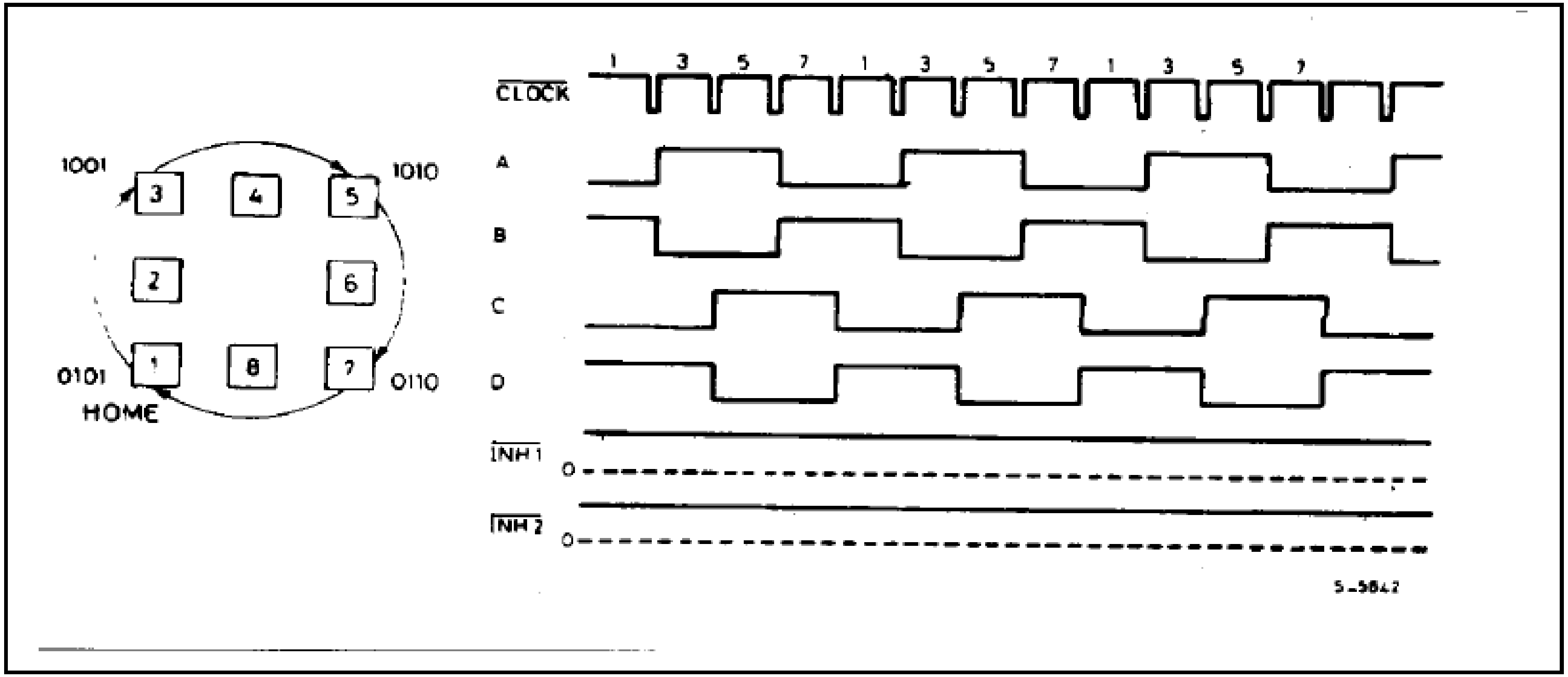
HALF STEP MODE

Half step mode is selected by a high level on the HALF/$\overline{\text{FULL}}$ input.

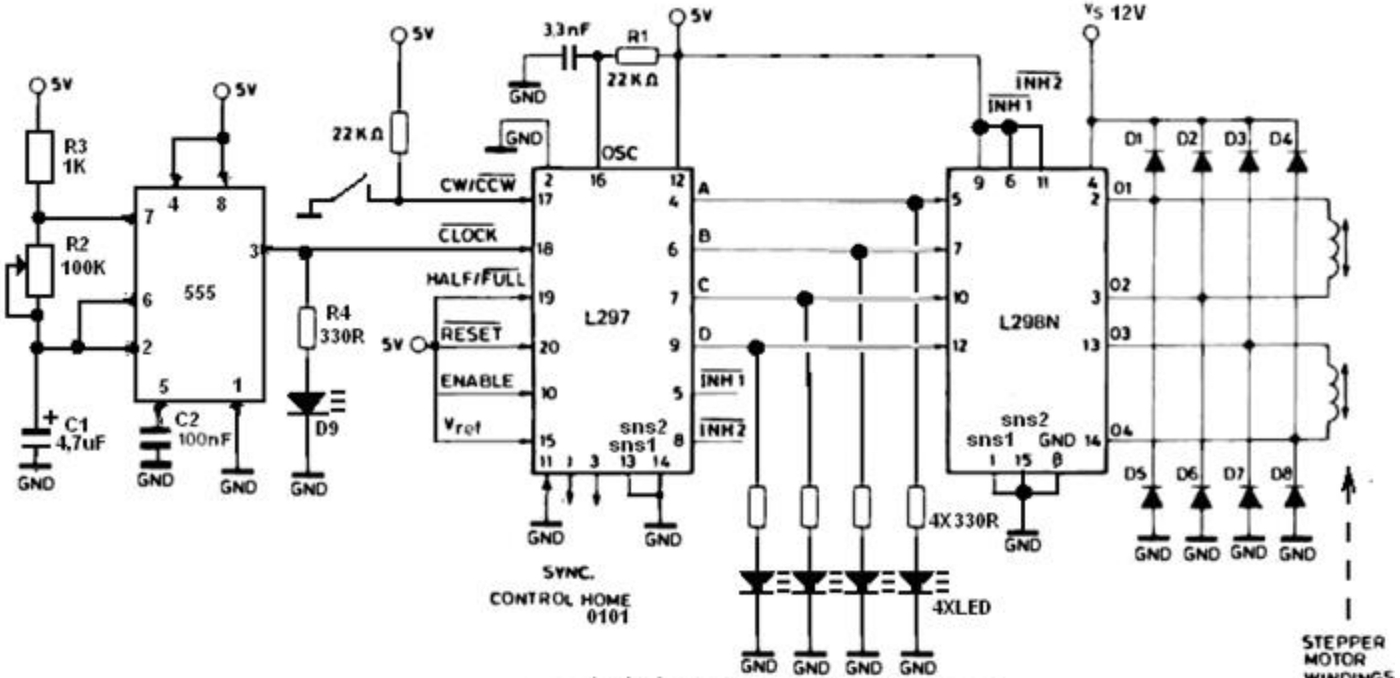


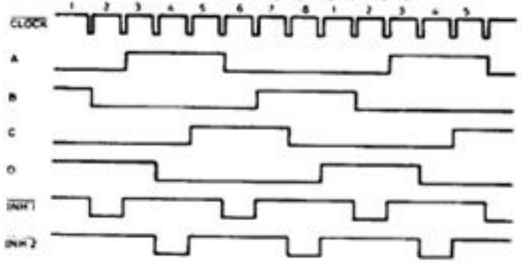
NORMAL DRIVE MODE

Normal drive mode (also called "two-phase-on" drive) is selected by a low level on the HALF/$\overline{\text{FULL}}$ input when the translator is at an odd numbered state (1, 3, 5 or 7). In this mode the $\overline{\text{INH1}}$ and $\overline{\text{INH2}}$ outputs remain high throughout.

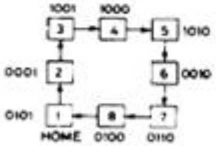


Exemplo de motor de passo:





HALF/FULL



15 REF

HALF ~~0101~~-0001-1010-1000-1010-0010-0110-0100

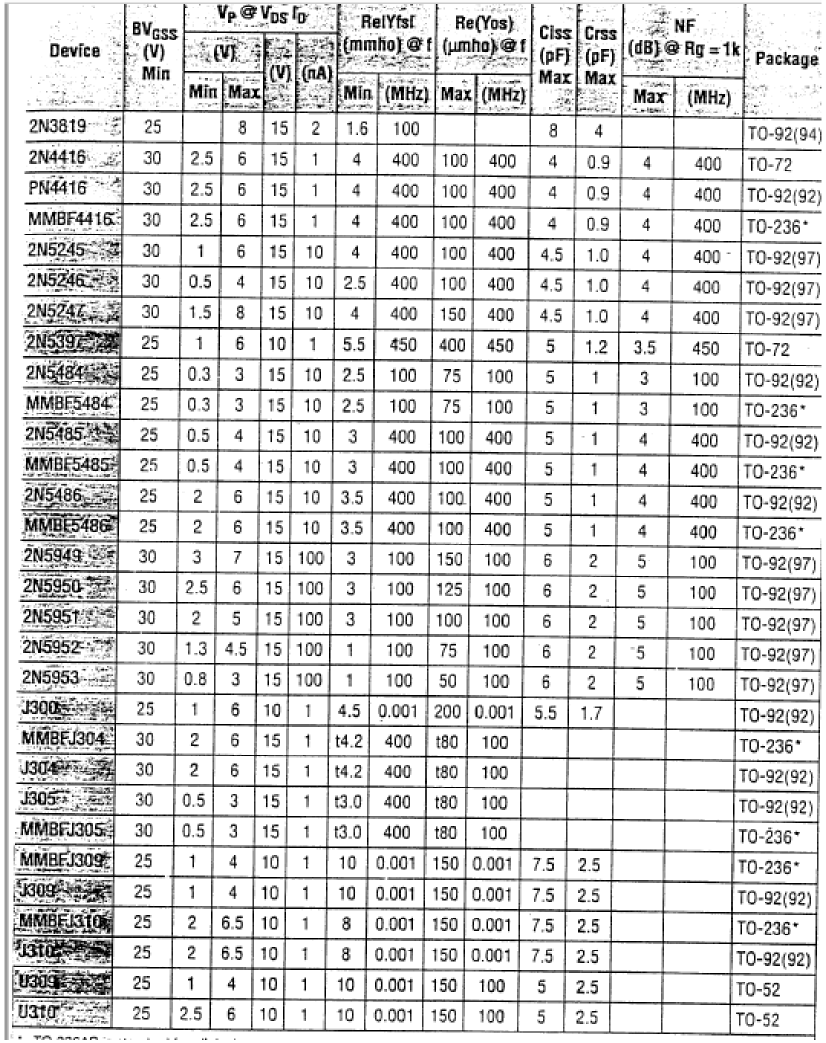
JFET

BF245 VP=2,4V IDSS=24 mA

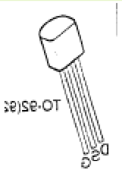
2N5457/58/59 tá na lista

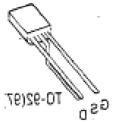
MPF102 VHFAMPLIFIER VGSOFF=-8V |Yfs|=2000 a 7500 umhos ciss 7pf

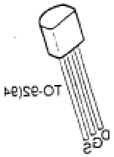
LISTA CANAL N

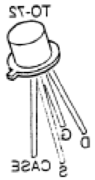


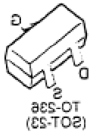
Device	BV_{GSS} (V) Min	V_P @ V_{DS} I_D (V)				Re|Yfs| (mmho) @ f		Re(Yos) (μmho) @ f		Ciss (pF) Max	Crss (pF) Max	NF (dB) @ Rg = 1k		Package
		Min	Max	(V)	(nA)	Min	(MHz)	Max	(MHz)			Max	(MHz)	
2N3819	25		8	15	2	1.6	100			8	4			TO-92(94)
2N4416	30	2.5	6	15	1	4	400	100	400	4	0.9	4	400	TO-72
PN4416	30	2.5	6	15	1	4	400	100	400	4	0.9	4	400	TO-92(92)
MMBF4416	30	2.5	6	15	1	4	400	100	400	4	0.9	4	400	TO-236*
2N5245	30	1	6	15	10	4	400	100	400	4.5	1.0	4	400	TO-92(97)
2N5246	30	0.5	4	15	10	2.5	400	100	400	4.5	1.0	4	400	TO-92(97)
2N5247	30	1.5	8	15	10	4	400	150	400	4.5	1.0	4	400	TO-92(97)
2N5397	25	1	6	10	1	5.5	450	400	450	5	1.2	3.5	450	TO-72
2N5484	25	0.3	3	15	10	2.5	100	75	100	5	1	3	100	TO-92(92)
MMBF5484	25	0.3	3	15	10	2.5	100	75	100	5	1	3	100	TO-236*
2N5485	25	0.5	4	15	10	3	400	100	400	5	1	4	400	TO-92(92)
MMBF5485	25	0.5	4	15	10	3	400	100	400	5	1	4	400	TO-236*
2N5486	25	2	6	15	10	3.5	400	100	400	5	1	4	400	TO-92(92)
MMBF5486	25	2	6	15	10	3.5	400	100	400	5	1	4	400	TO-236*
2N5949	30	3	7	15	100	3	100	150	100	6	2	5	100	TO-92(97)
2N5950	30	2.5	6	15	100	3	100	125	100	6	2	5	100	TO-92(97)
2N5951	30	2	5	15	100	3	100	100	100	6	2	5	100	TO-92(97)
2N5952	30	1.3	4.5	15	100	1	100	75	100	6	2	5	100	TO-92(97)
2N5953	30	0.8	3	15	100	1	100	50	100	6	2	5	100	TO-92(97)
J300	25	1	6	10	1	4.5	0.001	200	0.001	5.5	1.7			TO-92(92)
MMBFJ304	30	2	6	15	1	t4.2	400	t80	100					TO-236*
J304	30	2	6	15	1	t4.2	400	t80	100					TO-92(92)
J305	30	0.5	3	15	1	t3.0	400	t80	100					TO-92(92)
MMBFJ305	30	0.5	3	15	1	t3.0	400	t80	100					TO-236*
MMBFJ309	25	1	4	10	1	10	0.001	150	0.001	7.5	2.5			TO-236*
J309	25	1	4	10	1	10	0.001	150	0.001	7.5	2.5			TO-92(92)
MMBFJ310	25	2	6.5	10	1	8	0.001	150	0.001	7.5	2.5			TO-236*
J310	25	2	6.5	10	1	8	0.001	150	0.001	7.5	2.5			TO-92(92)
U309	25	1	4	10	1	10	0.001	150	100	5	2.5			TO-52
U310	25	2.5	6	10	1	10	0.001	150	100	5	2.5			TO-52











BF245

ON Semiconductor™

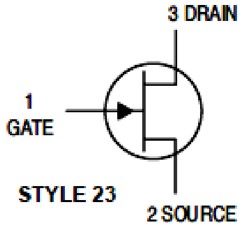
JFET VHF/UHF Amplifiers

N–Channel — Depletion

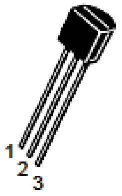
BF245A
BF245B

MAXIMUM RATINGS

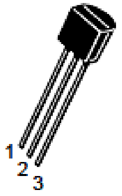
Rating	Symbol	Value	Unit
Drain–Source Voltage	V_{DS}	±30	Vdc
Drain–Gate Voltage	V_{DG}	30	Vdc
Gate–Source Voltage	V_{GS}	30	Vdc
Drain Current	I_D	100	mAdc
Forward Gate Current	$I_{G(f)}$	10	mAdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	350 2.8	mW mW/°C
Storage Channel Temperature Range	T_{stg}	–65 to +150	°C



STYLE 23



BF244A, BF244B
CASE 29–11, STYLE 22
TO–92 (TO–226AA)

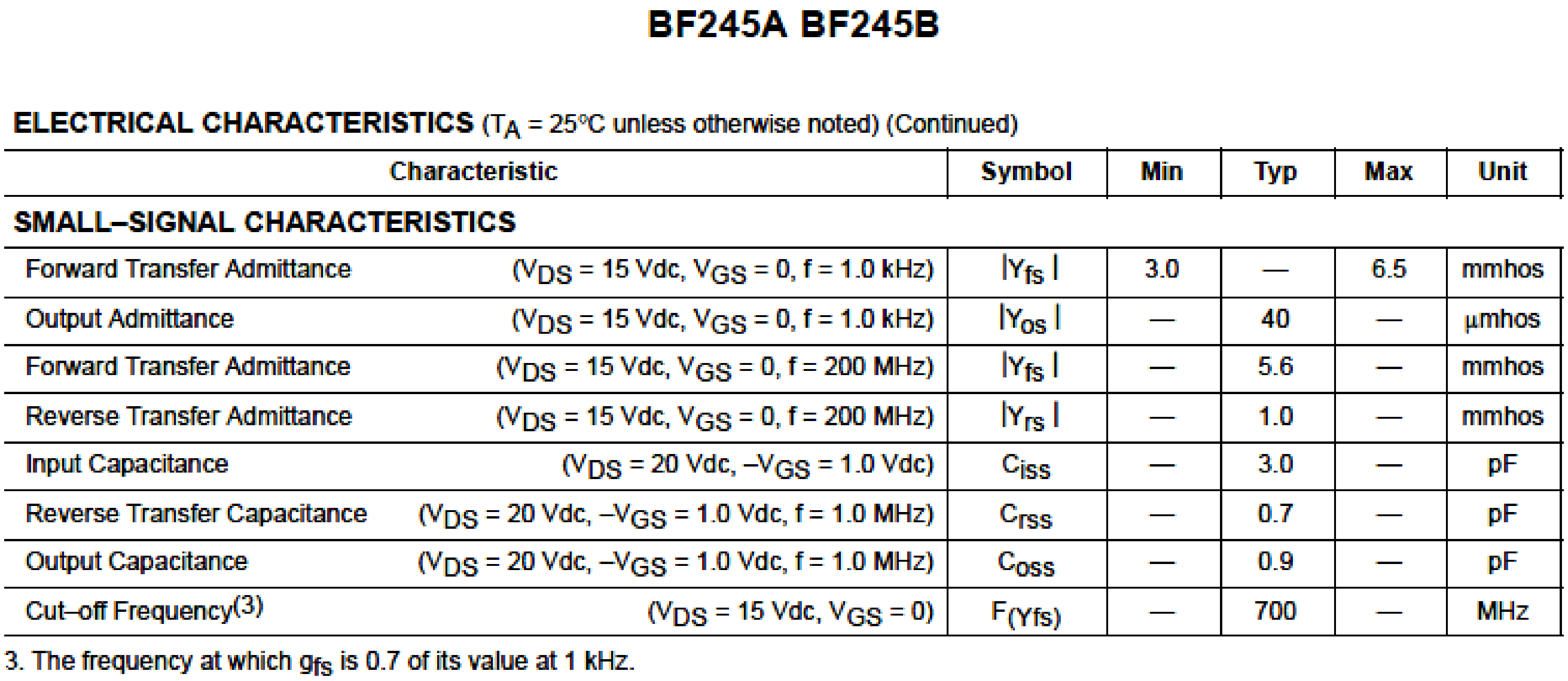


BF245, BF245A,
BF245B, BF245C
CASE 29–11, STYLE 23
TO–92 (TO–226AA)

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Gate–Source Breakdown Voltage (I_G = 1.0 µAdc, V_{DS} = 0)	$V_{(BR)GSS}$	30	—	—	Vdc
Gate–Source (V_{DS} = 15 Vdc, I_D = 200 µAdc)	V_{GS}				Vdc
BF245(1)		0.4	—	7.5	
BF245A, BF244A(2)		0.4	—	2.2	
BF245B, BF244B		1.6	—	3.8	
BF245C		3.2	—	7.5	
Gate–Source Cutoff Voltage (V_{DS} = 15 Vdc, I_D = 10 nAdc)	$V_{GS(off)}$	–0.5	—	–8.0	Vdc
Gate Reverse Current (V_{GS} = 20 Vdc, V_{DS} = 0)	I_{GSS}	—	—	5.0	nAdc
ON CHARACTERISTICS					
Zero–Gate–Voltage Drain Current (V_{DS} = 15 Vdc, V_{GS} = 0)	I_{DSS}				mAdc
BF245(1)		2.0	—	25	
BF245A, BF244A(2)		2.0	—	6.5	
BF245B, BF244B		6.0	—	15	
BF245C		12	—	25	

1. On orders against the BF245, any or all subgroups might be shipped.
2. On orders against the BF244A, any or all subgroups might be shipped.



BF245A BF245B

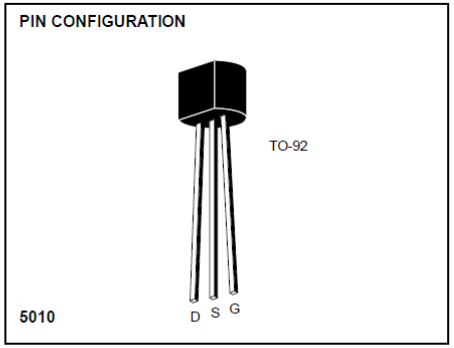
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) (Continued)

Characteristic		Symbol	Min	Typ	Max	Unit
SMALL–SIGNAL CHARACTERISTICS						
Forward Transfer Admittance	(V_{DS} = 15 Vdc, V_{GS} = 0, f = 1.0 kHz)	$\|Y_{fs}\|$	3.0	—	6.5	mmhos
Output Admittance	(V_{DS} = 15 Vdc, V_{GS} = 0, f = 1.0 kHz)	$\|Y_{os}\|$	—	40	—	µmhos
Forward Transfer Admittance	(V_{DS} = 15 Vdc, V_{GS} = 0, f = 200 MHz)	$\|Y_{fs}\|$	—	5.6	—	mmhos
Reverse Transfer Admittance	(V_{DS} = 15 Vdc, V_{GS} = 0, f = 200 MHz)	$\|Y_{rs}\|$	—	1.0	—	mmhos
Input Capacitance	(V_{DS} = 20 Vdc, $-V_{GS}$ = 1.0 Vdc)	C_{iss}	—	3.0	—	pF
Reverse Transfer Capacitance	(V_{DS} = 20 Vdc, $-V_{GS}$ = 1.0 Vdc, f = 1.0 MHz)	C_{rss}	—	0.7	—	pF
Output Capacitance	(V_{DS} = 20 Vdc, $-V_{GS}$ = 1.0 Vdc, f = 1.0 MHz)	C_{oss}	—	0.9	—	pF
Cut–off Frequency(3)	(V_{DS} = 15 Vdc, V_{GS} = 0)	$F_{(Yfs)}$	—	700	—	MHz

3. The frequency at which g_{fs} is 0.7 of its value at 1 kHz.

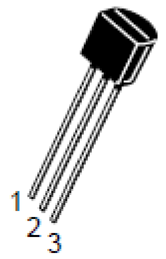
2N5457/2N5459 JFET MUITO USADO PELOS AMERICANOS

2N5457 – 2N5459

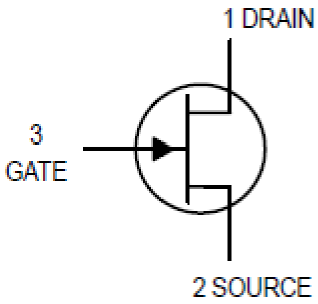


Uso geral muito usado pelos americanos

MPF-102 VHF AMPLIFIER

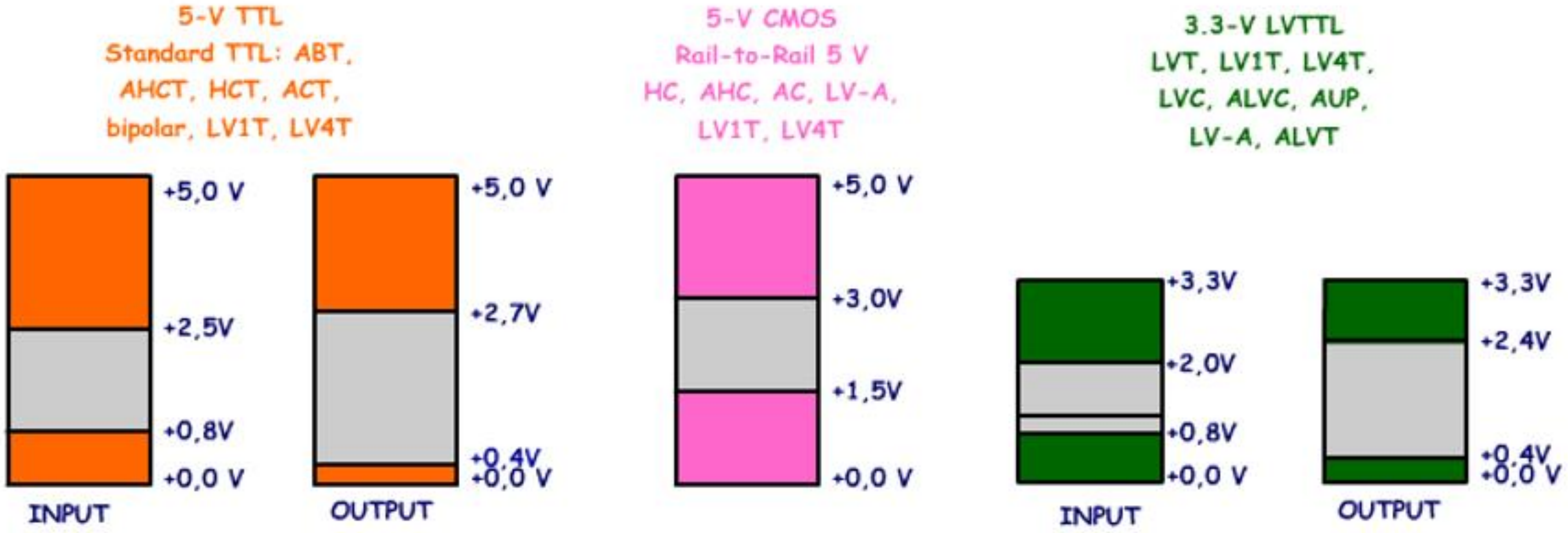


CASE 29–04, STYLE 5
TO–92 (TO–226AA)

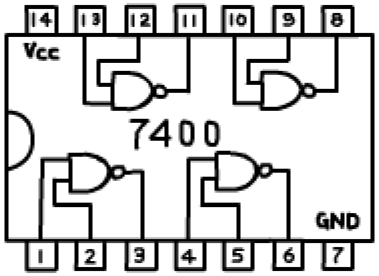


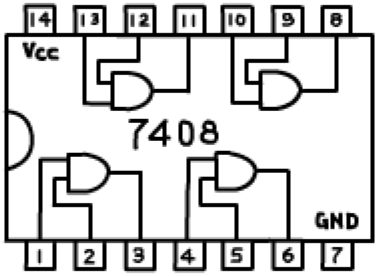
DIGITAL

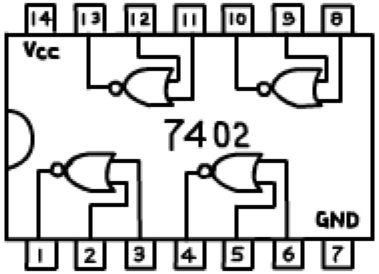
NÍVEIS DE TENSÃO TTL CMOS

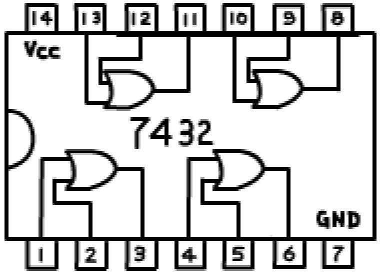


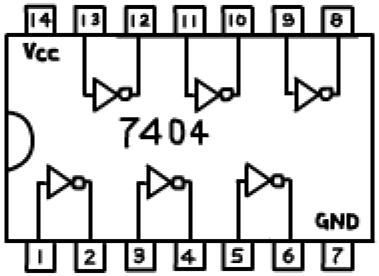
LISTA DAS PORTAS LÓGICAS TTL MAIS USADAS

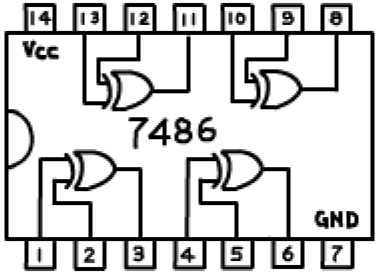












CONTADOR 7 SEGMENTOS 4026

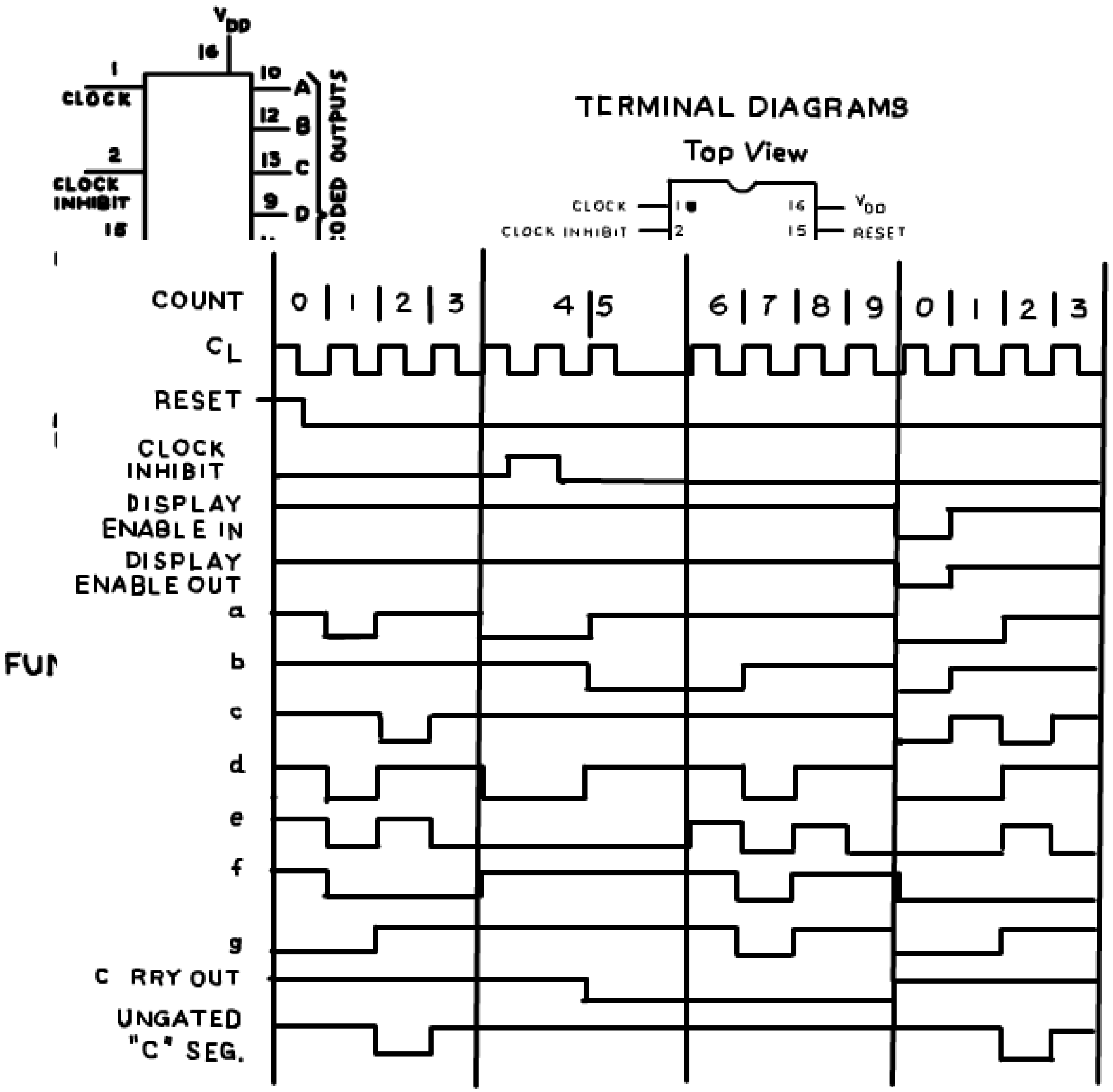
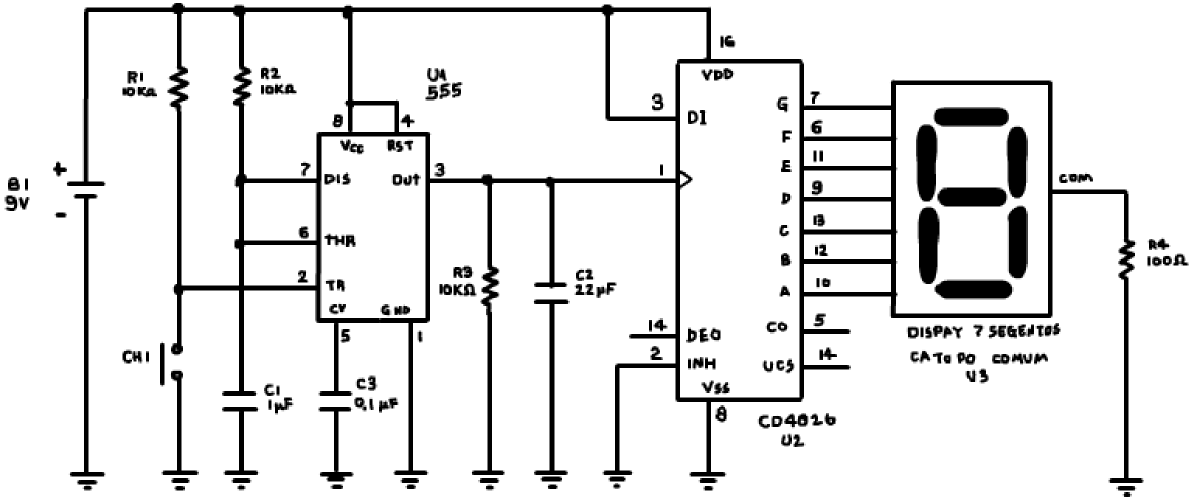


Fig. 3 — CD4026B timing diagram.

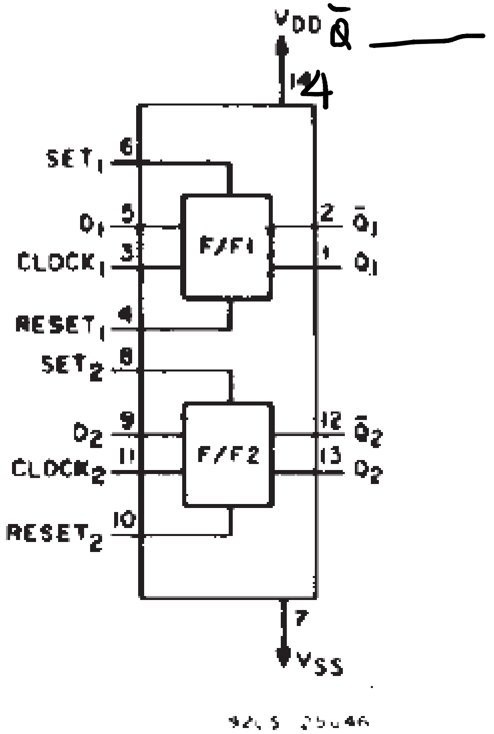
Exemplo de aplicação.



Contador digital 7segmentos com 4026

YOUTUBE: https://youtu.be/u0xZZCLX8hg

CD4013 DUAL D F-F CMOS

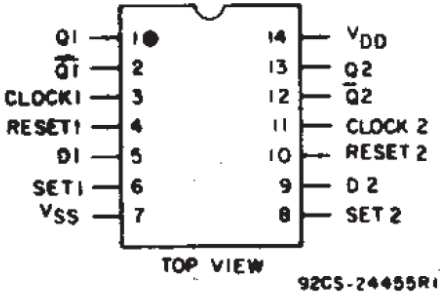


CD4013B
FUNCTIONAL DIAGRAM

TRUTH TABLE

CL▲	D	R	S	Q	$\bar{Q}$	
↗	0	0	0	0	1	
↗	1	0	0	1	0	
↘	X	0	0	Q	$\bar{Q}$	NO CHANGE
X	X	1	0	0	1	
X	X	0	1	1	0	
X	X	1	1	1	1	

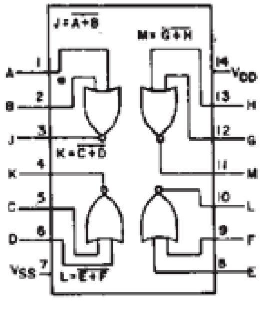
LOGIC 0 = LOW
LOGIC 1 = HIGH
▲ = LEVEL CHANGE
X = DON'T CARE
N(N) = FF1/FF2 TERMINAL ASSIGNMENTS



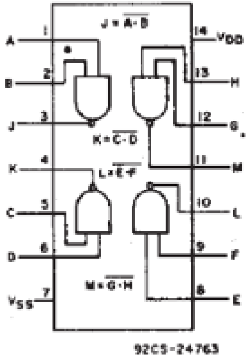
TERMINAL ASSIGNMENT

PORTAS LÓGICAS DA FAMÍLIA CMOS MAIS COMUNS

CD4001 CD4011 CD4069 CD4071

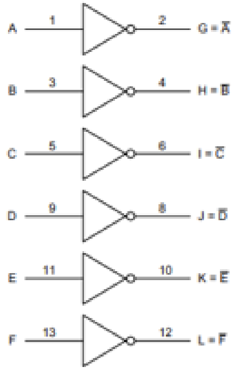


CD4001B FUNCTIONAL DIAGRAM

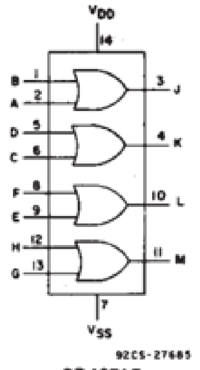


CD4011B FUNCTIONAL DIAGRAM

CD4069UB Functional Diagram

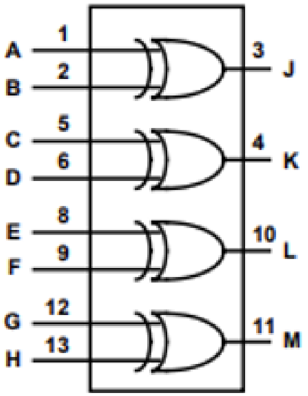


V_DD = Pin 14
V_SS = Pin 7

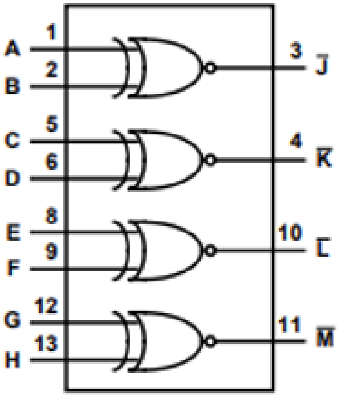


CD4071B FUNCTIONAL DIAGRAM

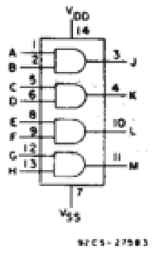
CD4070B



CD4077B

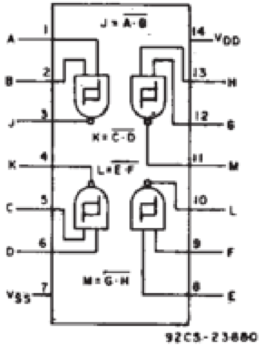


CD4081



CD4081B FUNCTIONAL DIAGRAM

CD4093



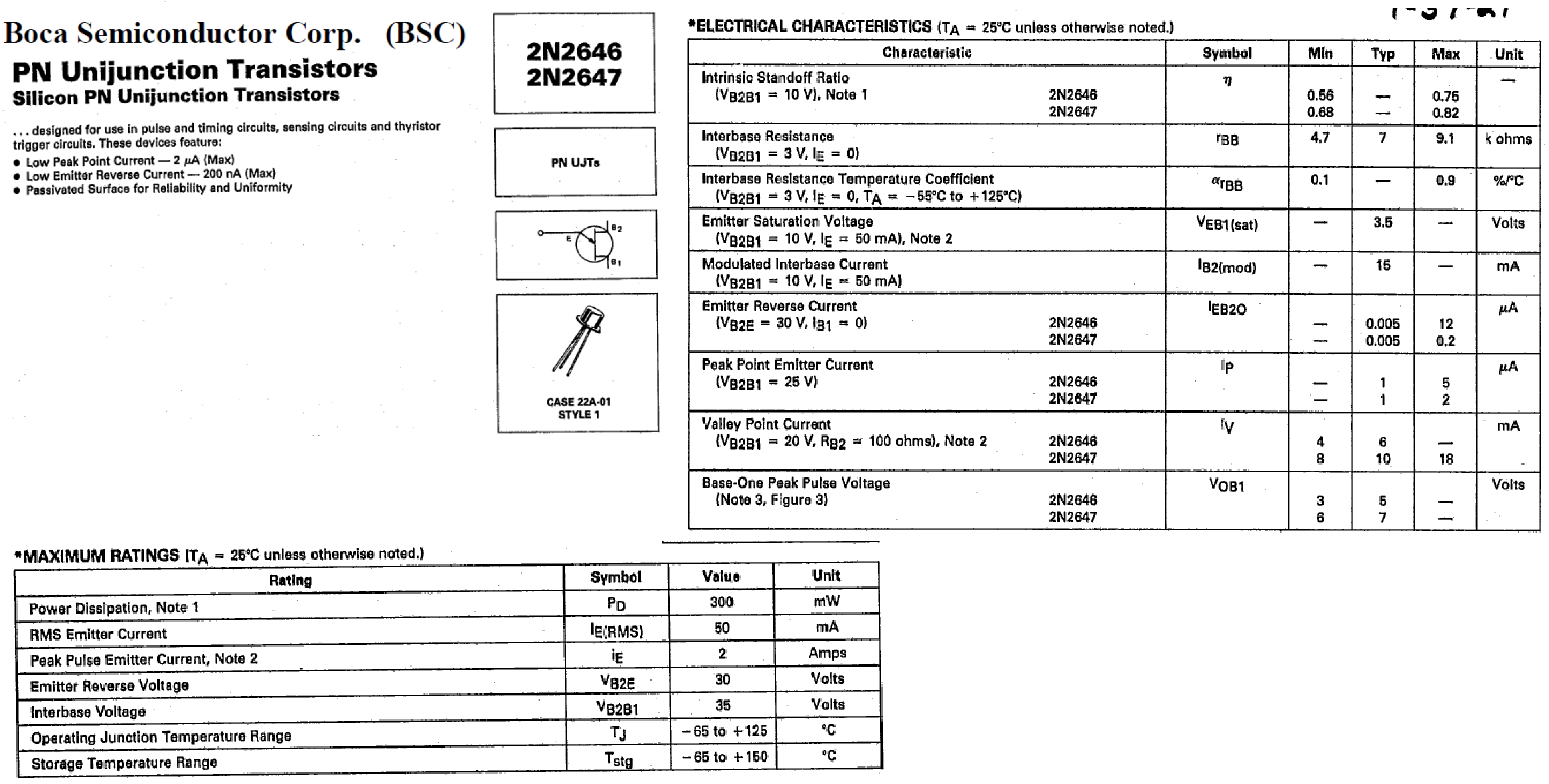
FUNCTIONAL DIAGRAM

BATERIAS PILHAS

TIPOS DE PILHAS

Fun fact: AAAA ("quadruple-A") cells exist, too, and they're tiny. As my daughter says, "the smaller the battery, the longer it screams."

2N2646 2N2647UNIJUNÇÃO



Boca Semiconductor Corp. (BSC)

PN Unijunction Transistors

Silicon PN Unijunction Transistors

. . . designed for use in pulse and timing circuits, sensing circuits and thyristor trigger circuits. These devices feature:

- Low Peak Point Current — 2 μA (Max)
- Low Emitter Reverse Current — 200 nA (Max)
- Passivated Surface for Reliability and Uniformity

2N2646
2N2647

PN UJTs

CASE 22A-01
STYLE 1

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

Characteristic		Symbol	Min	Typ	Max	Unit
Intrinsic Standoff Ratio (V_{B2B1} = 10 V), Note 1	2N2646 2N2647	η	0.56 0.68	— —	0.75 0.82	—
Interbase Resistance (V_{B2B1} = 3 V, I_E = 0)		r_{BB}	4.7	7	9.1	k ohms
Interbase Resistance Temperature Coefficient (V_{B2B1} = 3 V, I_E = 0, T_A = −55°C to +125°C)		αr_{BB}	0.1	—	0.9	%/°C
Emitter Saturation Voltage (V_{B2B1} = 10 V, I_E = 50 mA), Note 2		$V_{EB1(sat)}$	—	3.5	—	Volts
Modulated Interbase Current (V_{B2B1} = 10 V, I_E = 50 mA)		$I_{B2(mod)}$	—	15	—	mA
Emitter Reverse Current (V_{B2E} = 30 V, I_{B1} = 0)	2N2646 2N2647	I_{EB2O}	— —	0.005 0.005	12 0.2	μA
Peak Point Emitter Current (V_{B2B1} = 25 V)	2N2646 2N2647	I_P	— —	1 1	5 2	μA
Valley Point Current (V_{B2B1} = 20 V, R_{B2} = 100 ohms), Note 2	2N2646 2N2647	I_V	4 8	6 10	— 18	mA
Base-One Peak Pulse Voltage (Note 3, Figure 3)	2N2646 2N2647	V_{OB1}	3 6	5 7	— —	Volts

***MAXIMUM RATINGS** (T_A = 25°C unless otherwise noted.)

Rating	Symbol	Value	Unit
Power Dissipation, Note 1	P_D	300	mW
RMS Emitter Current	$I_{E(RMS)}$	50	mA
Peak Pulse Emitter Current, Note 2	i_E	2	Amps
Emitter Reverse Voltage	V_{B2E}	30	Volts
Interbase Voltage	V_{B2B1}	35	Volts
Operating Junction Temperature Range	T_J	−65 to +125	°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

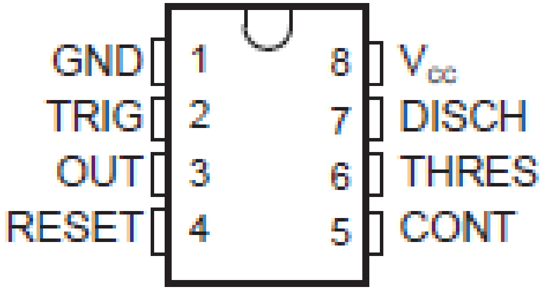
RELÉ DE ESTADO SÓLIDO TRIFÁSICO (SSR)

Relé Estado Sólido Trifásico Ssr 60a + Dissipador + Cooler

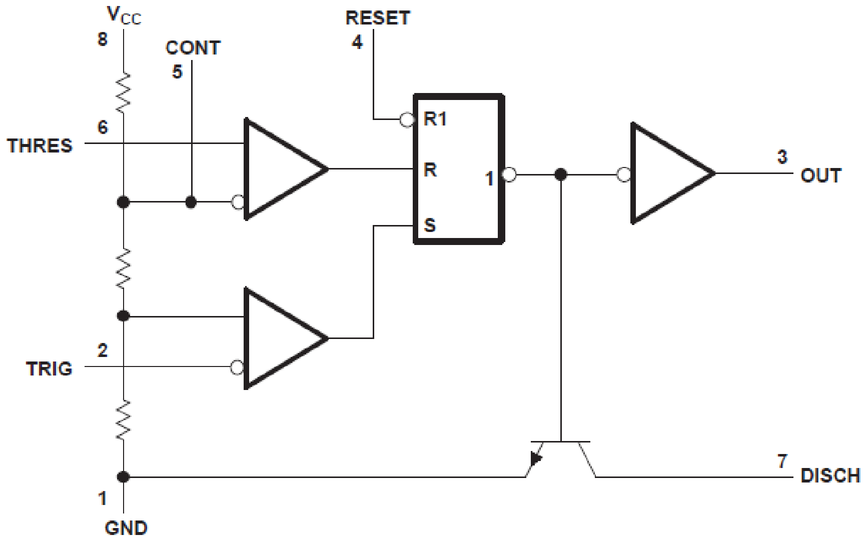
TEMPORIZADORES

TEMPORIZADOR 555

NA555...D OR P PACKAGE
NE555...D, P, PS, OR PW PACKAGE
SA555...D OR P PACKAGE
SE555...D, JG, OR P PACKAGE
(TOP VIEW)



FUNCTIONAL BLOCK DIAGRAM

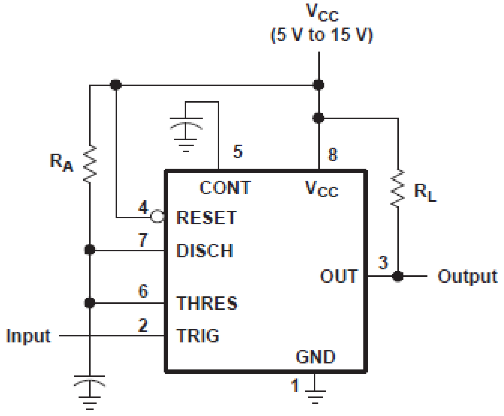


A. Pin numbers shown are for the D, JG, P, PS, and PW packages.

B. RESET can override TRIG, which can override THRES.

Monostable Operation

For monostable operation, any of these timers can be connected as shown in Figure 9. If the output is low, application of a negative-going pulse to the trigger (TRIG) sets the flip-flop ($\overline{Q}$ goes low), drives the output high, and turns off Q1. Capacitor C then is charged through R_A until the voltage across the capacitor reaches the threshold voltage of the threshold (THRES) input. If TRIG has returned to a high level, the output of the threshold comparator resets the flip-flop ($\overline{Q}$ goes high), drives the output low, and discharges C through Q1.



Pin numbers shown are for the D, JG, P, PS, and PW packages.

Figure 9. Circuit for Monostable Operation

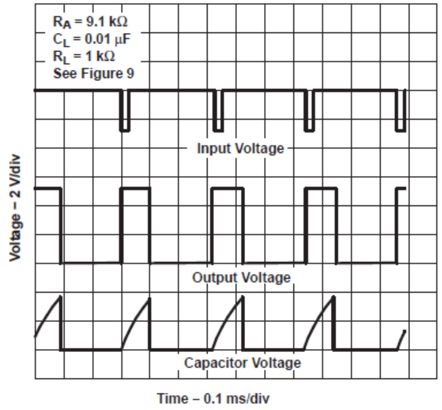


Figure 10. Typical Monostable Waveforms

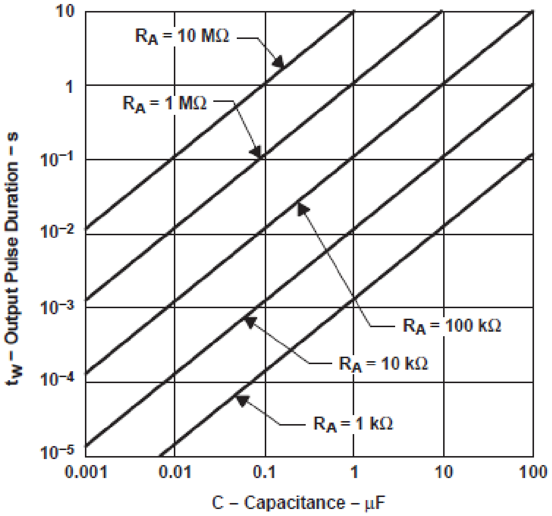


Figure 11. Output Pulse Duration vs Capacitance

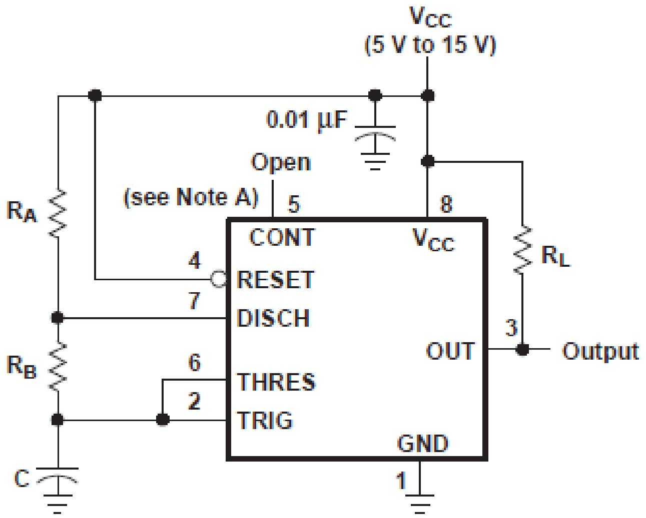
Monostable operation is initiated when TRIG voltage falls below the trigger threshold. Once initiated, the sequence ends only if TRIG is high for at least 10 µs before the end of the timing interval. When the trigger is grounded, the comparator storage time can be as long as 10 µs, which limits the minimum monostable pulse width to 10 µs. Because of the threshold level and saturation voltage of Q1, the output pulse duration is approximately $t_w = 1.1R_AC$. Figure 11 is a plot of the time constant for various values of R_A and C. The threshold levels and charge rates both are directly proportional to the supply voltage, V_{CC}. The timing interval is, therefore, independent of the supply voltage, so long as the supply voltage is constant during the time interval.

Applying a negative-going trigger pulse simultaneously to RESET and TRIG during the timing interval discharges C and reinitiates the cycle, commencing on the positive edge of the reset pulse. The output is held low as long as the reset pulse is low. To prevent false triggering, when RESET is not used, it should be connected to V_{CC}.

Astable Operation

As shown in Figure 12, adding a second resistor, R_B, to the circuit of Figure 9 and connecting the trigger input to the threshold input causes the timer to self-trigger and run as a multivibrator. The capacitor C charges through R_A and R_B and then discharges through R_B only. Therefore, the duty cycle is controlled by the values of R_A and R_B.

This astable connection results in capacitor C charging and discharging between the threshold-voltage level ($\approx 0.67 \times V_{CC}$) and the trigger-voltage level ($\approx 0.33 \times V_{CC}$). As in the monostable circuit, charge and discharge times (and, therefore, the frequency and duty cycle) are independent of the supply voltage.



Pin numbers shown are for the D, JG, P, PS, and PW packages.

NOTE A: Decoupling CONT voltage to ground with a capacitor can improve operation. This should be evaluated for individual applications.

Figure 12. Circuit for Astable Operation

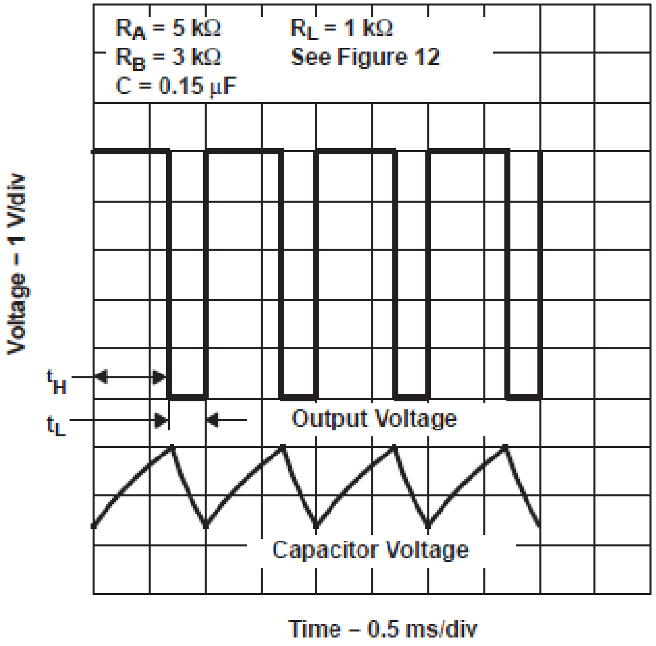


Figure 13. Typical Astable Waveforms

Figure 12 shows typical waveforms generated during astable operation. The output high-level duration t_H and low-level duration t_L can be calculated as follows:

$$t_H = 0.693\,(R_A + R_B)\,C$$

$$t_L = 0.693\,(R_B)\,C$$

Other useful relationships are shown below.

$$\text{period} = t_H + t_L = 0.693\,(R_A + 2R_B)\,C$$

$$\text{frequency} \approx \frac{1.44}{(R_A + 2R_B)\,C}$$

$$\text{Output driver duty cycle} = \frac{t_L}{t_H + t_L} = \frac{R_B}{R_A + 2R_B}$$

Output waveform duty cycle

$$= \frac{t_H}{t_H + t_L} = 1 - \frac{R_B}{R_A + 2R_B}$$

$$\text{Low-to-high ratio} = \frac{t_L}{t_H} = \frac{R_B}{R_A + R_B}$$

Figure .

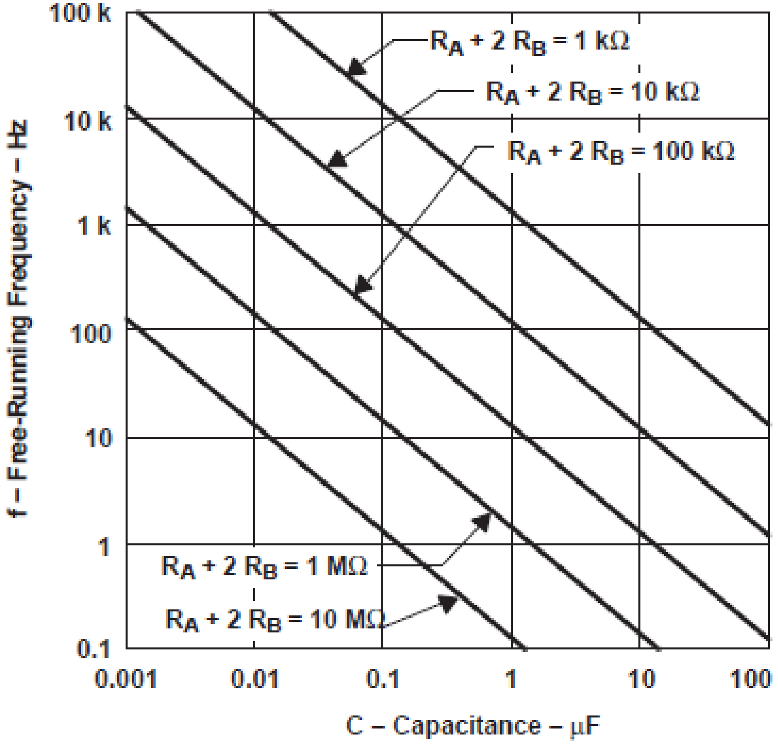
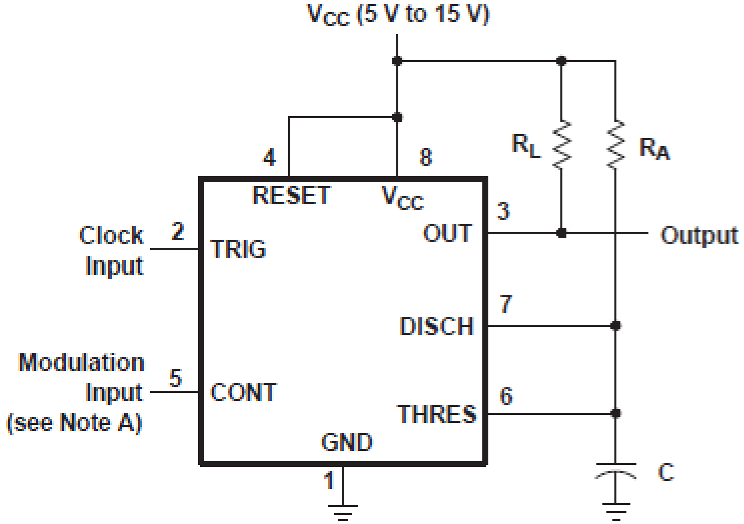


Figure 14. Free-Running Frequency

Pulse-Width Modulation

The operation of the timer can be modified by modulating the internal threshold and trigger voltages, which is accomplished by applying an external voltage (or current) to CONT. Figure 18 shows a circuit for pulse-width modulation. A continuous input pulse train triggers the monostable circuit, and a control signal modulates the threshold voltage. Figure 19 shows the resulting output pulse-width modulation. While a sine-wave modulation signal is shown, any wave shape could be used.



Pin numbers shown are for the D, JG, P, PS, and PW packages.

NOTE A: The modulating signal can be direct or capacitively coupled to CONT. For direct coupling, the effects of modulation source voltage and impedance on the bias of the timer should be considered.

Figure 18. Circuit for Pulse-Width Modulation

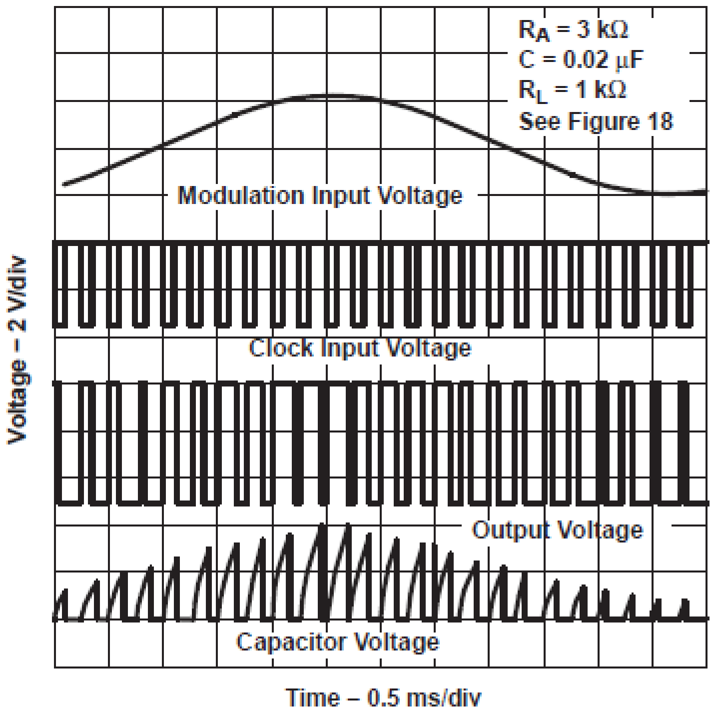
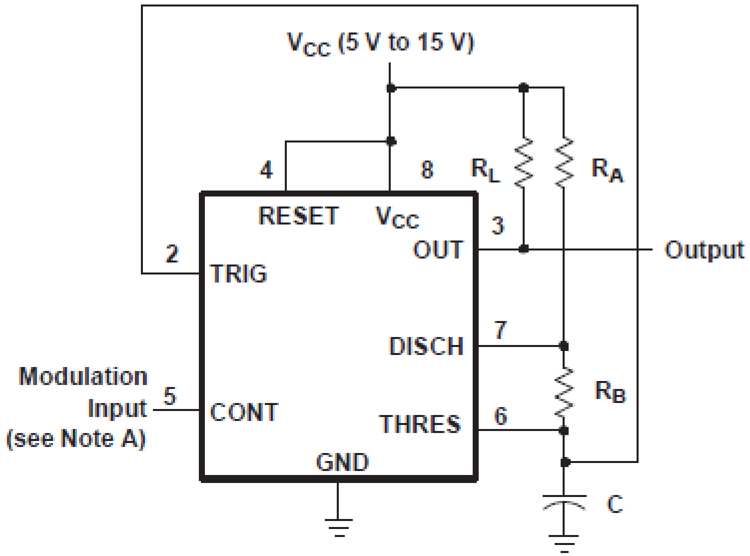


Figure 19. Pulse-Width-Modulation Waveforms

Pulse-Position Modulation

As shown in Figure 20, any of these timers can be used as a pulse-position modulator. This application modulates the threshold voltage and, thereby, the time delay, of a free-running oscillator. Figure 21 shows a triangular-wave modulation signal for such a circuit; however, any wave shape could be used.



Pin numbers shown are for the D, JG, P, PS, and PW packages.

NOTE A: The modulating signal can be direct or capacitively coupled to CONT. For direct coupling, the effects of modulation source voltage and impedance on the bias of the timer should be considered.

Figure 20. Circuit for Pulse-Position Modulation

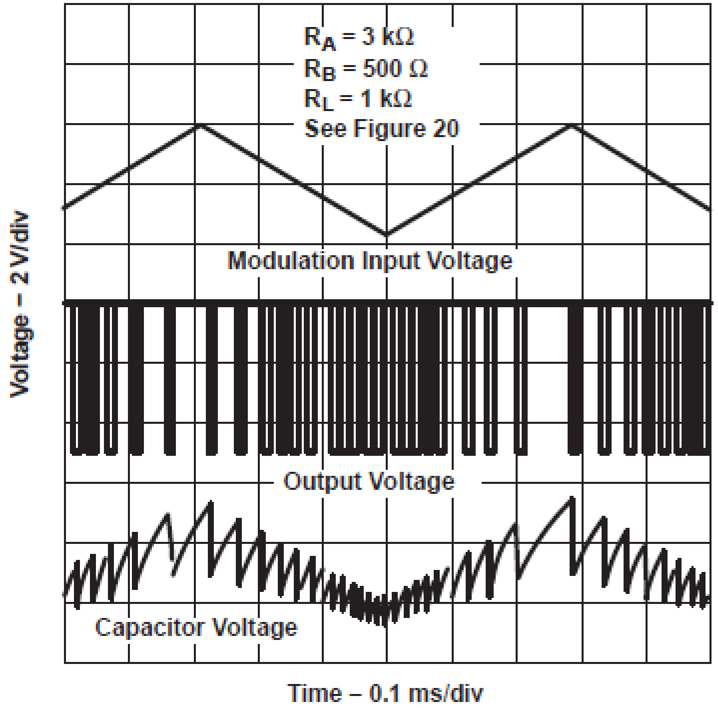
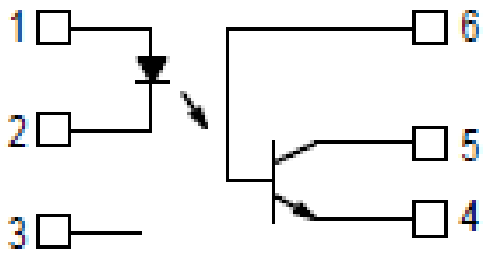


Figure 21. Pulse-Position-Modulation Waveforms

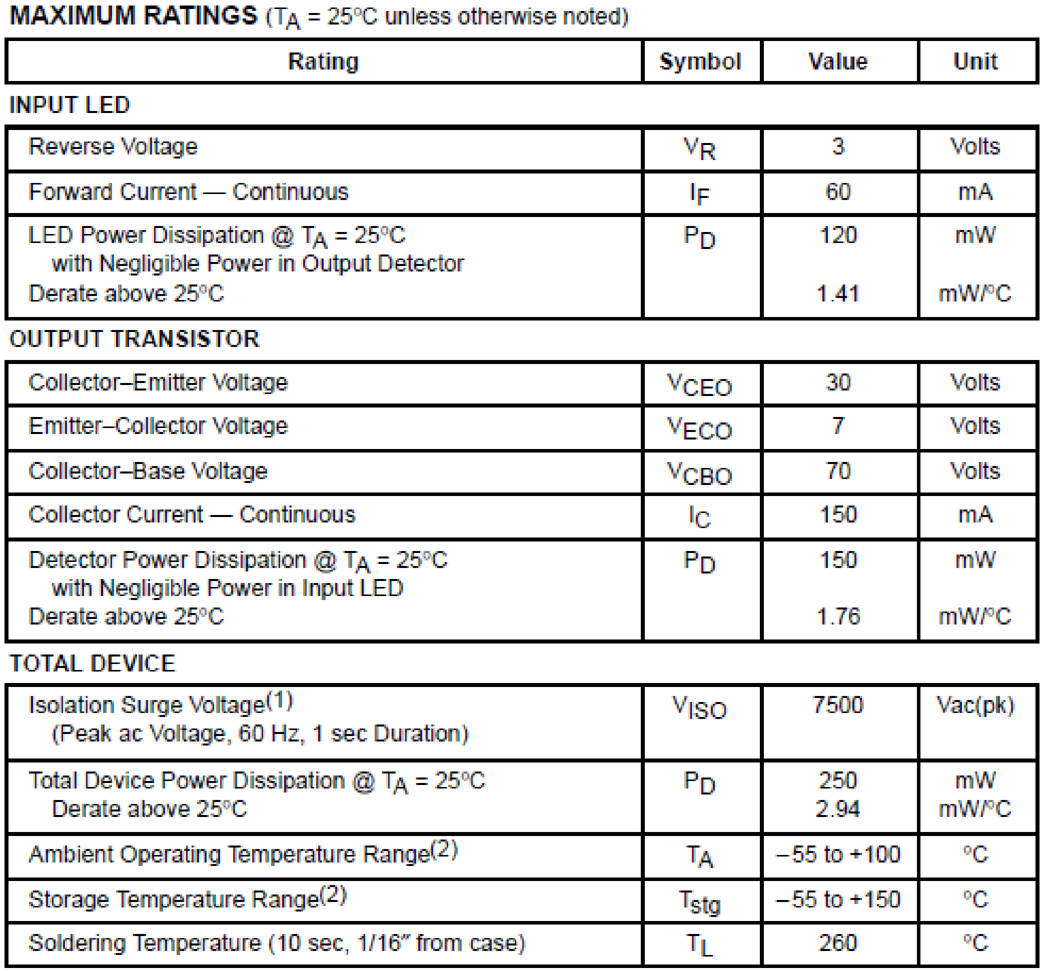
OPTO

OPTO-ACOPLADOR 4N25/4N25A/4N26/4N27/4N28

SCHEMATIC



PIN 1. LED ANODE
2. LED CATHODE
3. N.C.
4. EMITTER
5. COLLECTOR
6. BASE



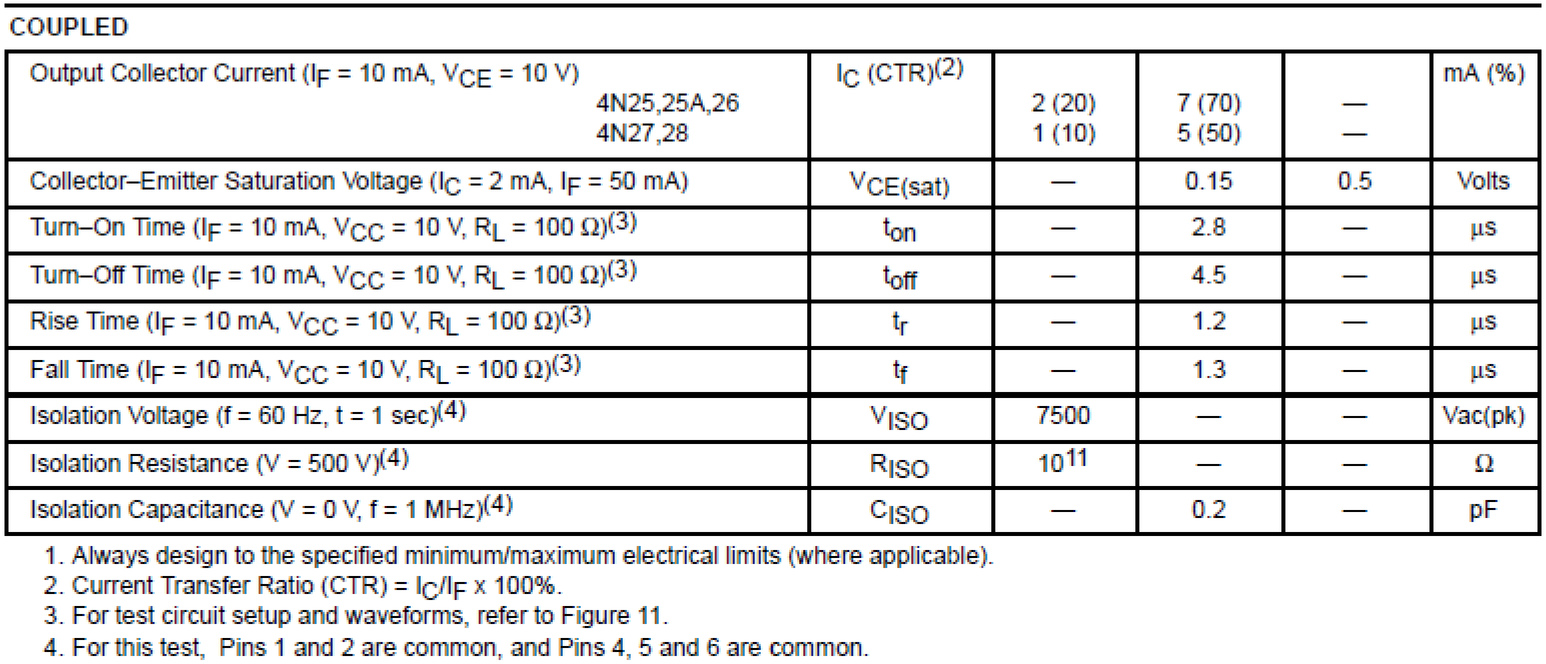
MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
INPUT LED			
Reverse Voltage	V_R	3	Volts
Forward Current — Continuous	I_F	60	mA
LED Power Dissipation @ T_A = 25°C with Negligible Power in Output Detector Derate above 25°C	P_D	120 1.41	mW mW/°C
OUTPUT TRANSISTOR			
Collector–Emitter Voltage	V_{CEO}	30	Volts
Emitter–Collector Voltage	V_{ECO}	7	Volts
Collector–Base Voltage	V_{CBO}	70	Volts
Collector Current — Continuous	I_C	150	mA
Detector Power Dissipation @ T_A = 25°C with Negligible Power in Input LED Derate above 25°C	P_D	150 1.76	mW mW/°C
TOTAL DEVICE			
Isolation Surge Voltage[1] (Peak ac Voltage, 60 Hz, 1 sec Duration)	V_{ISO}	7500	Vac(pk)
Total Device Power Dissipation @ T_A = 25°C Derate above 25°C	P_D	250 2.94	mW mW/°C
Ambient Operating Temperature Range[2]	T_A	–55 to +100	°C
Storage Temperature Range[2]	T_{stg}	–55 to +150	°C
Soldering Temperature (10 sec, 1/16″ from case)	T_L	260	°C

4N25 4N25A 4N26 4N27 4N28

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)[1]

Characteristic	Symbol	Min	Typ[1]	Max	Unit
INPUT LED					
Forward Voltage (I_F = 10 mA) T_A = 25°C	V_F	—	1.15	1.5	Volts
T_A = –55°C		—	1.3	—	
T_A = 100°C		—	1.05	—	
Reverse Leakage Current (V_R = 3 V)	I_R	—	—	100	µA
Capacitance (V = 0 V, f = 1 MHz)	C_J	—	18	—	pF
OUTPUT TRANSISTOR					
Collector–Emitter Dark Current (V_{CE} = 10 V, T_A = 25°C 4N25,25A,26,27	I_{CEO}	—	1	50	nA
4N28		—	1	100	
(V_{CE} = 10 V, T_A = 100°C) All Devices	I_{CEO}	—	1	—	µA
Collector–Base Dark Current (V_{CB} = 10 V)	I_{CBO}	—	0.2	—	nA
Collector–Emitter Breakdown Voltage (I_C = 1 mA)	$V_{(BR)CEO}$	30	45	—	Volts
Collector–Base Breakdown Voltage (I_C = 100 µA)	$V_{(BR)CBO}$	70	100	—	Volts
Emitter–Collector Breakdown Voltage (I_E = 100 µA)	$V_{(BR)ECO}$	7	7.8	—	Volts
DC Current Gain (I_C = 2 mA, V_{CE} = 5 V)	h_{FE}	—	500	—	—
Collector–Emitter Capacitance (f = 1 MHz, V_{CE} = 0)	C_{CE}	—	7	—	pF
Collector–Base Capacitance (f = 1 MHz, V_{CB} = 0)	C_{CB}	—	19	—	pF
Emitter–Base Capacitance (f = 1 MHz, V_{EB} = 0)	C_{EB}	—	9	—	pF



COUPLED

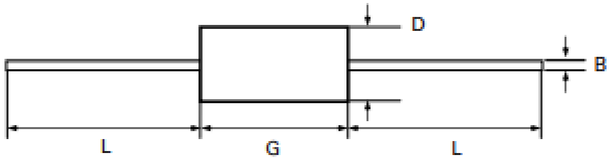
Output Collector Current (I_F = 10 mA, V_{CE} = 10 V) 4N25,25A,26 4N27,28	I_C (CTR)[2]	2 (20) 1 (10)	7 (70) 5 (50)	— —	mA (%)
Collector–Emitter Saturation Voltage (I_C = 2 mA, I_F = 50 mA)	$V_{CE(sat)}$	—	0.15	0.5	Volts
Turn–On Time (I_F = 10 mA, V_{CC} = 10 V, R_L = 100 Ω)[3]	t_{on}	—	2.8	—	µs
Turn–Off Time (I_F = 10 mA, V_{CC} = 10 V, R_L = 100 Ω)[3]	t_{off}	—	4.5	—	µs
Rise Time (I_F = 10 mA, V_{CC} = 10 V, R_L = 100 Ω)[3]	t_r	—	1.2	—	µs
Fall Time (I_F = 10 mA, V_{CC} = 10 V, R_L = 100 Ω)[3]	t_f	—	1.3	—	µs
Isolation Voltage (f = 60 Hz, t = 1 sec)[4]	V_{ISO}	7500	—	—	Vac(pk)
Isolation Resistance (V = 500 V)[4]	R_{ISO}	10^{11}	—	—	Ω
Isolation Capacitance (V = 0 V, f = 1 MHz)[4]	C_{ISO}	—	0.2	—	pF

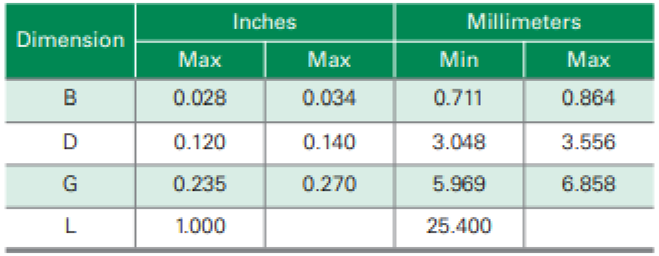
1. Always design to the specified minimum/maximum electrical limits (where applicable).
2. Current Transfer Ratio (CTR) = I_C/I_F x 100%.
3. For test circuit setup and waveforms, refer to Figure 11.
4. For this test, Pins 1 and 2 are common, and Pins 4, 5 and 6 are common.

Se alimentar o LED com 10mA, no 4N25 a saída será de 20Ma

DIODO SIDAC SÉRIE K000 LITTELFUSE

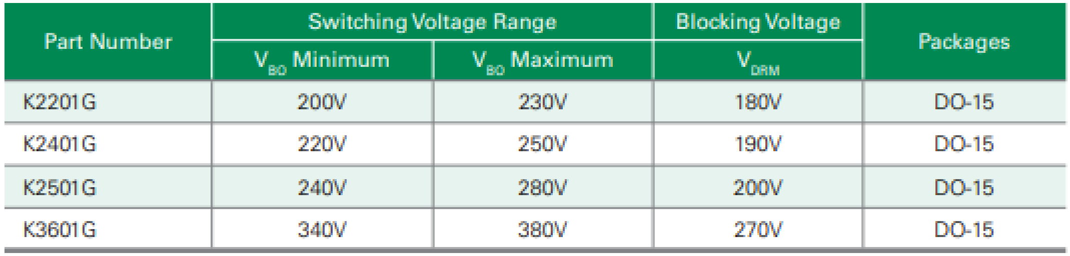
Dimensions — DO-15 (G Package)





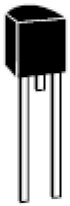
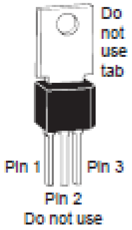
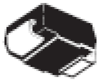
Dimension	Inches		Millimeters	
	Max	Max	Min	Max
B	0.028	0.034	0.711	0.864
D	0.120	0.140	3.048	3.556
G	0.235	0.270	5.969	6.858
L	1.000		25.400	

Product Selector

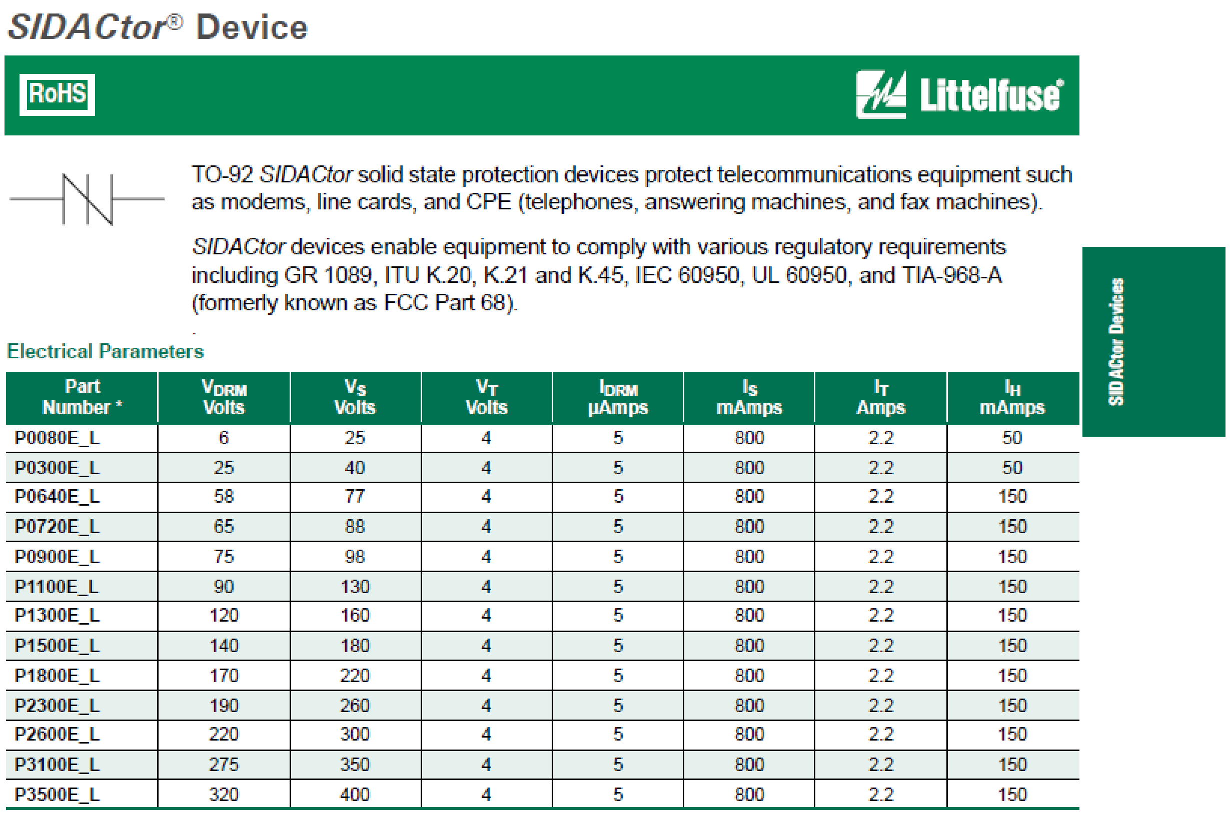


Part Number	Switching Voltage Range		Blocking Voltage	Packages
	V_{BO} Minimum	V_{BO} Maximum	V_{DRM}	
K2201G	200V	230V	180V	DO-15
K2401G	220V	250V	190V	DO-15
K2501G	240V	280V	200V	DO-15
K3601G	340V	380V	270V	DO-15

Onde comprar:https://produto.mercadolivre.com.br/MLB-3065555182-diodo-sidac-k220g-littelfuse-_JM#position=7&search_layout=stack&type=item&tracking_id=d20dc5e3-9686-4e31-85f7-32db44dd2f9e

Type	Part No.				$I_{T(RMS)}$	V_{DRM}	V_{BO}		I_{DRM}	I_{BO}	I_H	
	 TO-92	 DO-15X	(10)  TO-202	 DO-214	(6) (7) (8) Amps	Volts	(1) Volts		µAmps	(2) µAmps	(3) (4) mAmps	
	See "Package Dimensions" section for variations. (9)				MAX	MIN	MIN	MAX	MAX	MAX	TYP	MAX
	K0900E70	K0900G		K0900S	1	±70	79	97	5	10	60	150
	K1050E70	K1050G		K1050S	1	±90	95	113	5	10	60	150
	K1100E70	K1100G		K1100S	1	±90	104	118	5	10	60	150
	K1200E70	K1200G		K1200S	1	±90	110	125	5	10	60	150
	K1300E70	K1300G		K1300S	1	±90	120	138	5	10	60	150
	K1400E70	K1400G		K1400S	1	±90	130	146	5	10	60	150
	K1500E70	K1500G		K1500S	1	±90	140	170	5	10	60	150
	K2000E70	K2000G	K2000F1	K2000S	1	±180	190	215	5	10	60	150
	K2200E70	K2200G	K2200F1	K2200S	1	±180	205	230	5	10	60	150
	K2400E70	K2400G	K2400F1	K2400S	1	±190	220	250	5	10	60	150
			K2401F1		(11)	±190	220	250	5	10	60	150
	K2500E70	K2500G	K2500F1	K2500S	1	±200	240	280	5	10	60	150
			K3000F1		1	±200	270	330	5	10	60	150

SIDACTOR SIDAC LITTELFUSE SÉRIE P0000



SIDACtor® Device

RoHS

Littelfuse®

TO-92 *SIDACtor* solid state protection devices protect telecommunications equipment such as modems, line cards, and CPE (telephones, answering machines, and fax machines).

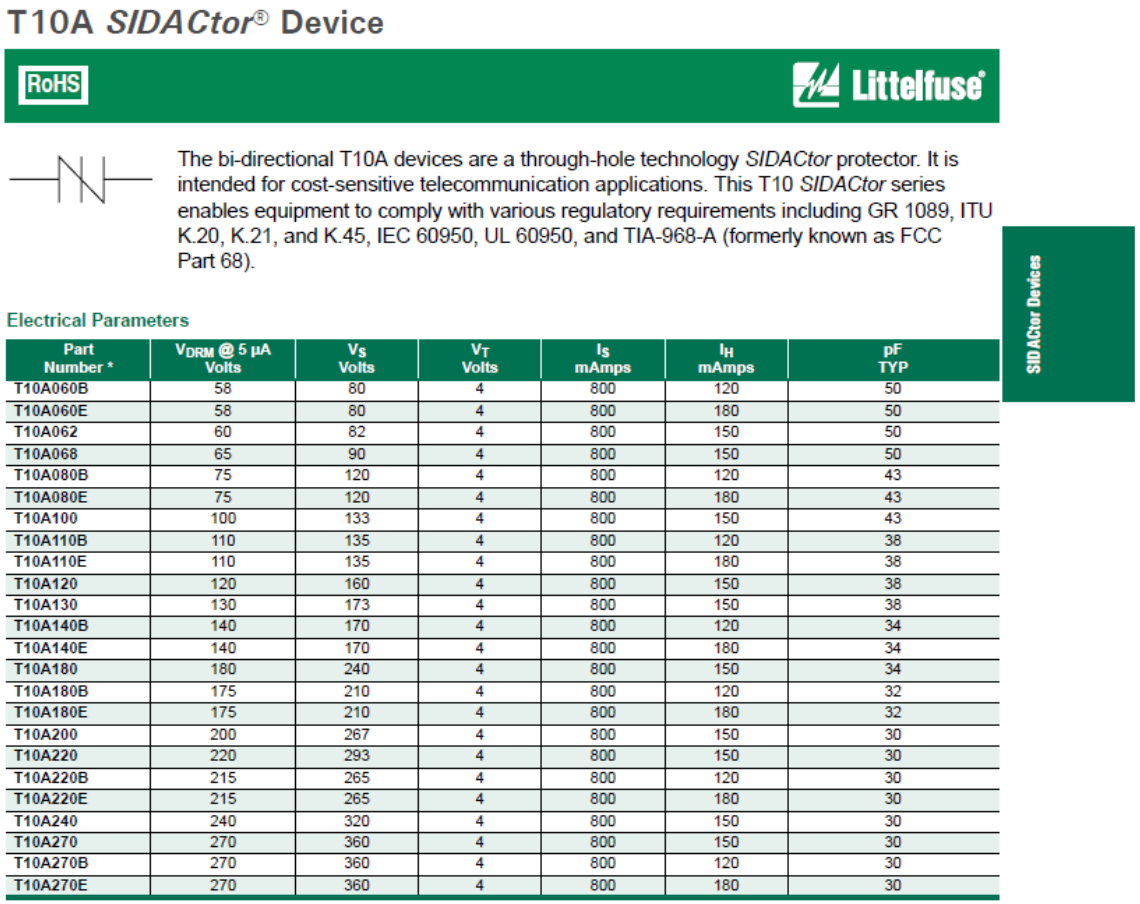
SIDACtor devices enable equipment to comply with various regulatory requirements including GR 1089, ITU K.20, K.21 and K.45, IEC 60950, UL 60950, and TIA-968-A (formerly known as FCC Part 68).

SIDACtor Devices

Electrical Parameters

Part Number *	V_{DRM} Volts	V_S Volts	V_T Volts	I_{DRM} µAmps	I_S mAmps	I_T Amps	I_H mAmps
P0080E_L	6	25	4	5	800	2.2	50
P0300E_L	25	40	4	5	800	2.2	50
P0640E_L	58	77	4	5	800	2.2	150
P0720E_L	65	88	4	5	800	2.2	150
P0900E_L	75	98	4	5	800	2.2	150
P1100E_L	90	130	4	5	800	2.2	150
P1300E_L	120	160	4	5	800	2.2	150
P1500E_L	140	180	4	5	800	2.2	150
P1800E_L	170	220	4	5	800	2.2	150
P2300E_L	190	260	4	5	800	2.2	150
P2600E_L	220	300	4	5	800	2.2	150
P3100E_L	275	350	4	5	800	2.2	150
P3500E_L	320	400	4	5	800	2.2	150

Onde comprar: https://produto.mercadolivre.com.br/MLB-2044642855-tiristor-sidac-p3100ealrp2-to-92-2-_JM#position=4&search_layout=stack&type=item&tracking_id=6e999ec4-526a-4ae2-9c5c-8eb27589f7d9



T10A *SIDACtor*® Device

RoHS

Littelfuse®

The bi-directional T10A devices are a through-hole technology *SIDACtor* protector. It is intended for cost-sensitive telecommunication applications. This T10 *SIDACtor* series enables equipment to comply with various regulatory requirements including GR 1089, ITU K.20, K.21, and K.45, IEC 60950, UL 60950, and TIA-968-A (formerly known as FCC Part 68).

SIDACtor Devices

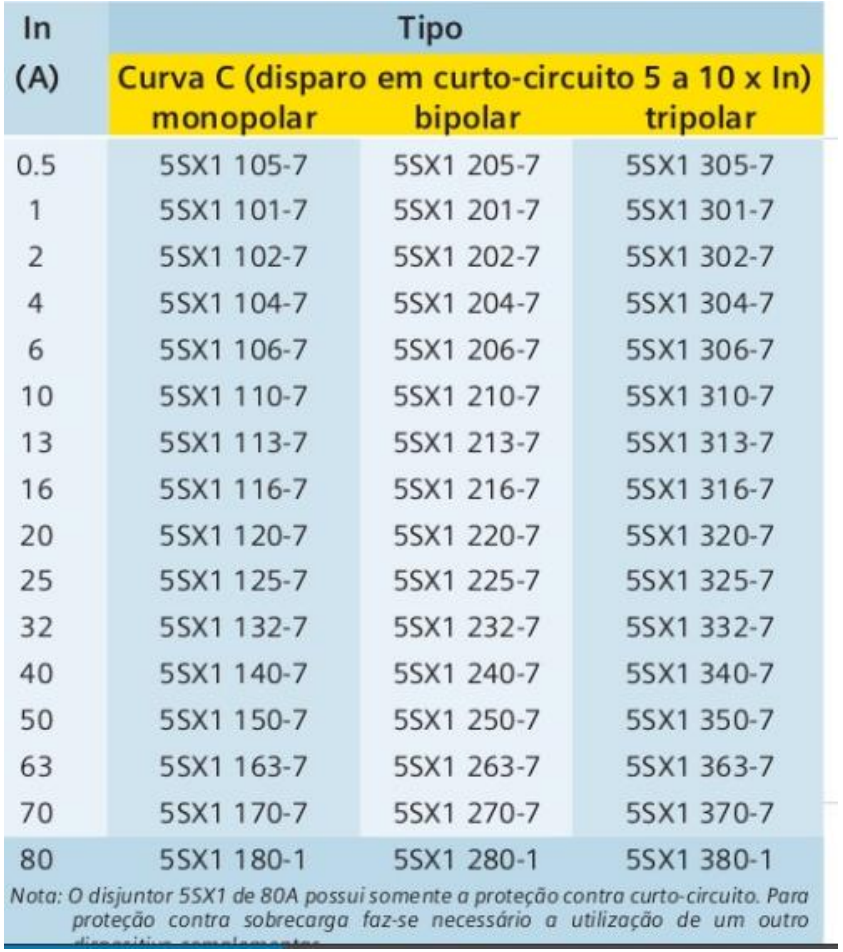
Electrical Parameters

Part Number *	V_{DRM} @ 5 µA Volts	V_S Volts	V_T Volts	I_S mAmps	I_H mAmps	pF TYP
T10A060B	58	80	4	800	120	50
T10A060E	58	80	4	800	180	50
T10A062	60	82	4	800	150	50
T10A068	65	90	4	800	150	50
T10A080B	75	120	4	800	120	43
T10A080E	75	120	4	800	180	43
T10A100	100	133	4	800	150	43
T10A110B	110	135	4	800	120	38
T10A110E	110	135	4	800	180	38
T10A120	120	160	4	800	150	38
T10A130	130	173	4	800	150	38
T10A140B	140	170	4	800	120	34
T10A140E	140	170	4	800	180	34
T10A180	180	240	4	800	150	34
T10A180B	175	210	4	800	120	32
T10A180E	175	210	4	800	180	32
T10A200	200	267	4	800	150	30
T10A220	220	293	4	800	150	30
T10A220B	215	265	4	800	120	30
T10A220E	215	265	4	800	180	30
T10A240	240	320	4	800	150	30
T10A270	270	360	4	800	150	30
T10A270B	270	360	4	800	120	30
T10A270E	270	360	4	800	180	30

https://produto.mercadolivre.com.br/MLB-3204374806-diodo-sidactor-t10a180e-_JM#position=7&search_layout=stack&type=item&tracking_id=77186c4d-872c-4609-85d0-9246f9ef7d5a

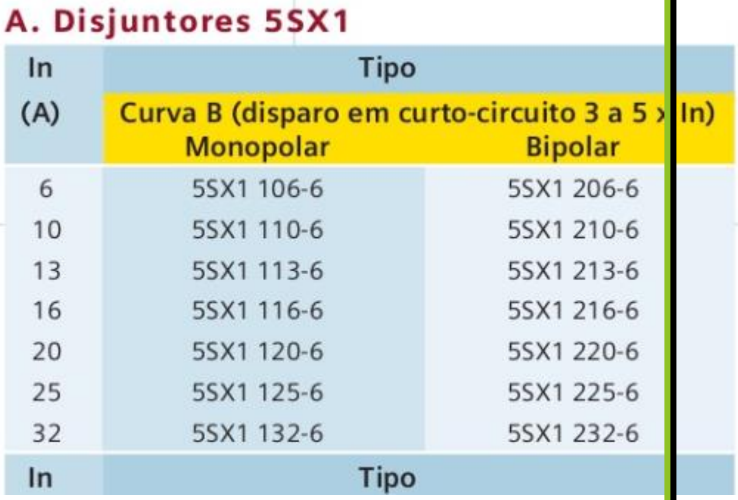
DISJUNTORES, TIPO E CORRENTE CURVA CARACTERÍSTICA

https://www.slideshare.net/akerman22/disjuntores-siemens



In (A)	Tipo Curva C (disparo em curto-circuito 5 a 10 x In) monopolar	 bipolar	 tripolar
0.5	5SX1 105-7	5SX1 205-7	5SX1 305-7
1	5SX1 101-7	5SX1 201-7	5SX1 301-7
2	5SX1 102-7	5SX1 202-7	5SX1 302-7
4	5SX1 104-7	5SX1 204-7	5SX1 304-7
6	5SX1 106-7	5SX1 206-7	5SX1 306-7
10	5SX1 110-7	5SX1 210-7	5SX1 310-7
13	5SX1 113-7	5SX1 213-7	5SX1 313-7
16	5SX1 116-7	5SX1 216-7	5SX1 316-7
20	5SX1 120-7	5SX1 220-7	5SX1 320-7
25	5SX1 125-7	5SX1 225-7	5SX1 325-7
32	5SX1 132-7	5SX1 232-7	5SX1 332-7
40	5SX1 140-7	5SX1 240-7	5SX1 340-7
50	5SX1 150-7	5SX1 250-7	5SX1 350-7
63	5SX1 163-7	5SX1 263-7	5SX1 363-7
70	5SX1 170-7	5SX1 270-7	5SX1 370-7
80	5SX1 180-1	5SX1 280-1	5SX1 380-1

Nota: O disjuntor 5SX1 de 80A possui somente a proteção contra curto-circuito. Para proteção contra sobrecarga faz-se necessário a utilização de um outro dispositivo complementar



A. Disjuntores 5SX1

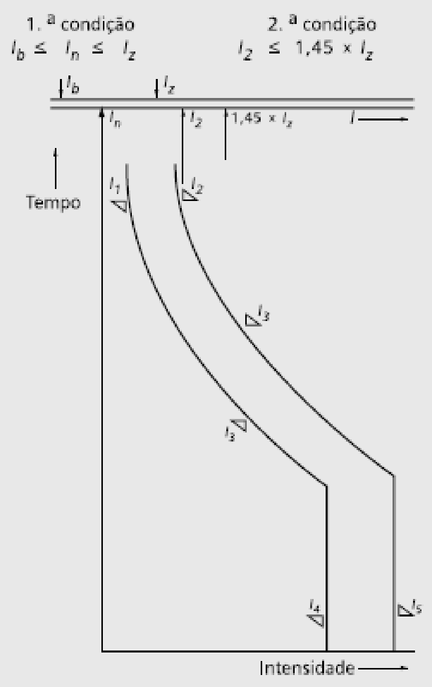
In (A)	Tipo Curva B (disparo em curto-circuito 3 a 5 x In) Monopolar	 Bipolar
6	5SX1 106-6	5SX1 206-6
10	5SX1 110-6	5SX1 210-6
13	5SX1 113-6	5SX1 213-6
16	5SX1 116-6	5SX1 216-6
20	5SX1 120-6	5SX1 220-6
25	5SX1 125-6	5SX1 225-6
32	5SX1 132-6	5SX1 232-6
In	Tipo	

Material retirado do catálogo de mini disjuntores da Siemens 2022

Curvas características **de disparo**

Curvas características

A função dos disjuntores termomagnéticos é a proteção dos condutores contra sobrecargas térmicas ou curto-circuitos. É por isso que as curvas de disparo dos disjuntores se adaptam às curvas dos condutores.



Na representação da figura ao lado, são coordenados os valores de referência dos condutores com os disjuntores termomagnéticos. Na Norma NBR NM 60898, são definidas as características, curvas B, C e D.

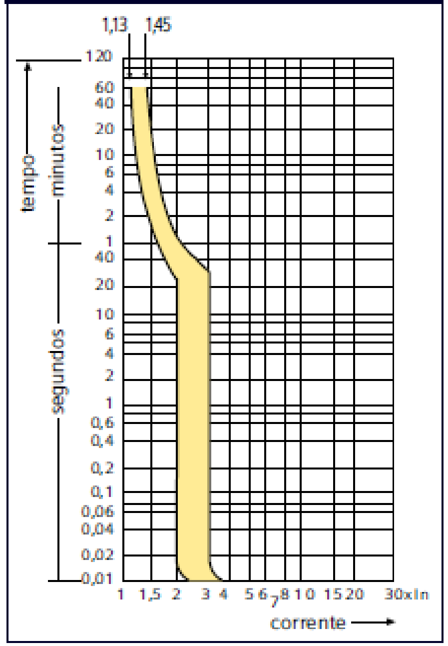
Deve-se cumprir para uma boa seleção, a seguinte fórmula:

$I_B < I_N < I_z$ e além disso, que $I_2 < 1{,}45 \times I_z$

Onde:

- I_B = Corrente de projeto do circuito.
- I_n = Corrente nominal do disjuntor termomagnético, nas condições previstas na instalação.
- I_z = Capacidade de condução de corrente dos condutores, nas condições previstas para sua instalação.
- **1,45 x** I_z = Corrente de sobrecarga máxima permitida, para uma condição de temperatura excedita, sem que haja o comprometimento do isolante dos condutores.
- I_1 = Corrente convencional de não atuação na sobrecarga.
- I_2 = Corrente convencional de atuação na sobrecarga
- I_3 = Limite de tolerância do disparador
- I_4 = Corrente convencional de não atuação no curto-circuito.
- I_5 = Corrente convencional de atuação no curto-circuito.

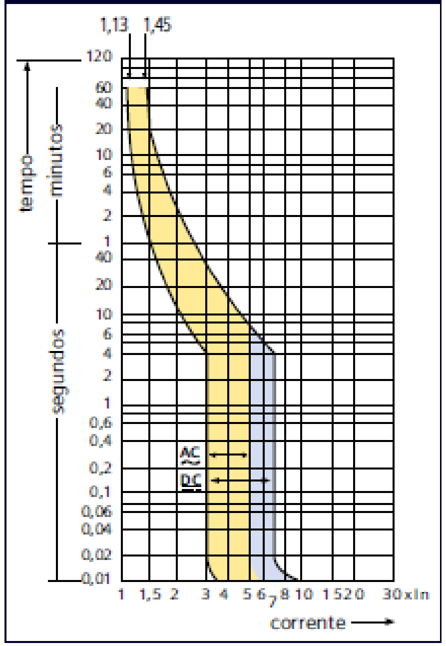
Curva A



Curva A: Para proteção de circuitos com semicondutores e circuitos de medição.

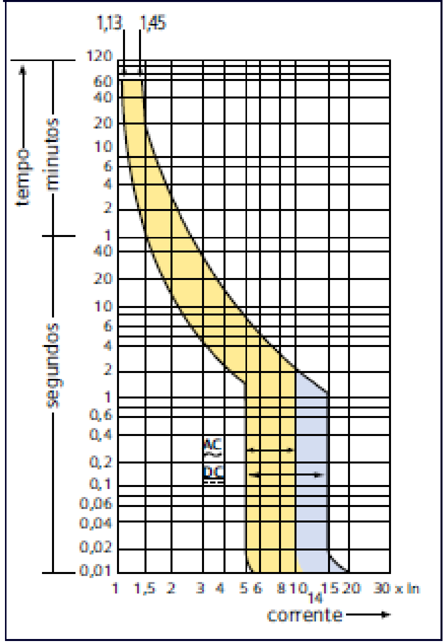
* Não designada na NBR NM 60898

Curva B



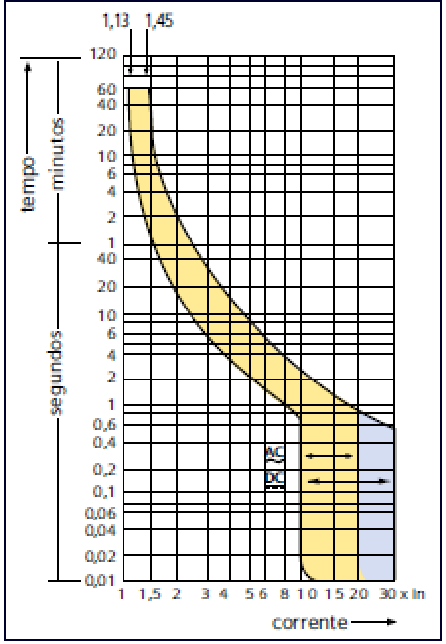
Curva B: Para proteção de circuitos que alimentam cargas com características predominantemente resistivas, como lâmpadas incandescentes, chuveiros, torneiras e aquecedores elétricos, além dos circuitos de tomadas de uso geral.

Curva C



Curva C: Para proteção de circuitos que alimentam especificamente cargas de natureza indutiva que apresentam picos de corrente no momento de ligação, como microondas, ar condicionado, motores para bombas, além de circuitos com cargas de características semelhantes a essas.

Curva D



Curva D: Para proteção de circuitos que alimentam cargas altamente indutivas que apresentam elevados picos de corrente no momento de ligação, como grandes motores, transformadores, além de circuitos com cargas de características semelhantes a essas.

TABELA SELEÇÃO DE INDUTORES

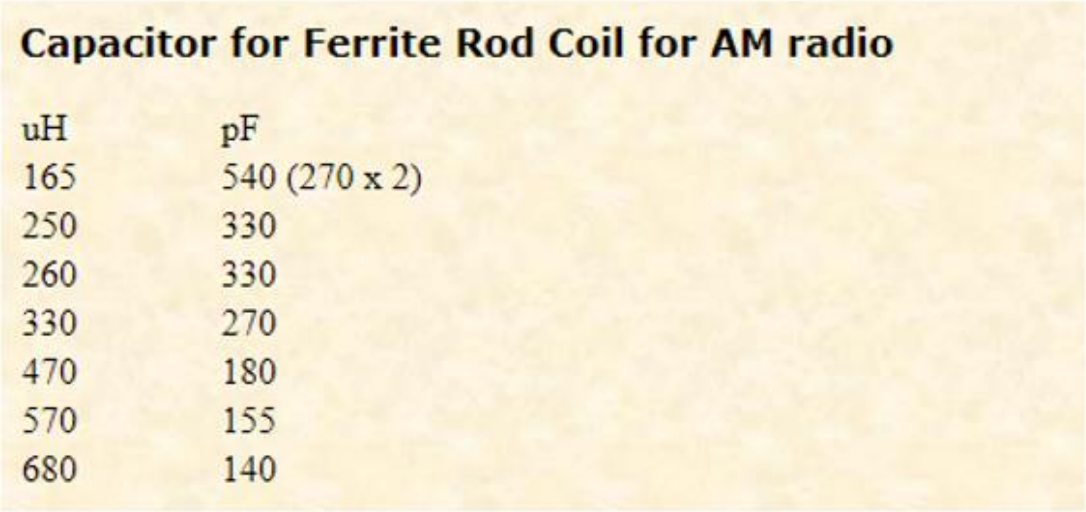
Table 2. Inductor Selection by Manufacturer's Part Number

Inductor Code	Inductor Value	Tech 39	Schott Corp.	Pulse Eng.	Renco
L47	47 μH	77 212	671 26980	PE–53112	RL2442
L68	68 μH	77 262	671 26990	PE–92114	RL2443
L100	100 μH	77 312	671 27000	PE–92108	RL2444
L150	150 μH	77 360	671 27010	PE–53113	RL1954
L220	220 μH	77 408	671 27020	PE–52626	RL1953
L330	330 μH	77 456	671 27030	PE–52627	RL1952
L470	470 μH	*	671 27040	PE–53114	RL1951
L680	680 μH	77 506	671 27050	PE–52629	RL1950
H150	150 μH	77 362	671 27060	PE–53115	RL2445
H220	220 μH	77 412	671 27070	PE–53116	RL2446
H330	330 μH	77 462	671 27080	PE–53117	RL2447
H470	470 μH	*	671 27090	PE–53118	RL1961
H680	680 μH	77 508	671 27100	PE–53119	RL1960
H1000	1000 μH	77 556	671 27110	PE–53120	RL1959
H1500	1500 μH	*	671 27120	PE–53121	RL1958
H2200	2200 μH	*	671 27130	PE–53122	RL2448

NOTE: *Contact Manufacturer

FONTE: Manual do LM2576

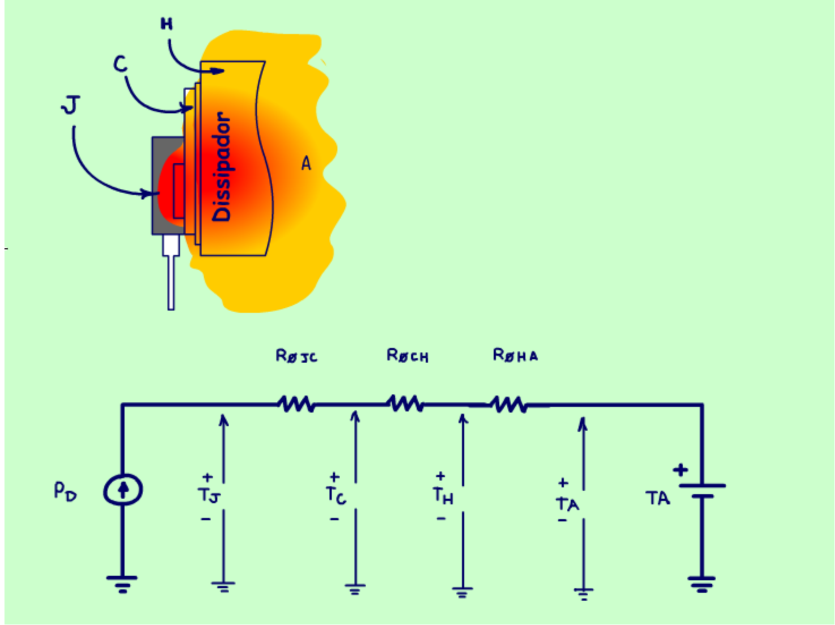
TABELA SELEÇÃO INDUTORES E CAPACITORES PARA CIRCUITO DE SINTONIA AM.



Capacitor for Ferrite Rod Coil for AM radio

uH	pF
165	540 (270 x 2)
250	330
260	330
330	270
470	180
570	155
680	140

DISSIPADORES



Esse é o circuito básico para o uso do dissipador de calor.

PD é a potência no transistor, essa será a corrente térmica nesse circuito.

RΦ é a resistência térmica.

A temperatura em cada resistência térmica é a tensão, o produto da corrente térmica e da resistência térmica.

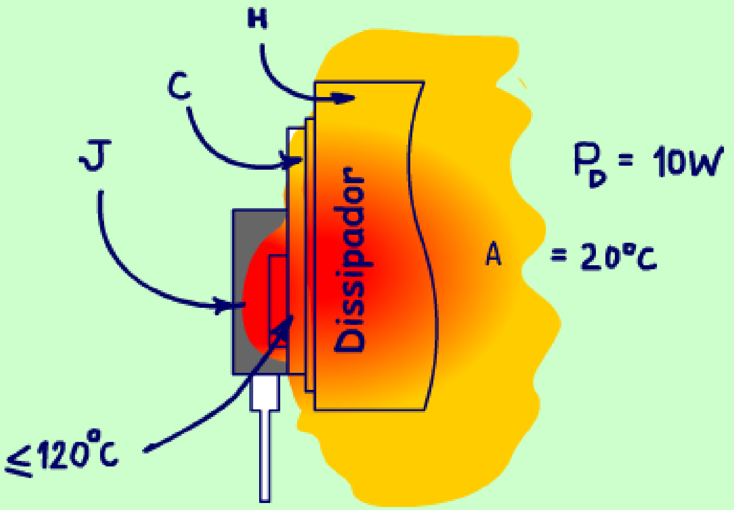
RΦJC é a resistência térmica entre a junção e o case (carcaça metálica do transistor)

RΦCH é a resistência térmica entre a carcaça e o dissipador, é a resistência térmica do isolante se tiver.

RΦHA é a resistência térmica entre o dissipador e o meio ambiente.

TA é a temperatura ambiente.

Exemplo

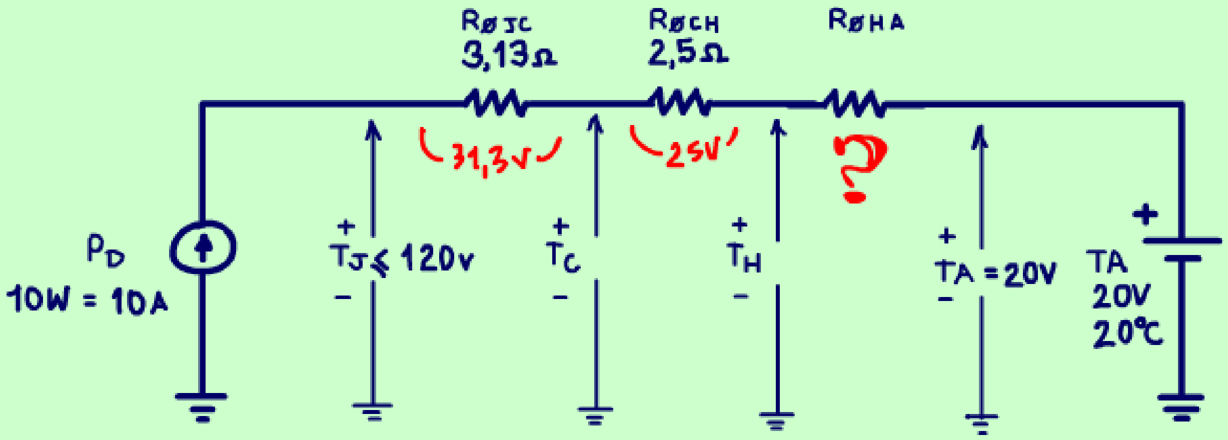


$$V_{JC} = R\theta_{JC} \,.\, I = 3{,}13 \,.\, 10 = 31{,}3\,V$$

$$V_{CH} = R\theta_{CH} \,.\, I = 2{,}5 \,.\, 10 = 25\,V$$

$$V_{HA} \leq 120v - 31{,}3v - 25v - 20$$

$$R\theta_{HA} \leq \frac{43{,}7}{10A} \leq 4{,}37\,\Omega$$



RESISTÊNCIA TÉRMICA TÍPICA DOS ISOLADORES

Fonte Pomilo.

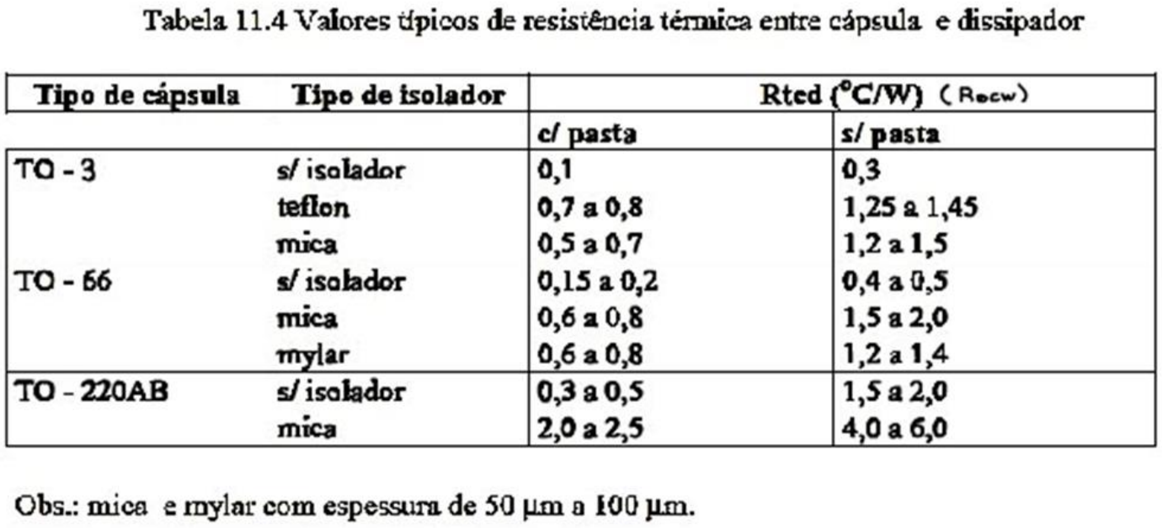


Tabela 11.4 Valores típicos de resistência térmica entre cápsula e dissipador

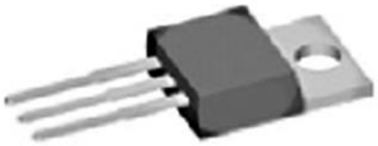
Tipo de cápsula	Tipo de isolador	Rtcd (°C/W) ($R_{\theta cw}$)	
		c/ pasta	s/ pasta
TO - 3	s/ isolador	0,1	0,3
	teflon	0,7 a 0,8	1,25 a 1,45
	mica	0,5 a 0,7	1,2 a 1,5
TO - 66	s/ isolador	0,15 a 0,2	0,4 a 0,5
	mica	0,6 a 0,8	1,5 a 2,0
	mylar	0,6 a 0,8	1,2 a 1,4
TO - 220AB	s/ isolador	0,3 a 0,5	1,5 a 2,0
	mica	2,0 a 2,5	4,0 a 6,0

Obs.: mica e mylar com espessura de 50 µm a 100 µm.

TO-3

TO-66

TO-220AB



CORREÇÃO DOCOMPRIMENTO DISSIPADORES DA HS

clique aqui para ir ao ind

1

ÍNDICE REMISSIVO

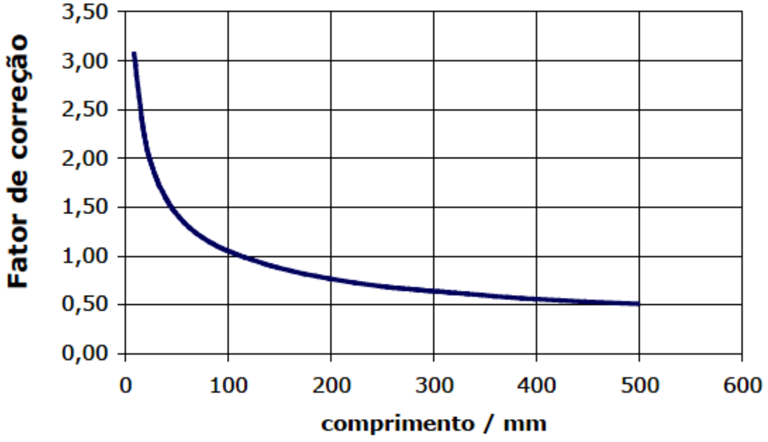
(clique sobre o nome para navegar até a página)

- nas páginas 8 a 14 encontra-se um índice com desenhos -

PRETO = perfis normalmente disponíveis
VERDE = esperamos disponibilizar em breve
VERMELHO = perfis indisponíveis (*)

(*) podemos vender alguns destes perfis indisponíveis condicionalmente

HS 0820	17.0 °C/W/4"	.... página 21
HS 1508	19.8 °C/W/4"	.... página 22
HS 1509	19.8 °C/W/4"	.... página 23
HS 1511	15.5 °C/W/4"	.... página 24
HS 1515	20.6 °C/W/4"	.... página 25
HS 1616	9.0 °C/W/4"	.... página 26
HS 1616L	10,6 °C/W/4"	.... página 27
HS 1710	14.6 °C/W/4"	.... página 28
HS 1807	19.8 °C/W/4"	.... página 29
HS 1818	13.4 °C/W/4"	.... página 30
HS 1920	11.5 °C/W/4"	.... página 31
HS 2053	4.2 °C/W/4"	.... página 32
HS 2053E	4.2 °C/W/4"	.... página 33
HS 2315	10.2 °C/W/4"	.... página 34
HS 2315M	10.2 °C/W/4	.... página 35
HS 2811	10.0 °C/W/4"	.... página 36
HS 2816	7.9 °C/W/4"	.... página 37
HS 3030	5.7 °C/W/4"	.... página 38
HS 3125	6.2 °C/W/4"	.... página 39
HS 3232	6.3 °C/W/4"	.... página 40
HS 3512	8.4 °C/W/4"	.... página 41
HS 3520	4.9 °C/W/4"	.... página 42
HS 3542	3.2 °C/W/4"	.... página 43
HS 3542L	3.9 °C/W/4"	.... página 44
HS 3818	6.6 °C/W/4"	.... página 45
HS 4017	7.8 °C/W/4"	.... página 46
HS 4225	4.4 °C/W/4"	.... página 47
HS 4262	3.7 °C/W/4"	.... página 48
HS 4313	8.9 °C/W/4"	.... página 49
HS 4320	4.1 °C/W/4"	.... página 50
HS 4328	3.1 °C-W-4"	.... página 51
HS 4425	4.4 °C/W/4"	.... página 52
HS 4525	4.4 °C/W/4"	.... página 53
HS 5073	2.28°C/W/4"	.... página 54
HS 5620	2,9 °C/W/4"	.... página 55
HS 6524	3.7 °C/W/4"	.... página 56
HS 6634	2.5 °C/W/4"	.... página 57
HS 6642	2.1 °C/W/4"	.... página 58
HS 6835	1.4 °C/W/4"	.... página 59
HS 7021	4.5 °C/W/4"	.... página 60
HS 7028	2.7 °C/W/4"	.... página 61
HS 7032	3.6 °C/W/4"	.... página 62
HS 7223	3.2 °C/W/4"	.... página 63
HS 7245	2.7 °C/W/4"	.... página 64
HS 7624	3.6 °C/W/4"	.... página 66
HS 8044	2.0 °C/W/4"	.... página 67
HS 8134	2.4 °C/W/4"	.... página 68
HS 8550	2.1 °C/W/4"	.... página 69
HS 8585	1.0 °C/W/4"	.... página 70
HS 8585T	1.0 °C/W/4"	.... página 71
HS 8620	2.92 °C/W/4"	.... página 72
HS 8620L	3.20 °C/W/4"	.... página 73
HS 8858	1,74 °C/W/4"	.... página 74
HS 9438	1,4 °C/W/4"	.... página 75
HS 9555	1.29 °C/W/4"	.... página 76
HS 10325	2.6 °C/W/4"	.... página 77
HS 10334	1.5 °C/W/4"	.... página 78
HS 10334L	1.9 °C/W/4"	.... página 79
HS 10425	1.8 °C/W/4"	.... página 80
HS 10425L	2.1 °C/W/4"	.... página 81
HS 10526	2.5 °C/W/4"	.... página 82
HS 11330	1.5 °C/W/4"	.... página 83
HS 11432	1.7 °C/W/4"	.... página 84
HS 11450	1.4 °C/W/4"	.... página 85
HS 11550	1.3 °C/W/4"	.... página 86
HS 11555	1.17 °C/W/4"	.... página 87
HS 11960	1.41 °C/W/4"	.... página 88
HS 12060	1.17 °C/W/4"	.... página 89
HS 12135	1.92 °C/W/4"	.... página 90
HS 12135N	1.88 °C/W/4"	.... página 91
HS 12149	1.64 °C/W/4"	.... página 92
HS 12168	1.26 °C/W/4"	.... página 93
HS 12454	1,09°C/W/4"	.... página 94
HS 12544	1.66 °C/W/4"	.... página 95
HS 12545	1.64 °C/W/4"	.... página 96
HS 12552	2.01 °C/W/4"	.... página 97
HS 12643A	1.72 °C/W/4"	.... página 98
HS 12643H	1.72 °C/W/4"	.... página 99
HS 12643N	1.71 °C/W/4"	.... página 100
HS 12764	1.02 °C/W/4"	.... página 101
HS 12764L	1.22 °C/W/4"	.... página 102
HS 13052	1.86 °C/W/4"	.... página 103
HS 13548	1.86 °C/W/4"	.... página 104
HS 14050	1.06 °C/W/4"	.... página 105
HS 14153	0,91 °C/W/4"	.... página 106
HS 14376	1.11 °C/W/4"	.... página 107
HS 14569	1.17 °C/W/4"	.... página 108
HS 14676	1.02 °C/W/4"	.... página 109
HS 15073	1.24 °C/W/4"	.... página 110
HS 15450	1.22 °C/W/4"	.... página 111
HS 15559	0.73 °C/W/4"	.... página 112
HS 15560L	1.01 °C/W/4"	.... página 114
HS 17050	2.14 °C/W/4"	.... página 115
HS 17232L	1.07 °C/W/4"	.... página 116
HS 17909	2.06 °C/W/4"	.... página 117
HS 18034	2,9 °C/W/4"	.... página 118
HS 19013	1.79 °C/W/4"	.... página 119
HS 19032	0.98 °C/W/4"	.... página 120
HS 19334	1.07 °C/W/4"	.... página 121
HS 20855	1.03 °C/W/4"	.... página 122
HS 21019	1.64°C/W/4"	.... página 123
HS 21021	1.45 °C/W/4"	.... página 124
HS 21060	0.83 °C/W/4"	.... página 125
HS 21073	0,66 °C/W/4"	.... página 126
HS 21526	1.07 °C/W/4"	.... página 127
HS 21575	0.56 °C/W/4"	.... página 128
HS 21577E	0.52 °C/W/4"	.... página 129
HS 23742	0.57 °C/W/4"	.... página 130
HS 25040	0.79 °C/W/4"	.... página 131
HS 26574	0.57 °C/W/4"	.... página 132
HS 271019	0.98 °C/W/4"	.... página 134
HS 100100	1.17 °C/W/4"	.... página 135
HS 120120	0.75 °C/W/4"	.... página 136
HS 125135	0.73 °C/W/4"	.... página 138
HS 125135L	0.73 °C/W/4"	.... página 140
HS 125136	0.74 °C/W/4"	.... página 142
HS 125137	0.66 °C/W/4"	.... página 144



correção da resistência térmica para outros comprimentos de dissipadores

Exemplo: O dissipador HS 6524 possui resistência térmica igual a **3,72 ºC / W / 4”**. Isto quer dizer que um pedaço medindo 4 polegadas de comprimento possui a resistência térmica de **3,72 ºC / W**. O mesmo dissipador com 40mm de comprimento possui resistência térmica igual a

3,72 ºC/W x 1,59 = 5,91 ºC/W

comprimento
10 mm
20 mm
30 mm
40 mm
50 mm
70 mm
100 mm
150 mm
200 mm
250 mm
300 mm
400 mm
500 mm

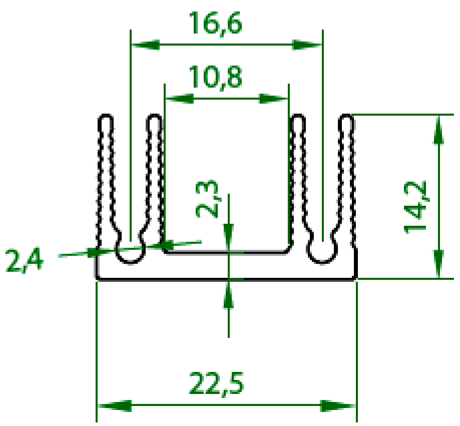
Obs: 4’’=10,16cm

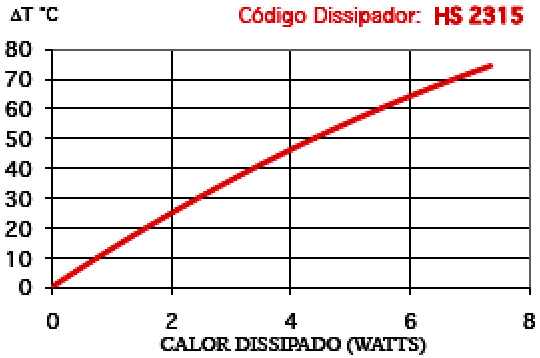
INDICE REMISSIVO DISSIPADORES DA HS

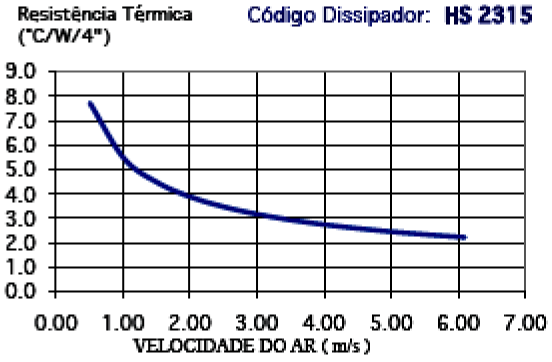
DISSIPADOR HS2315 10,2°C/W/4"

Código: HS 2315

Perímetro: 151 mm
Resistência Térmica: 10,2 ºC / W / 4”
Peso Linear: 0,28 kg/m
Capacidade Térmica: 921 J/kg K

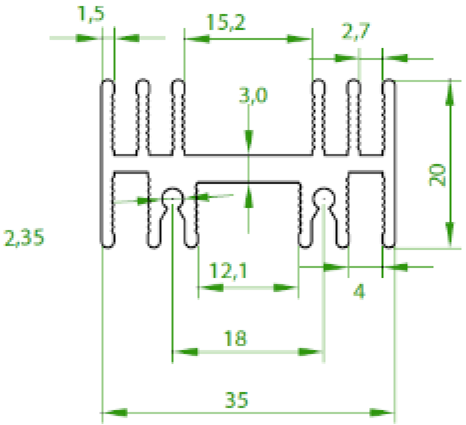




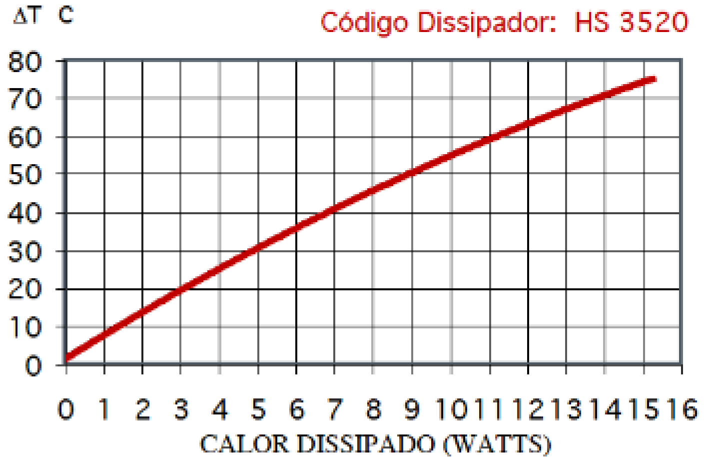


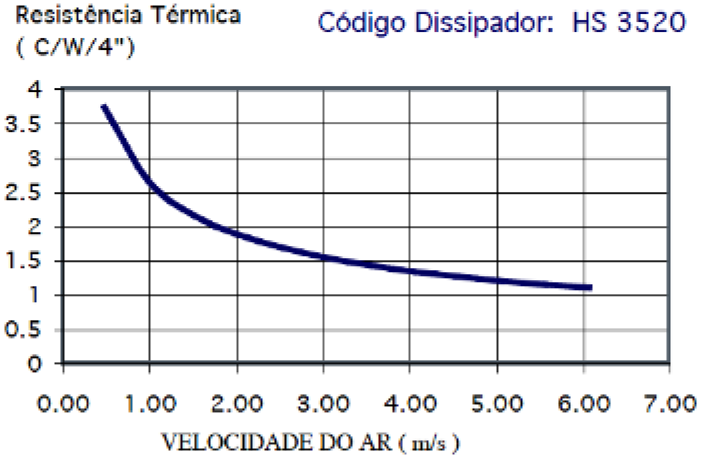
DISSIPADOR HS3520 4,89°C/W/4"

Código: HS 3520



Perímetro: 316 mm
Resistência Térmica: 4,89 ºC / W / 4”
Peso Linear: 0,71 kg/m
Capacidade Térmica: 921 J/kg K

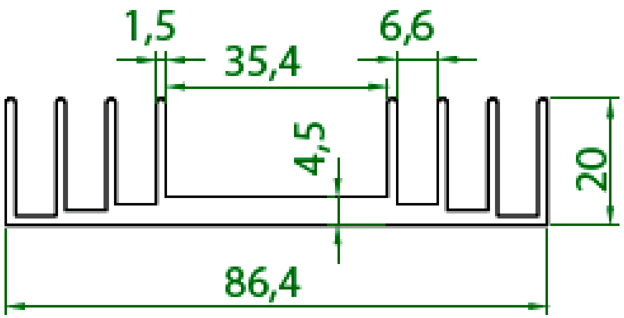


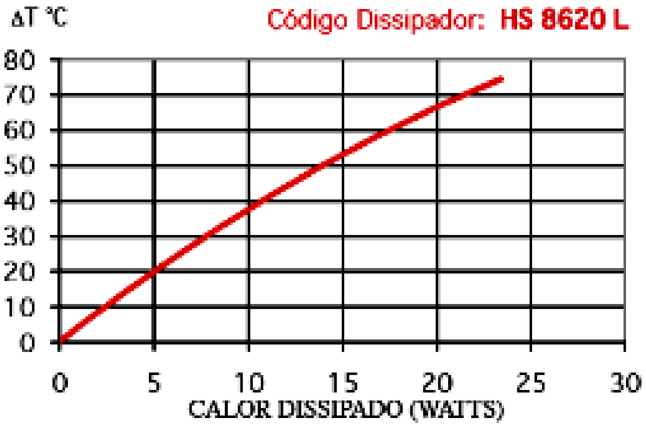


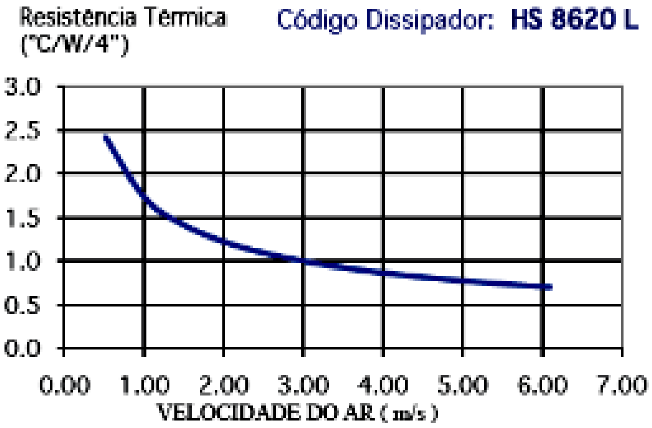
DISSIPADOR HS8620 L 3,20 °C/W/4"

Código: HS 8620 L

Perímetro: 484 mm
Resistência Térmica: 3,20 ºC / W / 4"
Peso Linear: 1,6 kg/m
Capacidade Térmica: 921 J/kg K



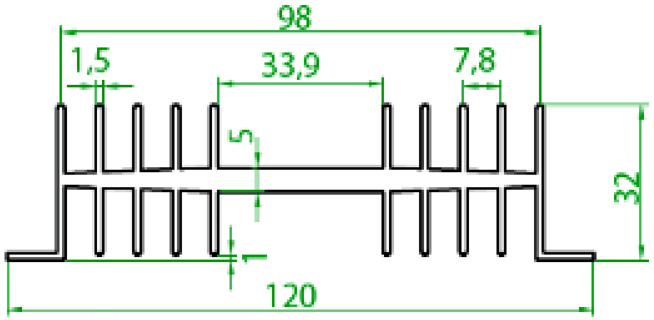


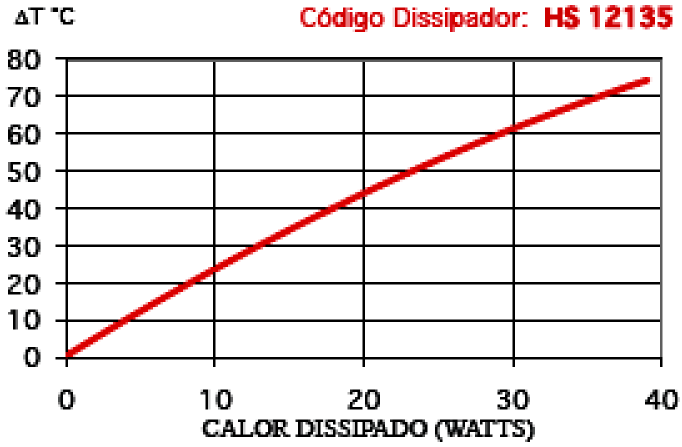


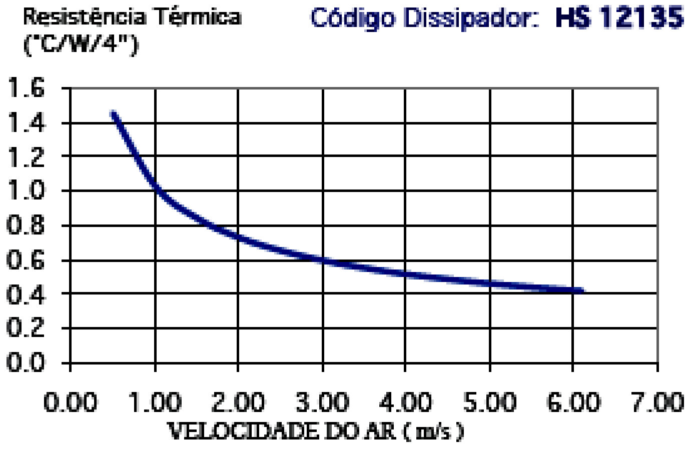
DISSIPADOR HS12135 1,92 °C/W/4"

Código: HS 12135

Perímetro: 804 mm
Resistência Térmica: 1,92 ºC / W / 4”
Peso Linear: 2,6 kg/m
Capacidade Térmica: 921 J/kg K



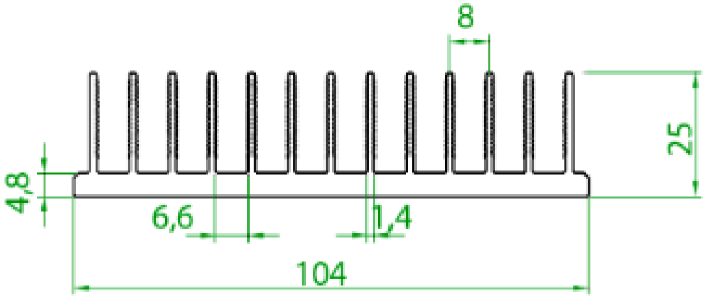


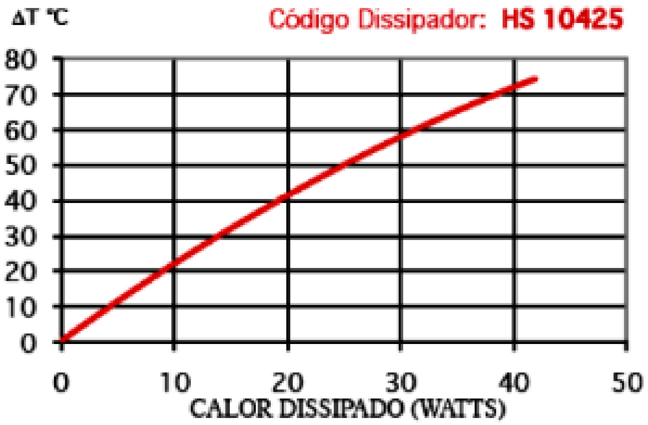


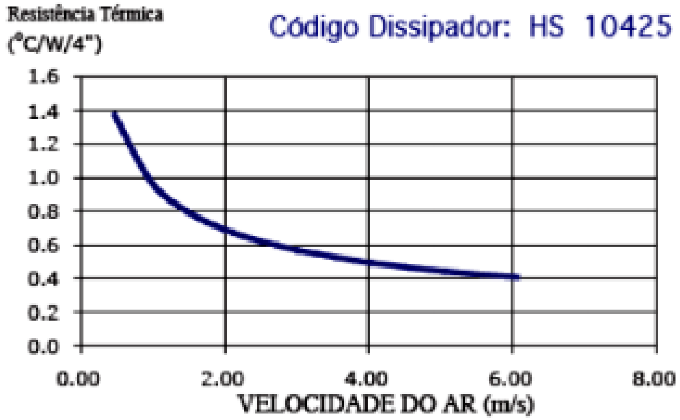
DISSIPADOR HS10425 1,75°C/W/4"

Código: HS 10425

Perímetro: 862 mm
Resistência Térmica: 1,79 °C / W / 4”
Peso Linear: 2,3 kg/m
Capacidade Térmica: 921 J/kg K



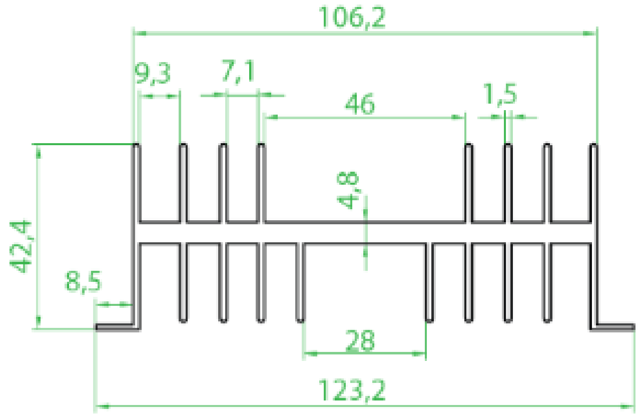


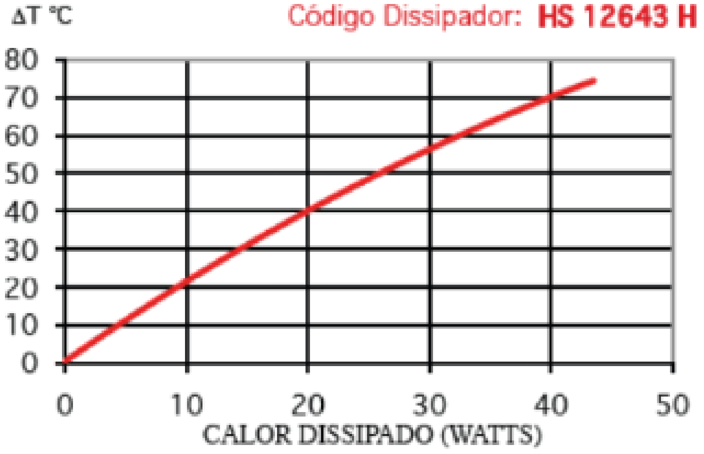


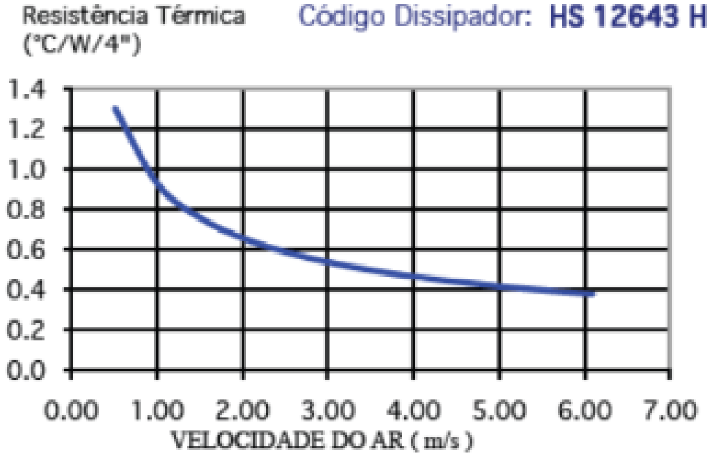
DISSIPADOR HS1643 1,72°C/W/4"

Código: HS 12643 H

Perímetro: 897 mm
Resistência Térmica: 1,72 °C / W / 4"
Peso Linear: 2,9 kg/m
Capacidade Térmica: 921 J/kg K

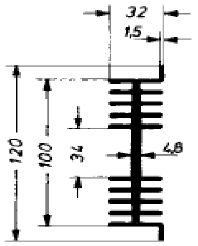




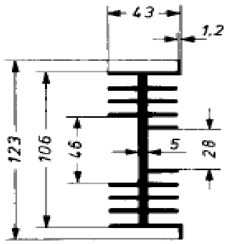


SEMIKRON

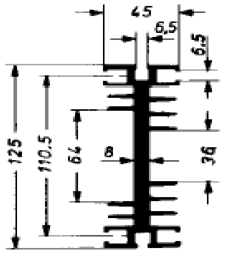
KP 1,6
L = 100 mm
R_{thha} = 1,6 °C/W
W = 240 g



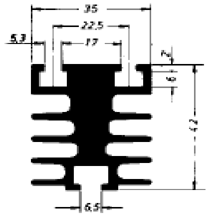
KP 1,4
L = 100 mm
R_{thha} = 1,4° C/W
W = 290 g



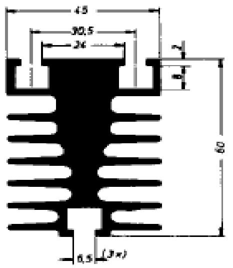
KP 1,25
L = 100 mm
R_{thha} = 1,25° C/W
W = 420 g



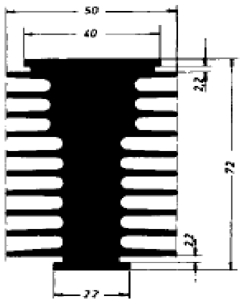
KP 3
L = 100 mm
R_{thha} = 3,0°C/W
W = 190 g



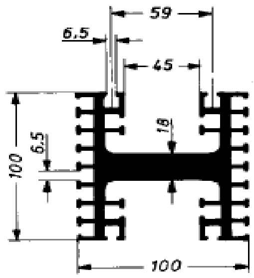
KP 2
L = 100 mm
R_{thha} = 2,0°C/W
W = 320 g



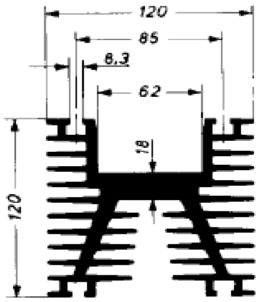
KP 1,5
L = 100 mm
R_{thha} = 1,5°C/W
W = 570 g



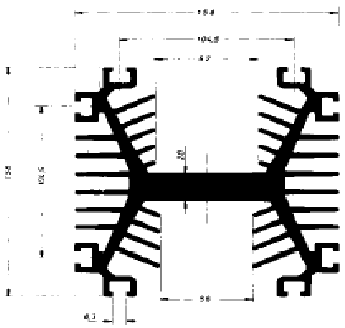
KP 0,8
L = 100 mm
R_{thha} = 0,80°C/W
W = 870 g



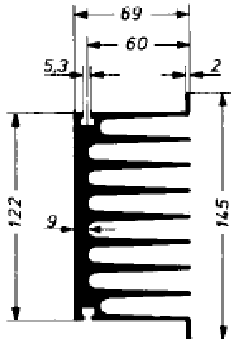
KP 0,6
L = 100 mm
R_{thha} = 0,65°C/W
W = 1.170 g



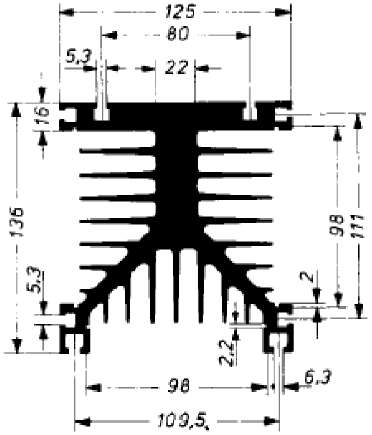
KP 0,4
L = 100 mm
R_{thha} = 0,40°C/W
W = 2.000 g



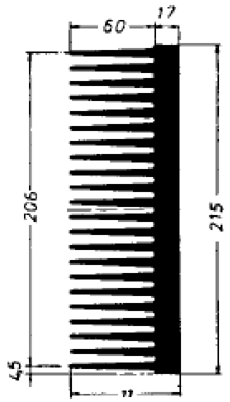
SP 0,25F
L = 100 mm
R_{thha} = 0,25°C/W
W = 850 g



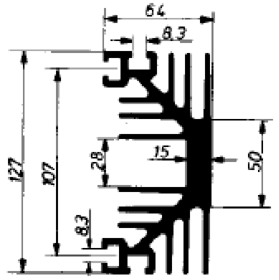
SP 0,20F
L = 100 mm
R_{thha} = 0,20°C/W
W = 1.630 g



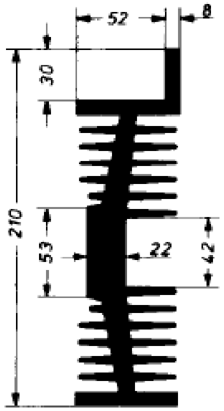
P 16
L = 100 mm
R_{thha} = 0,50°C/W
W = 2.350 g



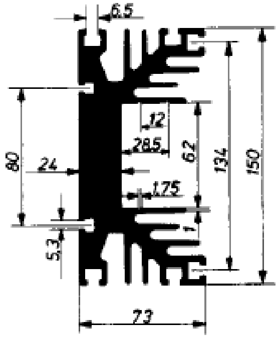
P 0,9
L = 100 mm
R_{thha} = 0,9°C/W
W = 745 g



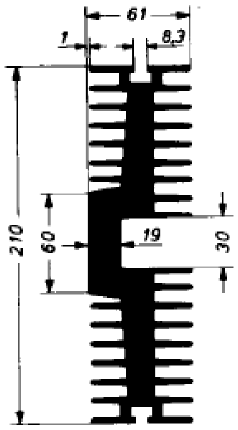
P 0,75
L = 100 mm
R_{thha} = 0,75°C/W
W = 1.360 g



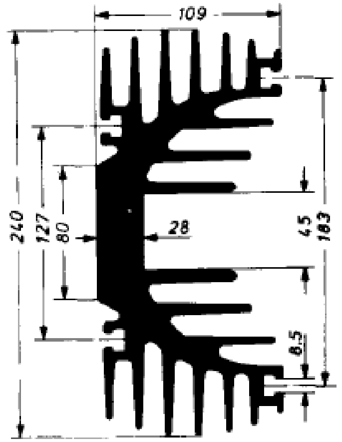
P 0,7
L = 100 mm
R_{thha} = 0,71°C/W
W = 1.210 g



P 0,53
L = 100 mm
R_{thha} = 0,53°C/W
W = 1.700 g



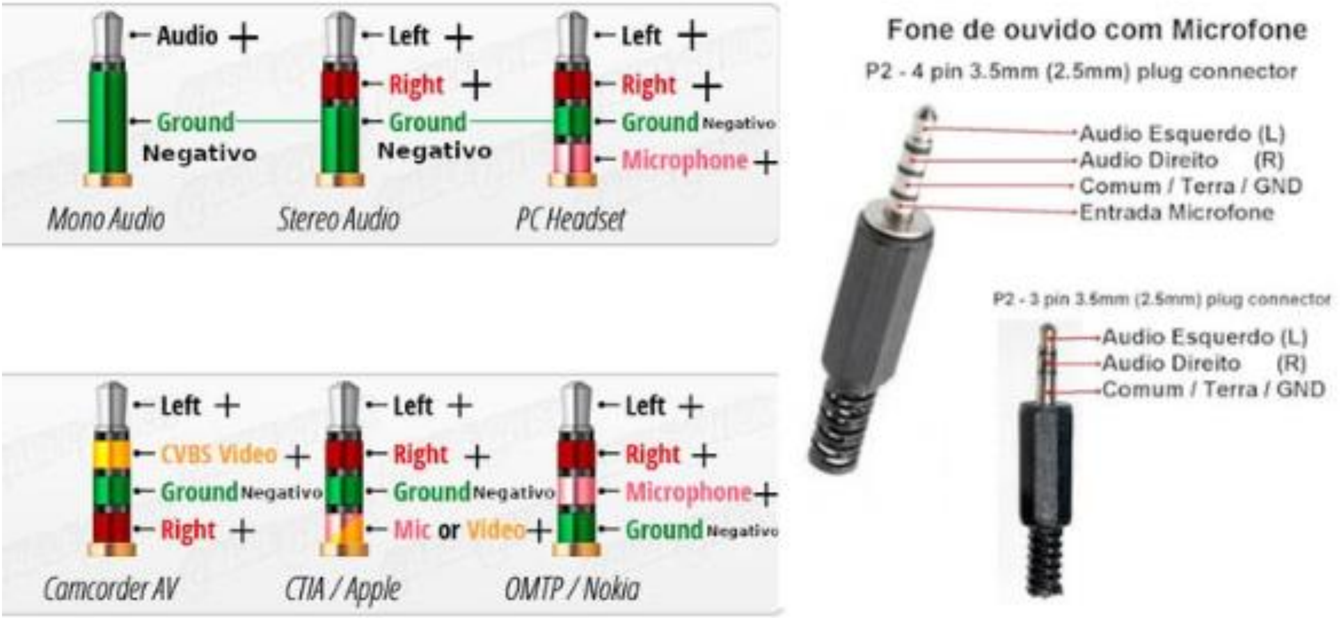
P 0,45
L = 100 mm
R_{thha} = 0,45°C/W
W = 2.500 g



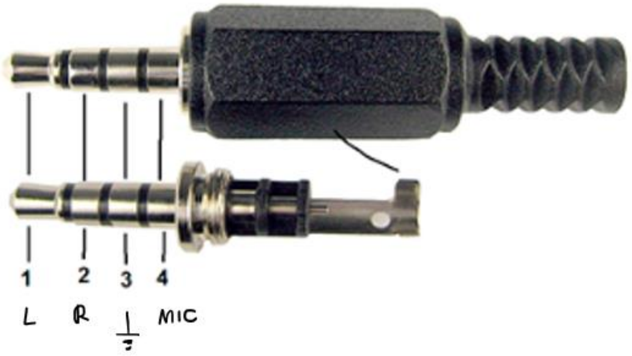
PLUGUES JACKS E CONECTORES

PLUGUE P2 SOM DO PC

Esquema de Ligação dos Pinos P2



CONEXÃO PLUGUE P3 NO CELULAR.



Estes plugues de 3,5 mm são usados na maioria dos celulares.

Identificação dos terminais:

1 – Saída do canal esquerdo do fone

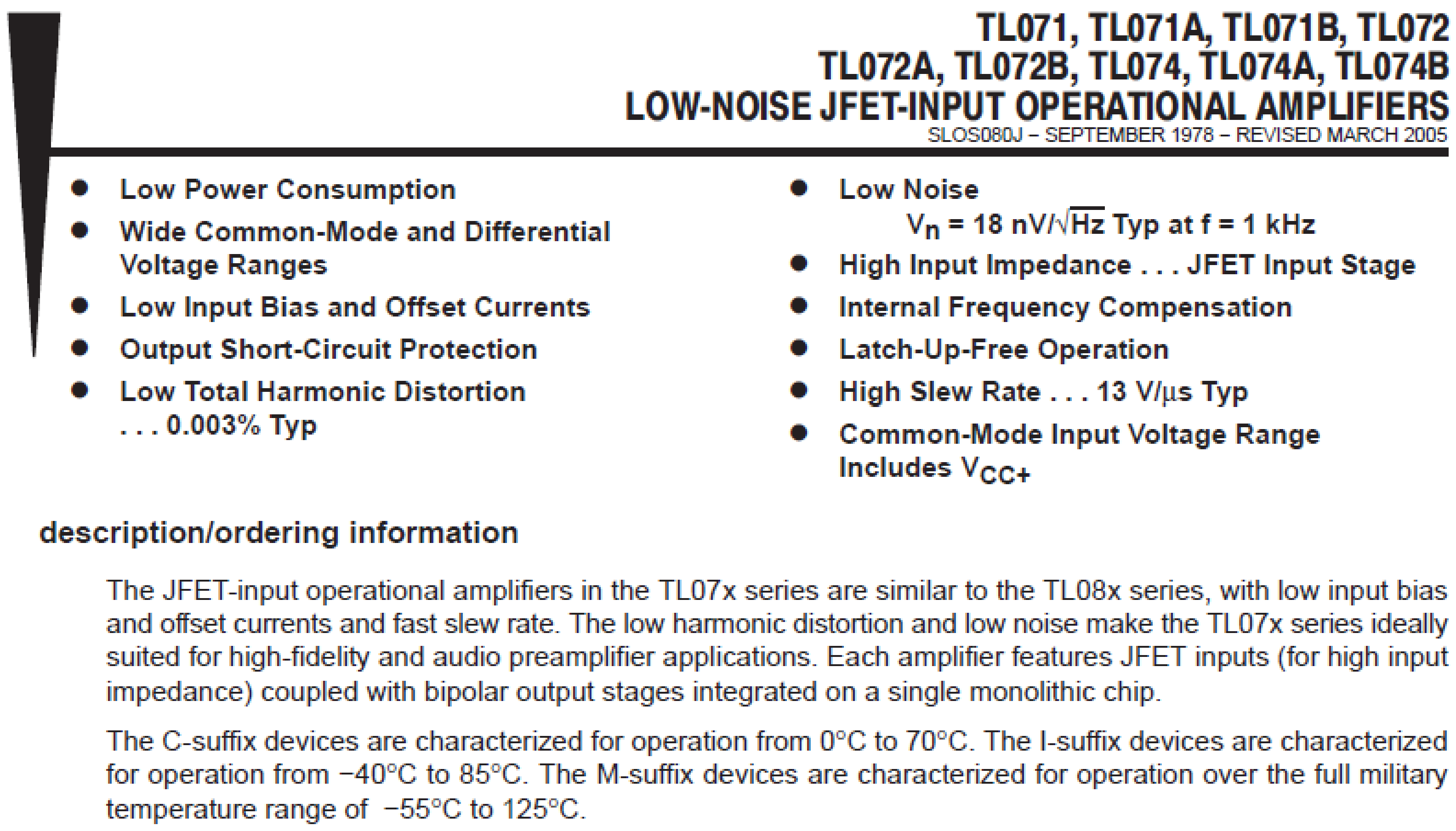
2 – Saída do canal direito do fone

3 – Comum (terra)

4 – Entrada do microfone

AMPLIFICADOR OPERACIONAL (AMPOP)

TL071 TL072 TL074



TL071, TL071A, TL071B, TL072
TL072A, TL072B, TL074, TL074A, TL074B
LOW-NOISE JFET-INPUT OPERATIONAL AMPLIFIERS

SLOS080J – SEPTEMBER 1978 – REVISED MARCH 2005

- **Low Power Consumption**
- **Wide Common-Mode and Differential Voltage Ranges**
- **Low Input Bias and Offset Currents**
- **Output Short-Circuit Protection**
- **Low Total Harmonic Distortion . . . 0.003% Typ**
- **Low Noise** $V_n = 18\ nV/\sqrt{Hz}$ **Typ at f = 1 kHz**
- **High Input Impedance . . . JFET Input Stage**
- **Internal Frequency Compensation**
- **Latch-Up-Free Operation**
- **High Slew Rate . . . 13 V/μs Typ**
- **Common-Mode Input Voltage Range Includes** V_{CC+}

description/ordering information

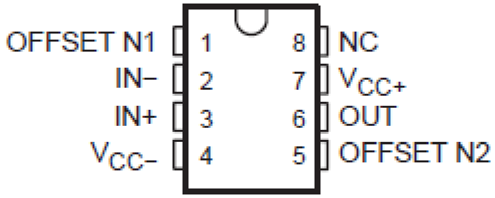
The JFET-input operational amplifiers in the TL07x series are similar to the TL08x series, with low input bias and offset currents and fast slew rate. The low harmonic distortion and low noise make the TL07x series ideally suited for high-fidelity and audio preamplifier applications. Each amplifier features JFET inputs (for high input impedance) coupled with bipolar output stages integrated on a single monolithic chip.

The C-suffix devices are characterized for operation from 0°C to 70°C. The I-suffix devices are characterized for operation from −40°C to 85°C. The M-suffix devices are characterized for operation over the full military temperature range of −55°C to 125°C.

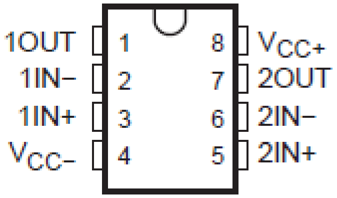
TL071, TL071A, TL071B, TL072
TL072A, TL072B, TL074, TL074A, TL074B
LOW-NOISE JFET-INPUT OPERATIONAL AMPLIFIERS

SLOS080J – SEPTEMBER 1978 – REVISED MARCH 2005

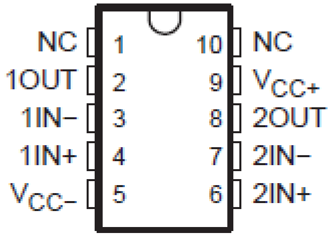
TL071, TL071A, TL071B
D, P, OR PS PACKAGE
(TOP VIEW)



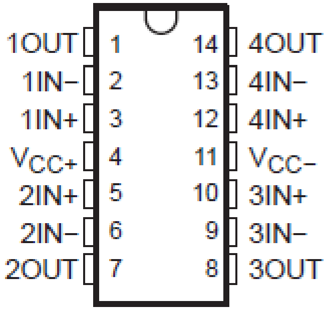
TL072, TL072A, TL072B
D, JG, P, PS, OR PW PACKAGE
(TOP VIEW)



TL072
U PACKAGE
(TOP VIEW)



TL074A, TL074B
D, J, N, NS, OR PW PACKAGE
TL074 . . . D, J, N, NS, PW,
OR W PACKAGE
(TOP VIEW)



ectrical characteristics, $V_{CC\pm} = \pm15$ V (unless otherwise noted)

	PARAMETER	TEST CONDITIONS†	T_A‡	TL071C TL072C TL074C			TL071AC TL072AC TL074AC			TL071BC TL072BC TL074BC			TL071I TL072I TL074I			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
O	Input offset voltage	$V_O = 0$, $R_S = 50\ \Omega$	25°C		3	10		3	6		2	3		3	6	mV
			Full range			13			7.5			5			8	
/O	Temperature coefficient of input offset voltage	$V_O = 0$, $R_S = 50\ \Omega$	Full range		18			18			18			18		μV/°C
O	Input offset current	$V_O = 0$	25°C		5	100		5	100		5	100		5	100	pA
			Full range			10			2			2			2	nA
	Input bias current§	$V_O = 0$	25°C		65	200		65	200		65	200		65	200	pA
			Full range			7			7			7			20	nA
CR	Common-mode input voltage range		25°C	±11	−12 to 15		±11	−12 to 15		±11	−12 to 15		±11	−12 to 15		V
OM	Maximum peak output voltage swing	$R_L = 10\ k\Omega$	25°C	±12	±13.5		±12	±13.5		±12	±13.5		±12	±13.5		V
		$R_L \geq 10\ k\Omega$	Full range	±12			±12			±12			±12			
		$R_L \geq 2\ k\Omega$		±10			±10			±10			±10			
D	Large-signal differential voltage amplification	$V_O = \pm10$ V, $R_L \geq 2\ k\Omega$	25°C	25	200		50	200		50	200		50	200		V/mV
			Full range	15			25			25			25			
	Unity-gain bandwidth		25°C		3			3			3			3		MHz
	Input resistance		25°C		10^{12}			10^{12}			10^{12}			10^{12}		Ω
MRR	Common-mode rejection ratio	$V_{IC} = V_{ICR}min$, $V_O = 0$, $R_S = 50\ \Omega$	25°C	70	100		75	100		75	100		75	100		dB
VR	Supply-voltage rejection ratio $(\Delta V_{CC\pm}/\Delta V_{IO})$	$V_{CC} = \pm9$ V to ±15 V, $V_O = 0$, $R_S = 50\ \Omega$	25°C	70	100		80	100		80	100		80	100		dB
C	Supply current (each amplifier)	$V_O = 0$, No load	25°C		1.4	2.5		1.4	2.5		1.4	2.5		1.4	2.5	mA
$_{O1}/V_{O2}$	Crosstalk attenuation	$A_{VD} = 100$	25°C		120			120			120			120		dB

---

l characteristics are measured under open-loop conditions with zero common-mode voltage, unless otherwise specified.

ull range is $T_A = 0°C$ to 70°C for TL07_C,TL07_AC, TL07_BC and is $T_A = -40°C$ to 85 °C for TL07_I.

put bias currents of an FET-input operational amplifier are normal junction reverse currents, which are temperature sensitive, as shown in Figure 4. Pulse techniques must be used at maintain the junction temperature as close to the ambient temperature as possible.

PARAMETER MEASUREMENT INFORMATION

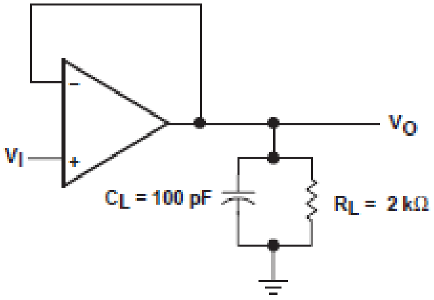


Figure 1. Unity-Gain Amplifier

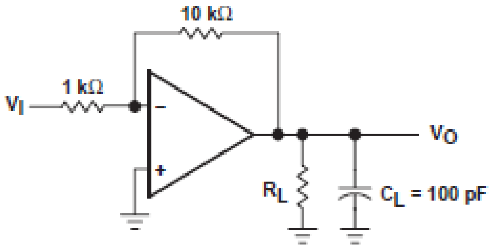


Figure 2. Gain-of-10 Inverting Amplifier

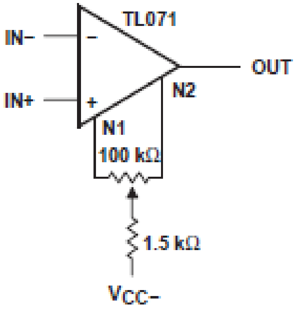
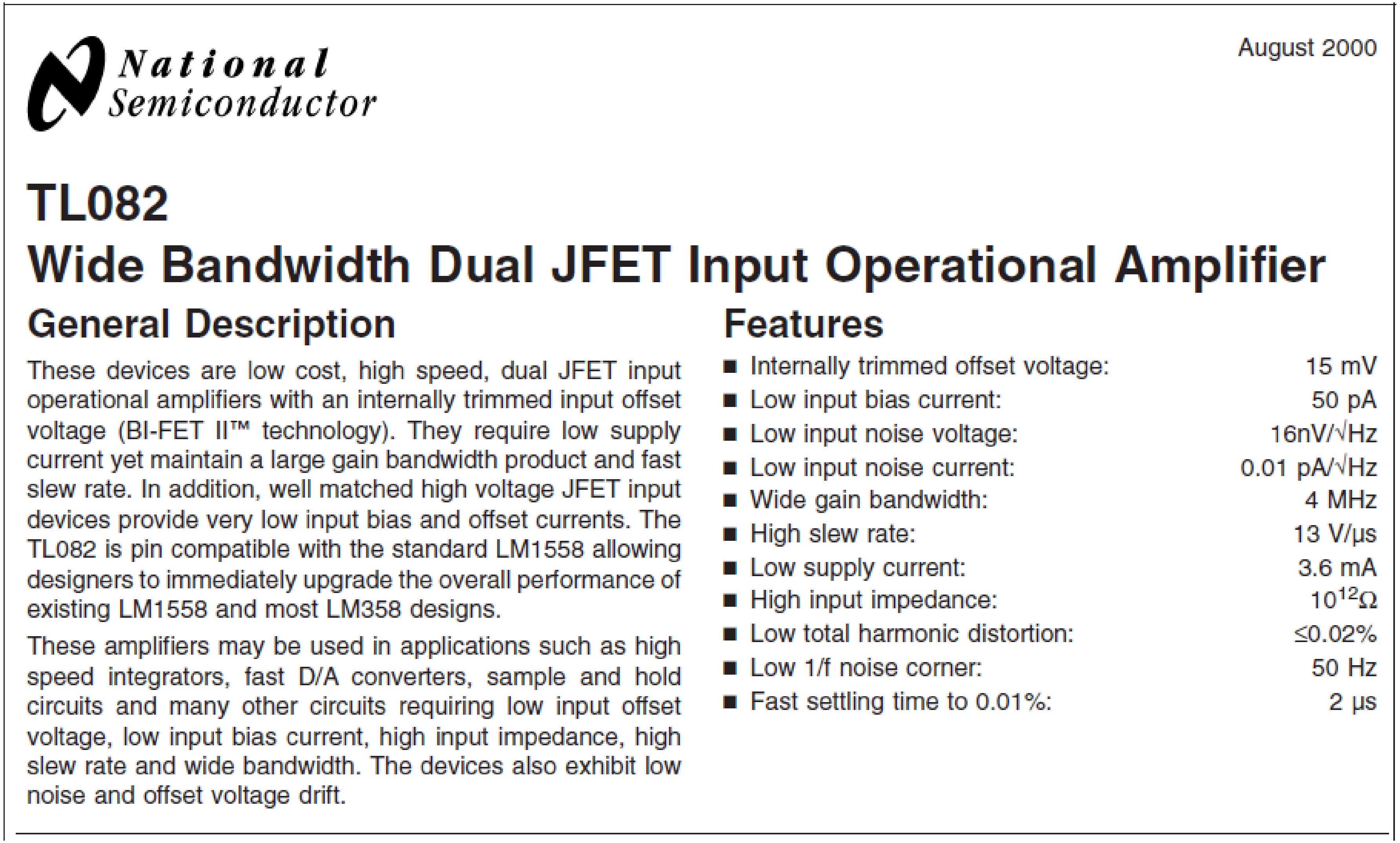


Figure 3. Input Offset-Voltage Null Circuit

TL082 WIDE BANDWITDH DUAL JFET INPUT



National
Semiconductor

August 2000

TL082

Wide Bandwidth Dual JFET Input Operational Amplifier

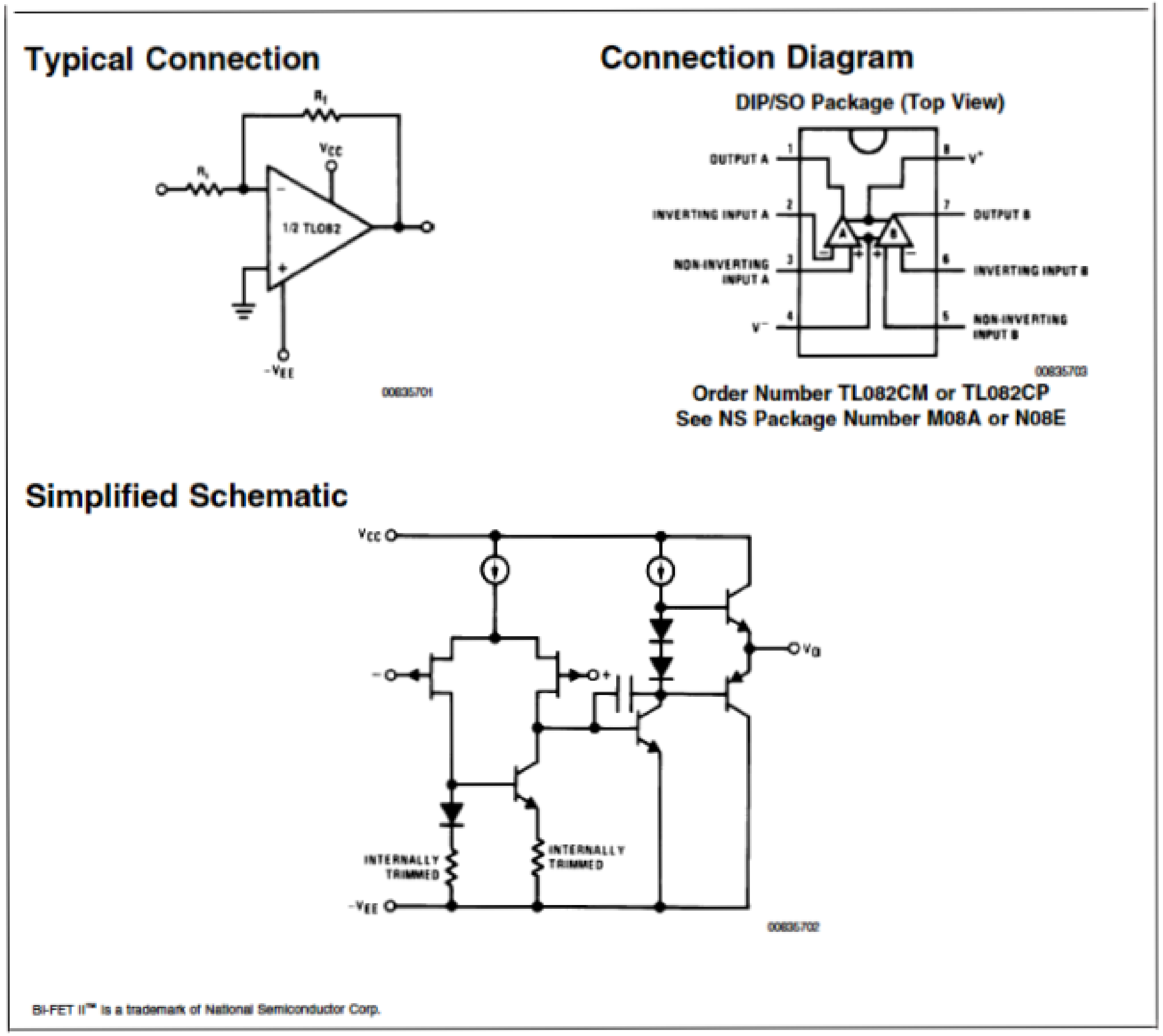
General Description

These devices are low cost, high speed, dual JFET input operational amplifiers with an internally trimmed input offset voltage (BI-FET II™ technology). They require low supply current yet maintain a large gain bandwidth product and fast slew rate. In addition, well matched high voltage JFET input devices provide very low input bias and offset currents. The TL082 is pin compatible with the standard LM1558 allowing designers to immediately upgrade the overall performance of existing LM1558 and most LM358 designs.

These amplifiers may be used in applications such as high speed integrators, fast D/A converters, sample and hold circuits and many other circuits requiring low input offset voltage, low input bias current, high input impedance, high slew rate and wide bandwidth. The devices also exhibit low noise and offset voltage drift.

Features

■ Internally trimmed offset voltage:	15 mV
■ Low input bias current:	50 pA
■ Low input noise voltage:	16nV/√Hz
■ Low input noise current:	0.01 pA/√Hz
■ Wide gain bandwidth:	4 MHz
■ High slew rate:	13 V/µs
■ Low supply current:	3.6 mA
■ High input impedance:	$10^{12}\Omega$
■ Low total harmonic distortion:	≤0.02%
■ Low 1/f noise corner:	50 Hz
■ Fast settling time to 0.01%:	2 µs



Typical Connection

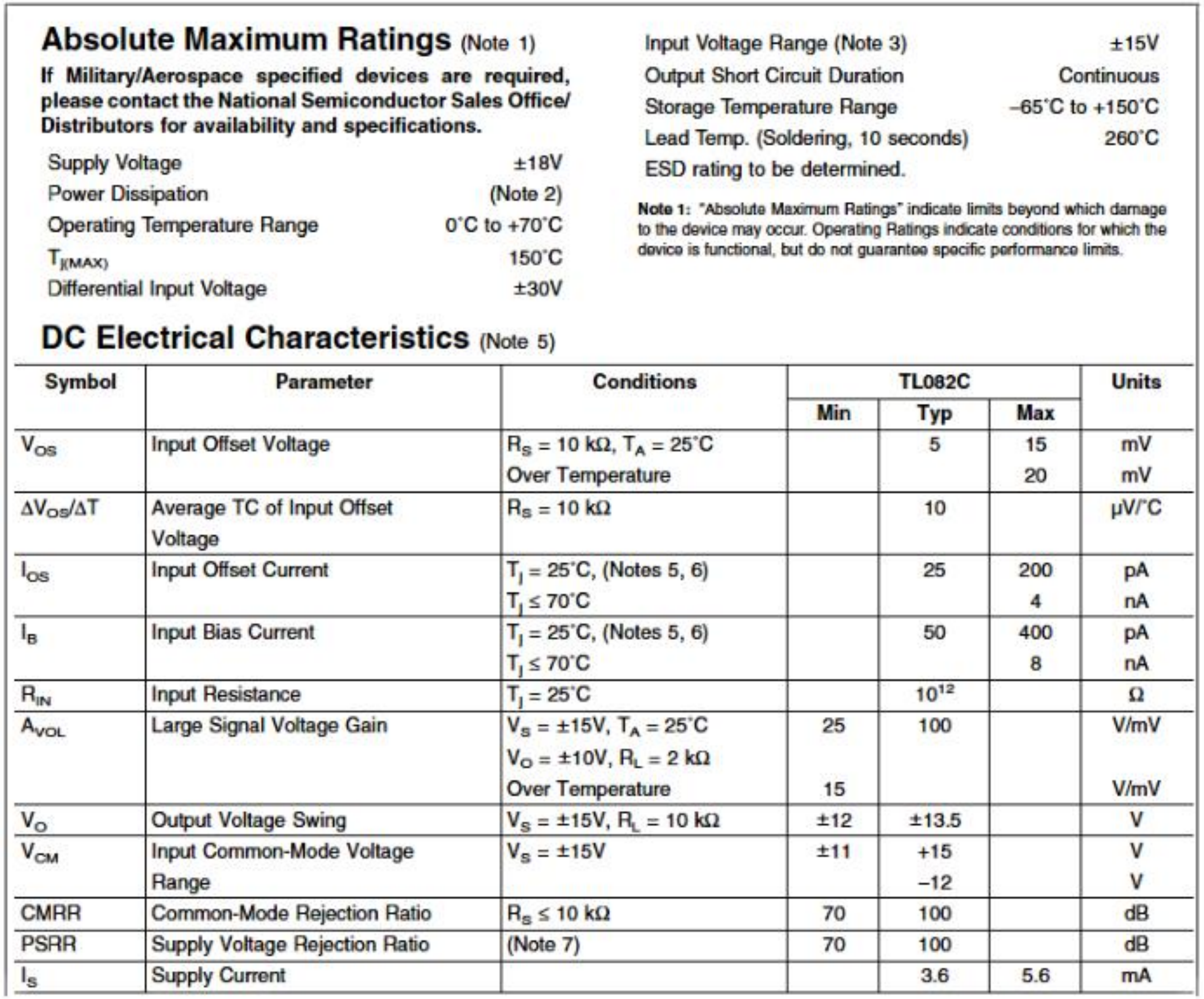
Connection Diagram

DIP/SO Package (Top View)

Order Number TL082CM or TL082CP
See NS Package Number M08A or N08E

Simplified Schematic

BI-FET II™ is a trademark of National Semiconductor Corp.



Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

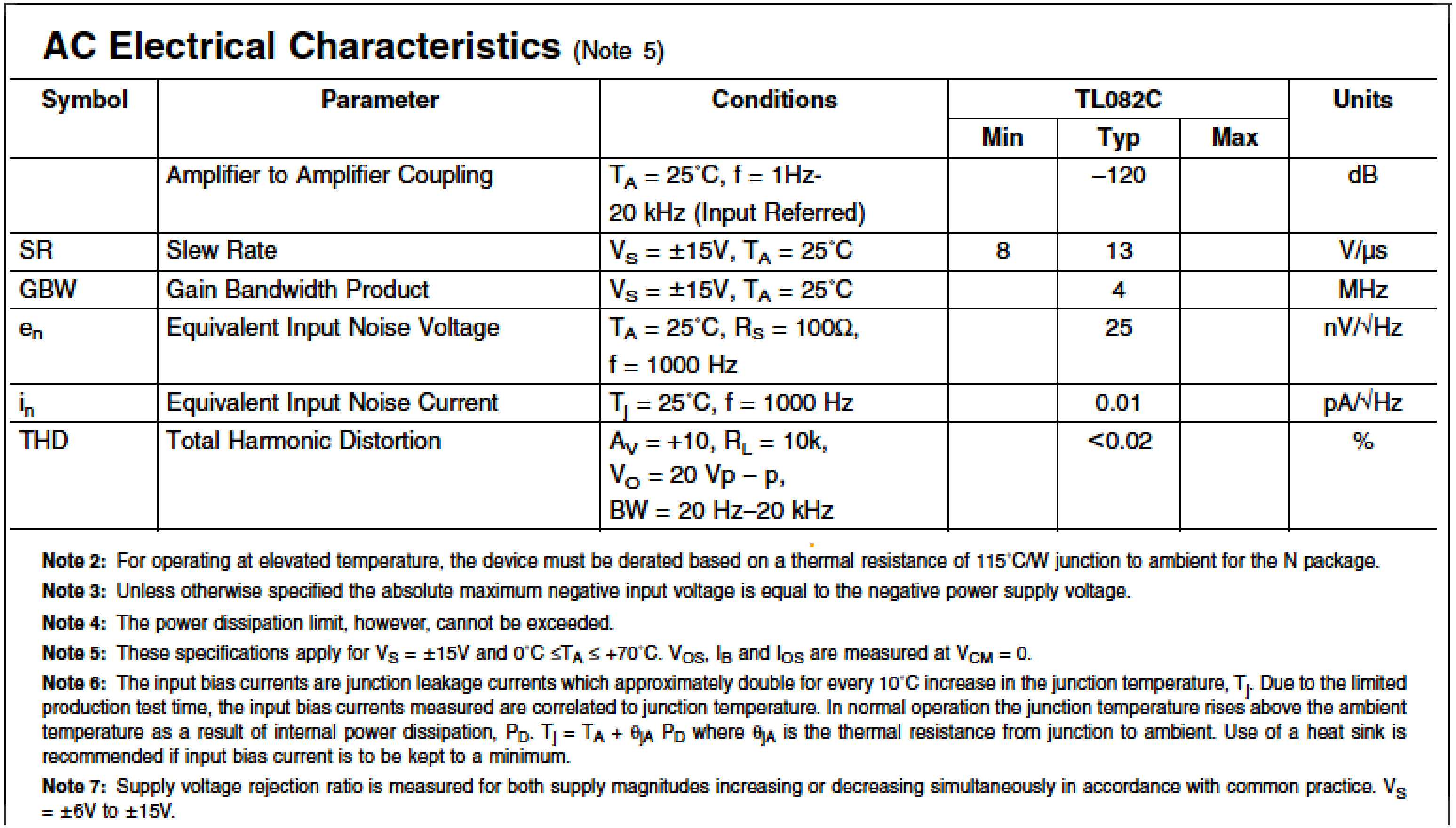
Supply Voltage	±18V
Power Dissipation	(Note 2)
Operating Temperature Range	0˚C to +70˚C
$T_{J(MAX)}$	150˚C
Differential Input Voltage	±30V
Input Voltage Range (Note 3)	±15V
Output Short Circuit Duration	Continuous
Storage Temperature Range	−65˚C to +150˚C
Lead Temp. (Soldering, 10 seconds)	260˚C

ESD rating to be determined.

Note 1: "Absolute Maximum Ratings" indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits.

DC Electrical Characteristics (Note 5)

Symbol	Parameter	Conditions	TL082C			Units
			Min	Typ	Max	
V_{OS}	Input Offset Voltage	$R_S = 10\ k\Omega$, $T_A = 25˚C$		5	15	mV
		Over Temperature			20	mV
$\Delta V_{OS}/\Delta T$	Average TC of Input Offset Voltage	$R_S = 10\ k\Omega$		10		µV/˚C
I_{OS}	Input Offset Current	$T_j = 25˚C$, (Notes 5, 6)		25	200	pA
		$T_j \le 70˚C$			4	nA
I_B	Input Bias Current	$T_j = 25˚C$, (Notes 5, 6)		50	400	pA
		$T_j \le 70˚C$			8	nA
R_{IN}	Input Resistance	$T_j = 25˚C$		10^{12}		Ω
A_{VOL}	Large Signal Voltage Gain	$V_S = \pm 15V$, $T_A = 25˚C$	25	100		V/mV
		$V_O = \pm 10V$, $R_L = 2\ k\Omega$				
		Over Temperature	15			V/mV
V_O	Output Voltage Swing	$V_S = \pm 15V$, $R_L = 10\ k\Omega$	±12	±13.5		V
V_{CM}	Input Common-Mode Voltage Range	$V_S = \pm 15V$	±11	+15		V
				−12		V
CMRR	Common-Mode Rejection Ratio	$R_S \le 10\ k\Omega$	70	100		dB
PSRR	Supply Voltage Rejection Ratio	(Note 7)	70	100		dB
I_S	Supply Current			3.6	5.6	mA



AC Electrical Characteristics (Note 5)

Symbol	Parameter	Conditions	TL082C			Units
			Min	Typ	Max	
	Amplifier to Amplifier Coupling	$T_A = 25^\circ C$, f = 1Hz- 20 kHz (Input Referred)		–120		dB
SR	Slew Rate	$V_S = \pm 15V$, $T_A = 25^\circ C$	8	13		V/μs
GBW	Gain Bandwidth Product	$V_S = \pm 15V$, $T_A = 25^\circ C$		4		MHz
e_n	Equivalent Input Noise Voltage	$T_A = 25^\circ C$, $R_S = 100\Omega$, f = 1000 Hz		25		nV/√Hz
i_n	Equivalent Input Noise Current	$T_j = 25^\circ C$, f = 1000 Hz		0.01		pA/√Hz
THD	Total Harmonic Distortion	$A_V = +10$, $R_L = 10k$, $V_O = 20$ Vp – p, BW = 20 Hz–20 kHz		<0.02		%

Note 2: For operating at elevated temperature, the device must be derated based on a thermal resistance of 115˚C/W junction to ambient for the N package.

Note 3: Unless otherwise specified the absolute maximum negative input voltage is equal to the negative power supply voltage.

Note 4: The power dissipation limit, however, cannot be exceeded.

Note 5: These specifications apply for $V_S = \pm 15V$ and $0^\circ C \le T_A \le +70^\circ C$. V_{OS}, I_B and I_{OS} are measured at $V_{CM} = 0$.

Note 6: The input bias currents are junction leakage currents which approximately double for every 10˚C increase in the junction temperature, T_j. Due to the limited production test time, the input bias currents measured are correlated to junction temperature. In normal operation the junction temperature rises above the ambient temperature as a result of internal power dissipation, P_D. $T_j = T_A + \theta_{jA} P_D$ where θ_{jA} is the thermal resistance from junction to ambient. Use of a heat sink is recommended if input bias current is to be kept to a minimum.

Note 7: Supply voltage rejection ratio is measured for both supply magnitudes increasing or decreasing simultaneously in accordance with common practice. $V_S = \pm 6V$ to $\pm 15V$.

Philips Semiconductors

Low power dual ope

DESCRIPTION

The 532/358/LM2904 consists of two in
internally frequency-compensated opera
frequency-compensated operational am
to operate from a single power supply o
Operation from dual power supplies is a
power supply current drain is independe
power supply voltage.

UNIQUE FEATURES

In the linear mode the input common-m
ground and the output voltage can also
and the output voltage can also swing t
operated from only a single power supp
cross frequency is temperature-compen
is also temperature-compensated

FEATURES

- Internally frequency-compensated for unity gain
- Large DC voltage gain: 100 dB
- Wide bandwidth (unity gain): 1 MHz (temperature-compensated)
- Wide power supply range single supply: 3 V_{DC} to 30 V_{DC}, or dual supplies: ±1.5 V_{DC} to ±15 V_{DC}
- Very low supply current drain (400 μA)—essentially independent of supply voltage (1 mW/op amp at +5 V_{DC})
- Low input biasing current: 45 nA_{DC} temperature-compensated
- Low input offset voltage: 2 mV_{DC}, and offset current: 5nA_{DC}
- Differential input voltage range equal to the power supply voltage
- Large output voltage: 0 V_{DC} to V+ 1.5 V_{DC} swing

EQUIVALENT CIRCUIT

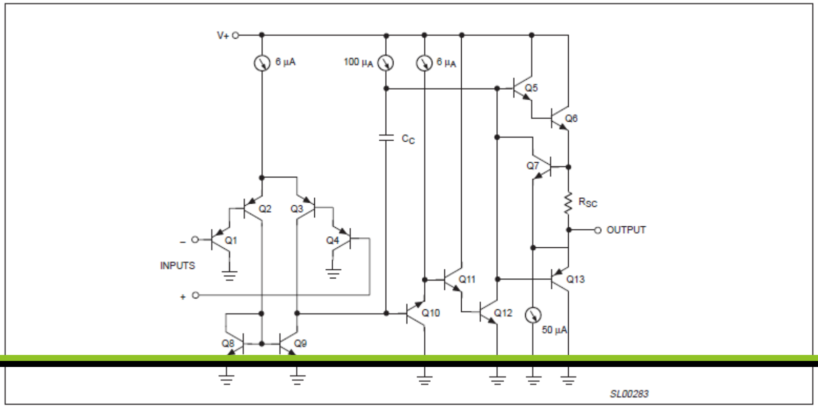
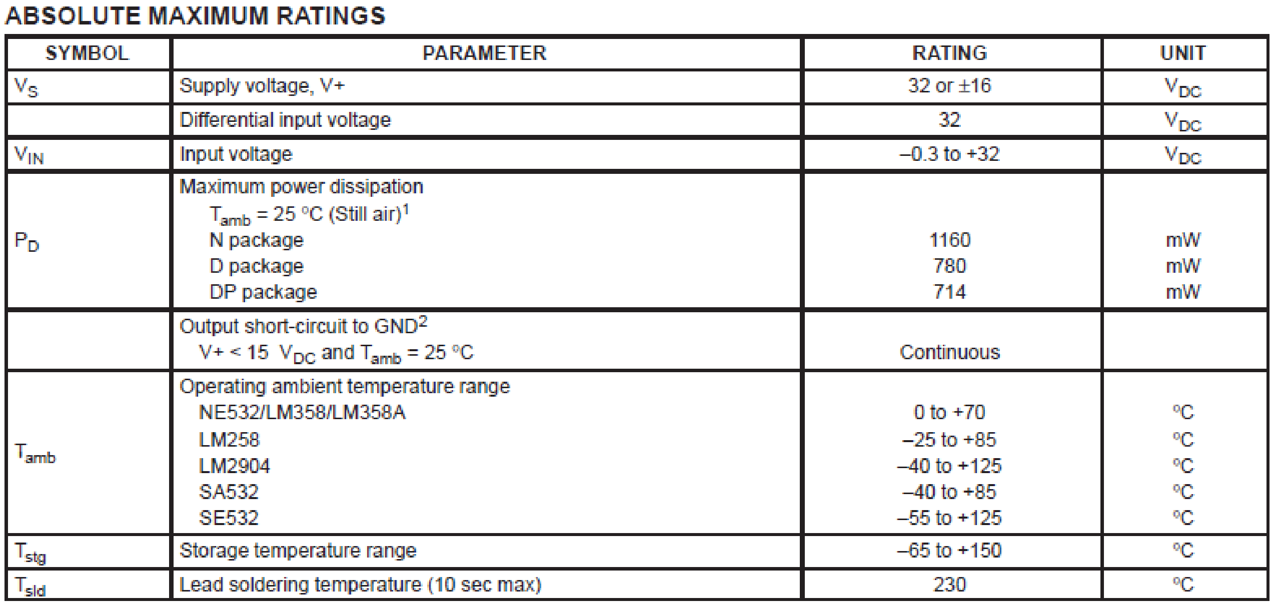
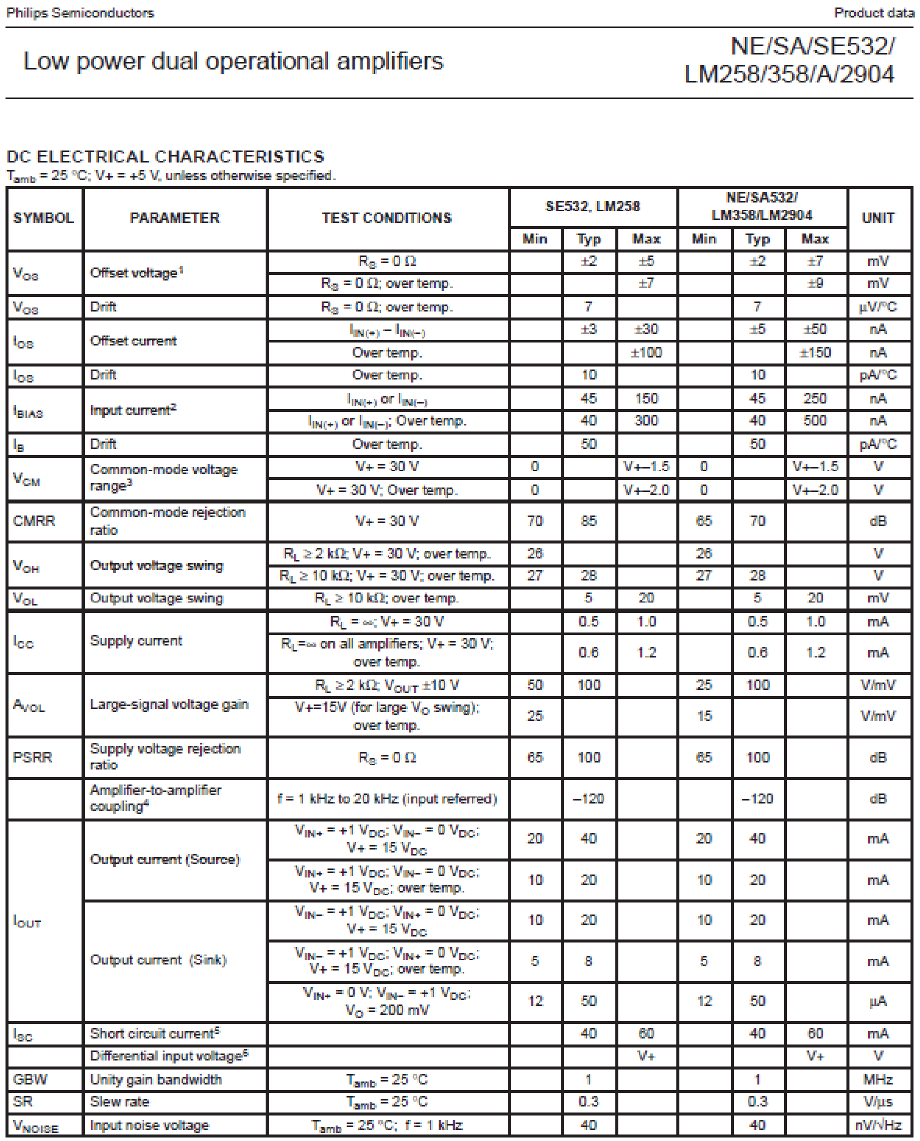


Figure 2. Equivalent circuit.



ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	RATING	UNIT
V_S	Supply voltage, V+	32 or ±16	V_{DC}
	Differential input voltage	32	V_{DC}
V_{IN}	Input voltage	–0.3 to +32	V_{DC}
P_D	Maximum power dissipation T_{amb} = 25 °C (Still air)[1] N package D package DP package	 1160 780 714	 mW mW mW
	Output short-circuit to GND[2] V+ < 15 V_{DC} and T_{amb} = 25 °C	 Continuous	
T_{amb}	Operating ambient temperature range NE532/LM358/LM358A LM258 LM2904 SA532 SE532	 0 to +70 –25 to +85 –40 to +125 –40 to +85 –55 to +125	 °C °C °C °C °C
T_{stg}	Storage temperature range	–65 to +150	°C
T_{sld}	Lead soldering temperature (10 sec max)	230	°C



Philips Semiconductors

Product data

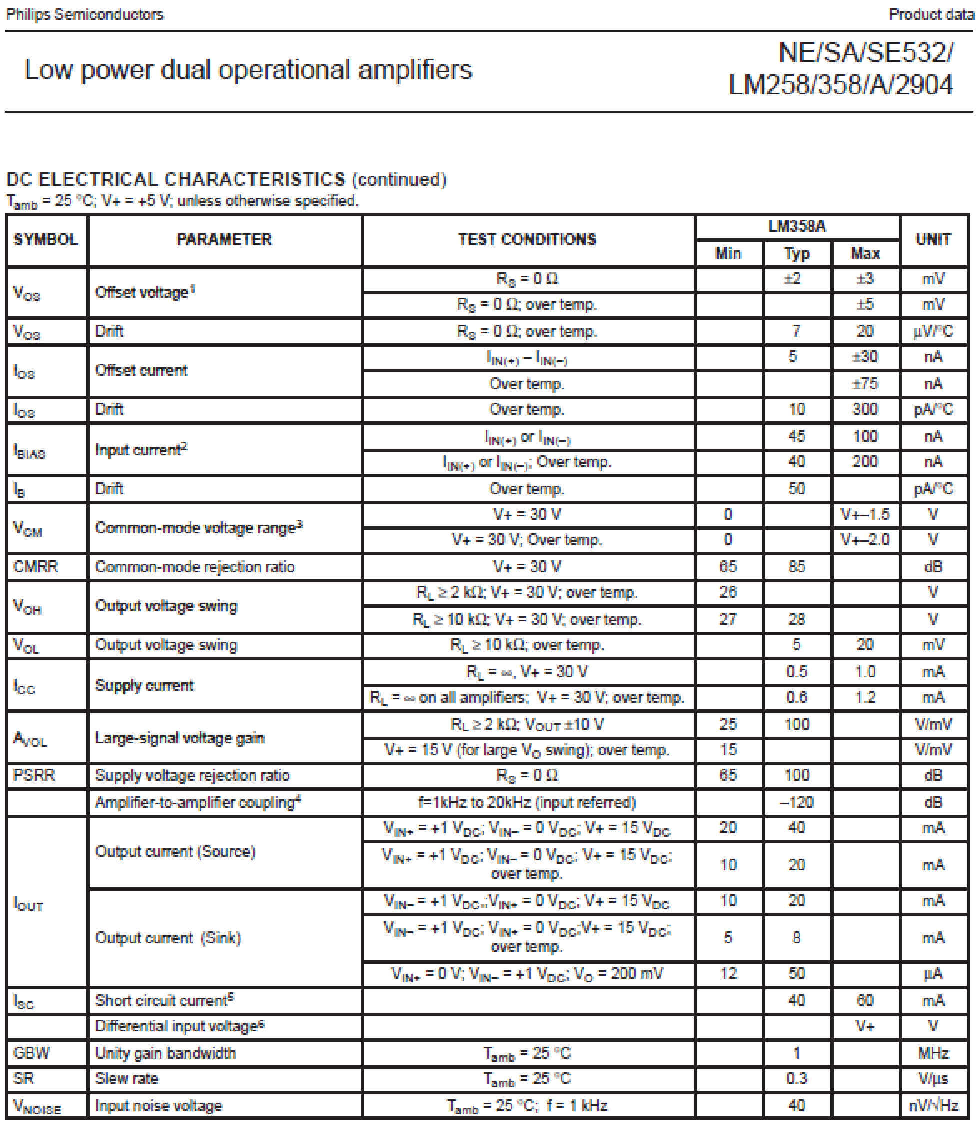
Low power dual operational amplifiers

NE/SA/SE532/
LM258/358/A/2904

DC ELECTRICAL CHARACTERISTICS

T_{amb} = 25 °C; V+ = +5 V, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	SE532, LM258			NE/SA532/ LM358/LM2904			UNIT
			Min	Typ	Max	Min	Typ	Max	
V_{OS}	Offset voltage[1]	$R_S = 0\ \Omega$		±2	±5		±2	±7	mV
		$R_S = 0\ \Omega$; over temp.			±7			±9	mV
V_{OS}	Drift	$R_S = 0\ \Omega$; over temp.		7			7		µV/°C
I_{OS}	Offset current	$I_{IN(+)} - I_{IN(-)}$		±3	±30		±5	±50	nA
		Over temp.			±100			±150	nA
I_{OS}	Drift	Over temp.		10			10		pA/°C
I_{BIAS}	Input current[2]	$I_{IN(+)}$ or $I_{IN(-)}$		45	150		45	250	nA
		$I_{IN(+)}$ or $I_{IN(-)}$; Over temp.		40	300		40	500	nA
I_B	Drift	Over temp.		50			50		pA/°C
V_{CM}	Common-mode voltage range[3]	V+ = 30 V	0		V+–1.5	0		V+–1.5	V
		V+ = 30 V; Over temp.	0		V+–2.0	0		V+–2.0	V
CMRR	Common-mode rejection ratio	V+ = 30 V	70	85		65	70		dB
V_{OH}	Output voltage swing	$R_L \geq 2\ k\Omega$; V+ = 30 V; over temp.	26			26			V
		$R_L \geq 10\ k\Omega$; V+ = 30 V; over temp.	27	28		27	28		V
V_{OL}	Output voltage swing	$R_L \geq 10\ k\Omega$; over temp.		5	20		5	20	mV
I_{CC}	Supply current	$R_L = \infty$; V+ = 30 V		0.5	1.0		0.5	1.0	mA
		$R_L = \infty$ on all amplifiers; V+ = 30 V; over temp.		0.6	1.2		0.6	1.2	mA
A_{VOL}	Large-signal voltage gain	$R_L \geq 2\ k\Omega$; V_{OUT} ±10 V	50	100		25	100		V/mV
		V+=15V (for large V_O swing); over temp.	25			15			V/mV
PSRR	Supply voltage rejection ratio	$R_S = 0\ \Omega$	65	100		65	100		dB
	Amplifier-to-amplifier coupling[4]	f = 1 kHz to 20 kHz (input referred)		–120			–120		dB
I_{OUT}	Output current (Source)	V_{IN+} = +1 V_{DC}; V_{IN-} = 0 V_{DC}; V+ = 15 V_{DC}	20	40		20	40		mA
		V_{IN+} = +1 V_{DC}; V_{IN-} = 0 V_{DC}; V+ = 15 V_{DC}; over temp.	10	20		10	20		mA
	Output current (Sink)	V_{IN-} = +1 V_{DC}; V_{IN+} = 0 V_{DC}; V+ = 15 V_{DC}	10	20		10	20		mA
		V_{IN-} = +1 V_{DC}; V_{IN+} = 0 V_{DC}; V+ = 15 V_{DC}; over temp.	5	8		5	8		mA
		V_{IN+} = 0 V; V_{IN-} = +1 V_{DC}; V_O = 200 mV	12	50		12	50		µA
I_{SC}	Short circuit current[5]			40	60		40	60	mA
	Differential input voltage[6]				V+			V+	V
GBW	Unity gain bandwidth	T_{amb} = 25 °C		1			1		MHz
SR	Slew rate	T_{amb} = 25 °C		0.3			0.3		V/µs
V_{NOISE}	Input noise voltage	T_{amb} = 25 °C; f = 1 kHz		40			40		nV/√Hz



Philips Semiconductors

Product data

Low power dual operational amplifiers

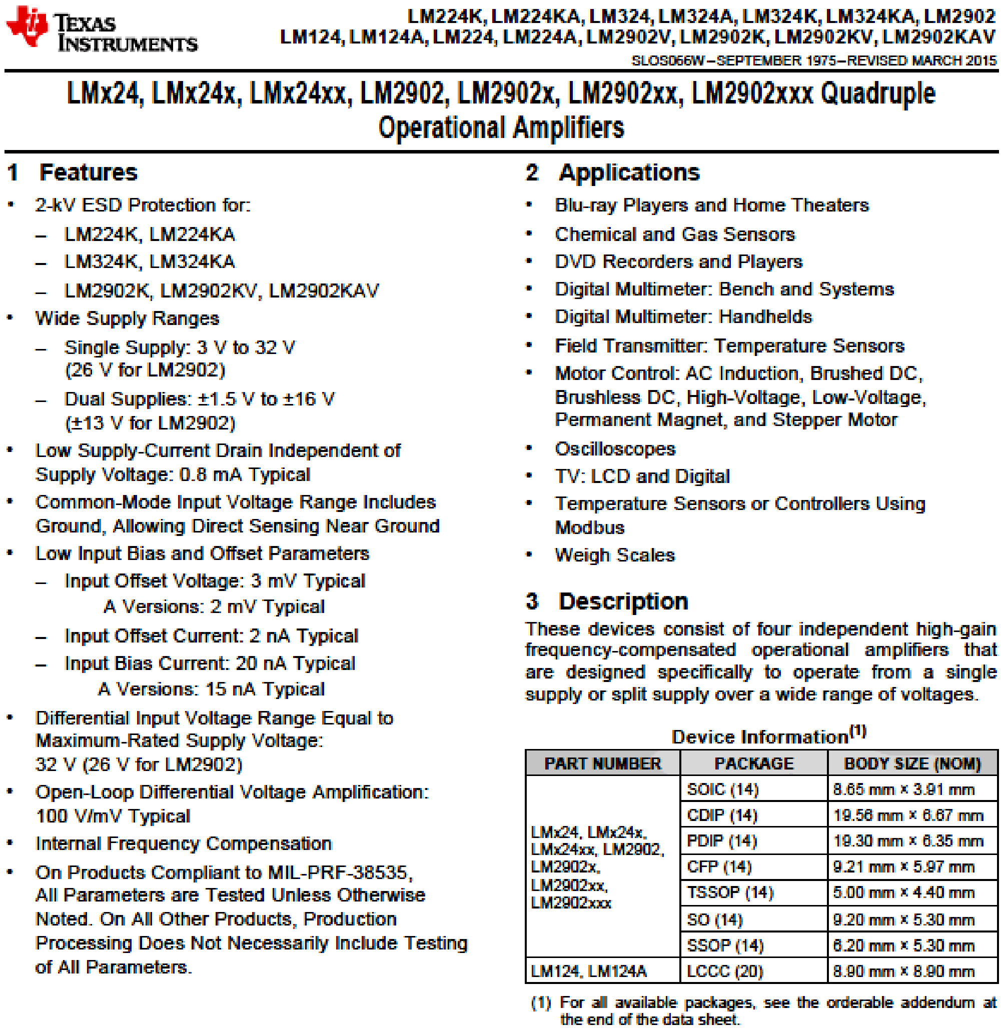
NE/SA/SE532/
LM258/358/A/2904

DC ELECTRICAL CHARACTERISTICS (continued)

T_{amb} = 25 °C; V+ = +5 V; unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	LM358A			UNIT
			Min	Typ	Max	
V_{OS}	Offset voltage[1]	$R_S = 0\ \Omega$		±2	±3	mV
		$R_S = 0\ \Omega$; over temp.			±5	mV
V_{OS}	Drift	$R_S = 0\ \Omega$; over temp.		7	20	µV/°C
I_{OS}	Offset current	$I_{IN(+)} - I_{IN(-)}$		5	±30	nA
		Over temp.			±75	nA
I_{OS}	Drift	Over temp.		10	300	pA/°C
I_{BIAS}	Input current[2]	$I_{IN(+)}$ or $I_{IN(-)}$		45	100	nA
		$I_{IN(+)}$ or $I_{IN(-)}$; Over temp.		40	200	nA
I_B	Drift	Over temp.		50		pA/°C
V_{CM}	Common-mode voltage range[3]	V+ = 30 V	0		V+–1.5	V
		V+ = 30 V; Over temp.	0		V+–2.0	V
CMRR	Common-mode rejection ratio	V+ = 30 V	65	85		dB
V_{OH}	Output voltage swing	$R_L \geq 2\ k\Omega$; V+ = 30 V; over temp.	26			V
		$R_L \geq 10\ k\Omega$; V+ = 30 V; over temp.	27	28		V
V_{OL}	Output voltage swing	$R_L \geq 10\ k\Omega$; over temp.		5	20	mV
I_{CC}	Supply current	$R_L = \infty$, V+ = 30 V		0.5	1.0	mA
		$R_L = \infty$ on all amplifiers; V+ = 30 V; over temp.		0.6	1.2	mA
A_{VOL}	Large-signal voltage gain	$R_L \geq 2\ k\Omega$; V_{OUT} ±10 V	25	100		V/mV
		V+ = 15 V (for large V_O swing); over temp.	15			V/mV
PSRR	Supply voltage rejection ratio	$R_S = 0\ \Omega$	65	100		dB
	Amplifier-to-amplifier coupling[4]	f=1kHz to 20kHz (input referred)		–120		dB
I_{OUT}	Output current (Source)	V_{IN+} = +1 V_{DC}; V_{IN-} = 0 V_{DC}; V+ = 15 V_{DC}	20	40		mA
		V_{IN+} = +1 V_{DC}; V_{IN-} = 0 V_{DC}; V+ = 15 V_{DC}; over temp.	10	20		mA
	Output current (Sink)	V_{IN-} = +1 V_{DC}.;V_{IN+} = 0 V_{DC}; V+ = 15 V_{DC}	10	20		mA
		V_{IN-} = +1 V_{DC}; V_{IN+} = 0 V_{DC};V+ = 15 V_{DC}; over temp.	5	8		mA
		V_{IN+} = 0 V; V_{IN-} = +1 V_{DC}; V_O = 200 mV	12	50		µA
I_{SC}	Short circuit current[5]			40	60	mA
	Differential input voltage[6]				V+	V
GBW	Unity gain bandwidth	T_{amb} = 25 °C		1		MHz
SR	Slew rate	T_{amb} = 25 °C		0.3		V/µs
V_{NOISE}	Input noise voltage	T_{amb} = 25 °C; f = 1 kHz		40		nV/√Hz

LM324 QUADRUPLO



TEXAS INSTRUMENTS

LM224K, LM224KA, LM324, LM324A, LM324K, LM324KA, LM2902
LM124, LM124A, LM224, LM224A, LM2902V, LM2902K, LM2902KV, LM2902KAV
SLOS066W – SEPTEMBER 1975 – REVISED MARCH 2015

LMx24, LMx24x, LMx24xx, LM2902, LM2902x, LM2902xx, LM2902xxx Quadruple Operational Amplifiers

1 Features

- 2-kV ESD Protection for:
  - LM224K, LM224KA
  - LM324K, LM324KA
  - LM2902K, LM2902KV, LM2902KAV
- Wide Supply Ranges
  - Single Supply: 3 V to 32 V (26 V for LM2902)
  - Dual Supplies: ±1.5 V to ±16 V (±13 V for LM2902)
- Low Supply-Current Drain Independent of Supply Voltage: 0.8 mA Typical
- Common-Mode Input Voltage Range Includes Ground, Allowing Direct Sensing Near Ground
- Low Input Bias and Offset Parameters
  - Input Offset Voltage: 3 mV Typical
    A Versions: 2 mV Typical
  - Input Offset Current: 2 nA Typical
  - Input Bias Current: 20 nA Typical
    A Versions: 15 nA Typical
- Differential Input Voltage Range Equal to Maximum-Rated Supply Voltage: 32 V (26 V for LM2902)
- Open-Loop Differential Voltage Amplification: 100 V/mV Typical
- Internal Frequency Compensation
- On Products Compliant to MIL-PRF-38535, All Parameters are Tested Unless Otherwise Noted. On All Other Products, Production Processing Does Not Necessarily Include Testing of All Parameters.

2 Applications

- Blu-ray Players and Home Theaters
- Chemical and Gas Sensors
- DVD Recorders and Players
- Digital Multimeter: Bench and Systems
- Digital Multimeter: Handhelds
- Field Transmitter: Temperature Sensors
- Motor Control: AC Induction, Brushed DC, Brushless DC, High-Voltage, Low-Voltage, Permanent Magnet, and Stepper Motor
- Oscilloscopes
- TV: LCD and Digital
- Temperature Sensors or Controllers Using Modbus
- Weigh Scales

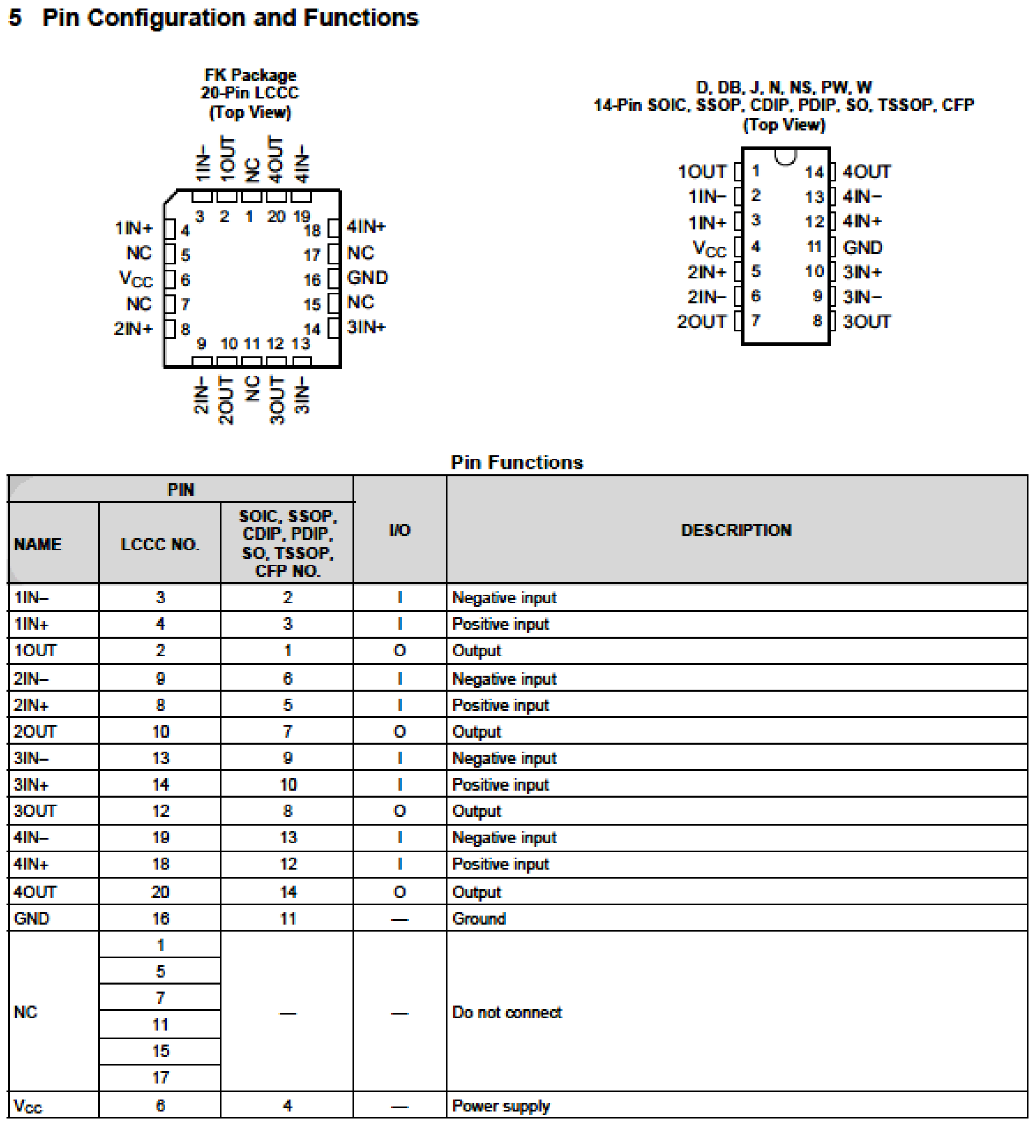
3 Description

These devices consist of four independent high-gain frequency-compensated operational amplifiers that are designed specifically to operate from a single supply or split supply over a wide range of voltages.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
LMx24, LMx24x, LMx24xx, LM2902, LM2902x, LM2902xx, LM2902xxx	SOIC (14)	8.65 mm × 3.91 mm
	CDIP (14)	19.56 mm × 6.67 mm
	PDIP (14)	19.30 mm × 6.35 mm
	CFP (14)	9.21 mm × 5.97 mm
	TSSOP (14)	5.00 mm × 4.40 mm
	SO (14)	9.20 mm × 5.30 mm
	SSOP (14)	6.20 mm × 5.30 mm
LM124, LM124A	LCCC (20)	8.90 mm × 8.90 mm

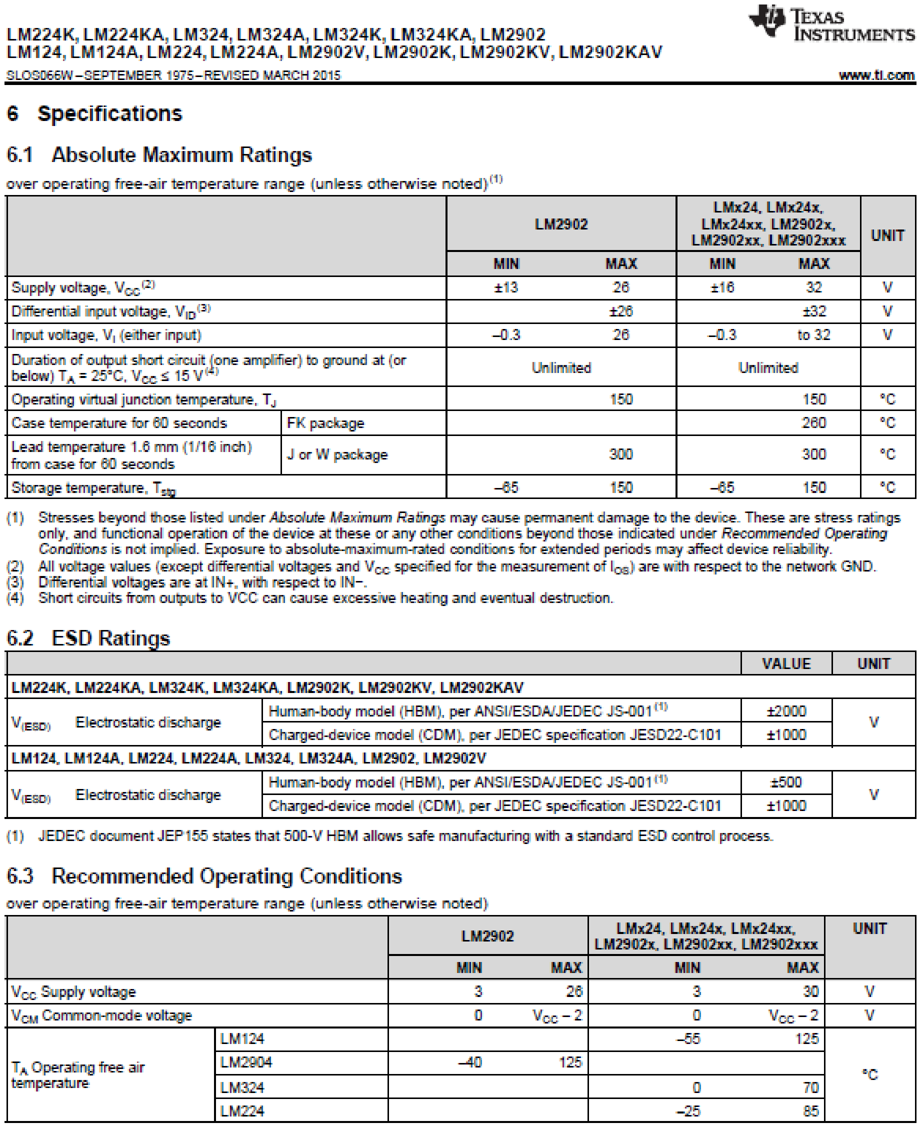
(1) For all available packages, see the orderable addendum at the end of the data sheet.



5 Pin Configuration and Functions

Pin Functions

PIN			I/O	DESCRIPTION
NAME	LCCC NO.	SOIC, SSOP, CDIP, PDIP, SO, TSSOP, CFP NO.		
1IN–	3	2	I	Negative input
1IN+	4	3	I	Positive input
1OUT	2	1	O	Output
2IN–	9	6	I	Negative input
2IN+	8	5	I	Positive input
2OUT	10	7	O	Output
3IN–	13	9	I	Negative input
3IN+	14	10	I	Positive input
3OUT	12	8	O	Output
4IN–	19	13	I	Negative input
4IN+	18	12	I	Positive input
4OUT	20	14	O	Output
GND	16	11	—	Ground
NC	1 5 7 11 15 17	—	—	Do not connect
V_{CC}	6	4	—	Power supply



LM224K, LM224KA, LM324, LM324A, LM324K, LM324KA, LM2902
LM124, LM124A, LM224, LM224A, LM2902V, LM2902K, LM2902KV, LM2902KAV

TEXAS INSTRUMENTS

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6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

		LM2902		LMx24, LMx24x, LMx24xx, LM2902x, LM2902xx, LM2902xxx		UNIT
		MIN	MAX	MIN	MAX	
Supply voltage, V_{CC} (2)		±13	26	±16	32	V
Differential input voltage, V_{ID} (3)			±26		±32	V
Input voltage, V_I (either input)		–0.3	26	–0.3	to 32	V
Duration of output short circuit (one amplifier) to ground at (or below) T_A = 25°C, $V_{CC} \leq 15$ V (4)		Unlimited		Unlimited		
Operating virtual junction temperature, T_J			150		150	°C
Case temperature for 60 seconds	FK package				260	°C
Lead temperature 1.6 mm (1/16 inch) from case for 60 seconds	J or W package		300		300	°C
Storage temperature, T_{stg}		–65	150	–65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltage values (except differential voltages and V_{CC} specified for the measurement of I_{OS}) are with respect to the network GND.
(3) Differential voltages are at IN+, with respect to IN−.
(4) Short circuits from outputs to VCC can cause excessive heating and eventual destruction.

6.2 ESD Ratings

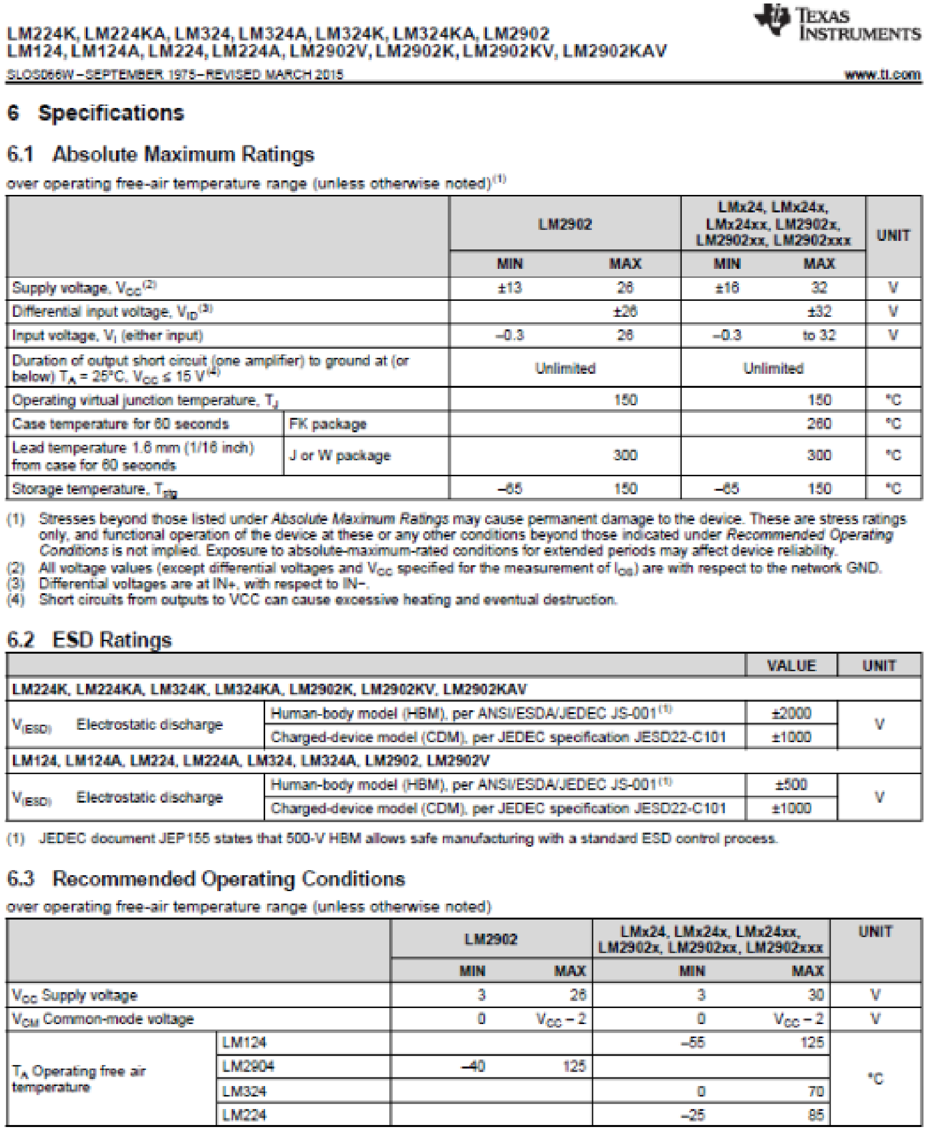
			VALUE	UNIT
LM224K, LM224KA, LM324K, LM324KA, LM2902K, LM2902KV, LM2902KAV				
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 (1)	±2000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101	±1000	
LM124, LM124A, LM224, LM224A, LM324, LM324A, LM2902, LM2902V				
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 (1)	±500	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101	±1000	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

		LM2902		LMx24, LMx24x, LMx24xx, LM2902x, LM2902xx, LM2902xxx		UNIT
		MIN	MAX	MIN	MAX	
V_{CC} Supply voltage		3	26	3	30	V
V_{CM} Common-mode voltage		0	$V_{CC} - 2$	0	$V_{CC} - 2$	V
T_A Operating free air temperature	LM124			–55	125	°C
	LM2904	–40	125			
	LM324			0	70	
	LM224			–25	85	



6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)[1]

		LM2902		LMx24, LMx24x, LMx24xx, LM2902x, LM2902xx, LM2902xxx		UNIT
		MIN	MAX	MIN	MAX	
Supply voltage, V_{CC}[2]		±13	26	±16	32	V
Differential input voltage, V_{ID}[3]			±26		±32	V
Input voltage, V_I (either input)		–0.3	26	–0.3	to 32	V
Duration of output short circuit (one amplifier) to ground at (or below) T_A = 25°C, $V_{CC} \le 15$ V[4]		Unlimited		Unlimited		
Operating virtual junction temperature, T_J			150		150	°C
Case temperature for 60 seconds	FK package				260	°C
Lead temperature 1.6 mm (1/16 inch) from case for 60 seconds	J or W package		300		300	°C
Storage temperature, T_{stg}		–65	150	–65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltage values (except differential voltages and V_{CC} specified for the measurement of I_{OS}) are with respect to the network GND.
(3) Differential voltages are at IN+, with respect to IN–.
(4) Short circuits from outputs to VCC can cause excessive heating and eventual destruction.

6.2 ESD Ratings

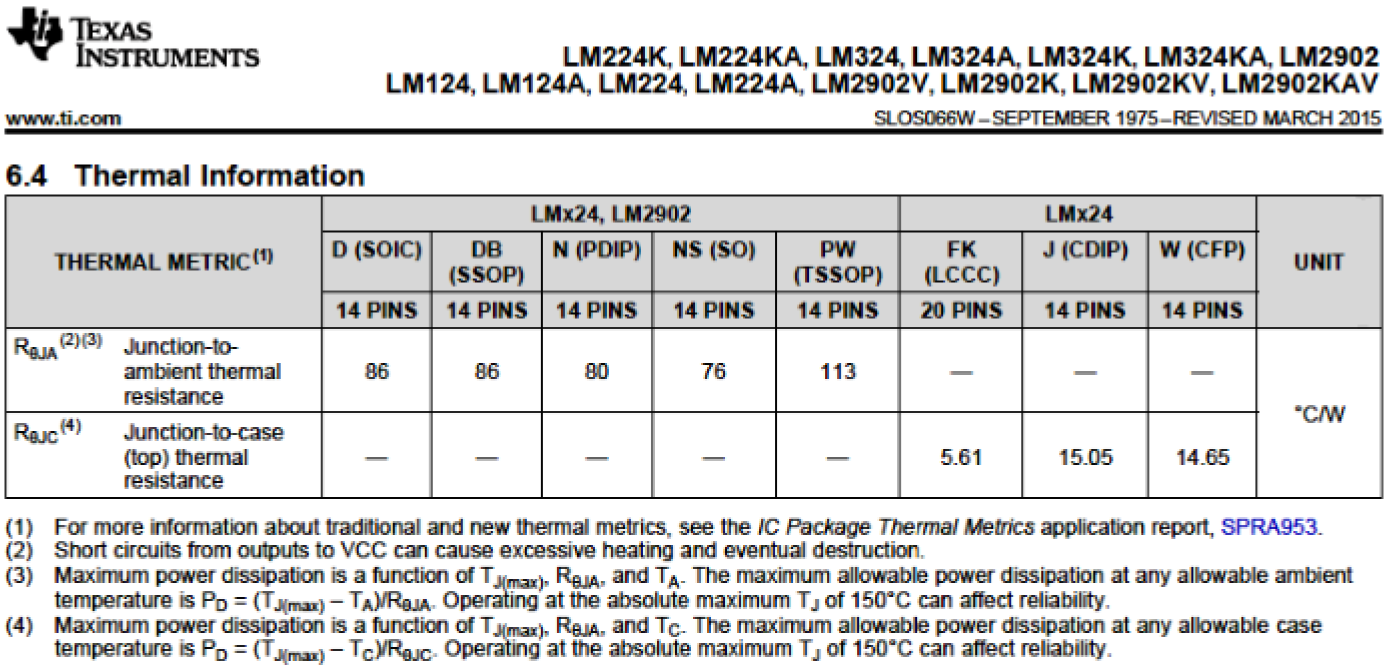
			VALUE	UNIT
LM224K, LM224KA, LM324K, LM324KA, LM2902K, LM2902KV, LM2902KAV				
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001[1]	±2000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101	±1000	
LM124, LM124A, LM224, LM224A, LM324, LM324A, LM2902, LM2902V				
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001[1]	±500	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101	±1000	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

		LM2902		LMx24, LMx24x, LMx24xx, LM2902x, LM2902xx, LM2902xxx		UNIT
		MIN	MAX	MIN	MAX	
V_{CC} Supply voltage		3	26	3	30	V
V_{CM} Common-mode voltage		0	$V_{CC} - 2$	0	$V_{CC} - 2$	V
T_A Operating free air temperature	LM124			–55	125	°C
	LM2904	–40	125			
	LM324			0	70	
	LM224			–25	85	



TEXAS INSTRUMENTS

LM224K, LM224KA, LM324, LM324A, LM324K, LM324KA, LM2902
LM124, LM124A, LM224, LM224A, LM2902V, LM2902K, LM2902KV, LM2902KAV

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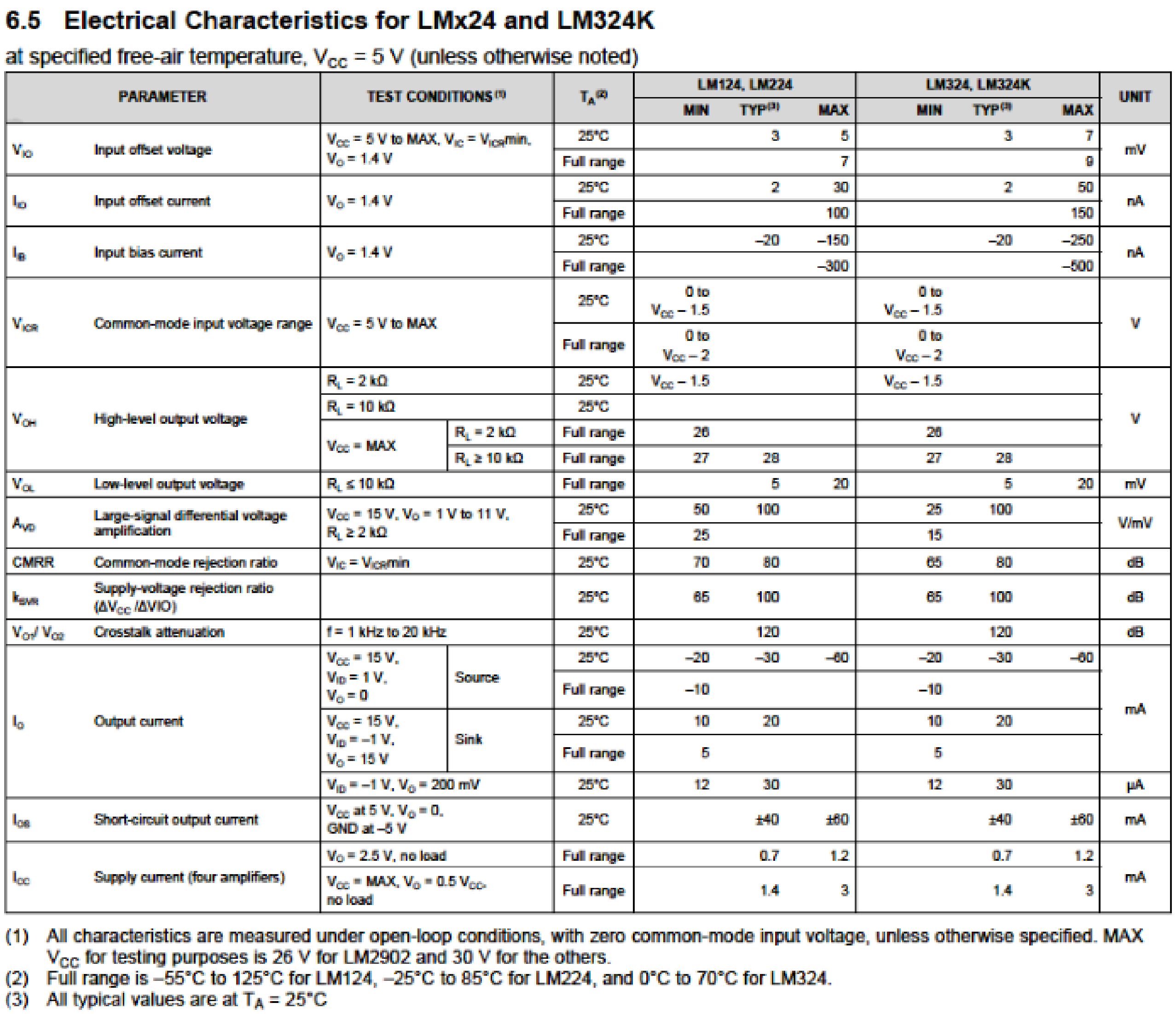
6.4 Thermal Information

THERMAL METRIC[1]		LMx24, LM2902					LMx24			UNIT
		D (SOIC)	DB (SSOP)	N (PDIP)	NS (SO)	PW (TSSOP)	FK (LCCC)	J (CDIP)	W (CFP)	
		14 PINS	14 PINS	14 PINS	14 PINS	14 PINS	20 PINS	14 PINS	14 PINS	
$R_{\theta JA}$[2][3]	Junction-to-ambient thermal resistance	86	86	80	76	113	—	—	—	°C/W
$R_{\theta JC}$[4]	Junction-to-case (top) thermal resistance	—	—	—	—	—	5.61	15.05	14.65	

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, SPRA953.
(2) Short circuits from outputs to VCC can cause excessive heating and eventual destruction.
(3) Maximum power dissipation is a function of $T_{J(max)}$, $R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_{J(max)} - T_A)/R_{\theta JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
(4) Maximum power dissipation is a function of $T_{J(max)}$, $R_{\theta JA}$, and T_C. The maximum allowable power dissipation at any allowable case temperature is $P_D = (T_{J(max)} - T_C)/R_{\theta JC}$. Operating at the absolute maximum T_J of 150°C can affect reliability.



6.5 Electrical Characteristics for LMx24 and LM324K

at specified free-air temperature, V_{CC} = 5 V (unless otherwise noted)

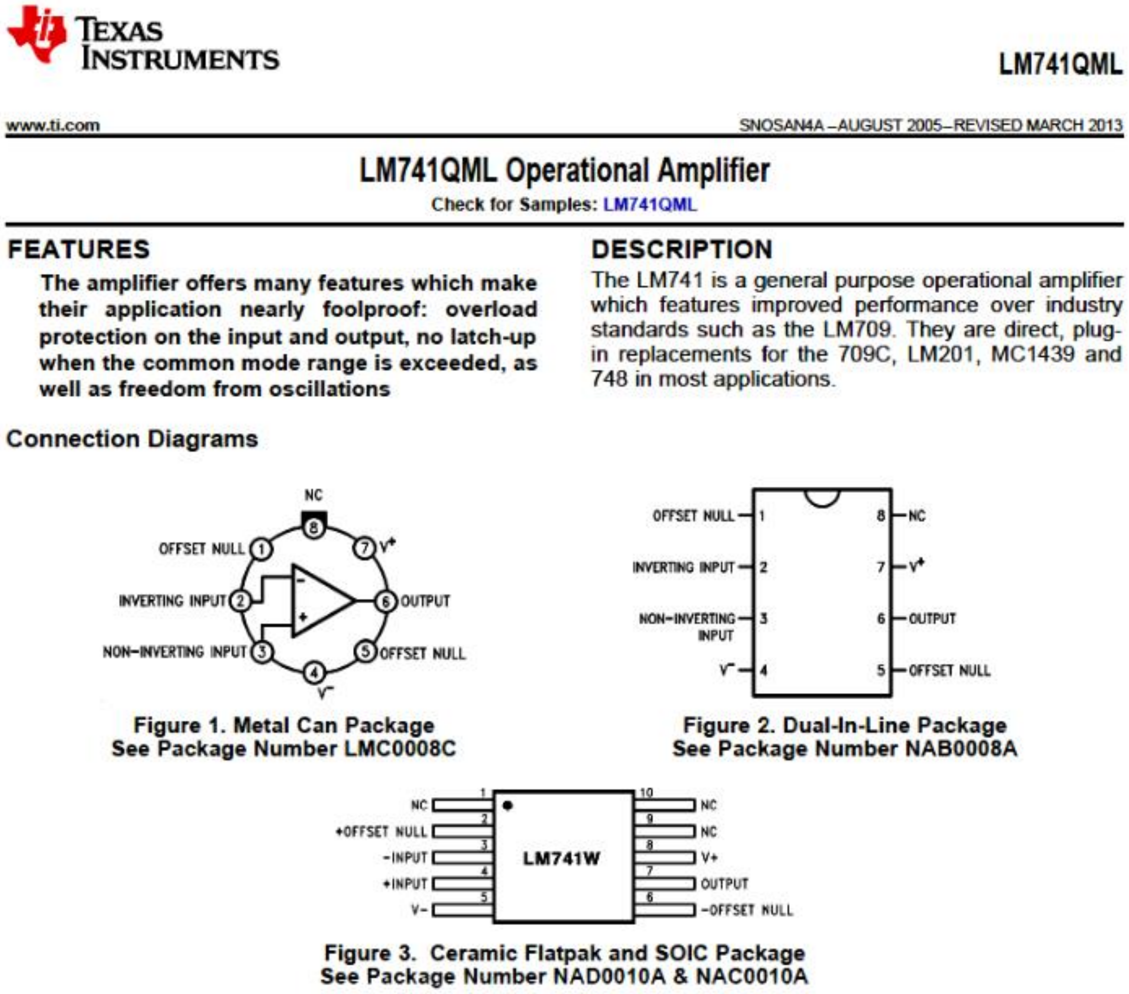
PARAMETER		TEST CONDITIONS[1]		T_A[2]	LM124, LM224			LM324, LM324K			UNIT
					MIN	TYP[3]	MAX	MIN	TYP[3]	MAX	
V_{IO}	Input offset voltage	V_{CC} = 5 V to MAX, V_{IC} = V_{ICR}min, V_O = 1.4 V		25°C		3	5		3	7	mV
				Full range			7			9	
I_{IO}	Input offset current	V_O = 1.4 V		25°C		2	30		2	50	nA
				Full range			100			150	
I_{IB}	Input bias current	V_O = 1.4 V		25°C		–20	–150		–20	–250	nA
				Full range			–300			–500	
V_{ICR}	Common-mode input voltage range	V_{CC} = 5 V to MAX		25°C	0 to V_{CC} – 1.5			0 to V_{CC} – 1.5			V
				Full range	0 to V_{CC} – 2			0 to V_{CC} – 2			
V_{OH}	High-level output voltage	R_L = 2 kΩ		25°C	V_{CC} – 1.5			V_{CC} – 1.5			V
		R_L = 10 kΩ		25°C							
		V_{CC} = MAX	R_L = 2 kΩ	Full range	26			26			
			R_L ≥ 10 kΩ	Full range	27	28		27	28		
V_{OL}	Low-level output voltage	R_L ≤ 10 kΩ		Full range		5	20		5	20	mV
A_{VD}	Large-signal differential voltage amplification	V_{CC} = 15 V, V_O = 1 V to 11 V, R_L ≥ 2 kΩ		25°C	50	100		25	100		V/mV
				Full range	25			15			
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min		25°C	70	80		65	80		dB
k_{SVR}	Supply-voltage rejection ratio (ΔV_{CC} /ΔVIO)			25°C	65	100		65	100		dB
V_{O1}/ V_{O2}	Crosstalk attenuation	f = 1 kHz to 20 kHz		25°C		120			120		dB
I_O	Output current	V_{CC} = 15 V, V_{ID} = 1 V, V_O = 0	Source	25°C	–20	–30	–60	–20	–30	–60	mA
				Full range	–10			–10			
		V_{CC} = 15 V, V_{ID} = –1 V, V_O = 15 V	Sink	25°C	10	20		10	20		
				Full range	5			5			
		V_{ID} = –1 V, V_O = 200 mV		25°C	12	30		12	30		μA
I_{OS}	Short-circuit output current	V_{CC} at 5 V, V_O = 0, GND at –5 V		25°C		±40	±60		±40	±60	mA
I_{CC}	Supply current (four amplifiers)	V_O = 2.5 V, no load		Full range		0.7	1.2		0.7	1.2	mA
		V_{CC} = MAX, V_O = 0.5 V_{CC}, no load		Full range		1.4	3		1.4	3	

(1) All characteristics are measured under open-loop conditions, with zero common-mode input voltage, unless otherwise specified. MAX V_{CC} for testing purposes is 26 V for LM2902 and 30 V for the others.

(2) Full range is –55°C to 125°C for LM124, –25°C to 85°C for LM224, and 0°C to 70°C for LM324.

(3) All typical values are at T_A = 25°C

LM741



TEXAS INSTRUMENTS

LM741QML

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SNOSAN4A – AUGUST 2005 – REVISED MARCH 2013

LM741QML Operational Amplifier

Check for Samples: LM741QML

FEATURES

The amplifier offers many features which make their application nearly foolproof: overload protection on the input and output, no latch-up when the common mode range is exceeded, as well as freedom from oscillations

DESCRIPTION

The LM741 is a general purpose operational amplifier which features improved performance over industry standards such as the LM709. They are direct, plug-in replacements for the 709C, LM201, MC1439 and 748 in most applications.

Connection Diagrams

Figure 1. Metal Can Package
See Package Number LMC0008C

Figure 2. Dual-In-Line Package
See Package Number NAB0008A

Figure 3. Ceramic Flatpak and SOIC Package
See Package Number NAD0010A & NAC0010A

COMPARADORES

LM393 DUAS COMPARADOR COLETOR ABERTO IOUT 0,02A

Order this document by LM393/D

MOTOROLA

LM393, LM393A, LM293, LM2903, LM2903V

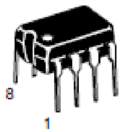
Low Offset Voltage Dual Comparators

The LM393 series are dual independent precision voltage comparators capable of single or split supply operation. These devices are designed to permit a common mode range–to–ground level with single supply operation. Input offset voltage specifications as low as 2.0 mV make this device an excellent selection for many applications in consumer automotive, and industrial electronics.

- Wide Single–Supply Range: 2.0 Vdc to 36 Vdc
- Split–Supply Range: ±1.0 Vdc to ±18 Vdc
- Very Low Current Drain Independent of Supply Voltage: 0.4 mA
- Low Input Bias Current: 25 nA
- Low Input Offset Current: 5.0 nA
- Low Input Offset Voltage: 2.0 mV (max) LM393A
  5.0 mV (max) LM293/393
- Input Common Mode Range to Ground Level
- Differential Input Voltage Range Equal to Power Supply Voltage
- Output Voltage Compatible with DTL, ECL, TTL, MOS, and CMOS Logic Levels
- ESD Clamps on the Inputs Increase the Ruggedness of the Device without Affecting Performance

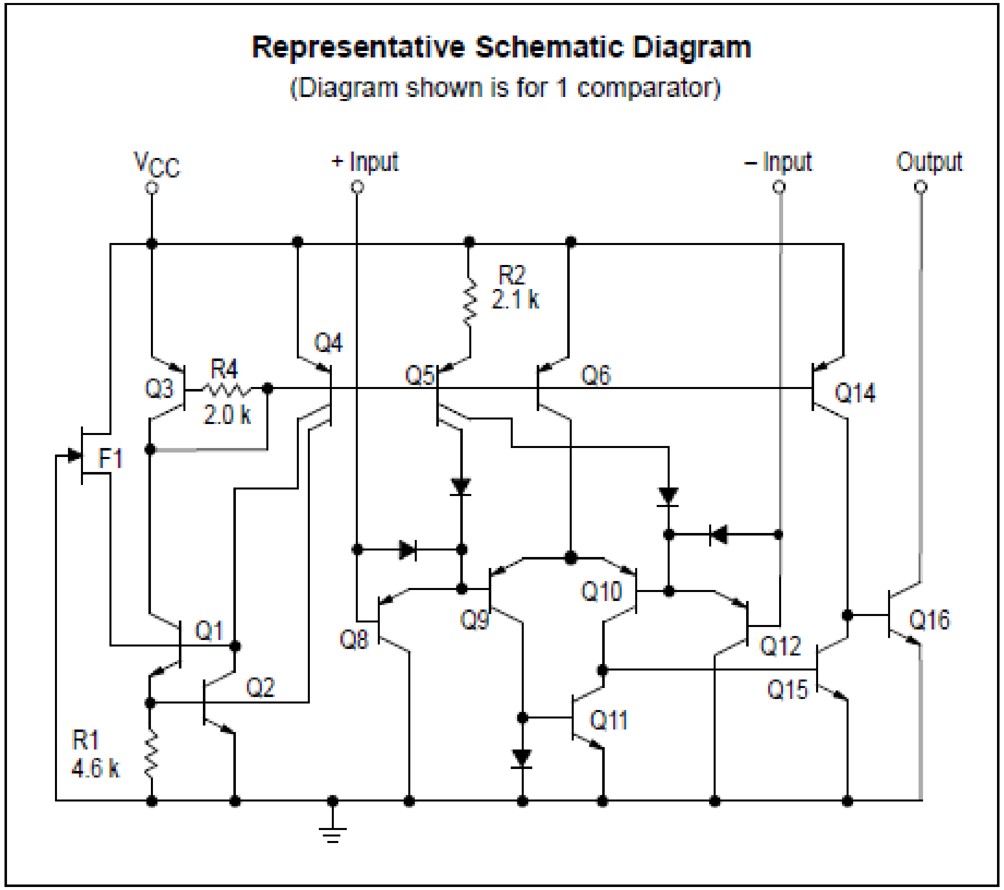
SINGLE SUPPLY, LOW POWER DUAL COMPARATORS

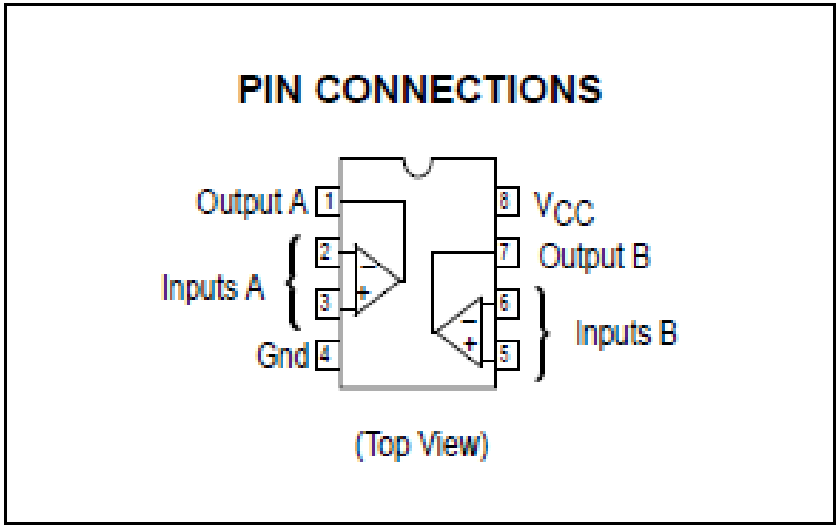
SEMICONDUCTOR TECHNICAL DATA



N SUFFIX
PLASTIC PACKAGE
CASE 626

D SUFFIX
PLASTIC PACKAGE
CASE 751
(SO–8)


Representative Schematic Diagram
(Diagram shown is for 1 comparator)


PIN CONNECTIONS

LM393, LM393A, LM293, LM2903, LM2903V

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Power Supply Voltage	V_{CC}	+36 or ±18	Vdc
Input Differential Voltage Range	V_{IDR}	36	Vdc
Input Common Mode Voltage Range	V_{ICR}	–0.3 to +36	Vdc
Output Short Circuit–to–Ground	I_{SC}	Continuous	mA
Output Sink Current (Note 1)	I_{Sink}	20	
Power Dissipation @ $T_A = 25°C$	P_D	570	mW
Derate above 25°C	$1/R_{\theta JA}$	5.7	mW/°C
Operating Ambient Temperature Range	T_A		°C
LM293		–25 to +85	
LM393, 393A		0 to +70	
LM2903		–40 to +105	
LM2903V		–40 to +125	
Maximum Operating Junction Temperature	$T_{J(max)}$		°C
LM393, 393A, 2903, LM2903V		125	
LM293		150	
Storage Temperature Range	T_{stg}	–65 to +150	°C

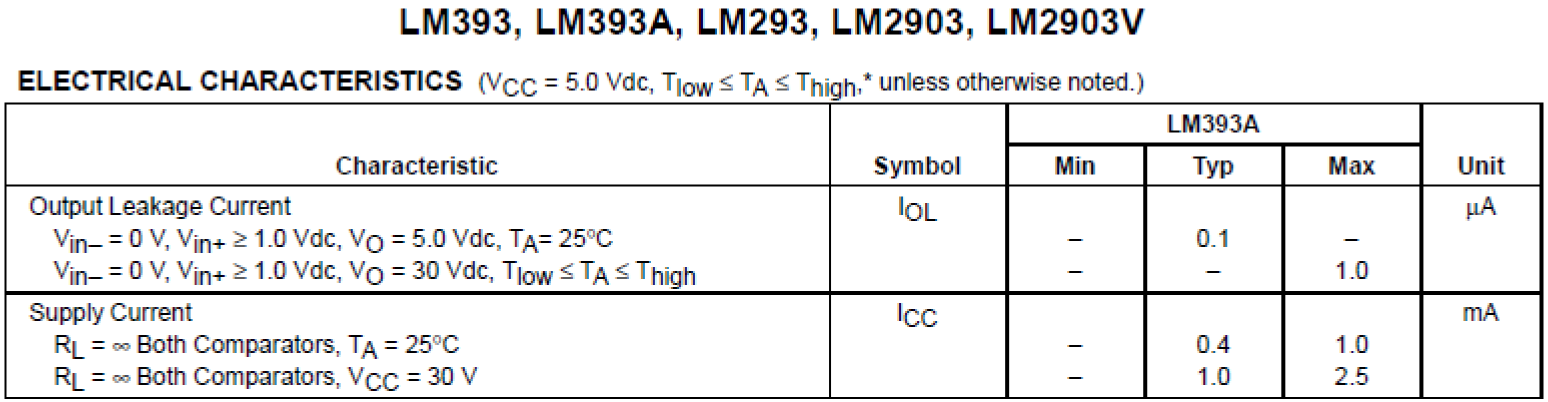
ELECTRICAL CHARACTERISTICS (V_{CC} = 5.0 Vdc, $T_{low} \le T_A \le T_{high}$,* unless otherwise noted.)

Characteristic	Symbol	LM393A			Unit
		Min	Typ	Max	
Input Offset Voltage (Note 2)	V_{IO}				mV
T_A = 25°C		–	±1.0	±2.0	
$T_{low} \le T_A \le T_{high}$		–	–	4.0	
Input Offset Current	I_{IO}				nA
T_A = 25°C		–	±50	±50	
$T_{low} \le T_A \le T_{high}$		–	–	±150	
Input Bias Current (Note 3)	I_{IB}				nA
T_A = 25°C		–	25	250	
$T_{low} \le T_A \le T_{high}$		–	–	400	
Input Common Mode Voltage Range (Note 4)	V_{ICR}				V
T_A = 25°C		0	–	V_{CC} −1.5	
$T_{low} \le T_A \le T_{high}$		0	–	V_{CC} −2.0	
Voltage Gain $R_L \ge 15$ kΩ, V_{CC} = 15 Vdc, T_A = 25°C	A_{VOL}	50	200	–	V/mV
Large Signal Response Time V_{in} = TTL Logic Swing, V_{ref} = 1.4 Vdc V_{RL} = 5.0 Vdc, R_L = 5.1 kΩ, T_A = 25°C	–	–	300	–	ns
Response Time (Note 5) V_{RL} = 5.0 Vdc, R_L = 5.1 kΩ, T_A = 25°C	t_{TLH}	–	1.3	–	µs
Input Differential Voltage (Note 6) All $V_{in} \ge$ Gnd or V– Supply (if used)	V_{ID}	–	–	V_{CC}	V
Output Sink Current $V_{in-} \ge 1.0$ Vdc, V_{in+} = 0 Vdc, $V_O \le 1.5$ Vdc, T_A = 25°C	I_{Sink}	6.0	16	–	mA
Output Saturation Voltage	V_{OL}				mV
$V_{in-} \ge 1.0$ Vdc, V_{in+} = 0 Vdc, $I_{Sink} \le 4.0$ mA, T_A = 25°C		–	150	400	
$T_{low} \le T_A \le T_{high}$		–	–	700	

*T_{low} = 0°C, T_{high} = +70°C for LM393/393A

NOTES:

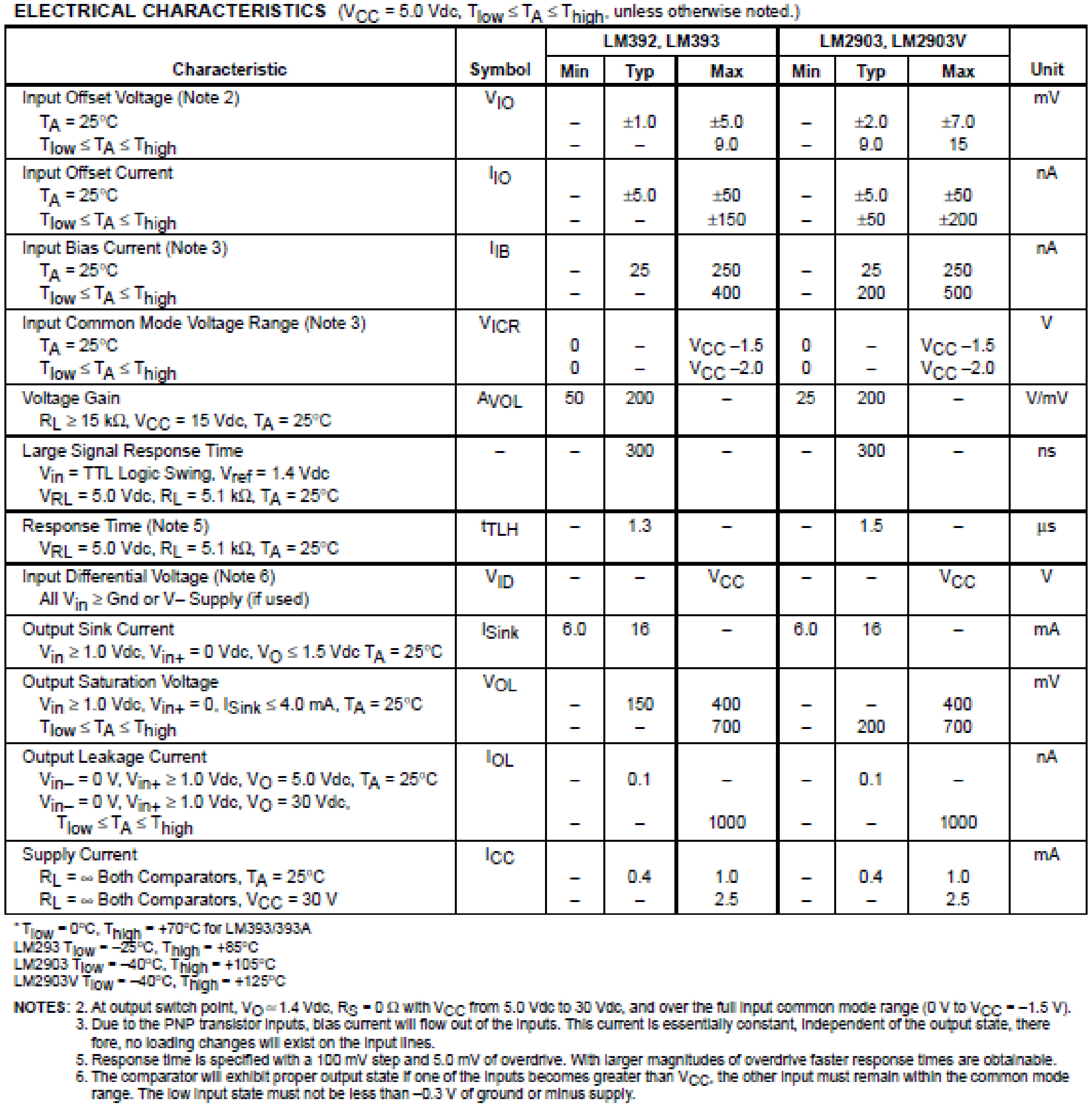
1. The maximum output current may be as high as 20 mA, independent of the magnitude of V_{CC}, output short circuits to V_{CC} can cause excessive heating and eventual destruction.
2. At output switch point, $V_O \simeq 1.4$ Vdc, R_S = 0 Ω with V_{CC} from 5.0 Vdc to 30 Vdc, and over the full input common mode range (0 V to V_{CC} = –1.5 V).
3. Due to the PNP transistor inputs, bias current will flow out of the inputs. This current is essentially constant, independent of the output state, there fore, no loading changes will exist on the input lines.
4. Input common mode of either input should not be permitted to go more than 0.3 V negative of ground or minus supply. The upper limit of common mode range is V_{CC} –1.5 V.
5. Response time is specified with a 100 mV step and 5.0 mV of overdrive. With larger magnitudes of overdrive faster response times are obtainable.
6. The comparator will exhibit proper output state if one of the inputs becomes greater than V_{CC}, the other input must remain within the common mode range. The low input state must not be less than –0.3 V of ground or minus supply.



LM393, LM393A, LM293, LM2903, LM2903V

ELECTRICAL CHARACTERISTICS (V_{CC} = 5.0 Vdc, $T_{low} \leq T_A \leq T_{high}$,* unless otherwise noted.)

Characteristic	Symbol	LM393A			Unit
		Min	Typ	Max	
Output Leakage Current	I_{OL}				μA
V_{in-} = 0 V, $V_{in+} \geq$ 1.0 Vdc, V_O = 5.0 Vdc, T_A= 25°C		–	0.1	–	
V_{in-} = 0 V, $V_{in+} \geq$ 1.0 Vdc, V_O = 30 Vdc, $T_{low} \leq T_A \leq T_{high}$		–	–	1.0	
Supply Current	I_{CC}				mA
$R_L = \infty$ Both Comparators, T_A = 25°C		–	0.4	1.0	
$R_L = \infty$ Both Comparators, V_{CC} = 30 V		–	1.0	2.5	



ELECTRICAL CHARACTERISTICS (V_{CC} = 5.0 Vdc, $T_{low} \le T_A \le T_{high}$, unless otherwise noted.)

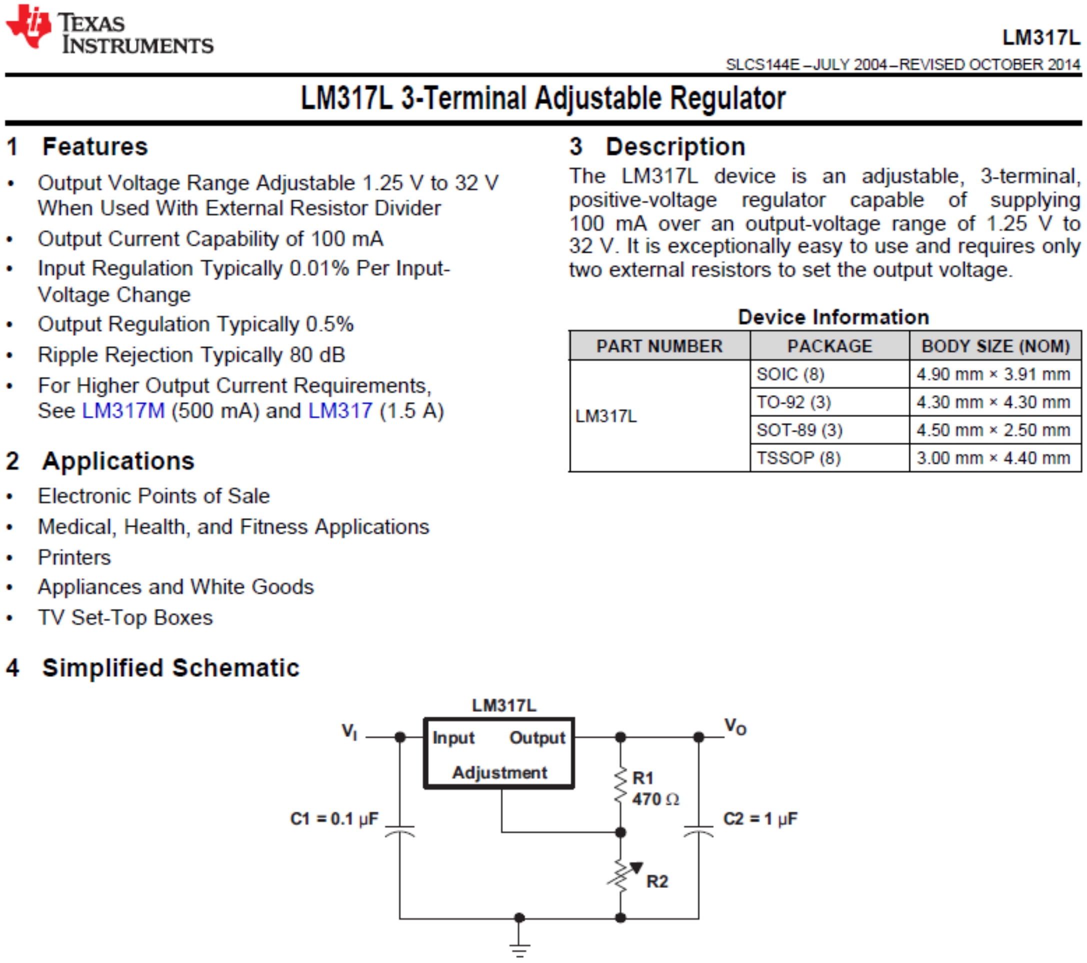
Characteristic	Symbol	LM392, LM393			LM2903, LM2903V			Unit
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage (Note 2)	V_{IO}							mV
T_A = 25°C		–	±1.0	±5.0	–	±2.0	±7.0	
$T_{low} \le T_A \le T_{high}$		–	–	9.0	–	9.0	15	
Input Offset Current	I_{IO}							nA
T_A = 25°C		–	±5.0	±50	–	±5.0	±50	
$T_{low} \le T_A \le T_{high}$		–	–	±150	–	±50	±200	
Input Bias Current (Note 3)	I_{IB}							nA
T_A = 25°C		–	25	250	–	25	250	
$T_{low} \le T_A \le T_{high}$		–	–	400	–	200	500	
Input Common Mode Voltage Range (Note 3)	V_{ICR}							V
T_A = 25°C		0	–	V_{CC} −1.5	0	–	V_{CC} −1.5	
$T_{low} \le T_A \le T_{high}$		0	–	V_{CC} −2.0	0	–	V_{CC} −2.0	
Voltage Gain $R_L \ge 15$ kΩ, V_{CC} = 15 Vdc, T_A = 25°C	A_{VOL}	50	200	–	25	200	–	V/mV
Large Signal Response Time V_{in} = TTL Logic Swing, V_{ref} = 1.4 Vdc V_{RL} = 5.0 Vdc, R_L = 5.1 kΩ, T_A = 25°C	–	–	300	–	–	300	–	ns
Response Time (Note 5) V_{RL} = 5.0 Vdc, R_L = 5.1 kΩ, T_A = 25°C	t_{TLH}	–	1.3	–	–	1.5	–	µs
Input Differential Voltage (Note 6) All $V_{in} \ge$ Gnd or V– Supply (if used)	V_{ID}	–	–	V_{CC}	–	–	V_{CC}	V
Output Sink Current $V_{in} \ge 1.0$ Vdc, V_{in+} = 0 Vdc, $V_O \le 1.5$ Vdc T_A = 25°C	I_{Sink}	6.0	16	–	6.0	16	–	mA
Output Saturation Voltage	V_{OL}							mV
$V_{in} \ge 1.0$ Vdc, V_{in+} = 0, $I_{Sink} \le 4.0$ mA, T_A = 25°C		–	150	400	–	–	400	
$T_{low} \le T_A \le T_{high}$		–	–	700	–	200	700	
Output Leakage Current	I_{OL}							nA
V_{in-} = 0 V, $V_{in+} \ge 1.0$ Vdc, V_O = 5.0 Vdc, T_A = 25°C		–	0.1	–	–	0.1	–	
V_{in-} = 0 V, $V_{in+} \ge 1.0$ Vdc, V_O = 30 Vdc, $T_{low} \le T_A \le T_{high}$		–	–	1000	–	–	1000	
Supply Current	I_{CC}							mA
R_L = ∞ Both Comparators, T_A = 25°C		–	0.4	1.0	–	0.4	1.0	
R_L = ∞ Both Comparators, V_{CC} = 30 V		–	–	2.5	–	–	2.5	

* T_{low} = 0°C, T_{high} = +70°C for LM393/393A
LM293 T_{low} = −25°C, T_{high} = +85°C
LM2903 T_{low} = −40°C, T_{high} = +105°C
LM2903V T_{low} = −40°C, T_{high} = +125°C

NOTES: 2. At output switch point, $V_O \simeq 1.4$ Vdc, R_S = 0 Ω with V_{CC} from 5.0 Vdc to 30 Vdc, and over the full input common mode range (0 V to V_{CC} = −1.5 V).
3. Due to the PNP transistor inputs, bias current will flow out of the inputs. This current is essentially constant, independent of the output state, therefore, no loading changes will exist on the input lines.
5. Response time is specified with a 100 mV step and 5.0 mV of overdrive. With larger magnitudes of overdrive faster response times are obtainable.
6. The comparator will exhibit proper output state if one of the inputs becomes greater than V_{CC}, the other input must remain within the common mode range. The low input state must not be less than −0.3 V of ground or minus supply.

REGULADORES DE TENSÃO.

LM317L 100MA REGULADOR AJUSTÁVEL



TEXAS INSTRUMENTS

LM317L

SLCS144E – JULY 2004 – REVISED OCTOBER 2014

LM317L 3-Terminal Adjustable Regulator

1 Features

- Output Voltage Range Adjustable 1.25 V to 32 V When Used With External Resistor Divider
- Output Current Capability of 100 mA
- Input Regulation Typically 0.01% Per Input-Voltage Change
- Output Regulation Typically 0.5%
- Ripple Rejection Typically 80 dB
- For Higher Output Current Requirements, See LM317M (500 mA) and LM317 (1.5 A)

2 Applications

- Electronic Points of Sale
- Medical, Health, and Fitness Applications
- Printers
- Appliances and White Goods
- TV Set-Top Boxes

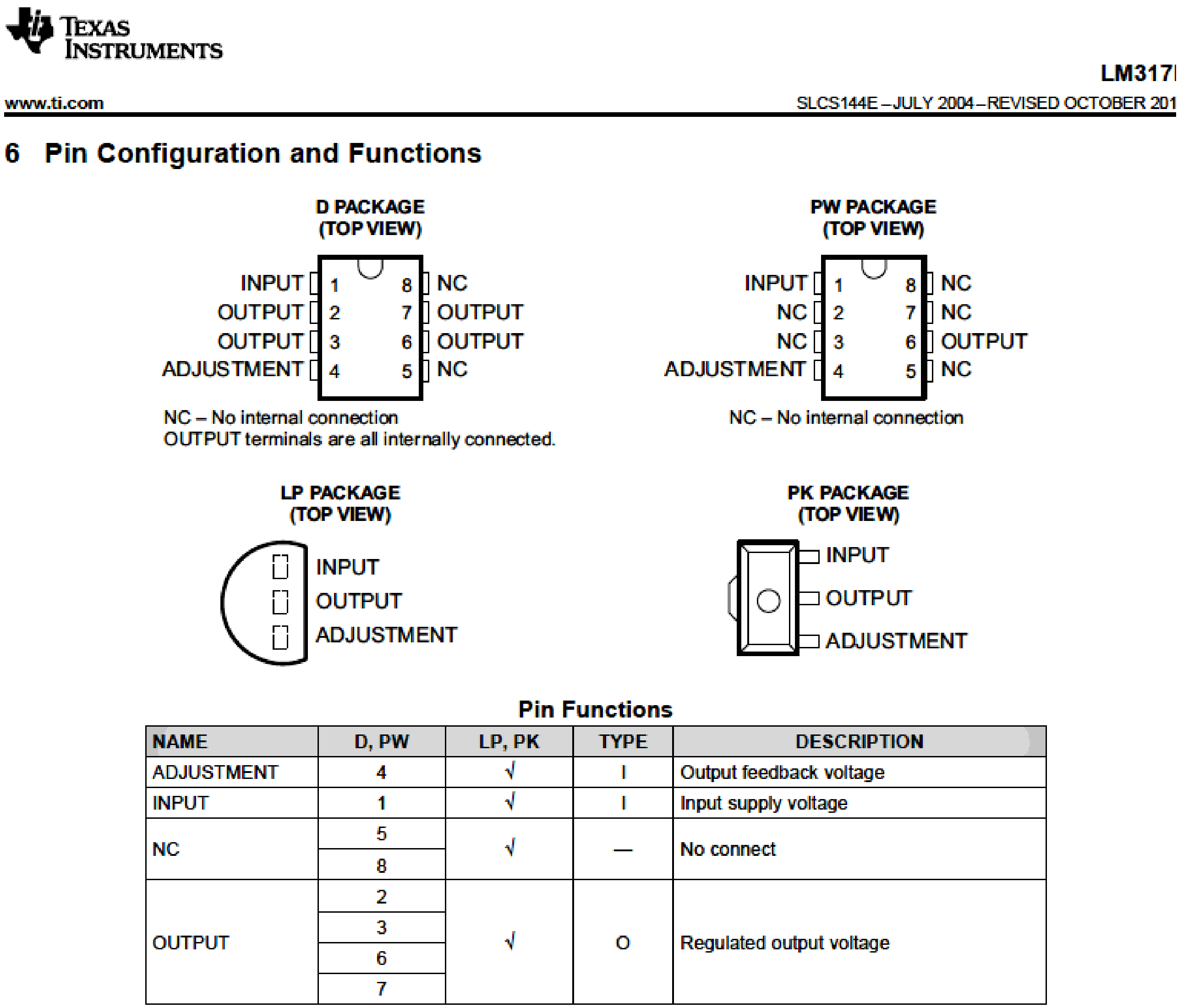
3 Description

The LM317L device is an adjustable, 3-terminal, positive-voltage regulator capable of supplying 100 mA over an output-voltage range of 1.25 V to 32 V. It is exceptionally easy to use and requires only two external resistors to set the output voltage.

Device Information

PART NUMBER	PACKAGE	BODY SIZE (NOM)
LM317L	SOIC (8)	4.90 mm × 3.91 mm
	TO-92 (3)	4.30 mm × 4.30 mm
	SOT-89 (3)	4.50 mm × 2.50 mm
	TSSOP (8)	3.00 mm × 4.40 mm

4 Simplified Schematic



Texas Instruments

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LM317

SLCS144E – JULY 2004 – REVISED OCTOBER 201

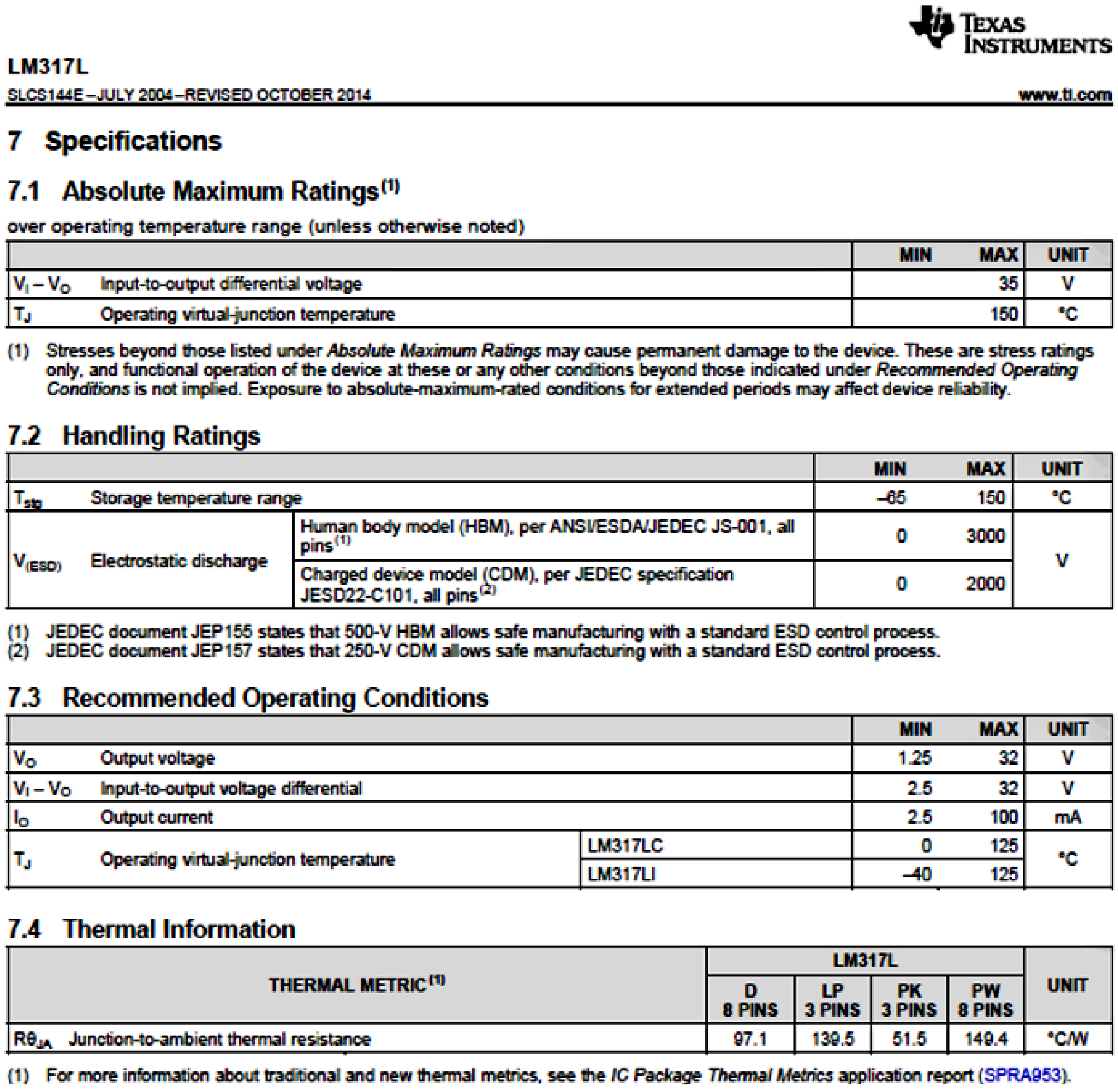
6 Pin Configuration and Functions

NC – No internal connection
OUTPUT terminals are all internally connected.

NC – No internal connection

Pin Functions

NAME	D, PW	LP, PK	TYPE	DESCRIPTION
ADJUSTMENT	4	√	I	Output feedback voltage
INPUT	1	√	I	Input supply voltage
NC	5 8	√	—	No connect
OUTPUT	2 3 6 7	√	O	Regulated output voltage



7 Specifications

7.1 Absolute Maximum Ratings(1)

over operating temperature range (unless otherwise noted)

		MIN	MAX	UNIT
$V_I - V_O$	Input-to-output differential voltage		35	V
T_J	Operating virtual-junction temperature		150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

7.2 Handling Ratings

			MIN	MAX	UNIT
T_{stg}	Storage temperature range		–65	150	°C
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins(1)	0	3000	V
		Charged device model (CDM), per JEDEC specification JESD22-C101, all pins(2)	0	2000	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

7.3 Recommended Operating Conditions

			MIN	MAX	UNIT
V_O	Output voltage		1.25	32	V
$V_I - V_O$	Input-to-output voltage differential		2.5	32	V
I_O	Output current		2.5	100	mA
T_J	Operating virtual-junction temperature	LM317LC	0	125	°C
		LM317LI	–40	125	

7.4 Thermal Information

THERMAL METRIC(1)		LM317L				UNIT
		D 8 PINS	LP 3 PINS	PK 3 PINS	PW 8 PINS	
$R\theta_{JA}$	Junction-to-ambient thermal resistance	97.1	139.5	51.5	149.4	°C/W

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report (SPRA953).

7.5 Electrical Characteristics

over recommended operating virtual-junction temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS[1]		MIN	TYP	MAX	UNIT
Input voltage regulation[2]	$V_I - V_O$ = 5 V to 35 V	T_J = 25°C		0.01	0.02	%V
		I_O = 2.5 mA to 100 mA		0.02	0.05	
Ripple regulation	V_O = 10 V,	f = 120 Hz		65		dB
	V_O = 10 V, 10-µF capacitor between ADJUSTMENT and ground		66	80		
Output voltage regulation	V_I = 5 V to 35 V, T_J = 25°C, I_O = 2.5 mA to 100 mA,	$V_O \le 5$ V		25		mV
		$V_O \ge 5$ V		5		mV/V
	V_I = 5 V to 35 V, I_O = 2.5 mA to 100 mA	$V_O \le 5$ V		50		mV
		$V_O \ge 5$ V		10		mV/V
Output voltage change with temperature	T_J = 0°C to 125°C			10		mV/V
Output voltage long-term drift	After 1000 hours at T_J = 125°C and $V_I - V_O$ = 35 V			3	10	mV/V
Output noise voltage	f = 10 Hz to 10 kHz,	T_J = 25°C		30		µV/V
Minimum output current to maintain regulation	$V_I - V_O$ = 35 V			1.5	2.5	mA
Peak output current	$V_I - V_O \le 35$ V		100	200		mA
ADJUSTMENT current				50	100	µA
Change in ADJUSTMENT current	$V_I - V_O$ = 2.5 V to 35 V,	I_O = 2.5 mA to 100 mA		0.2	5	µA
Reference voltage (output to ADJUSTMENT)	$V_I - V_O$ = 5 V to 35 V, P ≤ rated dissipation	I_O = 2.5 mA to 100 mA,	1.2	1.25	1.3	V

(1) Unless otherwise noted, these specifications apply for the following test conditions: $V_I - V_O$ = 5 V and I_O = 40 mA. Pulse-testing techniques must be used that maintain the junction temperature as close to the ambient temperature as possible. All characteristics are measured with a 0.1-µF capacitor across the input and a 1-µF capacitor across the output.

(2) Input voltage regulation is expressed here as the percentage change in output voltage per 1-V change at the input.

7.6 Typical Characteristics

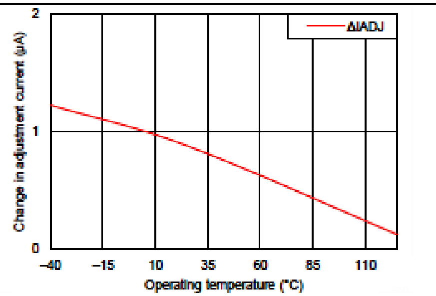
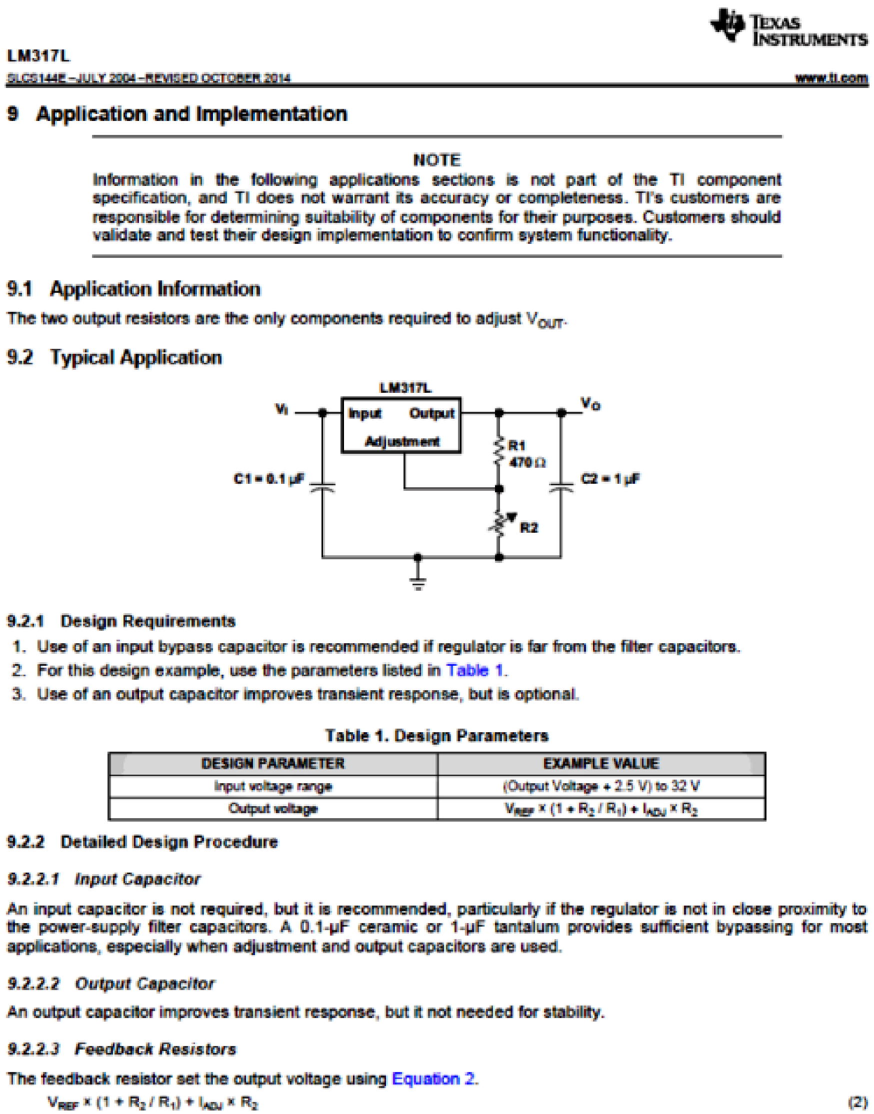


Figure 1. Change in Adjustment Current Over Temperature



9 Application and Implementation

NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

9.1 Application Information

The two output resistors are the only components required to adjust V_{OUT}.

9.2 Typical Application

9.2.1 Design Requirements

1. Use of an input bypass capacitor is recommended if regulator is far from the filter capacitors.
2. For this design example, use the parameters listed in Table 1.
3. Use of an output capacitor improves transient response, but is optional.

Table 1. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Input voltage range	(Output Voltage + 2.5 V) to 32 V
Output voltage	$V_{REF} \times (1 + R_2 / R_1) + I_{ADJ} \times R_2$

9.2.2 Detailed Design Procedure

9.2.2.1 *Input Capacitor*

An input capacitor is not required, but it is recommended, particularly if the regulator is not in close proximity to the power-supply filter capacitors. A 0.1-µF ceramic or 1-µF tantalum provides sufficient bypassing for most applications, especially when adjustment and output capacitors are used.

9.2.2.2 *Output Capacitor*

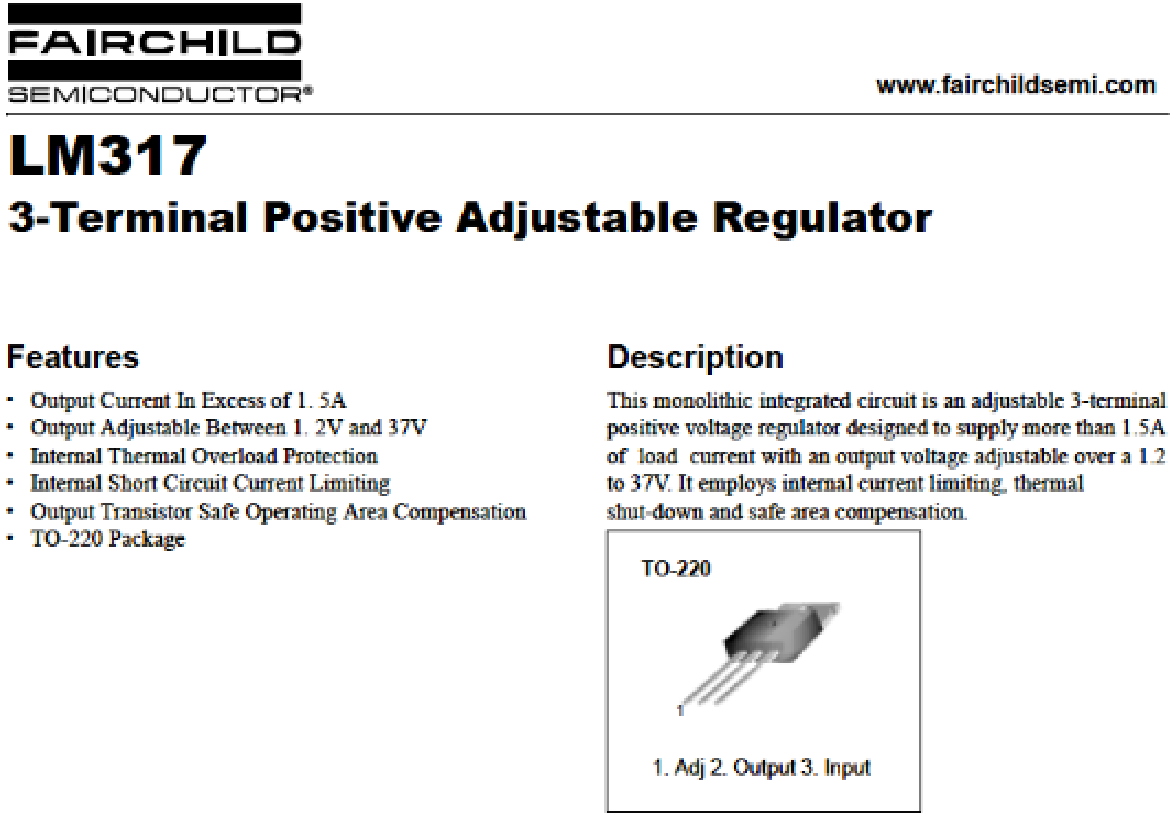
An output capacitor improves transient response, but it not needed for stability.

9.2.2.3 *Feedback Resistors*

The feedback resistor set the output voltage using Equation 2.

$$V_{REF} \times (1 + R_2 / R_1) + I_{ADJ} \times R_2 \qquad (2)$$

LM-317 REGULADOR DE TENSÃO AJUSTÁVEL 1,5A 1,2V A 37V



FAIRCHILD SEMICONDUCTOR®

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LM317

3-Terminal Positive Adjustable Regulator

Features

- Output Current In Excess of 1. 5A
- Output Adjustable Between 1. 2V and 37V
- Internal Thermal Overload Protection
- Internal Short Circuit Current Limiting
- Output Transistor Safe Operating Area Compensation
- TO-220 Package

Description

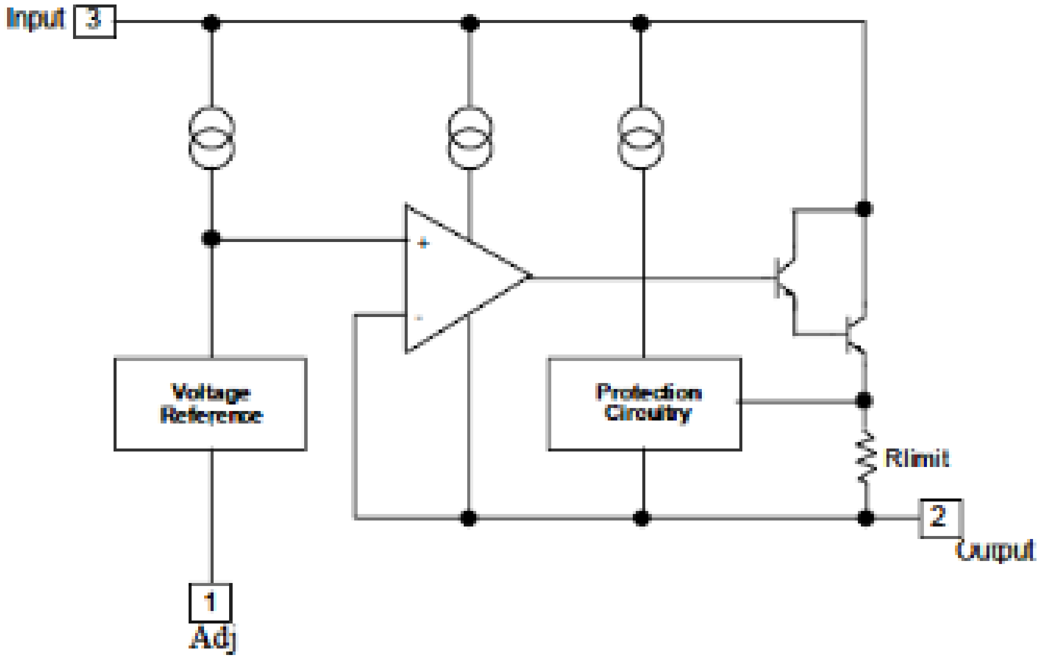
This monolithic integrated circuit is an adjustable 3-terminal positive voltage regulator designed to supply more than 1.5A of load current with an output voltage adjustable over a 1.2 to 37V. It employs internal current limiting, thermal shut-down and safe area compensation.

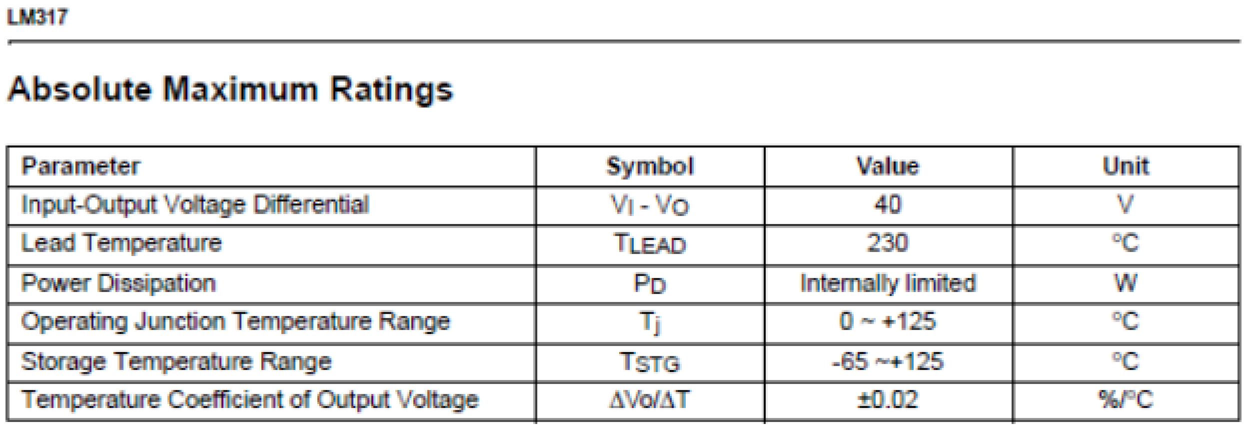
TO-220

1

1. Adj 2. Output 3. Input

Internal Block Diagram

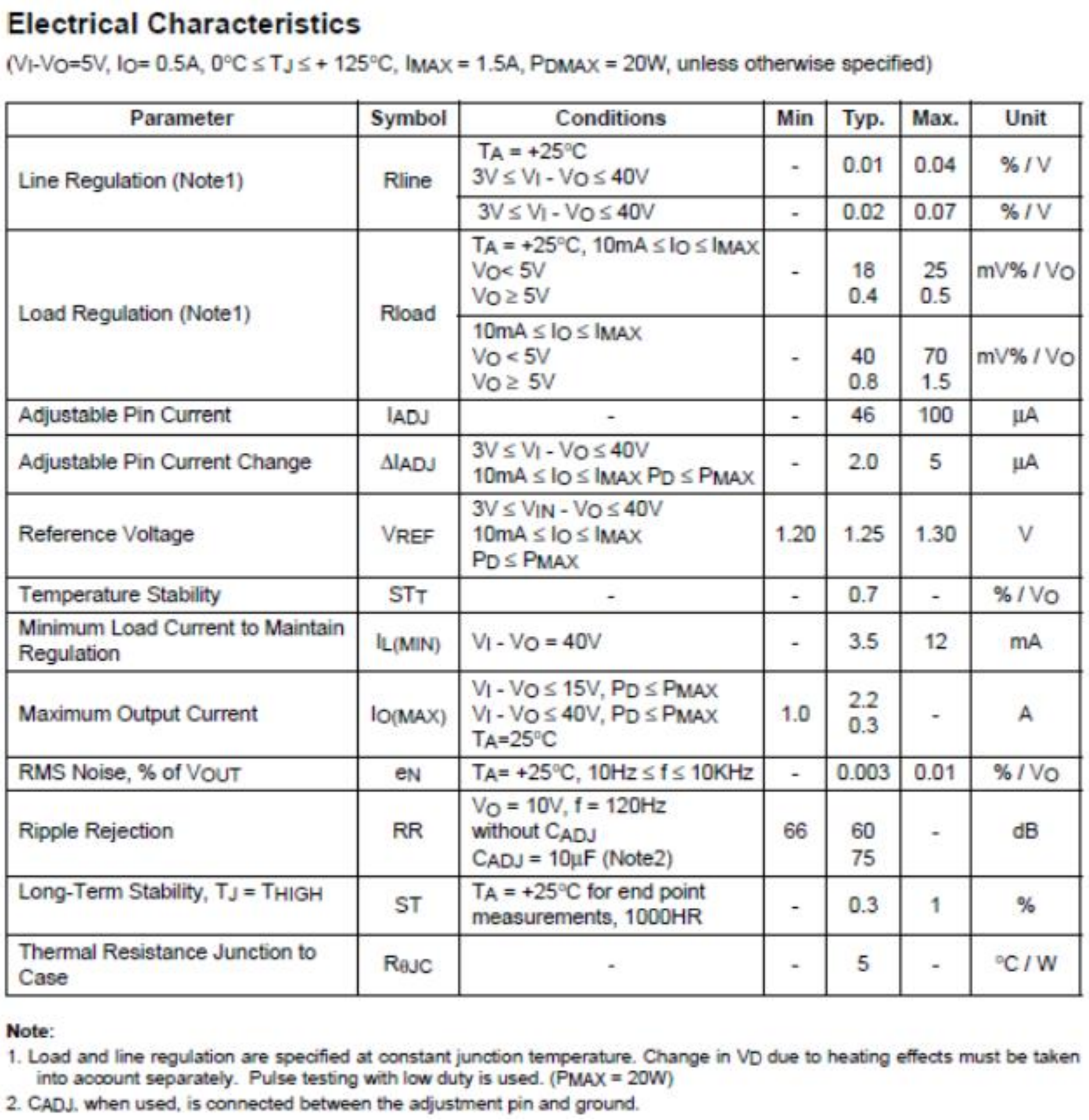




LM317

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Input-Output Voltage Differential	$V_I - V_O$	40	V
Lead Temperature	T_{LEAD}	230	°C
Power Dissipation	P_D	Internally limited	W
Operating Junction Temperature Range	T_j	0 ~ +125	°C
Storage Temperature Range	T_{STG}	-65 ~+125	°C
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	±0.02	%/°C



Electrical Characteristics

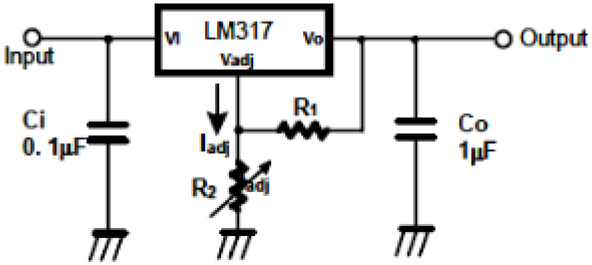
(V_I-V_O=5V, I_O= 0.5A, $0^\circ C \le T_J \le +125^\circ C$, I_{MAX} = 1.5A, P_{DMAX} = 20W, unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ.	Max.	Unit
Line Regulation (Note1)	Rline	$T_A = +25^\circ C$ $3V \le V_I - V_O \le 40V$	-	0.01	0.04	% / V
		$3V \le V_I - V_O \le 40V$	-	0.02	0.07	% / V
Load Regulation (Note1)	Rload	$T_A = +25^\circ C$, $10mA \le I_O \le I_{MAX}$ $V_O < 5V$ $V_O \ge 5V$	-	18 0.4	25 0.5	mV% / V_O
		$10mA \le I_O \le I_{MAX}$ $V_O < 5V$ $V_O \ge 5V$	-	40 0.8	70 1.5	mV% / V_O
Adjustable Pin Current	I_{ADJ}	-	-	46	100	µA
Adjustable Pin Current Change	ΔI_{ADJ}	$3V \le V_I - V_O \le 40V$ $10mA \le I_O \le I_{MAX}$ $P_D \le P_{MAX}$	-	2.0	5	µA
Reference Voltage	V_{REF}	$3V \le V_{IN} - V_O \le 40V$ $10mA \le I_O \le I_{MAX}$ $P_D \le P_{MAX}$	1.20	1.25	1.30	V
Temperature Stability	ST_T	-	-	0.7	-	% / V_O
Minimum Load Current to Maintain Regulation	$I_{L(MIN)}$	$V_I - V_O = 40V$	-	3.5	12	mA
Maximum Output Current	$I_{O(MAX)}$	$V_I - V_O \le 15V$, $P_D \le P_{MAX}$ $V_I - V_O \le 40V$, $P_D \le P_{MAX}$ $T_A = 25^\circ C$	1.0	2.2 0.3	-	A
RMS Noise, % of V_{OUT}	e_N	$T_A = +25^\circ C$, $10Hz \le f \le 10KHz$	-	0.003	0.01	% / V_O
Ripple Rejection	RR	V_O = 10V, f = 120Hz without C_{ADJ} C_{ADJ} = 10µF (Note2)	66	60 75	-	dB
Long-Term Stability, $T_J = T_{HIGH}$	ST	$T_A = +25^\circ C$ for end point measurements, 1000HR	-	0.3	1	%
Thermal Resistance Junction to Case	$R_{\theta JC}$	-	-	5	-	°C / W

Note:

1. Load and line regulation are specified at constant junction temperature. Change in V_D due to heating effects must be taken into account separately. Pulse testing with low duty is used. (P_{MAX} = 20W)
2. C_{ADJ}, when used, is connected between the adjustment pin and ground.

Typical Application

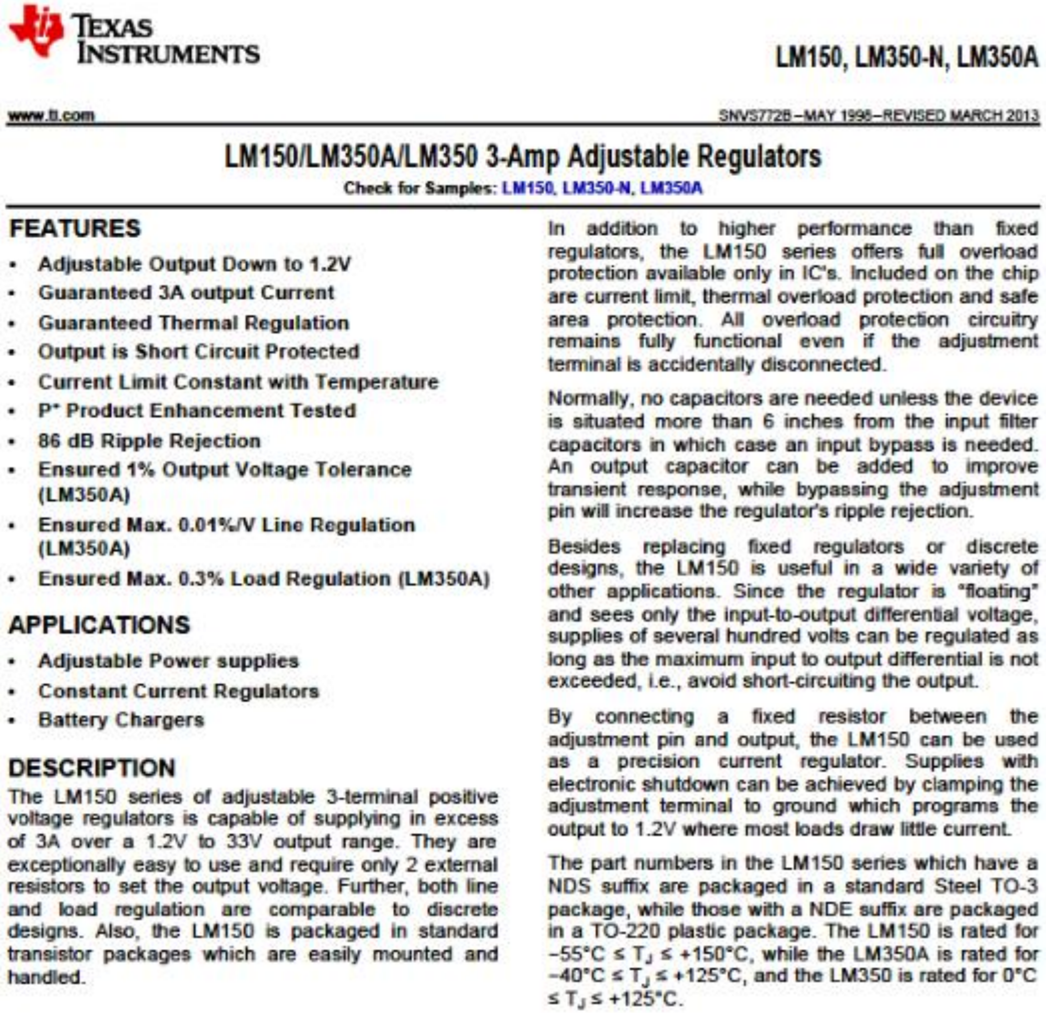


$$V_O = 1.25V (1+ R_2/ R_1)+I_{adj} R_2$$

Figure 5. Programmable Regulator

C_i is required when regulator is located an appreciable distance from power supply filter.
C_o is not needed for stability, however, it does improve transient response.
Since I_{ADJ} is controlled to less than 100µA, the error associated with this term is negligible in most applications.

LM150 LM350 Regulador ajustável 3A



TEXAS INSTRUMENTS

LM150, LM350-N, LM350A

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SNVS772B –MAY 1998–REVISED MARCH 2013

LM150/LM350A/LM350 3-Amp Adjustable Regulators

Check for Samples: LM150, LM350-N, LM350A

FEATURES

- Adjustable Output Down to 1.2V
- Guaranteed 3A output Current
- Guaranteed Thermal Regulation
- Output is Short Circuit Protected
- Current Limit Constant with Temperature
- P⁺ Product Enhancement Tested
- 86 dB Ripple Rejection
- Ensured 1% Output Voltage Tolerance (LM350A)
- Ensured Max. 0.01%/V Line Regulation (LM350A)
- Ensured Max. 0.3% Load Regulation (LM350A)

APPLICATIONS

- Adjustable Power supplies
- Constant Current Regulators
- Battery Chargers

DESCRIPTION

The LM150 series of adjustable 3-terminal positive voltage regulators is capable of supplying in excess of 3A over a 1.2V to 33V output range. They are exceptionally easy to use and require only 2 external resistors to set the output voltage. Further, both line and load regulation are comparable to discrete designs. Also, the LM150 is packaged in standard transistor packages which are easily mounted and handled.

In addition to higher performance than fixed regulators, the LM150 series offers full overload protection available only in IC's. Included on the chip are current limit, thermal overload protection and safe area protection. All overload protection circuitry remains fully functional even if the adjustment terminal is accidentally disconnected.

Normally, no capacitors are needed unless the device is situated more than 6 inches from the input filter capacitors in which case an input bypass is needed. An output capacitor can be added to improve transient response, while bypassing the adjustment pin will increase the regulator's ripple rejection.

Besides replacing fixed regulators or discrete designs, the LM150 is useful in a wide variety of other applications. Since the regulator is "floating" and sees only the input-to-output differential voltage, supplies of several hundred volts can be regulated as long as the maximum input to output differential is not exceeded, i.e., avoid short-circuiting the output.

By connecting a fixed resistor between the adjustment pin and output, the LM150 can be used as a precision current regulator. Supplies with electronic shutdown can be achieved by clamping the adjustment terminal to ground which programs the output to 1.2V where most loads draw little current.

The part numbers in the LM150 series which have a NDS suffix are packaged in a standard Steel TO-3 package, while those with a NDE suffix are packaged in a TO-220 plastic package. The LM150 is rated for $-55°C \leq T_J \leq +150°C$, while the LM350A is rated for $-40°C \leq T_J \leq +125°C$, and the LM350 is rated for $0°C \leq T_J \leq +125°C$.

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings(1)(2)(3)

Power Dissipation		Internally Limited
Input-Output Voltage Differential		+35V
Storage Temperature		−65°C to +150°C
Lead Temperature	Metal Package (Soldering, 10 sec.)	300°C
	Plastic Package (Soldering, 4 sec.)	260°C
ESD Tolerance		TBD
Operating Temperature Range	LM150	$-55°C \le T_J \le +150°C$
	LM350A	$-40°C \le T_J \le +125°C$
	LM350	$0°C \le T_J \le +125°C$

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not ensure specific performance limits. For ensured specifications and test conditions, see the Electrical Characteristics.
(2) Refer to RETS150K drawing for military specifications of the LM150K.
(3) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/ Distributors for availability and specifications.

Connection Diagram

Case is Output

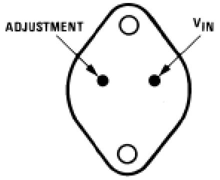


**Figure 1. (TO-3 STEEL) Metal Can Package
Bottom View
See Package Number NDS0002A**

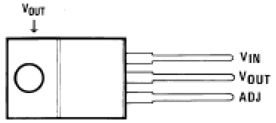
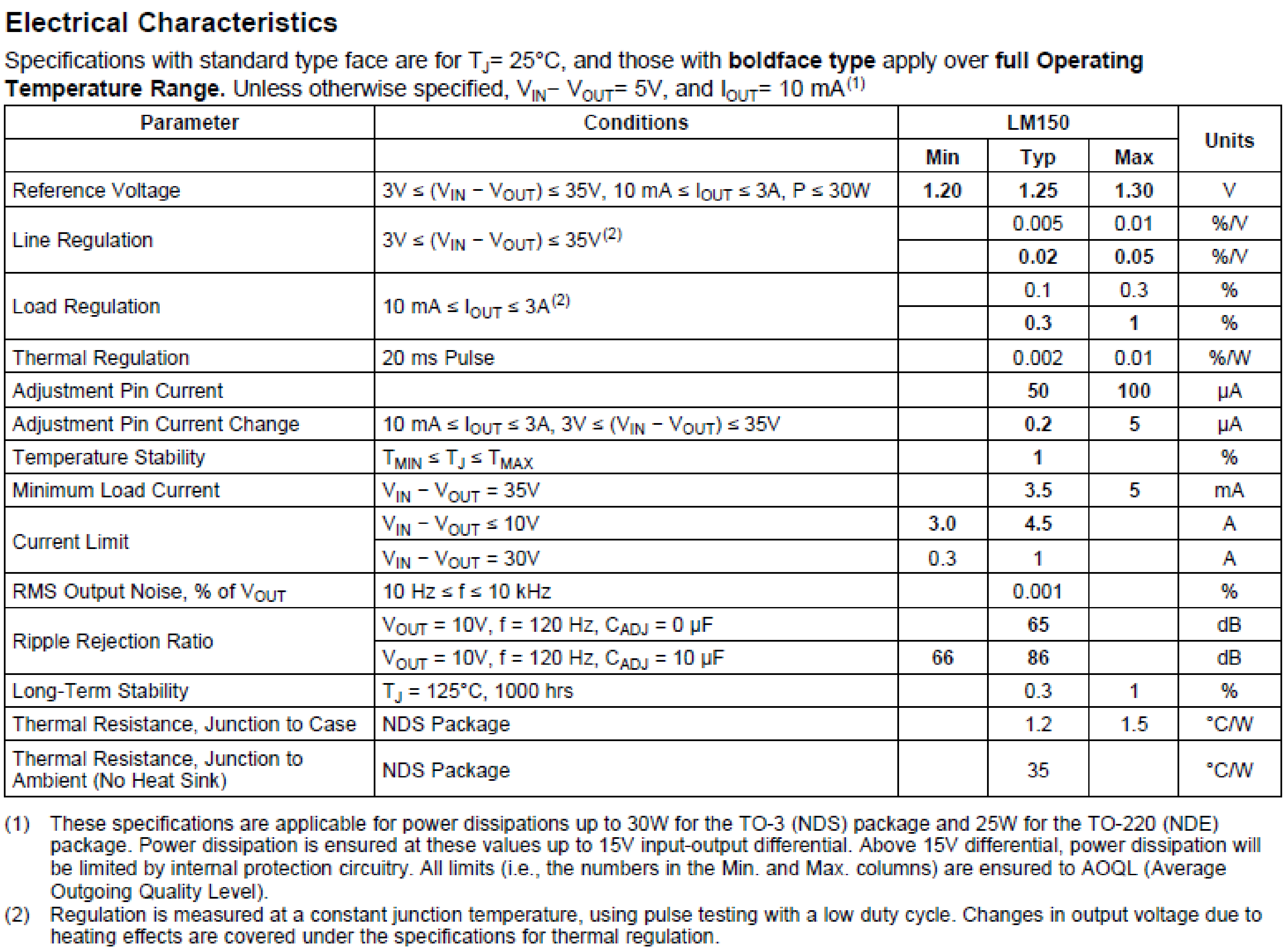


**Figure 2. (TO-220) Plastic Package
Front View
See Package Number NDE0003B**



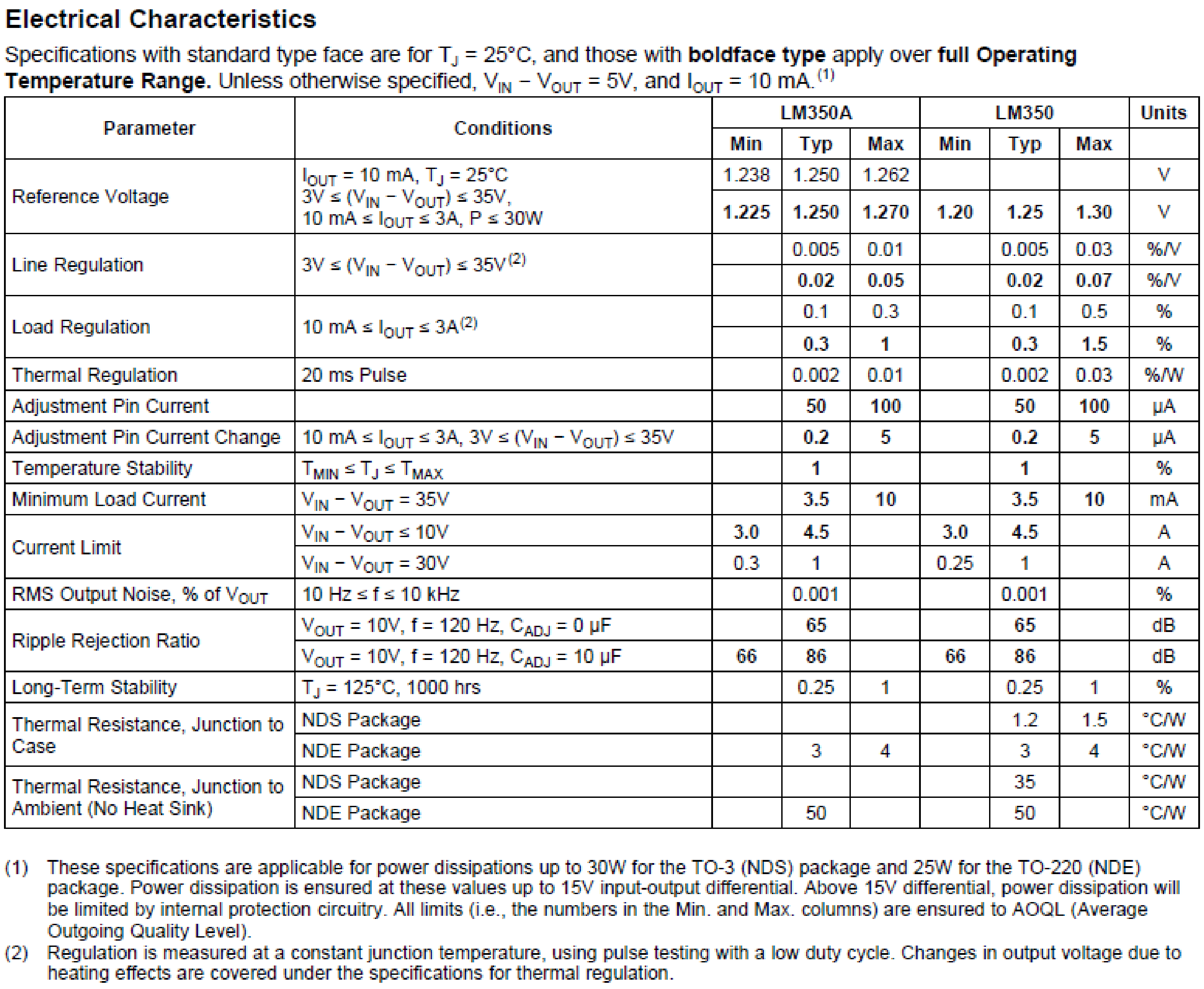
Electrical Characteristics

Specifications with standard type face are for T_J= 25°C, and those with **boldface type** apply over **full Operating Temperature Range.** Unless otherwise specified, V_{IN}− V_{OUT}= 5V, and I_{OUT}= 10 mA[(1)]

Parameter	Conditions	LM150			Units
		Min	Typ	Max	
Reference Voltage	3V ≤ (V_{IN} − V_{OUT}) ≤ 35V, 10 mA ≤ I_{OUT} ≤ 3A, P ≤ 30W	**1.20**	**1.25**	**1.30**	V
Line Regulation	3V ≤ (V_{IN} − V_{OUT}) ≤ 35V(2)		0.005	0.01	%/V
			0.02	**0.05**	%/V
Load Regulation	10 mA ≤ I_{OUT} ≤ 3A(2)		0.1	0.3	%
			0.3	**1**	%
Thermal Regulation	20 ms Pulse		0.002	0.01	%/W
Adjustment Pin Current			**50**	**100**	μA
Adjustment Pin Current Change	10 mA ≤ I_{OUT} ≤ 3A, 3V ≤ (V_{IN} − V_{OUT}) ≤ 35V		**0.2**	**5**	μA
Temperature Stability	T_{MIN} ≤ T_J ≤ T_{MAX}		**1**		%
Minimum Load Current	V_{IN} − V_{OUT} = 35V		3.5	5	mA
Current Limit	V_{IN} − V_{OUT} ≤ 10V	**3.0**	**4.5**		A
	V_{IN} − V_{OUT} = 30V	0.3	1		A
RMS Output Noise, % of V_{OUT}	10 Hz ≤ f ≤ 10 kHz		0.001		%
Ripple Rejection Ratio	V_{OUT} = 10V, f = 120 Hz, C_{ADJ} = 0 μF		**65**		dB
	V_{OUT} = 10V, f = 120 Hz, C_{ADJ} = 10 μF	**66**	**86**		dB
Long-Term Stability	T_J = 125°C, 1000 hrs		0.3	1	%
Thermal Resistance, Junction to Case	NDS Package		1.2	1.5	°C/W
Thermal Resistance, Junction to Ambient (No Heat Sink)	NDS Package		35		°C/W

(1) These specifications are applicable for power dissipations up to 30W for the TO-3 (NDS) package and 25W for the TO-220 (NDE) package. Power dissipation is ensured at these values up to 15V input-output differential. Above 15V differential, power dissipation will be limited by internal protection circuitry. All limits (i.e., the numbers in the Min. and Max. columns) are ensured to AOQL (Average Outgoing Quality Level).

(2) Regulation is measured at a constant junction temperature, using pulse testing with a low duty cycle. Changes in output voltage due to heating effects are covered under the specifications for thermal regulation.



Electrical Characteristics

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over **full Operating Temperature Range.** Unless otherwise specified, $V_{IN} - V_{OUT}$ = 5V, and I_{OUT} = 10 mA.(1)

Parameter	Conditions	LM350A			LM350			Units
		Min	Typ	Max	Min	Typ	Max	
Reference Voltage	I_{OUT} = 10 mA, T_J = 25°C	1.238	1.250	1.262				V
	3V ≤ ($V_{IN} - V_{OUT}$) ≤ 35V, 10 mA ≤ I_{OUT} ≤ 3A, P ≤ 30W	**1.225**	**1.250**	**1.270**	**1.20**	**1.25**	**1.30**	V
Line Regulation	3V ≤ ($V_{IN} - V_{OUT}$) ≤ 35V(2)		0.005	0.01		0.005	0.03	%/V
			0.02	**0.05**		**0.02**	**0.07**	%/V
Load Regulation	10 mA ≤ I_{OUT} ≤ 3A(2)		0.1	0.3		0.1	0.5	%
			0.3	**1**		**0.3**	**1.5**	%
Thermal Regulation	20 ms Pulse		0.002	0.01		0.002	0.03	%/W
Adjustment Pin Current			**50**	**100**		**50**	**100**	µA
Adjustment Pin Current Change	10 mA ≤ I_{OUT} ≤ 3A, 3V ≤ ($V_{IN} - V_{OUT}$) ≤ 35V		**0.2**	**5**		**0.2**	**5**	µA
Temperature Stability	$T_{MIN} \le T_J \le T_{MAX}$		**1**			**1**		%
Minimum Load Current	$V_{IN} - V_{OUT}$ = 35V		**3.5**	**10**		**3.5**	**10**	mA
Current Limit	$V_{IN} - V_{OUT}$ ≤ 10V	**3.0**	**4.5**		**3.0**	**4.5**		A
	$V_{IN} - V_{OUT}$ = 30V	0.3	1		0.25	1		A
RMS Output Noise, % of V_{OUT}	10 Hz ≤ f ≤ 10 kHz		0.001			0.001		%
Ripple Rejection Ratio	V_{OUT} = 10V, f = 120 Hz, C_{ADJ} = 0 µF		65			65		dB
	V_{OUT} = 10V, f = 120 Hz, C_{ADJ} = 10 µF	**66**	86		**66**	86		dB
Long-Term Stability	T_J = 125°C, 1000 hrs		0.25	1		0.25	1	%
Thermal Resistance, Junction to Case	NDS Package					1.2	1.5	°C/W
	NDE Package		3	4		3	4	°C/W
Thermal Resistance, Junction to Ambient (No Heat Sink)	NDS Package					35		°C/W
	NDE Package		50			50		°C/W

(1) These specifications are applicable for power dissipations up to 30W for the TO-3 (NDS) package and 25W for the TO-220 (NDE) package. Power dissipation is ensured at these values up to 15V input-output differential. Above 15V differential, power dissipation will be limited by internal protection circuitry. All limits (i.e., the numbers in the Min. and Max. columns) are ensured to AOQL (Average Outgoing Quality Level).

(2) Regulation is measured at a constant junction temperature, using pulse testing with a low duty cycle. Changes in output voltage due to heating effects are covered under the specifications for thermal regulation.

APPLICATION HINTS

In operation, the LM150 develops a nominal 1.25V reference voltage, V_{REF}, between the output and adjustment terminal. The reference voltage is impressed across program resistor R1 and, since the voltage is constant, a constant current I_1 then flows through the output set resistor R2, giving an output voltage of

$$V_{OUT} = V_{REF}\left(1 + \frac{R2}{R1}\right) + I_{ADJ}\,R2. \tag{1}$$

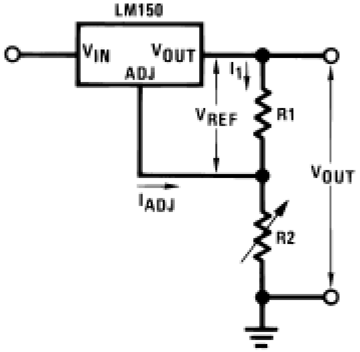


Figure 15.

Since the 50 μA current from the adjustment terminal represents an error term, the LM150 was designed to minimize I_{ADJ} and make it very constant with line and load changes. To do this, all quiescent operating current is returned to the output establishing a minimum load current requirement. If there is insufficient load on the output, the output will rise.

EXTERNAL CAPACITORS

An input bypass capacitor is recommended. A 0.1 μF disc or 1 μF solid tantalum on the input is suitable input bypassing for almost all applications. The device is more sensitive to the absence of input bypassing when adjustment or output capacitors are used but the above values will eliminate the possibility of problems.

The adjustment terminal can be bypassed to ground on the LM150 to improve ripple rejection. This bypass capacitor prevents ripple from being amplified as the output voltage is increased. With a 10 μF bypass capacitor 86 dB ripple rejection is obtainable at any output level. Increases over 10 μF do not appreciably improve the ripple rejection at frequencies above 120 Hz. If the bypass capacitor is used, it is sometimes necessary to include protection diodes to prevent the capacitor from discharging through internal low current paths and damaging the device.

In general, the best type of capacitors to use is solid tantalum. Solid tantalum capacitors have low impedance even at high frequencies. Depending upon capacitor construction, it takes about 25 μF in aluminum electrolytic to equal 1 μF solid tantalum at high frequencies. Ceramic capacitors are also good at high frequencies, but some types have a large decrease in capacitance at frequencies around 0.5 MHz. For this reason, 0.01 μF disc may seem to work better than a 0.1 μF disc as a bypass.

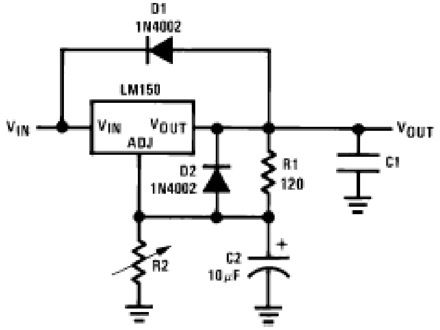
Although the LM150 is stable with no output capacitors, like any feedback circuit, certain values of external capacitance can cause excessive ringing. This occurs with values between 500 pF and 5000 pF. A 1 μF solid tantalum (or 25 μF aluminum electrolytic) on the output swamps this effect and insures stability.

PROTECTION DIODES

When external capacitors are used with *any* IC regulator it is sometimes necessary to add protection diodes to prevent the capacitors from discharging through low current points into the regulator. Most 10 µF capacitors have low enough internal series resistance to deliver 20A spikes when shorted. Although the surge is short, there is enough energy to damage parts of the IC.

When an output capacitor is connected to a regulator and the input is shorted, the output capacitor will discharge into the output of the regulator. The discharge current depends on the value of the capacitor, the output voltage of the regulator, and the rate of decrease of V_{IN}. In the LM150, this discharge path is through a large junction that is able to sustain 25A surge with no problem. This is not true of other types of positive regulators. For output capacitors of 25 µF or less, there is no need to use diodes.

The bypass capacitor on the adjustment terminal can discharge through a low current junction. Discharge occurs when *either* the input or output is shorted. Internal to the LM150 is a 50Ω resistor which limits the peak discharge current. No protection is needed for output voltages of 25V or less and 10 µF capacitance. Figure 17 shows an LM150 with protection diodes included for use with outputs greater than 25V and high values of output capacitance.



D1 protects against C1
D2 protects against C2

Figure 17. Regulator with Protection Diodes

$$V_{OUT} = 1.25V \left(1 + \frac{R2}{R1}\right) + I_{ADJ}R2 \qquad (2)$$

9.2 Typical Application

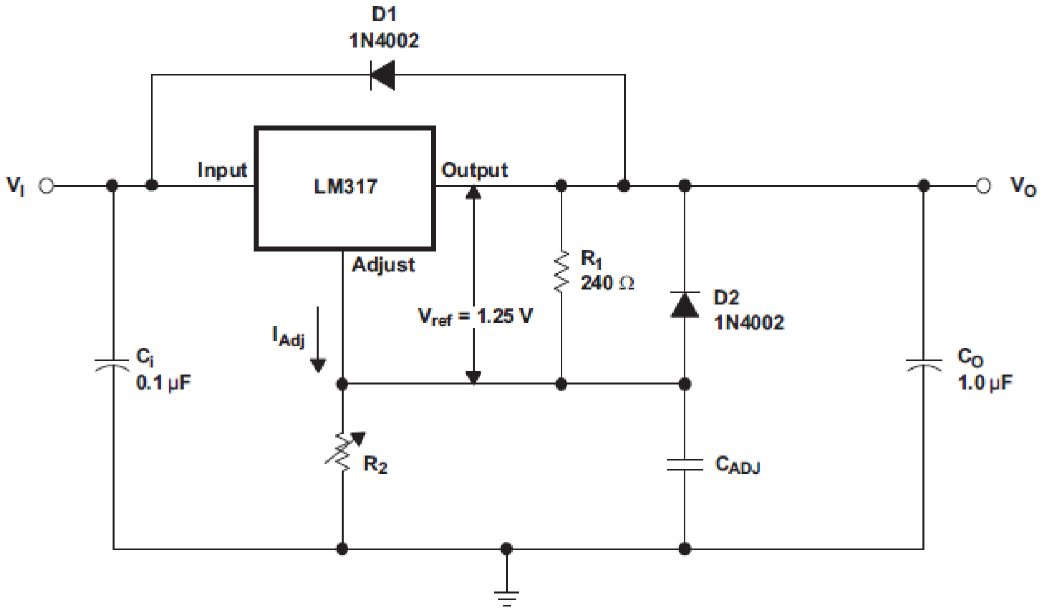


Figure 9. Adjustable Voltage Regulator

9.2.2 Detailed Design Procedure

V_O is calculated as shown in Equation 1. I_{ADJ} is typically 50 µA and negligible in most applications.

$$V_O = V_{REF} (1 + R2 / R1) + (I_{ADJ} \times R2)$$

9.3.1 0-V to 30-V Regulator Circuit

Here, the voltage is determined by $V_{OUT} = V_{REF}\left(1 + \frac{R_2 + R_3}{R_1}\right) - 10\,V$

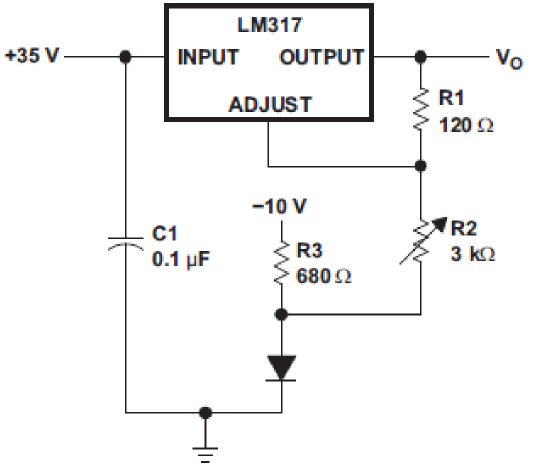


Figure 12. 0-V to 30-V Regulator Circuit

9.3.3 Precision Current-Limiter Circuit

This application limits the output current to the I_{LIMIT} in the diagram.

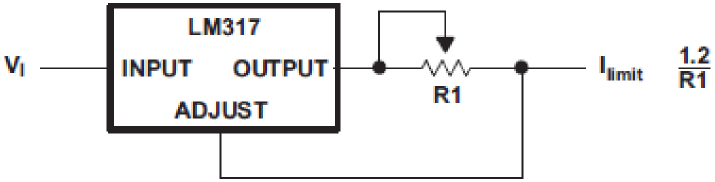


Figure 14. Precision Current-Limiter Circuit

9.3.6 Battery-Charger Circuit

The series resistor limits the current output of the LM317, minimizing damage to the battery cell.

$$V_{OUT} = 1.25\ V \times \left(1 + \frac{R2}{R1}\right)$$

$$I_{OUT}(short) = \frac{1.25V}{RS}$$

$$\text{Output Impedance} = RS \times \left(1 + \frac{R2}{R1}\right)$$

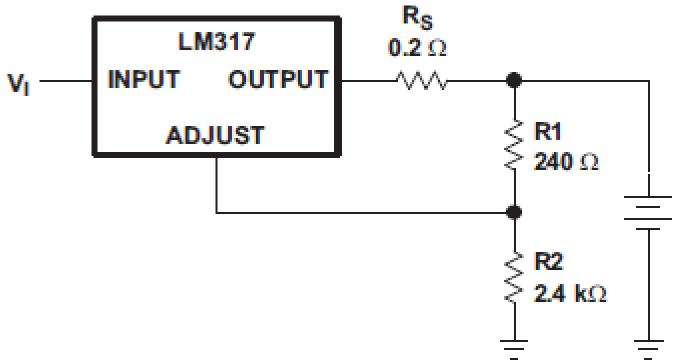


Figure 17. Battery-Charger Circuit

System Examples (continued)

9.3.12 High-Current Adjustable Regulator Circuit

The NPNs at the top of the schematic allow higher currents at V_{OUT} than the LM317 can provide, while still keeping the output voltage at levels determined by the adjustment pin resistor divider of the LM317.

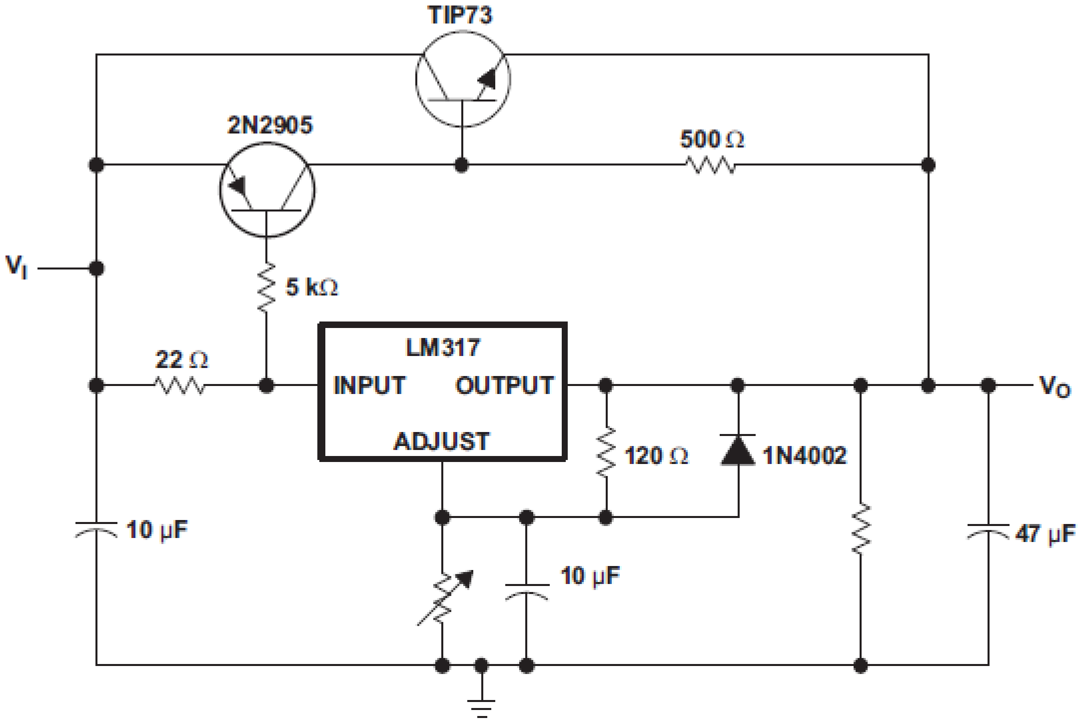


Figure 23. High-Current Adjustable Regulator Circuit

LM138 5A REGULADOR AJUSTÁVEL

SGS-THOMSON
MICROELECTRONICS

LM138/238
LM338

THREE-TERMINAL 5-A ADJUSTABLE VOLTAGE REGULATORS

- GUARANTEED 7A PEAK OUTPUT CURRENT
- GUARANTEED 5A OUTPUT CURRENT
- ADJUSTABLE OUTPUT DOWN TO 1.2V
- LINE REGULATION TYPICALLY 0.005% /V
- LOAD REGULATION TYPICALLY 0.1%
- GUARANTEED THERMAL REGULATION
- CURRENT LIMIT CONSTANT WITH TEMPERATURE
- STANDARD 3-LEAD TRANSISTOR PACKAGE

DESCRIPTION

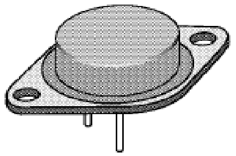
The LM138/LM238/LM338 are adjustable 3-terminal positive voltage regulators capable of supplying in excess of 5A over a 1.2V to 32V output range. They are exceptionally easy to use and require only 2 resistors to set the output voltage. Careful circuit design has resulted in outstanding load and line regulation comparable to many commercial power supplies. The LM138 family is supplied in a standard 3-lead transistor package.

A unique feature of the LM138 family is time-dependent current limiting. The current limit circuitry allows peak currents of up to 12A to be drawn from the regulator for short periods of time. This allows the LM138 to be used with heavy transient loads and speeds start-up under full-load conditions. Under sustained loading conditions, the current limit decreases to a safe value protecting the regulator. Also included on the chip are thermal overload protection and safe area protection for the power transistor. Overload protection remains functional even if the adjustment pin is accidentally disconnected.

Normally, no capacitors are needed unless the device is situated far from the input filter capacitors in which case an input bypass is needed. An optional output capacitor can be added to improve transient response. The adjustment terminal can be bypassed to achieve very high ripple rejection ratios which are difficult to achieve with standard 3-terminal regulators.

Besides replacing fixed regulators or discrete designs, the LM238 is useful in a wide variety of other applications. Since the regulator is "floating" and sees only the input-to-output differential voltage, supplies of several hundred volts can be regulated as long as the maximum input to input differential is not exceeded.

The LM138/LM238/LM338 are packaged in standard steel TO-3 transistor packages. The LM138 is rated for operation from -55 °C to 150 °C, the LM238 from – 25°C to + 150°C and the LM338 from 0°C to + 125°C.



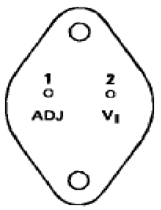
TO3
K SUFFIX
(Steel Can)

ORDER CODE

PART NUMBER	TEMPERATURE RANGE	PACKAGE
		K
LM138	-55 °C to + 150 °C	•
LM238	-25 °C to + 150 °C	•
LM338	0 °C to + 125 °C	•

EXAMPLE: LM138K

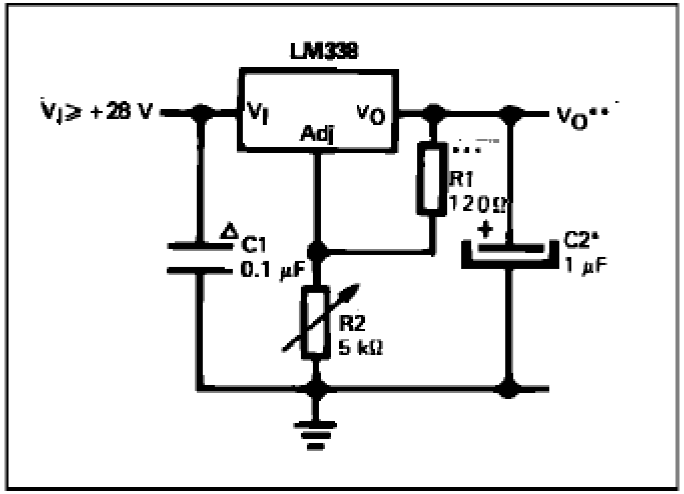
PIN CONNECTION
(bottom view)



Case is output

TYPICAL APPLICATIONS

+ 1.2V to + 25V ADJUSTABLE REGULATOR

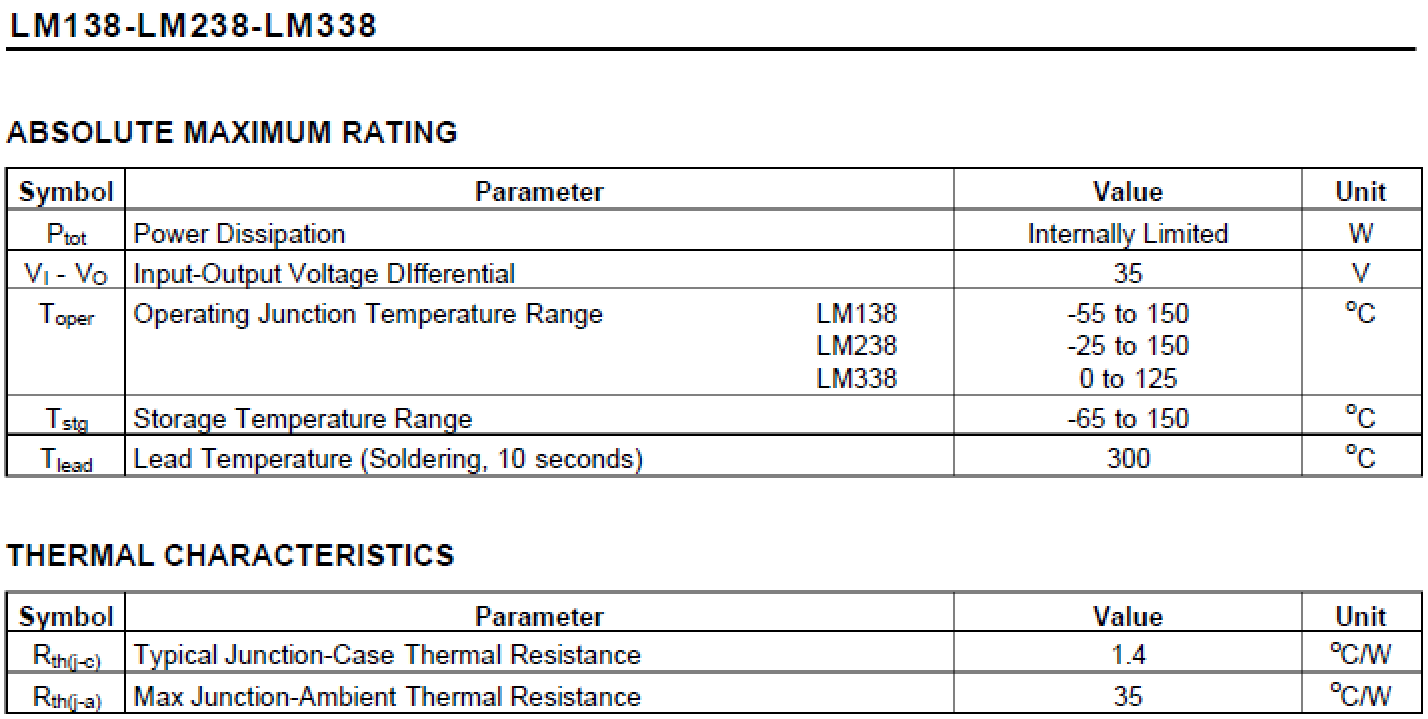


Δ Needed if device is far from filter capacitors.

* Optional-improves transient response. Output capacitors in the range of 1µF to 100µF of aluminium or tantalum electrolytic are commonly used to provide improved output impedance and rejection of tran-sients.

** $V_O = 1.25V \left(1 + \frac{R2}{R1}\right)$

*** R1 = 240Ω for LM138 and LM238



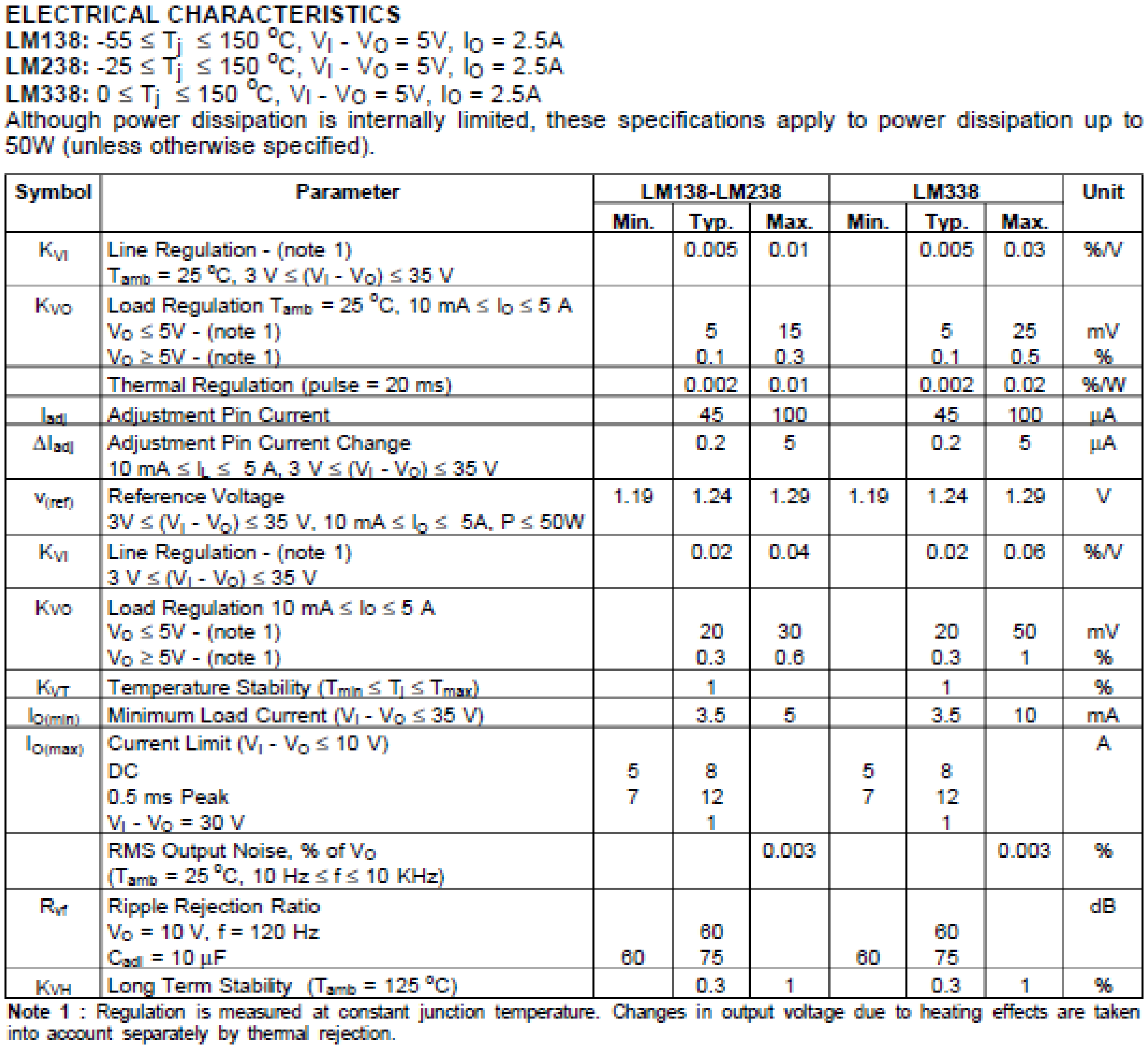
LM138-LM238-LM338

ABSOLUTE MAXIMUM RATING

Symbol	Parameter		Value	Unit
P_{tot}	Power Dissipation		Internally Limited	W
V_I - V_O	Input-Output Voltage DIfferential		35	V
T_{oper}	Operating Junction Temperature Range	LM138 LM238 LM338	-55 to 150 -25 to 150 0 to 125	°C
T_{stg}	Storage Temperature Range		-65 to 150	°C
T_{lead}	Lead Temperature (Soldering, 10 seconds)		300	°C

THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
$R_{th(j-c)}$	Typical Junction-Case Thermal Resistance	1.4	°C/W
$R_{th(j-a)}$	Max Junction-Ambient Thermal Resistance	35	°C/W



ELECTRICAL CHARACTERISTICS

LM138: $-55 \le T_j \le 150\ ^oC$, $V_I - V_O = 5V$, $I_O = 2.5A$

LM238: $-25 \le T_j \le 150\ ^oC$, $V_I - V_O = 5V$, $I_O = 2.5A$

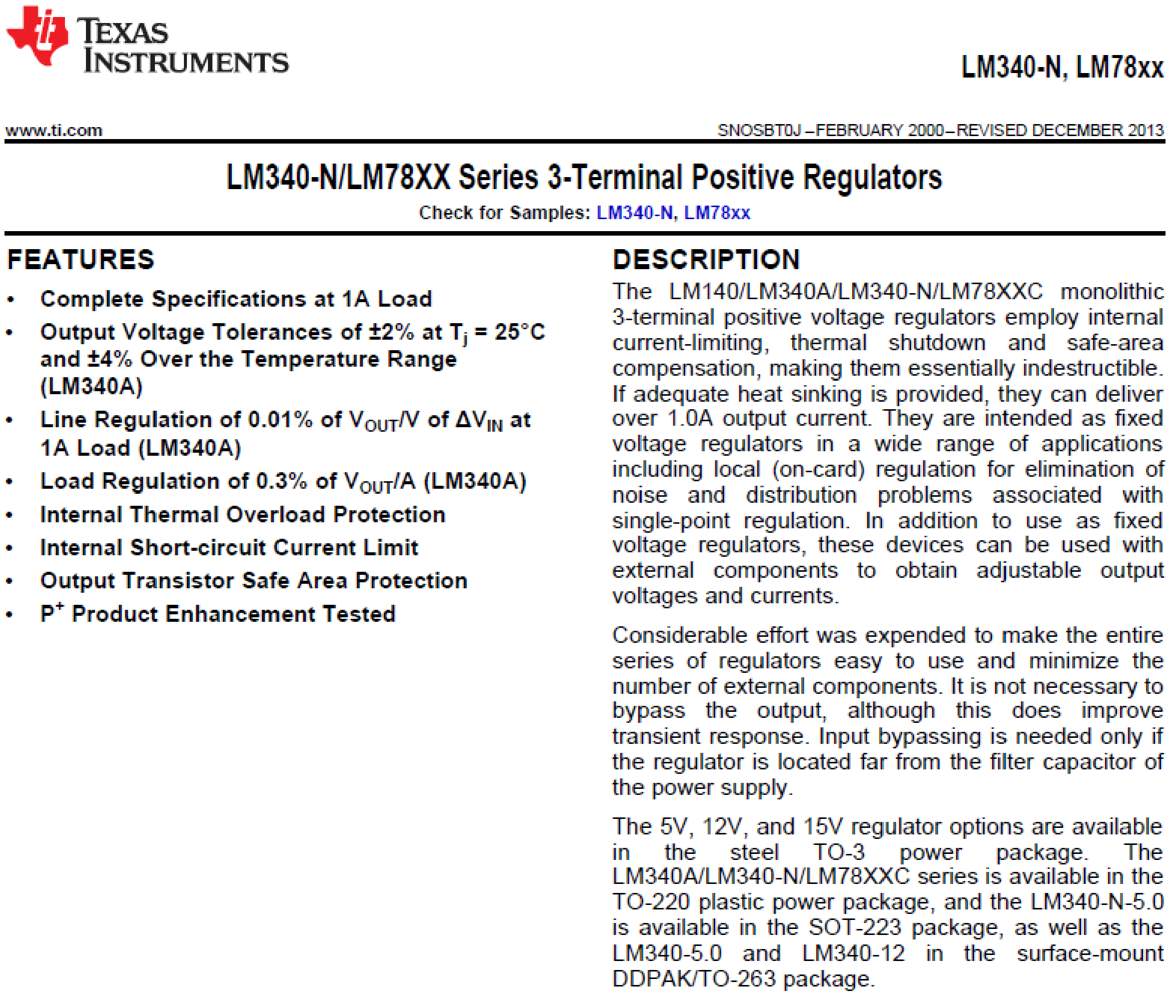
LM338: $0 \le T_j \le 150\ ^oC$, $V_I - V_O = 5V$, $I_O = 2.5A$

Although power dissipation is internally limited, these specifications apply to power dissipation up to 50W (unless otherwise specified).

Symbol	Parameter	LM138-LM238			LM338			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
K_{VI}	Line Regulation - (note 1) $T_{amb} = 25\ ^oC$, $3\ V \le (V_I - V_O) \le 35\ V$		0.005	0.01		0.005	0.03	%/V
K_{VO}	Load Regulation $T_{amb} = 25\ ^oC$, $10\ mA \le I_O \le 5\ A$ $V_O \le 5V$ - (note 1) $V_O \ge 5V$ - (note 1)		5 0.1	15 0.3		5 0.1	25 0.5	mV %
	Thermal Regulation (pulse = 20 ms)		0.002	0.01		0.002	0.02	%/W
I_{adj}	Adjustment Pin Current		45	100		45	100	µA
ΔI_{adj}	Adjustment Pin Current Change $10\ mA \le I_L \le 5\ A$, $3\ V \le (V_I - V_O) \le 35\ V$		0.2	5		0.2	5	µA
$V_{(ref)}$	Reference Voltage $3V \le (V_I - V_O) \le 35\ V$, $10\ mA \le I_O \le 5A$, $P \le 50W$	1.19	1.24	1.29	1.19	1.24	1.29	V
K_{VI}	Line Regulation - (note 1) $3\ V \le (V_I - V_O) \le 35\ V$		0.02	0.04		0.02	0.06	%/V
K_{VO}	Load Regulation $10\ mA \le I_O \le 5\ A$ $V_O \le 5V$ - (note 1) $V_O \ge 5V$ - (note 1)		20 0.3	30 0.6		20 0.3	50 1	mV %
K_{VT}	Temperature Stability ($T_{min} \le T_j \le T_{max}$)		1			1		%
$I_{O(min)}$	Minimum Load Current ($V_I - V_O \le 35\ V$)		3.5	5		3.5	10	mA
$I_{O(max)}$	Current Limit ($V_I - V_O \le 10\ V$) DC 0.5 ms Peak $V_I - V_O = 30\ V$	5 7	8 12 1		5 7	8 12 1		A
	RMS Output Noise, % of V_O ($T_{amb} = 25\ ^oC$, $10\ Hz \le f \le 10\ KHz$)			0.003			0.003	%
R_{vf}	Ripple Rejection Ratio $V_O = 10\ V$, $f = 120\ Hz$ $C_{adj} = 10\ \mu F$	60	60 75		60	60 75		dB
K_{VH}	Long Term Stability ($T_{amb} = 125\ ^oC$)		0.3	1		0.3	1	%

Note 1 : Regulation is measured at constant junction temperature. Changes in output voltage due to heating effects are taken into account separately by thermal rejection.

LM340-5 LM340-12 LM340-15



TEXAS INSTRUMENTS

LM340-N, LM78xx

www.ti.com

SNOSBT0J –FEBRUARY 2000–REVISED DECEMBER 2013

LM340-N/LM78XX Series 3-Terminal Positive Regulators

Check for Samples: LM340-N, LM78xx

FEATURES

- Complete Specifications at 1A Load
- Output Voltage Tolerances of ±2% at T_j = 25°C and ±4% Over the Temperature Range (LM340A)
- Line Regulation of 0.01% of V_{OUT}/V of ΔV_{IN} at 1A Load (LM340A)
- Load Regulation of 0.3% of V_{OUT}/A (LM340A)
- Internal Thermal Overload Protection
- Internal Short-circuit Current Limit
- Output Transistor Safe Area Protection
- P^+ Product Enhancement Tested

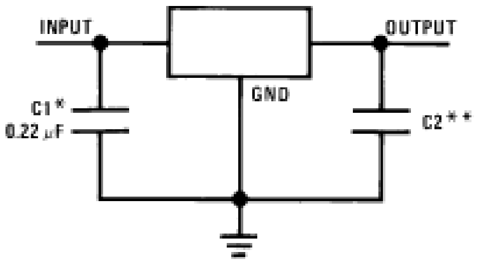
DESCRIPTION

The LM140/LM340A/LM340-N/LM78XXC monolithic 3-terminal positive voltage regulators employ internal current-limiting, thermal shutdown and safe-area compensation, making them essentially indestructible. If adequate heat sinking is provided, they can deliver over 1.0A output current. They are intended as fixed voltage regulators in a wide range of applications including local (on-card) regulation for elimination of noise and distribution problems associated with single-point regulation. In addition to use as fixed voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents.

Considerable effort was expended to make the entire series of regulators easy to use and minimize the number of external components. It is not necessary to bypass the output, although this does improve transient response. Input bypassing is needed only if the regulator is located far from the filter capacitor of the power supply.

The 5V, 12V, and 15V regulator options are available in the steel TO-3 power package. The LM340A/LM340-N/LM78XXC series is available in the TO-220 plastic power package, and the LM340-N-5.0 is available in the SOT-223 package, as well as the LM340-5.0 and LM340-12 in the surface-mount DDPAK/TO-263 package.

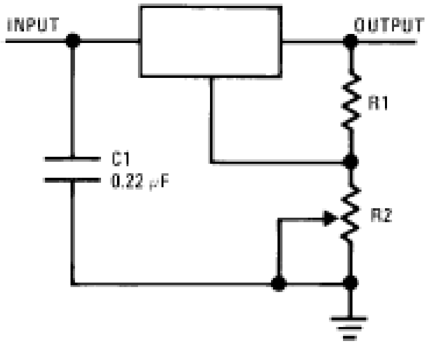
Typical Applications



*Required if the regulator is located far from the power supply filter.

**Although no output capacitor is needed for stability, it does help transient response. (If needed, use 0.1 µF, ceramic disc).

Figure 1. Fixed Output Regulator



V_{OUT} = 5V + (5V/R1 + I_Q) R2 5V/R1 > 3 I_Q,
load regulation (L_r) ≈ [(R1 + R2)/R1] (L_r of LM340-5).

Figure 2. Adjustable Output Regulator

Connection Diagrams

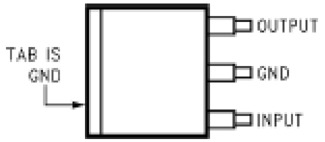


Figure 5. DDPAK/TO-263 Surface-Mount Package
Top View
See Package Number KTT0003B

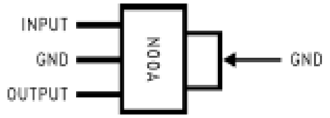
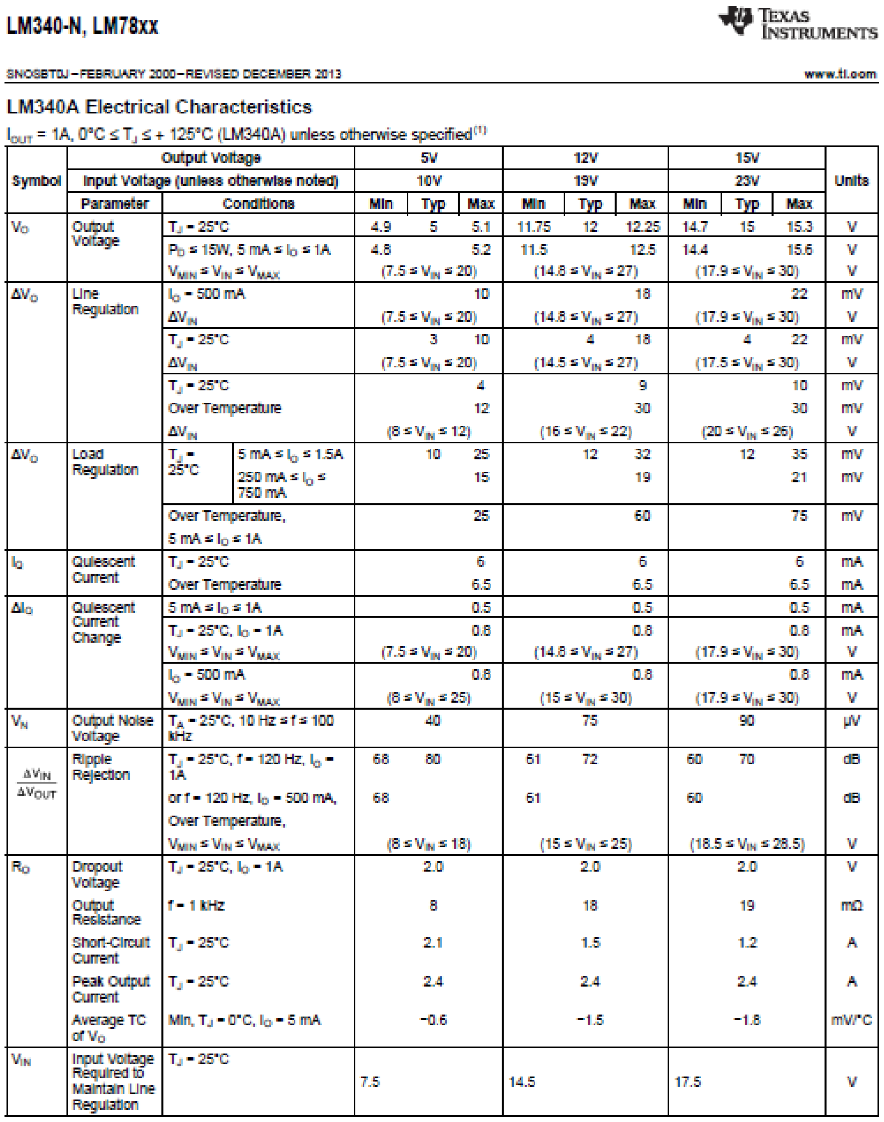


Figure 6. 3-Lead SOT-223
Top View
See Package Number DCY

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings (1) (2) (3)

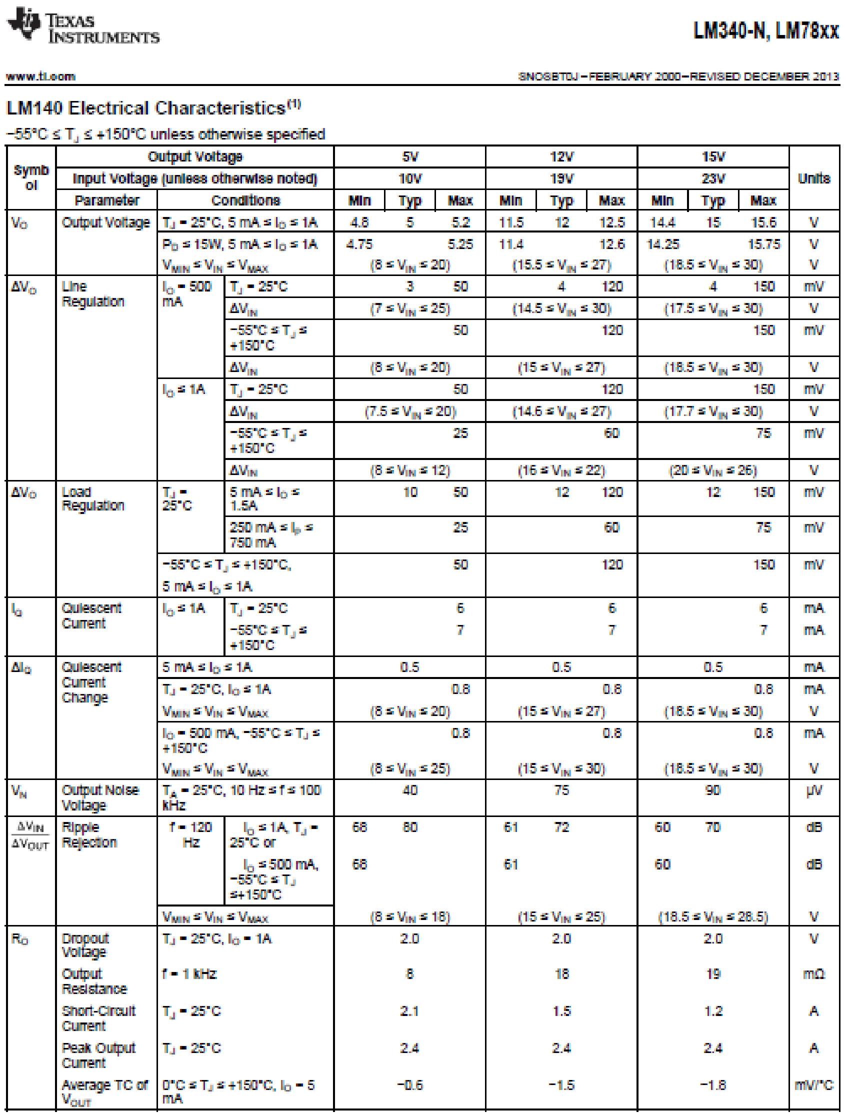
DC Input Voltage		35V
Internal Power Dissipation (4)		Internally Limited
Maximum Junction Temperature		150°C
Storage Temperature Range		−65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	TO-3 Package (NDS)	300°C
	TO-220 Package (NDE), DDPAK/TO-263 Package (KTT)	230°C
ESD Susceptibility (5)		2 kV



LM340A Electrical Characteristics

I_{OUT} = 1A, 0°C ≤ T_J ≤ + 125°C (LM340A) unless otherwise specified(1)

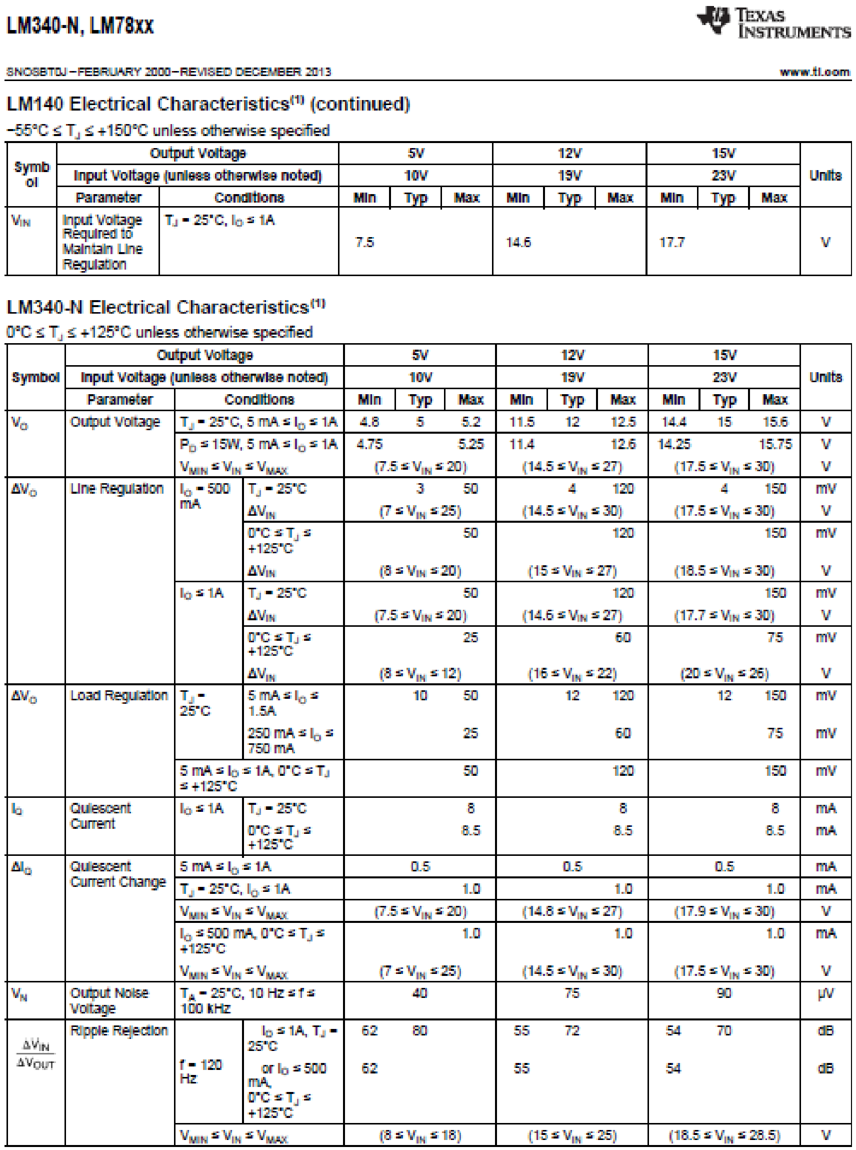
Symbol	Output Voltage			5V			12V			15V			Units
	Input Voltage (unless otherwise noted)				10V			19V			23V		
	Parameter	Conditions		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
V_O	Output Voltage	T_J = 25°C		4.9	5	5.1	11.75	12	12.25	14.7	15	15.3	V
		P_D ≤ 15W, 5 mA ≤ I_O ≤ 1A		4.8		5.2	11.5		12.5	14.4		15.6	V
		V_{MIN} ≤ V_{IN} ≤ V_{MAX}			(7.5 ≤ V_{IN} ≤ 20)			(14.8 ≤ V_{IN} ≤ 27)			(17.9 ≤ V_{IN} ≤ 30)		V
ΔV_O	Line Regulation	I_O = 500 mA				10			18			22	mV
		ΔV_{IN}			(7.5 ≤ V_{IN} ≤ 20)			(14.8 ≤ V_{IN} ≤ 27)			(17.9 ≤ V_{IN} ≤ 30)		V
		T_J = 25°C			3	10		4	18		4	22	mV
		ΔV_{IN}			(7.5 ≤ V_{IN} ≤ 20)			(14.5 ≤ V_{IN} ≤ 27)			(17.5 ≤ V_{IN} ≤ 30)		V
		T_J = 25°C				4			9			10	mV
		Over Temperature				12			30			30	mV
		ΔV_{IN}			(8 ≤ V_{IN} ≤ 12)			(16 ≤ V_{IN} ≤ 22)			(20 ≤ V_{IN} ≤ 26)		V
ΔV_O	Load Regulation	T_J = 25°C	5 mA ≤ I_O ≤ 1.5A		10	25		12	32		12	35	mV
			250 mA ≤ I_O ≤ 750 mA			15			19			21	mV
		Over Temperature, 5 mA ≤ I_O ≤ 1A				25			60			75	mV
I_Q	Quiescent Current	T_J = 25°C				6			6			6	mA
		Over Temperature				6.5			6.5			6.5	mA
ΔI_Q	Quiescent Current Change	5 mA ≤ I_O ≤ 1A				0.5			0.5			0.5	mA
		T_J = 25°C, I_O = 1A				0.8			0.8			0.8	mA
		V_{MIN} ≤ V_{IN} ≤ V_{MAX}			(7.5 ≤ V_{IN} ≤ 20)			(14.8 ≤ V_{IN} ≤ 27)			(17.9 ≤ V_{IN} ≤ 30)		V
		I_O = 500 mA				0.8			0.8			0.8	mA
		V_{MIN} ≤ V_{IN} ≤ V_{MAX}			(8 ≤ V_{IN} ≤ 25)			(15 ≤ V_{IN} ≤ 30)			(17.9 ≤ V_{IN} ≤ 30)		V
V_N	Output Noise Voltage	T_A = 25°C, 10 Hz ≤ f ≤ 100 kHz			40			75			90		μV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	T_J = 25°C, f = 120 Hz, I_O = 1A		68	80		61	72		60	70		dB
		or f = 120 Hz, I_O = 500 mA,		68			61			60			dB
		Over Temperature,											
		V_{MIN} ≤ V_{IN} ≤ V_{MAX}			(8 ≤ V_{IN} ≤ 18)			(15 ≤ V_{IN} ≤ 25)			(18.5 ≤ V_{IN} ≤ 28.5)		V
R_O	Dropout Voltage	T_J = 25°C, I_O = 1A			2.0			2.0			2.0		V
	Output Resistance	f = 1 kHz			8			18			19		mΩ
	Short-Circuit Current	T_J = 25°C			2.1			1.5			1.2		A
	Peak Output Current	T_J = 25°C			2.4			2.4			2.4		A
	Average TC of V_O	Min, T_J = 0°C, I_O = 5 mA			−0.6			−1.5			−1.8		mV/°C
V_{IN}	Input Voltage Required to Maintain Line Regulation	T_J = 25°C		7.5			14.5			17.5			V



LM140 Electrical Characteristics(1)

−55°C ≤ T_J ≤ +150°C unless otherwise specified

Symbol	Output Voltage			5V			12V			15V			Units
	Input Voltage (unless otherwise noted)				10V			19V			23V		
	Parameter	Conditions		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
V_O	Output Voltage	T_J = 25°C, 5 mA ≤ I_O ≤ 1A		4.8	5	5.2	11.5	12	12.5	14.4	15	15.6	V
		P_D ≤ 15W, 5 mA ≤ I_O ≤ 1A		4.75		5.25	11.4		12.6	14.25		15.75	V
		V_{MIN} ≤ V_{IN} ≤ V_{MAX}			(8 ≤ V_{IN} ≤ 20)			(15.5 ≤ V_{IN} ≤ 27)			(18.5 ≤ V_{IN} ≤ 30)		V
ΔV_O	Line Regulation	I_O = 500 mA	T_J = 25°C		3	50		4	120		4	150	mV
			ΔV_{IN}		(7 ≤ V_{IN} ≤ 25)			(14.5 ≤ V_{IN} ≤ 30)			(17.5 ≤ V_{IN} ≤ 30)		V
			−55°C ≤ T_J ≤ +150°C			50			120			150	mV
			ΔV_{IN}		(8 ≤ V_{IN} ≤ 20)			(15 ≤ V_{IN} ≤ 27)			(18.5 ≤ V_{IN} ≤ 30)		V
		I_O ≤ 1A	T_J = 25°C			50			120			150	mV
			ΔV_{IN}		(7.5 ≤ V_{IN} ≤ 20)			(14.6 ≤ V_{IN} ≤ 27)			(17.7 ≤ V_{IN} ≤ 30)		V
			−55°C ≤ T_J ≤ +150°C			25			60			75	mV
			ΔV_{IN}		(8 ≤ V_{IN} ≤ 12)			(16 ≤ V_{IN} ≤ 22)			(20 ≤ V_{IN} ≤ 26)		V
ΔV_O	Load Regulation	T_J = 25°C	5 mA ≤ I_O ≤ 1.5A		10	50		12	120		12	150	mV
			250 mA ≤ I_O ≤ 750 mA			25			60			75	mV
		−55°C ≤ T_J ≤ +150°C, 5 mA ≤ I_O ≤ 1A				50			120			150	mV
I_Q	Quiescent Current	I_O ≤ 1A	T_J = 25°C			6			6			6	mA
			−55°C ≤ T_J ≤ +150°C			7			7			7	mA
ΔI_Q	Quiescent Current Change	5 mA ≤ I_O ≤ 1A			0.5			0.5			0.5		mA
		T_J = 25°C, I_O ≤ 1A				0.8			0.8			0.8	mA
		V_{MIN} ≤ V_{IN} ≤ V_{MAX}			(8 ≤ V_{IN} ≤ 20)			(15 ≤ V_{IN} ≤ 27)			(18.5 ≤ V_{IN} ≤ 30)		V
		I_O = 500 mA, −55°C ≤ T_J ≤ +150°C				0.8			0.8			0.8	mA
		V_{MIN} ≤ V_{IN} ≤ V_{MAX}			(8 ≤ V_{IN} ≤ 25)			(15 ≤ V_{IN} ≤ 30)			(18.5 ≤ V_{IN} ≤ 30)		V
V_N	Output Noise Voltage	T_A = 25°C, 10 Hz ≤ f ≤ 100 kHz			40			75			90		μV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	f = 120 Hz	I_O ≤ 1A, T_J = 25°C or	68	80		61	72		60	70		dB
			I_O ≤ 500 mA, −55°C ≤ T_J ≤+150°C	68			61			60			dB
		V_{MIN} ≤ V_{IN} ≤ V_{MAX}			(8 ≤ V_{IN} ≤ 18)			(15 ≤ V_{IN} ≤ 25)			(18.5 ≤ V_{IN} ≤ 28.5)		V
R_O	Dropout Voltage	T_J = 25°C, I_O = 1A			2.0			2.0			2.0		V
	Output Resistance	f = 1 kHz			8			18			19		mΩ
	Short-Circuit Current	T_J = 25°C			2.1			1.5			1.2		A
	Peak Output Current	T_J = 25°C			2.4			2.4			2.4		A
	Average TC of V_{OUT}	0°C ≤ T_J ≤ +150°C, I_O = 5 mA			−0.6			−1.5			−1.8		mV/°C



LM340-N, LM78xx

TEXAS INSTRUMENTS

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LM140 Electrical Characteristics[1] (continued)

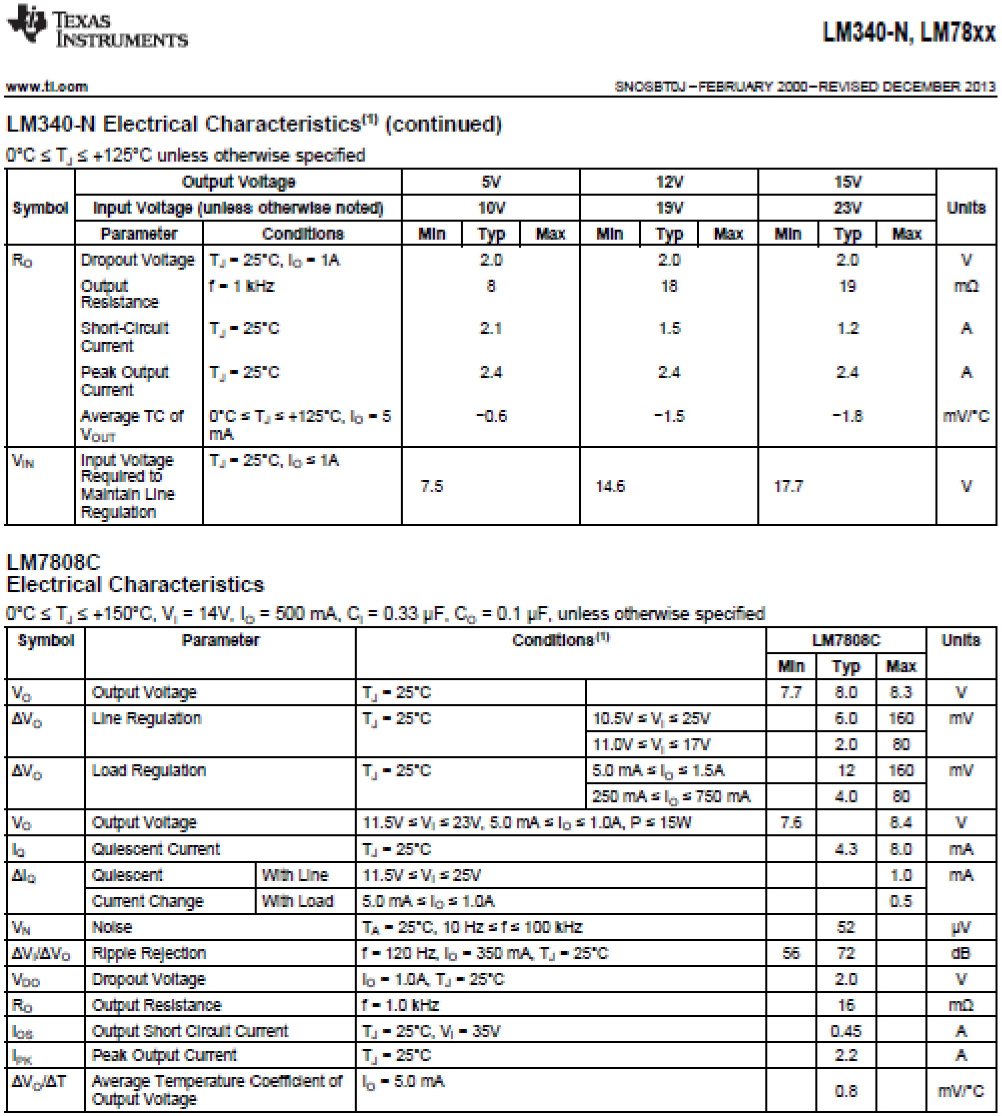
$-55°C \le T_J \le +150°C$ unless otherwise specified

Symbol	Output Voltage		5V			12V			15V			Units
	Input Voltage (unless otherwise noted)		10V			19V			23V			
	Parameter	Conditions	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
V_{IN}	Input Voltage Required to Maintain Line Regulation	$T_J = 25°C$, $I_O \le 1A$	7.5			14.6			17.7			V

LM340-N Electrical Characteristics[1]

$0°C \le T_J \le +125°C$ unless otherwise specified

Symbol	Output Voltage			5V			12V			15V			Units
	Input Voltage (unless otherwise noted)			10V			19V			23V			
	Parameter	Conditions		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
V_O	Output Voltage	$T_J = 25°C$, $5 mA \le I_O \le 1A$		4.8	5	5.2	11.5	12	12.5	14.4	15	15.6	V
		$P_D \le 15W$, $5 mA \le I_O \le 1A$		4.75		5.25	11.4		12.6	14.25		15.75	V
		$V_{MIN} \le V_{IN} \le V_{MAX}$			$(7.5 \le V_{IN} \le 20)$			$(14.5 \le V_{IN} \le 27)$			$(17.5 \le V_{IN} \le 30)$		V
ΔV_O	Line Regulation	$I_O = 500 mA$	$T_J = 25°C$		3	50		4	120		4	150	mV
			ΔV_{IN}		$(7 \le V_{IN} \le 25)$			$(14.5 \le V_{IN} \le 30)$			$(17.5 \le V_{IN} \le 30)$		V
			$0°C \le T_J \le +125°C$			50			120			150	mV
			ΔV_{IN}		$(8 \le V_{IN} \le 20)$			$(15 \le V_{IN} \le 27)$			$(18.5 \le V_{IN} \le 30)$		V
		$I_O \le 1A$	$T_J = 25°C$			50			120			150	mV
			ΔV_{IN}		$(7.5 \le V_{IN} \le 20)$			$(14.6 \le V_{IN} \le 27)$			$(17.7 \le V_{IN} \le 30)$		V
			$0°C \le T_J \le +125°C$			25			60			75	mV
			ΔV_{IN}		$(8 \le V_{IN} \le 12)$			$(16 \le V_{IN} \le 22)$			$(20 \le V_{IN} \le 26)$		V
ΔV_O	Load Regulation	$T_J = 25°C$	$5 mA \le I_O \le 1.5A$		10	50		12	120		12	150	mV
			$250 mA \le I_O \le 750 mA$			25			60			75	mV
		$5 mA \le I_O \le 1A$, $0°C \le T_J \le +125°C$				50			120			150	mV
I_Q	Quiescent Current	$I_O \le 1A$	$T_J = 25°C$			8			8			8	mA
			$0°C \le T_J \le +125°C$			8.5			8.5			8.5	mA
ΔI_Q	Quiescent Current Change	$5 mA \le I_O \le 1A$			0.5			0.5			0.5		mA
		$T_J = 25°C$, $I_O \le 1A$				1.0			1.0			1.0	mA
		$V_{MIN} \le V_{IN} \le V_{MAX}$			$(7.5 \le V_{IN} \le 20)$			$(14.8 \le V_{IN} \le 27)$			$(17.9 \le V_{IN} \le 30)$		V
		$I_O \le 500 mA$, $0°C \le T_J \le +125°C$				1.0			1.0			1.0	mA
		$V_{MIN} \le V_{IN} \le V_{MAX}$			$(7 \le V_{IN} \le 25)$			$(14.5 \le V_{IN} \le 30)$			$(17.5 \le V_{IN} \le 30)$		V
V_N	Output Noise Voltage	$T_A = 25°C$, $10 Hz \le f \le 100 kHz$			40			75			90		μV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	f = 120 Hz	$I_O \le 1A$, $T_J = 25°C$	62	80		55	72		54	70		dB
			or $I_O \le 500 mA$, $0°C \le T_J \le +125°C$	62			55			54			dB
		$V_{MIN} \le V_{IN} \le V_{MAX}$			$(8 \le V_{IN} \le 18)$			$(15 \le V_{IN} \le 25)$			$(18.5 \le V_{IN} \le 28.5)$		V



TEXAS INSTRUMENTS

LM340-N, LM78xx

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LM340-N Electrical Characteristics[1] (continued)

$0°C \le T_J \le +125°C$ unless otherwise specified

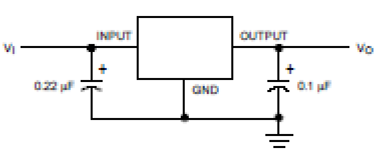
Symbol	Output Voltage		5V			12V			15V			Units
	Input Voltage (unless otherwise noted)		10V			19V			23V			
	Parameter	Conditions	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
R_O	Dropout Voltage	$T_J = 25°C$, $I_O = 1A$		2.0			2.0			2.0		V
	Output Resistance	f = 1 kHz		8			18			19		mΩ
	Short-Circuit Current	$T_J = 25°C$		2.1			1.5			1.2		A
	Peak Output Current	$T_J = 25°C$		2.4			2.4			2.4		A
	Average TC of V_{OUT}	$0°C \le T_J \le +125°C$, $I_O = 5 mA$		−0.6			−1.5			−1.8		mV/°C
V_{IN}	Input Voltage Required to Maintain Line Regulation	$T_J = 25°C$, $I_O \le 1A$	7.5			14.6			17.7			V

LM7808C
Electrical Characteristics

$0°C \le T_J \le +150°C$, $V_I = 14V$, $I_O = 500 mA$, $C_I = 0.33 μF$, $C_O = 0.1 μF$, unless otherwise specified

Symbol	Parameter		Conditions[1]		LM7808C			Units
					Min	Typ	Max	
V_O	Output Voltage		$T_J = 25°C$		7.7	8.0	8.3	V
ΔV_O	Line Regulation		$T_J = 25°C$	$10.5V \le V_I \le 25V$		6.0	160	mV
				$11.0V \le V_I \le 17V$		2.0	80	
ΔV_O	Load Regulation		$T_J = 25°C$	$5.0 mA \le I_O \le 1.5A$		12	160	mV
				$250 mA \le I_O \le 750 mA$		4.0	80	
V_O	Output Voltage		$11.5V \le V_I \le 23V$, $5.0 mA \le I_O \le 1.0A$, $P \le 15W$		7.6		8.4	V
I_Q	Quiescent Current		$T_J = 25°C$			4.3	8.0	mA
ΔI_Q	Quiescent	With Line	$11.5V \le V_I \le 25V$				1.0	mA
	Current Change	With Load	$5.0 mA \le I_O \le 1.0A$				0.5	
V_N	Noise		$T_A = 25°C$, $10 Hz \le f \le 100 kHz$			52		μV
$\Delta V_I/\Delta V_O$	Ripple Rejection		f = 120 Hz, $I_O = 350 mA$, $T_J = 25°C$		56	72		dB
V_{DO}	Dropout Voltage		$I_O = 1.0A$, $T_J = 25°C$			2.0		V
R_O	Output Resistance		f = 1.0 kHz			16		mΩ
I_{OS}	Output Short Circuit Current		$T_J = 25°C$, $V_I = 35V$			0.45		A
I_{PK}	Peak Output Current		$T_J = 25°C$			2.2		A
$\Delta V_O/\Delta T$	Average Temperature Coefficient of Output Voltage		$I_O = 5.0 mA$			0.8		mV/°C

Typical Applications



Bypass capacitors are recommended for optimum stability and transient response, and should be located as close as possible to the regulator.

Figure 28. Fixed Output Regulator

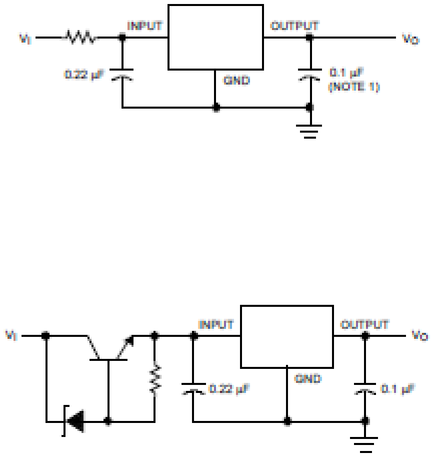
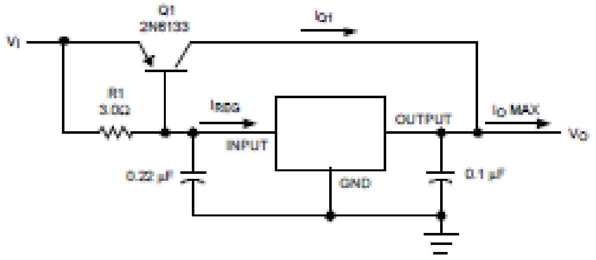


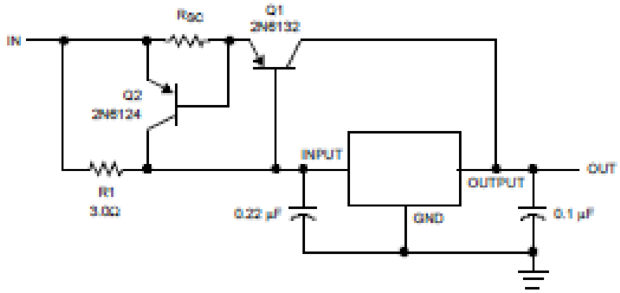
Figure 29. High Input Voltage Circuits



$$\beta(Q1) \geq \frac{I_{O\,Max}}{I_{REG\,Max}}$$

$$R1 = \frac{0.9}{I_{REG}} = \frac{\beta(Q1)\,V_{BE(Q1)}}{I_{REG\,Max}\,(\beta + 1) - I_{O\,Max}}$$

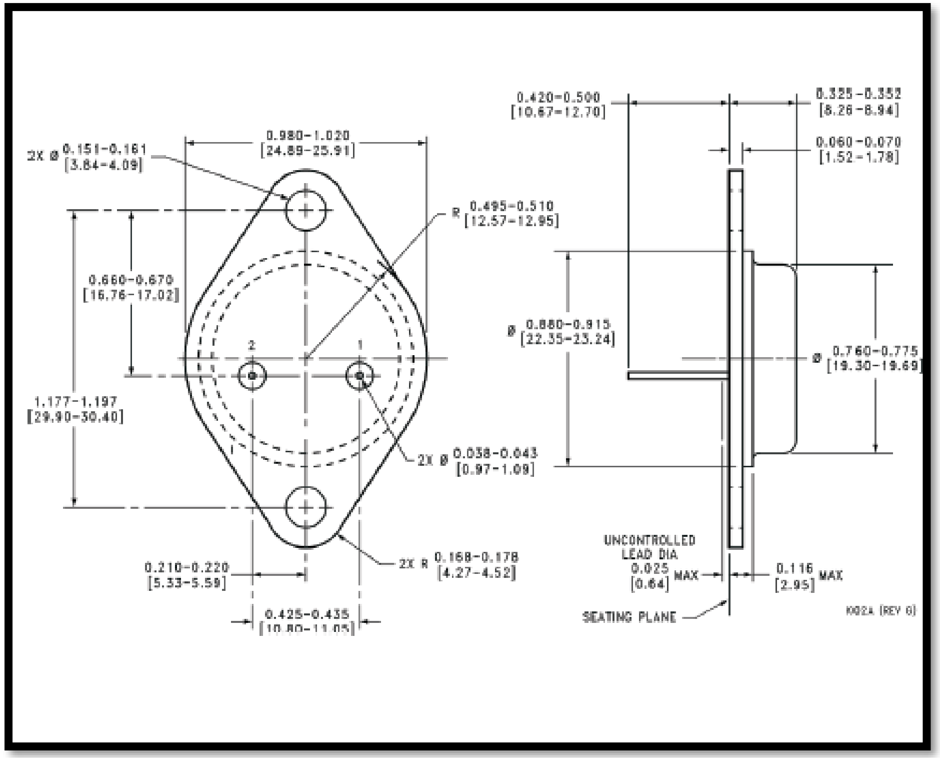
Figure 30. High Current Voltage Regulator

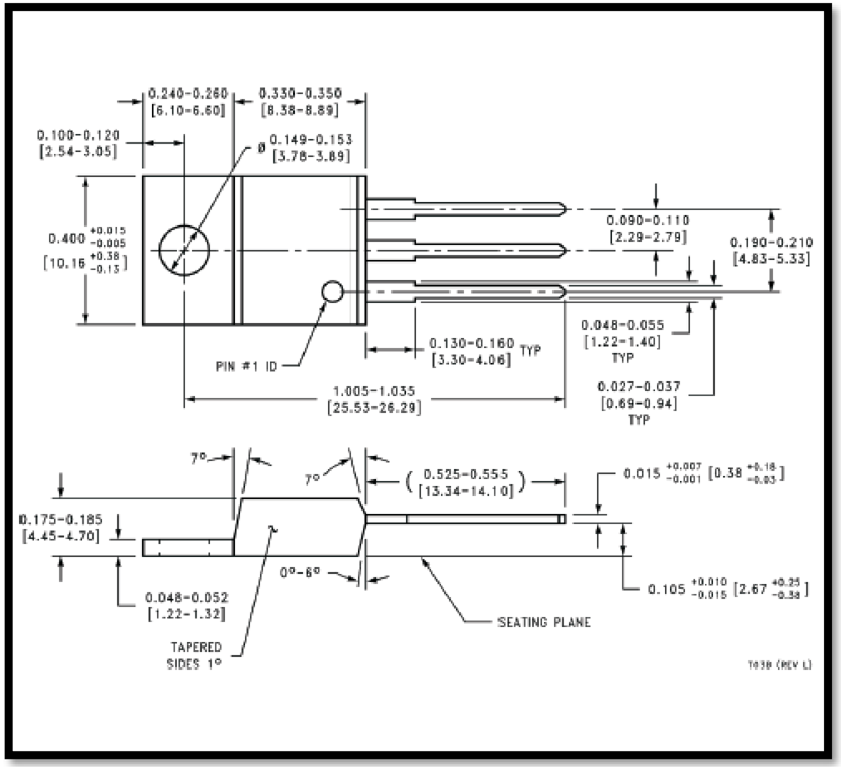


$$R_{SC} = \frac{0.8}{I_{SC}}$$

$$R1 = \frac{\beta V_{BE(Q1)}}{I_{REG\,Max}\,(\beta + 1) - I_{O\,Max}}$$

Figure 31. High Output Current, Short Circuit Protected





1: Input

2: GND

3: Output

LM333 3A REGULADOR DE TENSÃO NEGATIVO

LM333
3-Ampere Adjustable Negative Regulator

General Description

The LM333 is an adjustable 3-terminal negative voltage regulator capable of supplying in excess of −3.0A over an output voltage range of −1.2V to −32V. This regulator is exceptionally easy to apply, requiring only 2 external resistors to set the output voltage and 1 output capacitor for frequency compensation. The circuit design has been optimized for excellent regulation and low thermal transients. Further, the LM333 features internal current limiting, thermal shutdown and safe-area compensation, making them substantially immune to failure from overloads.

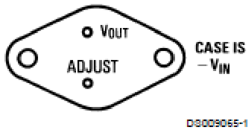
The LM333 serves a wide variety of applications including local on-card regulation, programmable-output voltage regulation or precision current regulation. The LM333 is an ideal complement to the LM150/LM350 adjustable positive regulators.

Features

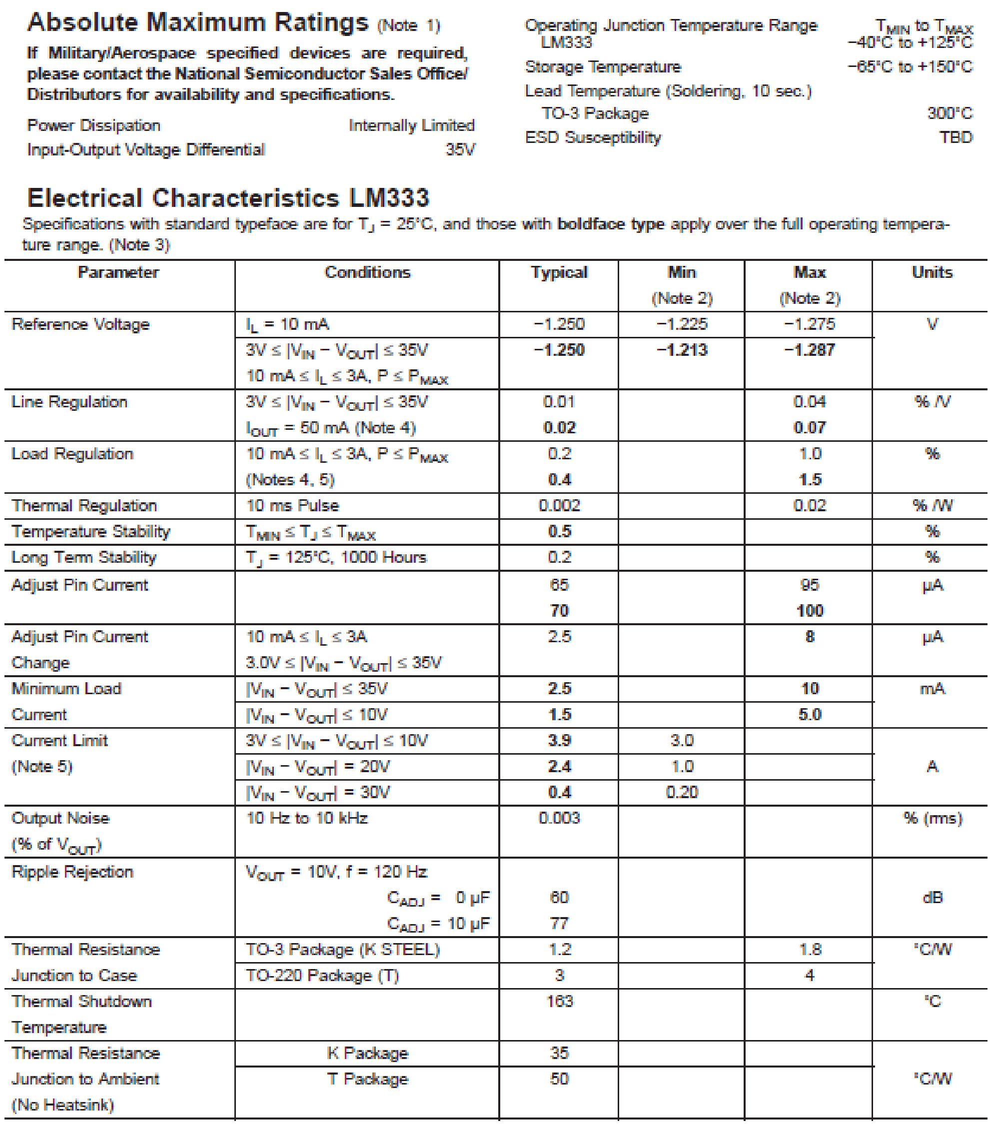
- Output voltage adjustable from −1.2V to −32V
- 3.0A output current guaranteed, −55˚C to +150˚C
- Line regulation typically 0.01%/V
- Load regulation typically 0.2%
- Excellent rejection of thermal transients
- 50 ppm/˚C temperature coefficient
- Temperature-independent current limit
- Internal thermal overload protection
- Standard 3-lead transistor package
- Output is short circuit protected

Connection Diagram

TO-3
Metal Can Package



Bottom View
Steel TO-3 Metal Can Package (K STEEL)
Order Number LM333K STEEL
See NS Package Number K02A



Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Power Dissipation	Internally Limited
Input-Output Voltage Differential	35V

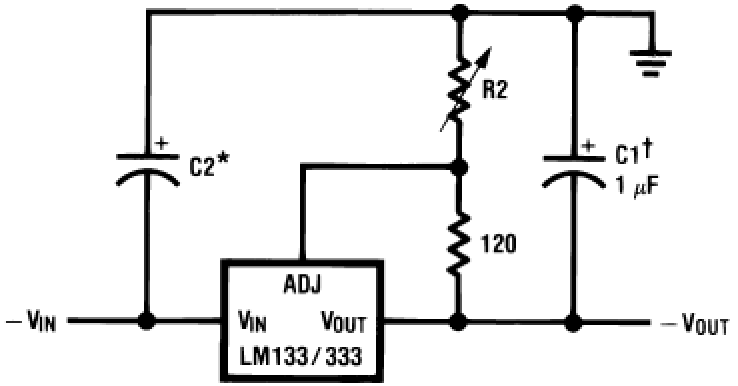
Operating Junction Temperature Range	T_{MIN} to T_{MAX}
LM333	−40°C to +125°C
Storage Temperature	−65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	
TO-3 Package	300°C
ESD Susceptibility	TBD

Electrical Characteristics LM333

Specifications with standard typeface are for T_J = 25°C, and those with **boldface type** apply over the full operating temperature range. (Note 3)

Parameter	Conditions	Typical	Min (Note 2)	Max (Note 2)	Units
Reference Voltage	I_L = 10 mA	−1.250	−1.225	−1.275	V
	$3V \le \lvert V_{IN} - V_{OUT} \rvert \le 35V$ $10\ mA \le I_L \le 3A$, $P \le P_{MAX}$	**−1.250**	**−1.213**	**−1.287**	
Line Regulation	$3V \le \lvert V_{IN} - V_{OUT} \rvert \le 35V$	0.01		0.04	% /V
	I_{OUT} = 50 mA (Note 4)	**0.02**		**0.07**	
Load Regulation	$10\ mA \le I_L \le 3A$, $P \le P_{MAX}$	0.2		1.0	%
	(Notes 4, 5)	**0.4**		**1.5**	
Thermal Regulation	10 ms Pulse	0.002		0.02	% /W
Temperature Stability	$T_{MIN} \le T_J \le T_{MAX}$	**0.5**			%
Long Term Stability	T_J = 125°C, 1000 Hours	0.2			%
Adjust Pin Current		65		95	µA
		70		**100**	
Adjust Pin Current Change	$10\ mA \le I_L \le 3A$ $3.0V \le \lvert V_{IN} - V_{OUT} \rvert \le 35V$	2.5		**8**	µA
Minimum Load Current	$\lvert V_{IN} - V_{OUT} \rvert \le 35V$	**2.5**		**10**	mA
	$\lvert V_{IN} - V_{OUT} \rvert \le 10V$	**1.5**		**5.0**	
Current Limit (Note 5)	$3V \le \lvert V_{IN} - V_{OUT} \rvert \le 10V$	**3.9**	3.0		A
	$\lvert V_{IN} - V_{OUT} \rvert = 20V$	**2.4**	1.0		
	$\lvert V_{IN} - V_{OUT} \rvert = 30V$	**0.4**	0.20		
Output Noise (% of V_{OUT})	10 Hz to 10 kHz	0.003			% (rms)
Ripple Rejection	V_{OUT} = 10V, f = 120 Hz				
	C_{ADJ} = 0 µF	60			dB
	C_{ADJ} = 10 µF	77			
Thermal Resistance Junction to Case	TO-3 Package (K STEEL)	1.2		1.8	°C/W
	TO-220 Package (T)	3		4	
Thermal Shutdown Temperature		163			°C
Thermal Resistance Junction to Ambient (No Heatsink)	K Package	35			°C/W
	T Package	50			

Adjustable Negative Voltage Regulator



DS009065-3

$$-V_{OUT} = -1.25V\left(1+\frac{R2}{120\Omega}\right) + \left(-I_{ADJ}\times R2\right)$$

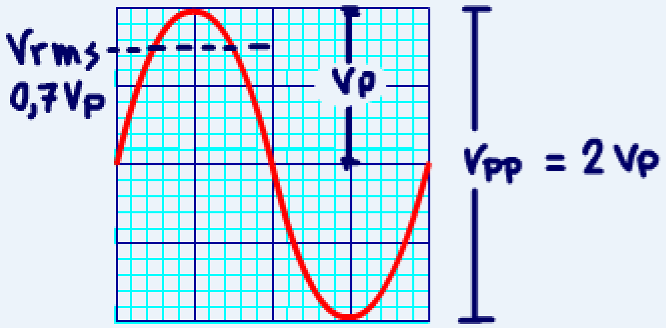
†C1 = 1 µF solid tantalum or 10 µF aluminum electrolytic required for stability.

*C2 = 1 µF solid tantalum is required only if regulator is more than 4" from power supply filter capacitor.

Output capacitors in the range of 1 µF to 1000 µF of aluminum or tantalum electrolytic are commonly used to provide lower output impedance and improved transient response.

AMPLIFICADORES

EQUAÇÕES DA POTÊNCIA EM AMPLIFICADORES



$$PMPO = \frac{V_{PP}^2}{R_L}$$

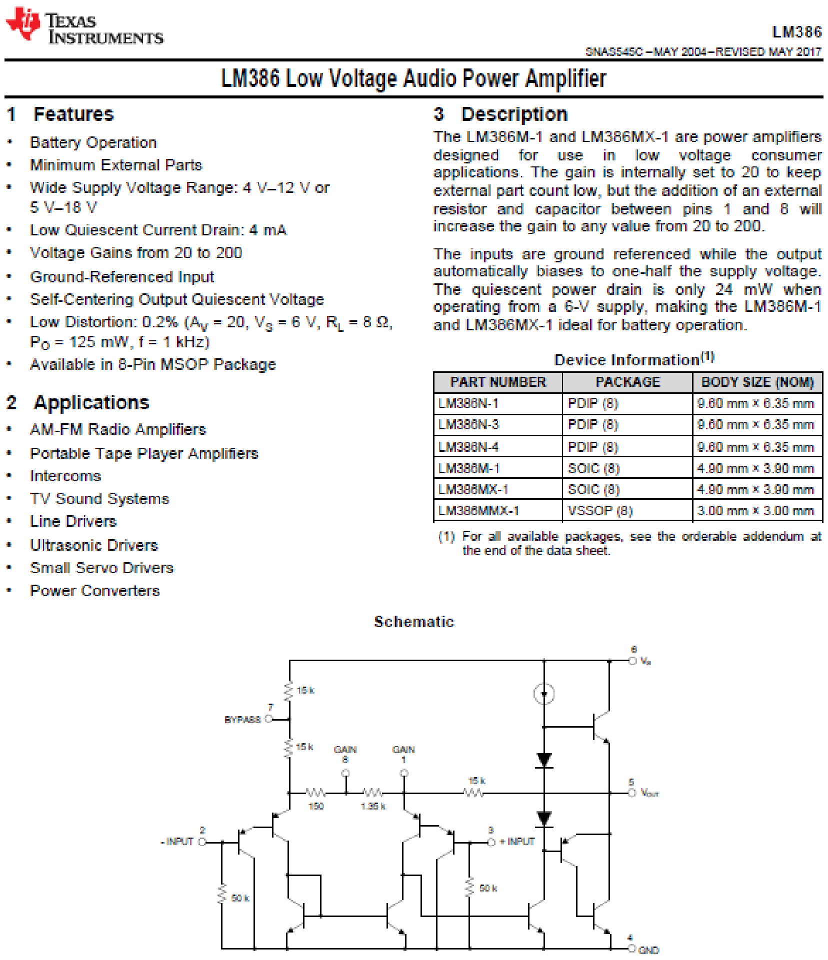
$$V_P = \sqrt{2}\, V_{rms}$$

$$P_{rms} = \frac{V_{rms}^2}{R_L}$$

$$V_{rms} = \frac{V_P}{\sqrt{2}} = \frac{V_{PP}}{2\sqrt{2}}$$

$$P_{rms} = \frac{\left(\frac{V_{PP}}{2\sqrt{2}}\right)^2}{R_L} = \frac{\frac{V_{PP}^2}{4.2}}{R_L} = \frac{V_{PP}^2}{8\,R_L}$$

LM386 LOW VOLTAGE AUDIO POWER AMPLIFIER



TEXAS INSTRUMENTS

LM386

SNAS545C – MAY 2004 – REVISED MAY 2017

LM386 Low Voltage Audio Power Amplifier

1 Features

- Battery Operation
- Minimum External Parts
- Wide Supply Voltage Range: 4 V–12 V or 5 V–18 V
- Low Quiescent Current Drain: 4 mA
- Voltage Gains from 20 to 200
- Ground-Referenced Input
- Self-Centering Output Quiescent Voltage
- Low Distortion: 0.2% (A_V = 20, V_S = 6 V, R_L = 8 Ω, P_O = 125 mW, f = 1 kHz)
- Available in 8-Pin MSOP Package

2 Applications

- AM-FM Radio Amplifiers
- Portable Tape Player Amplifiers
- Intercoms
- TV Sound Systems
- Line Drivers
- Ultrasonic Drivers
- Small Servo Drivers
- Power Converters

3 Description

The LM386M-1 and LM386MX-1 are power amplifiers designed for use in low voltage consumer applications. The gain is internally set to 20 to keep external part count low, but the addition of an external resistor and capacitor between pins 1 and 8 will increase the gain to any value from 20 to 200.

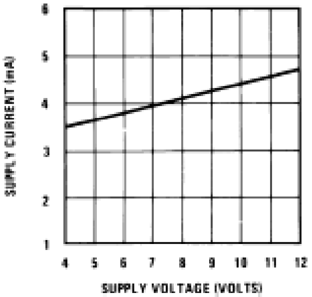
The inputs are ground referenced while the output automatically biases to one-half the supply voltage. The quiescent power drain is only 24 mW when operating from a 6-V supply, making the LM386M-1 and LM386MX-1 ideal for battery operation.

Device Information[1]

PART NUMBER	PACKAGE	BODY SIZE (NOM)
LM386N-1	PDIP (8)	9.60 mm × 6.35 mm
LM386N-3	PDIP (8)	9.60 mm × 6.35 mm
LM386N-4	PDIP (8)	9.60 mm × 6.35 mm
LM386M-1	SOIC (8)	4.90 mm × 3.90 mm
LM386MX-1	SOIC (8)	4.90 mm × 3.90 mm
LM386MMX-1	VSSOP (8)	3.00 mm × 3.00 mm

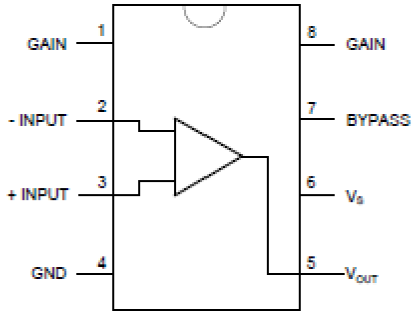
(1) For all available packages, see the orderable addendum at the end of the data sheet.

Schematic



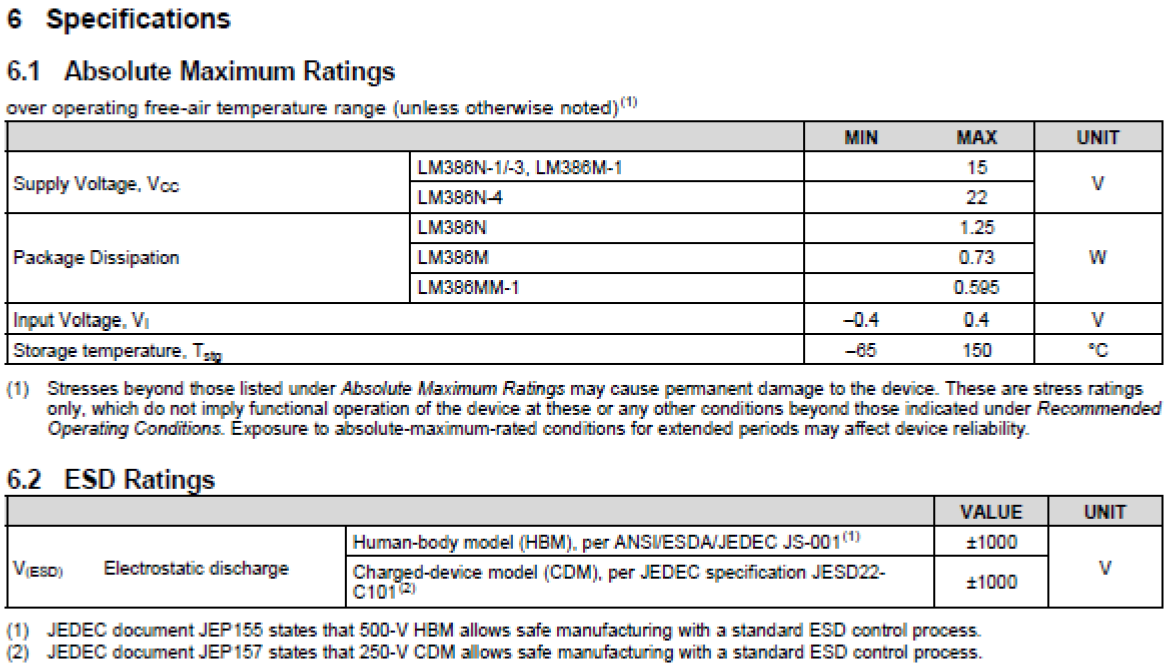
5 Pin Configuration and Functions

D Package
8-Pin MSOP
Top View



Pin Functions

PIN		TYPE	DESCRIPTION
NAME	NO.		
GAIN	1	–	Gain setting pin
–INPUT	2	I	Inverting input
+INPUT	3	I	Noninverting input
GND	4	P	Ground reference
V_{OUT}	5	O	Output
V_S	6	P	Power supply voltage
BYPASS	7	O	Bypass decoupling path
GAIN	8	–	Gain setting pin



6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

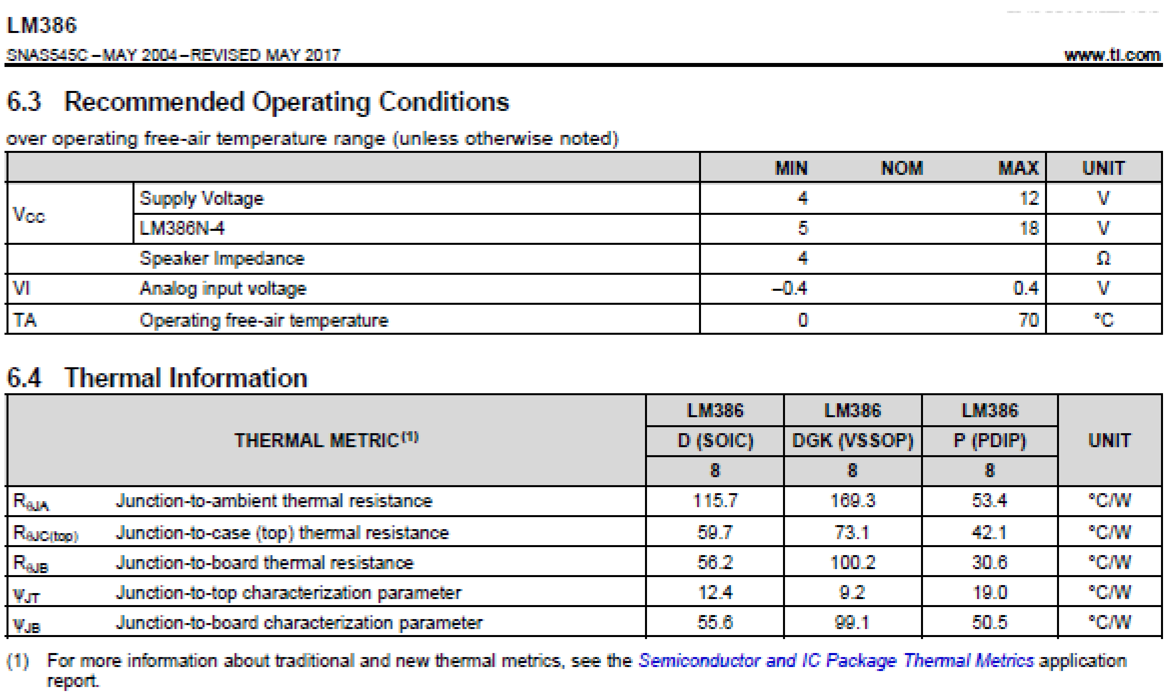
		MIN	MAX	UNIT
Supply Voltage, V_{CC}	LM386N-1/-3, LM386M-1		15	V
	LM386N-4		22	
Package Dissipation	LM386N		1.25	W
	LM386M		0.73	
	LM386MM-1		0.595	
Input Voltage, V_I		–0.4	0.4	V
Storage temperature, T_{stg}		–65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	±1000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101(2)	±1000	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.



LM386

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6.3 Recommended Operating Conditions

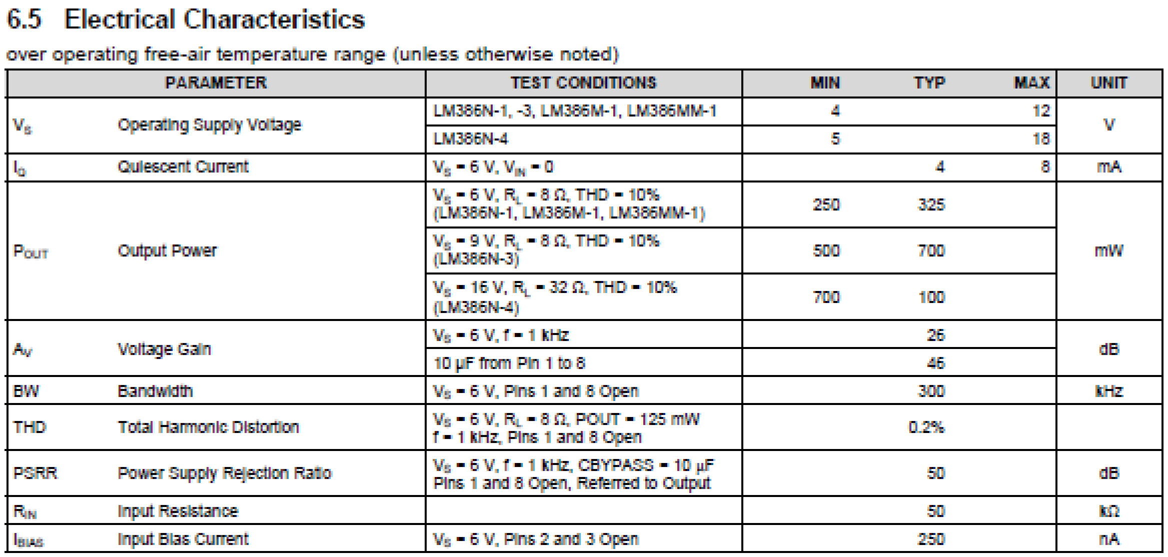
over operating free-air temperature range (unless otherwise noted)

		MIN	NOM	MAX	UNIT
V_{CC}	Supply Voltage	4		12	V
	LM386N-4	5		18	V
	Speaker Impedance	4			Ω
VI	Analog input voltage	–0.4		0.4	V
TA	Operating free-air temperature	0		70	°C

6.4 Thermal Information

THERMAL METRIC[1]		LM386	LM386	LM386	UNIT
		D (SOIC)	DGK (VSSOP)	P (PDIP)	
		8	8	8	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	115.7	169.3	53.4	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	59.7	73.1	42.1	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	56.2	100.2	30.6	°C/W
ψ_{JT}	Junction-to-top characterization parameter	12.4	9.2	19.0	°C/W
ψ_{JB}	Junction-to-board characterization parameter	55.6	99.1	50.5	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report.



6.5 Electrical Characteristics

over operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_S	Operating Supply Voltage	LM386N-1, -3, LM386M-1, LM386MM-1	4		12	V
		LM386N-4	5		18	
I_Q	Quiescent Current	V_S = 6 V, V_{IN} = 0		4	8	mA
P_{OUT}	Output Power	V_S = 6 V, R_L = 8 Ω, THD = 10% (LM386N-1, LM386M-1, LM386MM-1)	250	325		mW
		V_S = 9 V, R_L = 8 Ω, THD = 10% (LM386N-3)	500	700		
		V_S = 16 V, R_L = 32 Ω, THD = 10% (LM386N-4)	700	100		
A_V	Voltage Gain	V_S = 6 V, f = 1 kHz		26		dB
		10 µF from Pin 1 to 8		46		
BW	Bandwidth	V_S = 6 V, Pins 1 and 8 Open		300		kHz
THD	Total Harmonic Distortion	V_S = 6 V, R_L = 8 Ω, POUT = 125 mW f = 1 kHz, Pins 1 and 8 Open		0.2%		
PSRR	Power Supply Rejection Ratio	V_S = 6 V, f = 1 kHz, CBYPASS = 10 µF Pins 1 and 8 Open, Referred to Output		50		dB
R_{IN}	Input Resistance			50		kΩ
I_{BIAS}	Input Bias Current	V_S = 6 V, Pins 2 and 3 Open		250		nA

9.2 Typical Application

9.2.1 LM386 with Gain = 20

Figure 10 shows the minimum part count application that can be implemented using LM386. Its gain is internally set to 20.

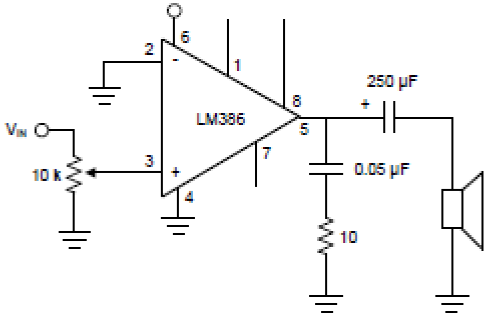


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Figure 10. LM386 with Gain = 20

9.2.1.1 *Design Requirements*

Table 1. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Load Impedance	4 Ω to 32 Ω
Supply Voltage	5 V to 12 V

9.2.1.3 *Application Curve*

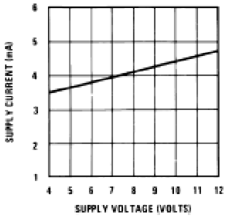
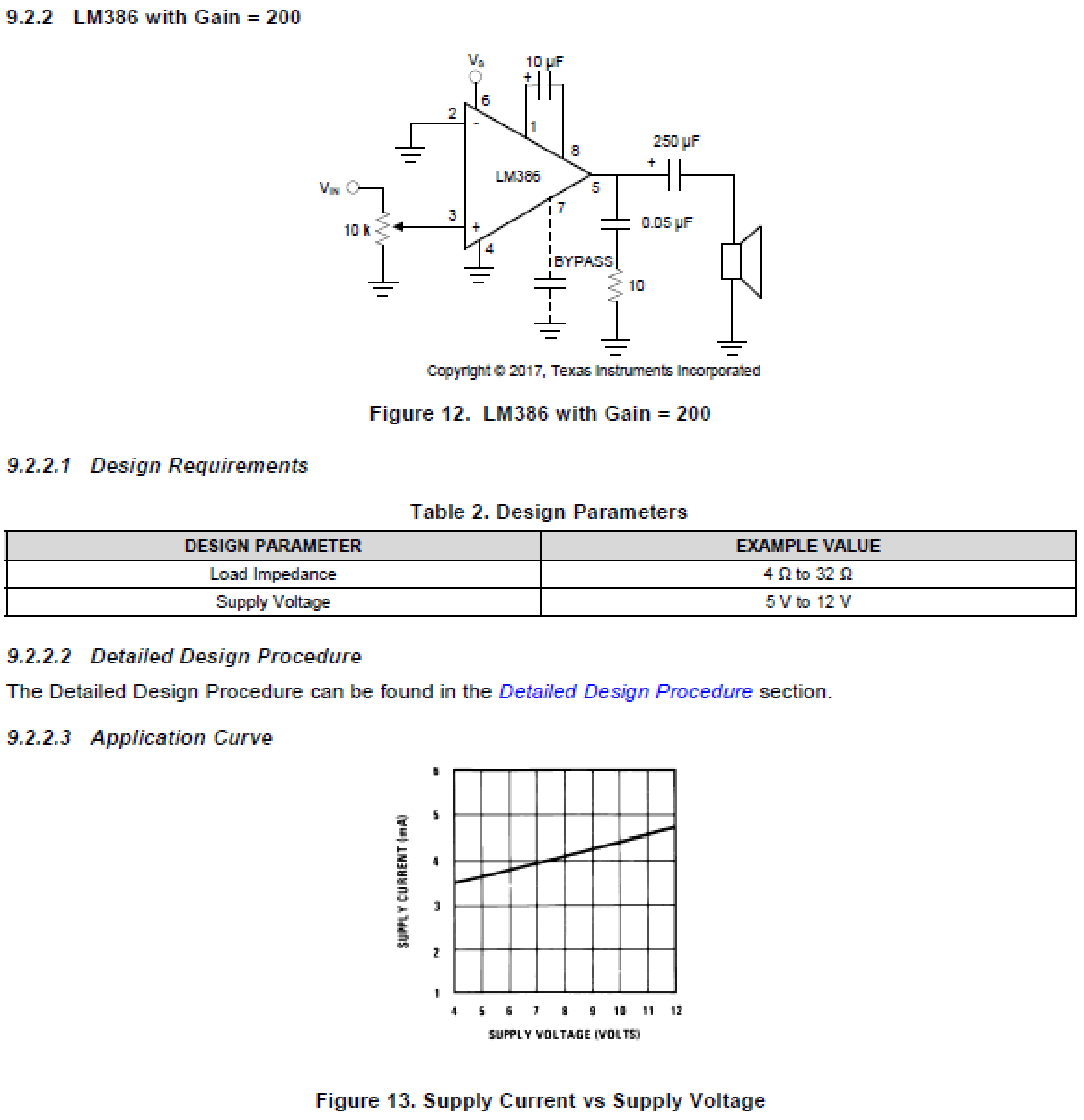


Figure 11. Supply Current vs Supply Voltage



9.2.2 LM386 with Gain = 200

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Figure 12. LM386 with Gain = 200

9.2.2.1 *Design Requirements*

Table 2. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Load Impedance	4 Ω to 32 Ω
Supply Voltage	5 V to 12 V

9.2.2.2 *Detailed Design Procedure*

The Detailed Design Procedure can be found in the *Detailed Design Procedure* section.

9.2.2.3 *Application Curve*

Figure 13. Supply Current vs Supply Voltage

9.2.3 LM386 with Gain = 50

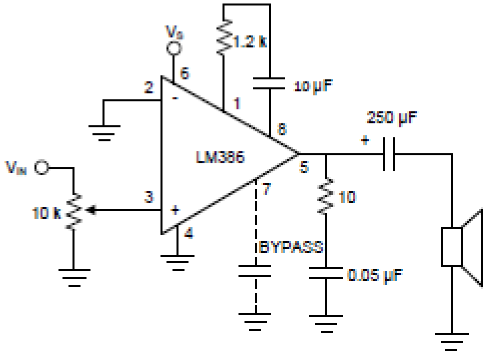

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Figure 14. LM386 with Gain = 50

9.2.3.1 Design Requirements

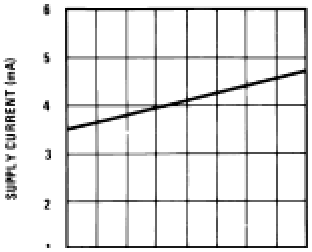
Table 3. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Load Impedance	4 Ω to 32 Ω
Supply Voltage	5 V to 12 V

9.2.3.2 Detailed Design Procedure

The Detailed Design Procedure can be found in the *Detailed Design Procedure* section.

9.2.3.3 Application Curve



9.2.4 Low Distortion Power Wienbridge Oscillator

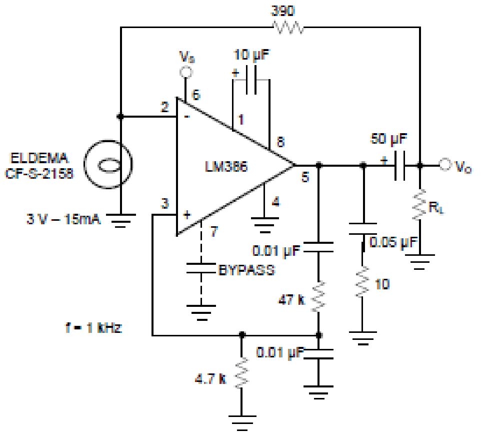


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Figure 16. Low Distortion Power Wienbridge Oscillator

9.2.4.1 *Design Requirements*

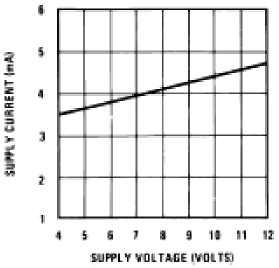
Table 4. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Load Impedance	4 Ω to 32 Ω
Supply Voltage	5 V to 12 V

9.2.4.2 *Detailed Design Procedure*

The Detailed Design Procedure can be found in the *Detailed Design Procedure* section.

9.2.4.3 *Application Curve*



9.2.5 LM386 with Bass Boost

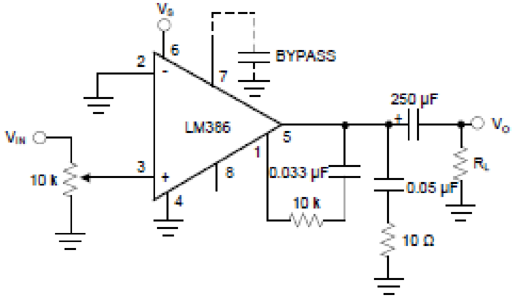


Figure 18. LM386 with Bass Boost

9.2.5.1 *Design Requirements*

Table 5. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Load Impedance	4 Ω to 32 Ω
Supply Voltage	5 V to 12 V

9.2.5.2 *Detailed Design Procedure*

The Detailed Design Procedure can be found in the *Detailed Design Procedure* section.

9.2.5.3 *Application Curve*

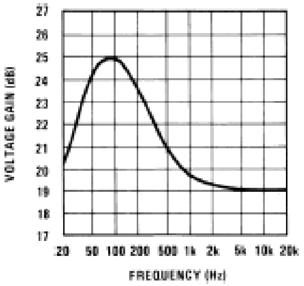


Figure 19. Voltage Gain vs Frequency

9.2.6 Square Wave Oscillator

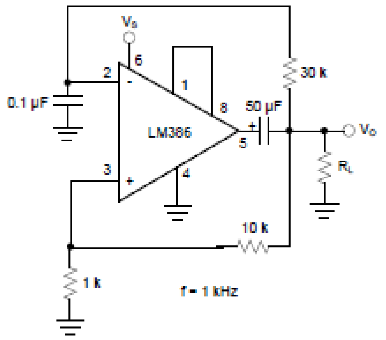


Figure 20. Square Wave Oscillator

Table 6. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Load Impedance	4 Ω to 32 Ω
Supply Voltage	5 V to 12 V

9.2.6.1 *Detailed Design Procedure*

The Detailed Design Procedure can be found in the *Detailed Design Procedure* section.

9.2.6.2 *Application Curve*

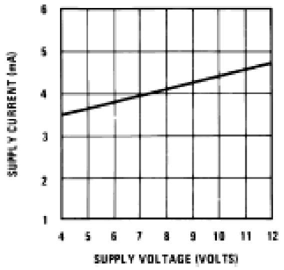


Figure 21. Supply Current vs Supply Voltage

9.2.7 AM Radio Power Amplifier

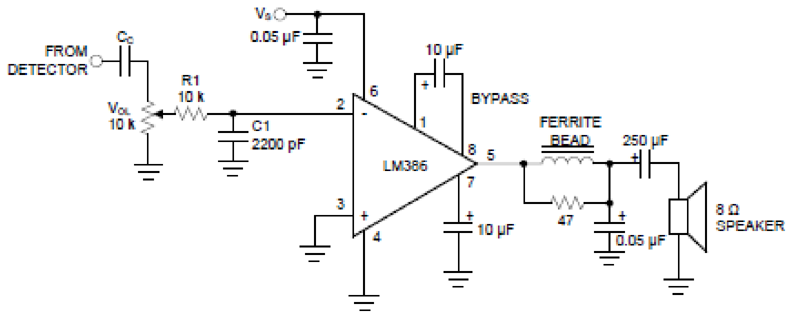


Figure 22. AM Radio Power Amplifier

9.2.7.1 *Design Requirements*

Table 7. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Load Impedance	4 Ω to 32 Ω
Supply Voltage	5 V to 12 V

9.2.7.2 *Detailed Design Procedure*

The Detailed Design Procedure can be found in the *Detailed Design Procedure* section.

9.2.7.3 *Application Curve*

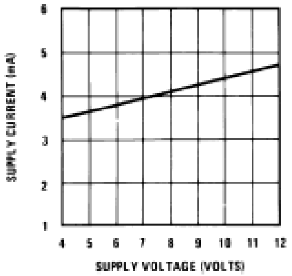


Figure 23. Supply Current vs Supply Voltage

11 Layout

11.1 Layout Guidelines

Place all required components as close as possible to the device. Use short traces for the output to the speaker connection. Route the analog traces far from the digital signal traces and avoid crossing them.

11.2 Layout Examples

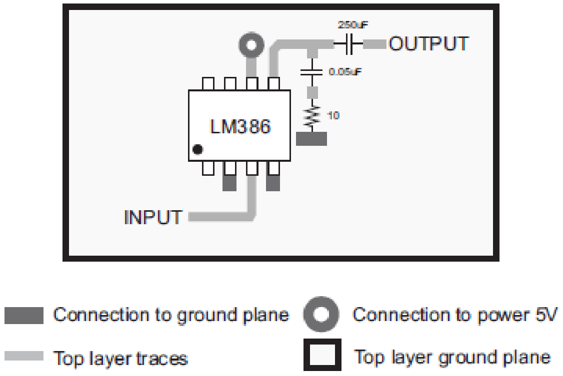


Figure 24. Layout Example for Minimum Parts Gain = 20 dB on PDIP package

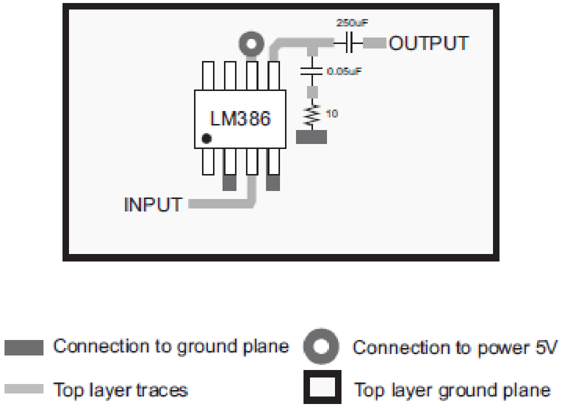


Figure 25. Layout Example for Minimum Parts Gain = 20 dB on SOIC package

LA4282 2 CANAL 10W STEREO COM MUTE PARA HOME TV

Monolithic Linear IC

SANYO

LA4282

2-Channel 10 W AF Power Amplifier for Use in Home Stereo, TV Applications

Overview

The LA4282 is an IC which seals a high-output power amplifier for TVs and monitors in a compact package.

Features

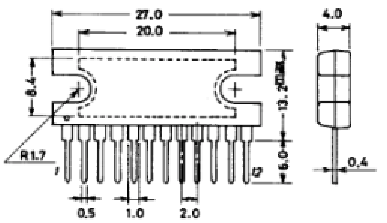
- High-power 2-channel AF power amplifier
- Low distortion
- Minimum number of external parts required (no bootstrap capacitor required)
- Low pop noise at the time of power supply ON/OFF
- Good ripple rejection (58 dB typ)
- Wide operating voltage range
- External muting available
- On-chip protector against abnormality (thermal shutdown, overvoltage)

Package Dimensions

unit : mm

3049A-SIP12H

[LA4282]



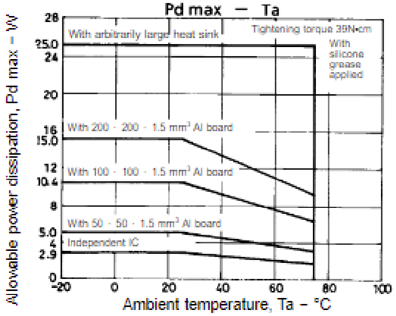
SANYO : SIP12H

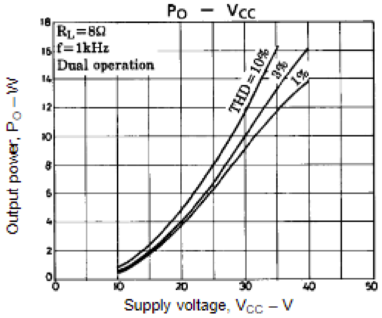
Specifications

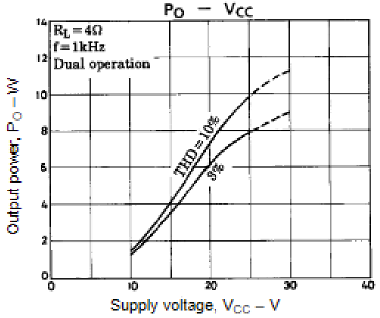
Maximum Ratings at Ta = 25 °C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max	Quiescent	45	V
Maximum output current	$I_{O\ peak}$		4	A
Allowable power dissipation	Pd max	With heat sink	25	W
Operating temperature	Topr		–20 to +75	°C
Storage temperature	Tstg		–40 to +150	°C

Operating Conditions at Ta = 25°C







SANYO Electric Co.,Ltd. Semiconductor Bussiness Headquarters
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110 JAPAN

22896HA(II)/7118TA,TS No.2683-1/6

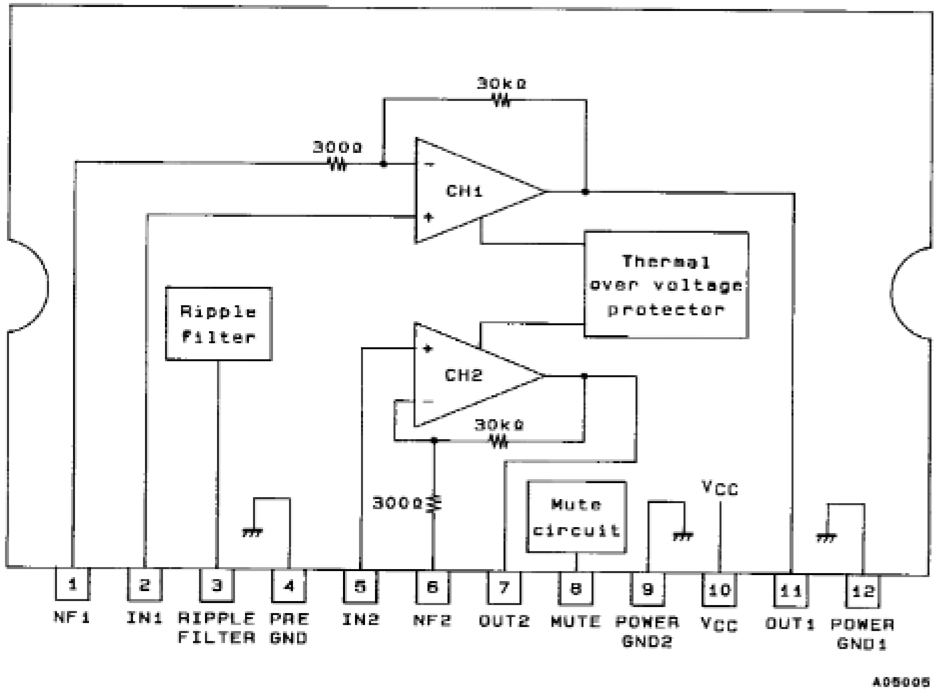
LA4282

Operating Characteristics at Ta = 25°C, V_{CC}= 32 V, R_L = 8 Ω, f = 1 kHz, Rg = 600 Ω, See Test Circuit.

Parameter	Symbol	Conditions	min	typ	max	Unit
Quiescent current	$I_{CCO}(1)$	Quiescent	30	60	100	mA
	$I_{CCO}(2)$	Muting switch On	30	56	100	mA
Voltage gain	VG		38	40	42	dB
Voltage gain difference	ΔVG				1.5	dB
Output power	P_O (1)	THD = 1%	9.0	10.0		W
	P_O (2)	THD = 3%	10.0	11.5		W
Total harmonic distortion	THD	P_O = 2 W		0.05	0.20	%
Output noise voltage	V_{NO}	Rg = 10 kΩ, BW = 20 Hz to 20 kHz		0.25	1.0	mV
Ripple rejection	SVRR	Rg = 10 kΩ, f_R = 100 Hz, V_R = 0 dBm	45	58		dB
Crosstalk	CT	Rg = 10 kΩ	45	60		dB
Muting	$V_{O(MT)}$	Muting switch On, V_{IN} = –5 dBm			–35	dBm

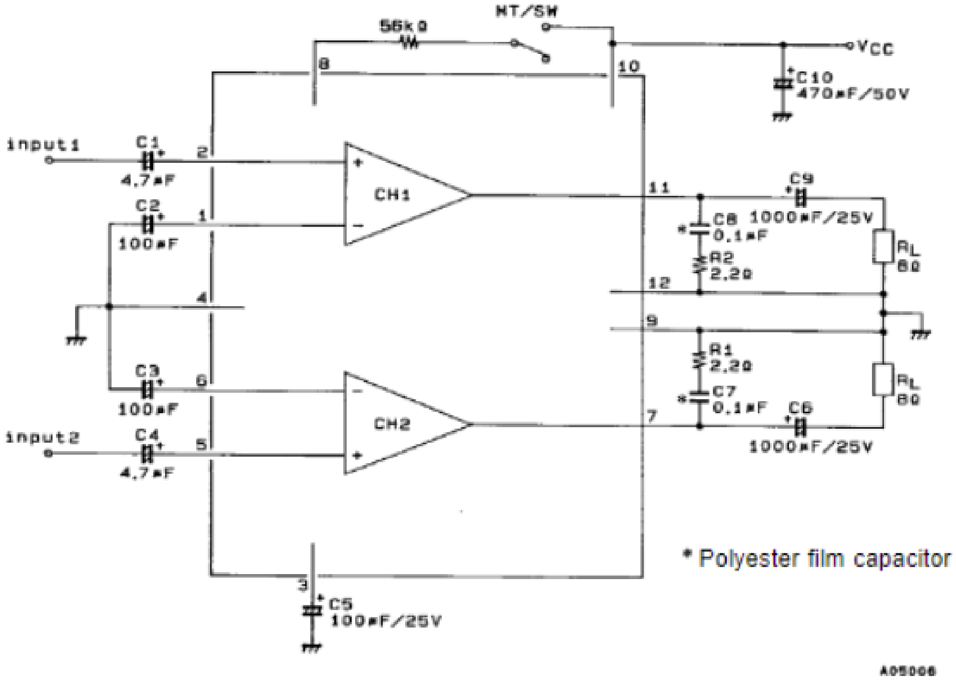
Equivalent Circuit Block Diagram and Pin Assignment

Equivalent Circuit Block Diagram and Pin Assignment



LA4282

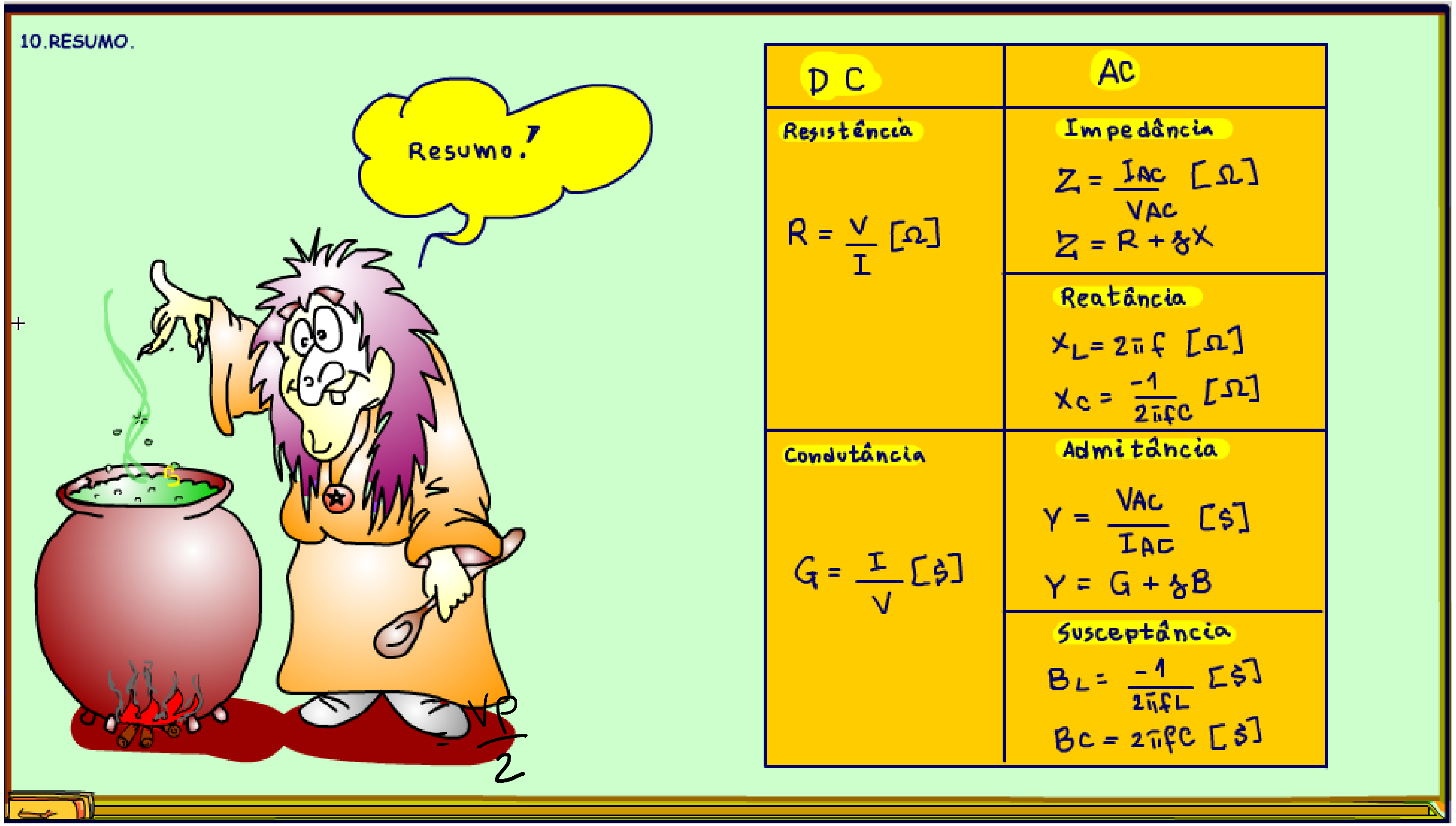
Test Circuit



* Polyester film capacitor

FÓRMULAS E GRANDEZAS ELÉTRICAS.

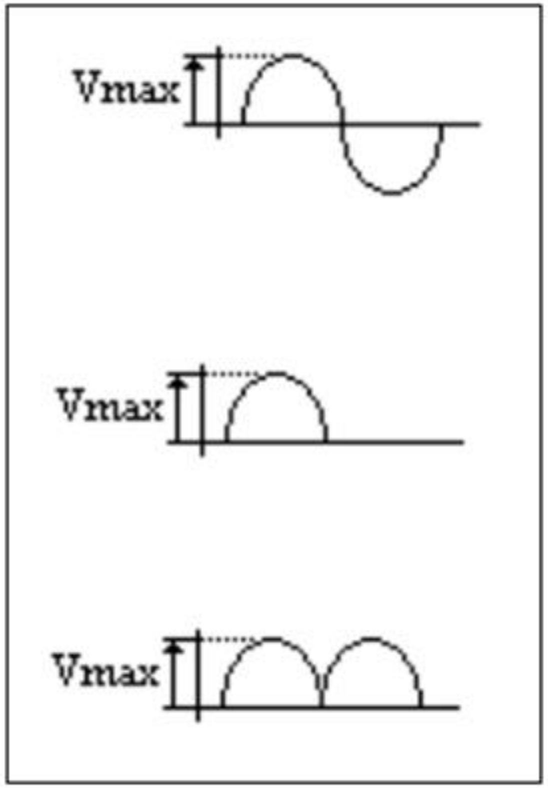
RELAÇÃO E FÓRMULAS DAS PRINCIPAIS GRANDEZAS ELÉTRICAS.



10.RESUMO.

D C	AC
Resistência $R = \frac{V}{I}\ [\Omega]$	**Impedância** $Z = \frac{I_{AC}}{V_{AC}}\ [\Omega]$ $Z = R + \gamma X$
	Reatância $X_L = 2\pi f\ [\Omega]$ $X_C = \frac{-1}{2\pi f C}\ [\Omega]$
Condutância $G = \frac{I}{V}\ [\$]$	**Admitância** $Y = \frac{V_{AC}}{I_{AC}}\ [\$]$ $Y = G + \gamma B$
	Susceptância $B_L = \frac{-1}{2\pi f L}\ [\$]$ $B_C = 2\pi f C\ [\$]$

FÓRMULA DA TENSÃO RMS E TENSÃO DC EM RETIFICADORES.



Corrente Alternada :

$$V_{rms} = \frac{V_{max}}{\sqrt{2}} \qquad V_{med} = 0$$

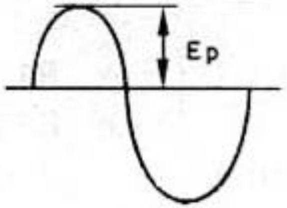
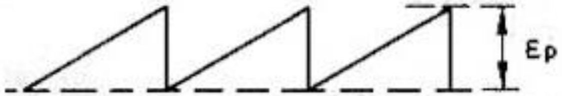
Meia Onda :

$$V_{rms} = \frac{V_{max}}{2} \qquad V_{med} = \frac{V_{max}}{\pi}$$

Onda Completa :

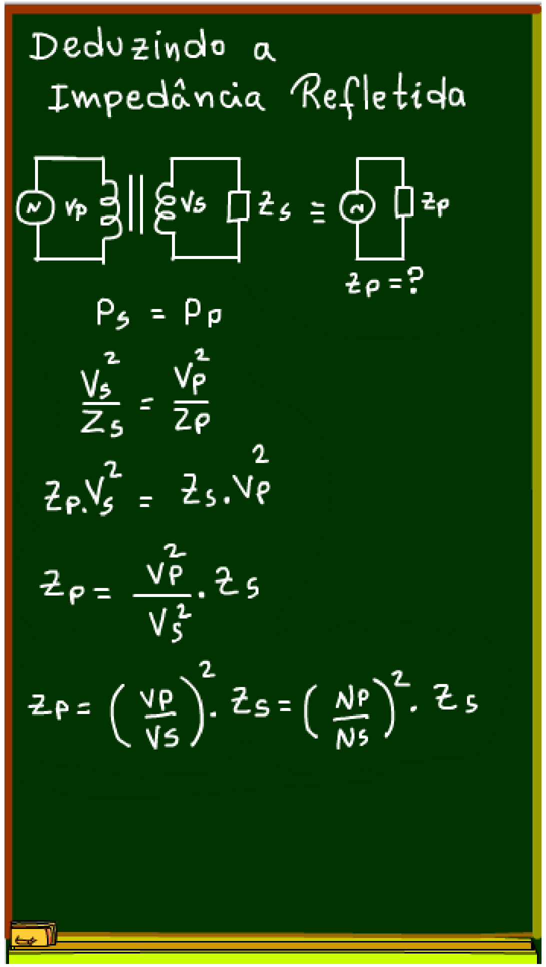
$$V_{rms} = \frac{V_{max}}{\sqrt{2}} \qquad V_{med} = \frac{2V_{max}}{\pi}$$

Tensão RMS e média em outras formas de ondas.

	E_{rms}	E_m
	$\frac{E_p}{\sqrt{2}}$	$\frac{2E_p}{\pi}$
	$E_p\sqrt{\frac{1}{2}}$	$\frac{E_p}{2}$
	$\frac{E_p}{\sqrt{3}}$	$\frac{E_p}{2}$

Cálculos para valores médios e RMS

FÓRMUILA IMPEDÂNCIA REFLETIDA NO TRANSFORMADOR.



Forma rápida de deduzir a impedância refletida

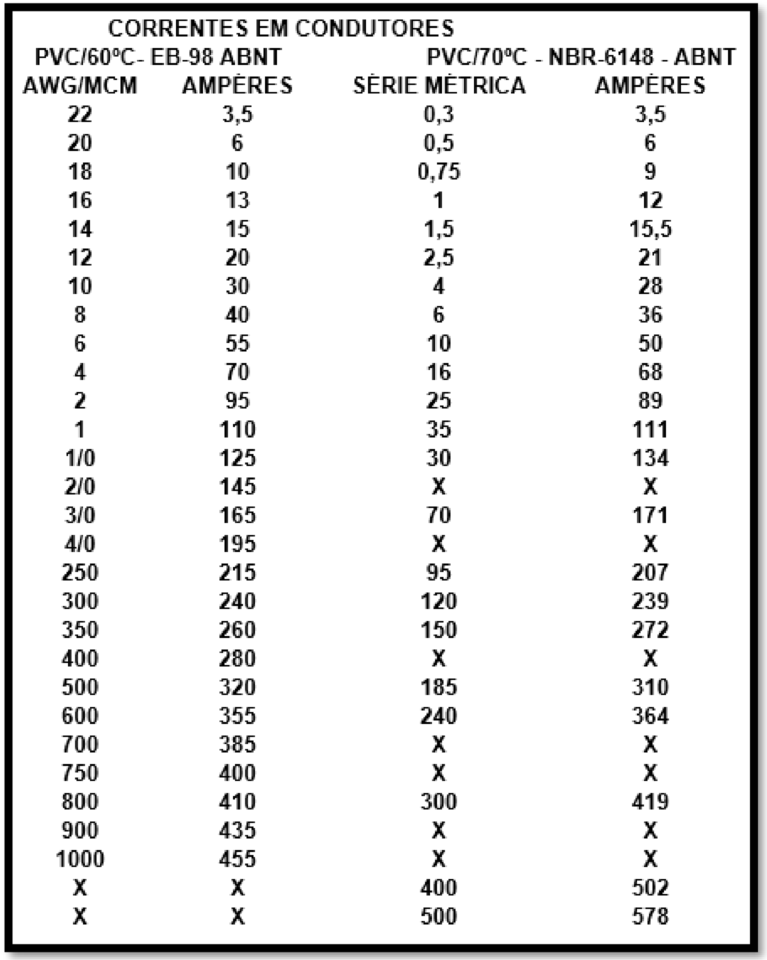
Todo mundo sabe que a impedância do secundário aparece refletida no primário, mas a equação a gente esquece toda hora, vou mostrar uma forma simples de deduzir, para você nunca mais esquecer.

O truque é usar a potência do transformador escrevendo a potência em função da resistência e da tensão, aqui em função da impedância e da tensão.

A impedância do secundário refletida no primário é igual ao quadrado da relação de espiras, número de espira do primário sobre o número de espiras do secundário ao quadrado multiplicado pela impedância do secundário.

YOUTUBE: https://youtu.be/W3eDnH1vQcE

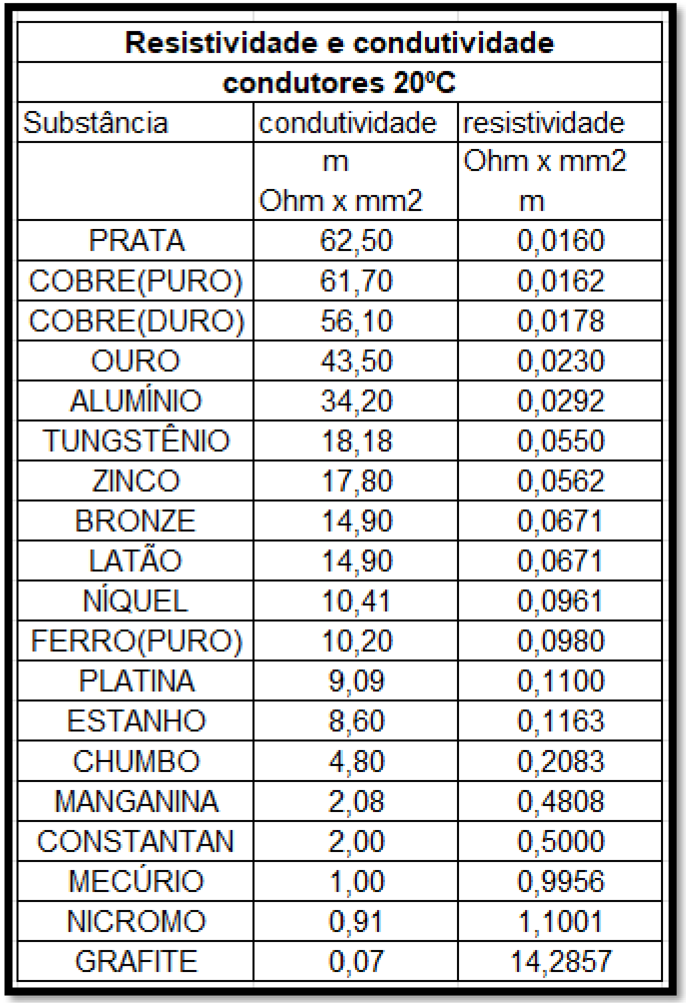
TABELA: CORRENTE MÁXIMAS NOS CONDUTORES SÉRIE MM E AWG.



CORRENTES EM CONDUTORES			
PVC/60ºC- EB-98 ABNT		PVC/70ºC - NBR-6148 - ABNT	
AWG/MCM	AMPÈRES	SÉRIE MÉTRICA	AMPÈRES
22	3,5	0,3	3,5
20	6	0,5	6
18	10	0,75	9
16	13	1	12
14	15	1,5	15,5
12	20	2,5	21
10	30	4	28
8	40	6	36
6	55	10	50
4	70	16	68
2	95	25	89
1	110	35	111
1/0	125	30	134
2/0	145	X	X
3/0	165	70	171
4/0	195	X	X
250	215	95	207
300	240	120	239
350	260	150	272
400	280	X	X
500	320	185	310
600	355	240	364
700	385	X	X
750	400	X	X
800	410	300	419
900	435	X	X
1000	455	X	X
X	X	400	502
X	X	500	578

As correntes indicas aqui são para instalações em eletrônica.

TABELA COM A RESISTIVIDADE E CONDUTIVIDADE DOS CONDUTORES.



Resistividade e condutividade condutores 20ºC		
Substância	condutividade	resistividade
	m Ohm x mm2	Ohm x mm2 m
PRATA	62,50	0,0160
COBRE(PURO)	61,70	0,0162
COBRE(DURO)	56,10	0,0178
OURO	43,50	0,0230
ALUMÍNIO	34,20	0,0292
TUNGSTÊNIO	18,18	0,0550
ZINCO	17,80	0,0562
BRONZE	14,90	0,0671
LATÃO	14,90	0,0671
NÍQUEL	10,41	0,0961
FERRO(PURO)	10,20	0,0980
PLATINA	9,09	0,1100
ESTANHO	8,60	0,1163
CHUMBO	4,80	0,2083
MANGANINA	2,08	0,4808
CONSTANTAN	2,00	0,5000
MECÚRIO	1,00	0,9956
NICROMO	0,91	1,1001
GRAFITE	0,07	14,2857

Quanto maior a condutividade melhor como condutor, quanto maior a resistividade melhor como isolante, veja a lista dos melhores condutores comparando a condutividade em m/OHM x mm^2.

Prata	62,50
Cobre	58,82
OURO	45,05
Alumínio	35,97
Platina	9,09
Estanho	8,33
Chumbo	4,81

FIM

CRÉDITOS

E por favor, se você não é inscrito, se inscreva e marque o sininho para receber as notificações do canal e não esqueça de deixar aquele like e compartilhar para dar uma força ao canal do professor bairros.

Arthurzinho: E não tem site.

Tem sim é www.bairrospd.com lá você encontra o pdf e tutoriais sobre esse e outros assuntos da eletrônica

E fique atento ao canal do professor bairros para mais tutoriais sobre eletrônica, até lá!

www.bairrospd.com

https://www.youtube.com/channel/UC_ttfxnYdBh4IbiR9twtpPA

Sim, mais um e-book do Professor Bairros especialmente desenvolvido para os amantes da eletrônica.
Aqui você encontra uma lista dos componentes mais usados na montagem de circuitos eletrônicos. Os componentes são organizados mostrando os modelos mais comuns e suas principais características o que vai ajudar o técnico a escolher o melhor modelo, ou melhor substituto.

A eletrônica é divertida, divirta-se!

VISITE O SITE DO PROFESSOR BAIRROS LÁ TEM O PDF E MUITO MAIS

PARA AULAS ONLINE CONTATE VIA SITE

www.bairrospd.com

SOM: pop alegre Mysteries -30 (fonte YOUTUBE)

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