

# MPSA70

## Amplifier Transistor

### PNP Silicon

#### Features

- Pb-Free Package is Available\*

#### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	$V_{CEO}$	–40	Vdc
Emitter–Base Voltage	$V_{EBO}$	–4.0	Vdc
Collector Current – Continuous	$I_C$	–100	mA dc
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	625 5.0	mW mW/ $^\circ\text{C}$
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	1.5 12	W mW/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	–55 to +150	$^\circ\text{C}$

#### THERMAL CHARACTERISTICS

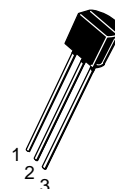
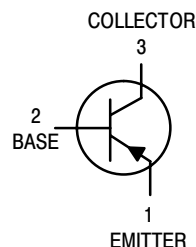
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction–to–Ambient	$R_{\theta JA}$	200	$^\circ\text{C/W}$
Thermal Resistance, Junction–to–Case	$R_{\theta JC}$	83.3	$^\circ\text{C/W}$

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.



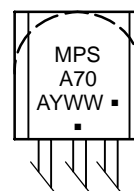
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TO-92  
CASE 29-11  
STYLE 1

#### MARKING DIAGRAM



MPSA70 = Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

#### ORDERING INFORMATION

Device	Package	Shipping
MPSA70RLRM	TO-92	2,000/Ammo Pack
MPSA70RLRMG	TO-92 (Pb-Free)	2,000/Ammo Pack

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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## ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector–Emitter Breakdown Voltage (Note 1) ( $I_C = -1.0\text{ mA}$ , $I_E = 0$ )	$V_{(BR)CEO}$	-40	–	Vdc
Emitter–Base Breakdown Voltage ( $I_E = -100\text{ }\mu\text{A}$ , $I_C = 0$ )	$V_{(BR)EBO}$	-4.0	–	Vdc
Collector Cutoff Current ( $V_{CB} = -30\text{ Vdc}$ , $I_E = 0$ )	$I_{CBO}$	–	-100	nAdc
<b>ON CHARACTERISTICS</b>				
DC Current Gain ( $I_C = -5.0\text{ mA}$ , $V_{CE} = -10\text{ Vdc}$ )	$h_{FE}$	40	400	–
Collector–Emitter Saturation Voltage ( $I_C = -10\text{ mA}$ , $I_B = -1.0\text{ mA}$ )	$V_{CE(sat)}$	–	-0.25	Vdc
<b>SMALL–SIGNAL CHARACTERISTICS</b>				
Current–Gain – Bandwidth Product ( $I_C = -5.0\text{ mA}$ , $V_{CE} = -10\text{ Vdc}$ , $f = 100\text{ MHz}$ )	$f_T$	125	–	MHz
Output Capacitance ( $V_{CB} = -10\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )	$C_{obo}$	–	4.0	pF

1. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ ; Duty Cycle  $\leq 2.0\%$ .

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## TYPICAL NOISE CHARACTERISTICS

( $V_{CE} = -5.0$  Vdc,  $T_A = 25^\circ\text{C}$ )

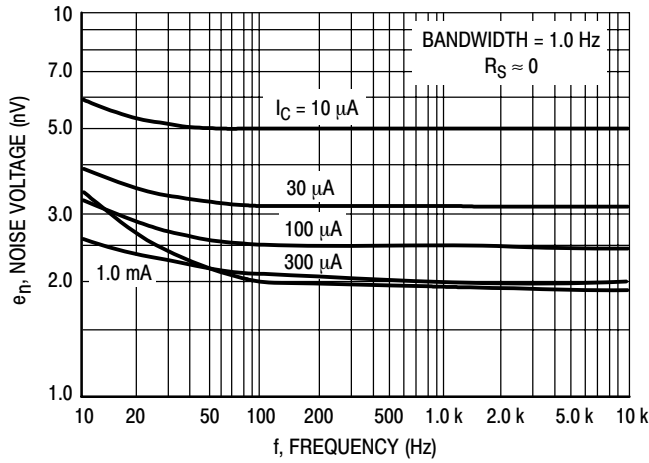


Figure 1. Noise Voltage

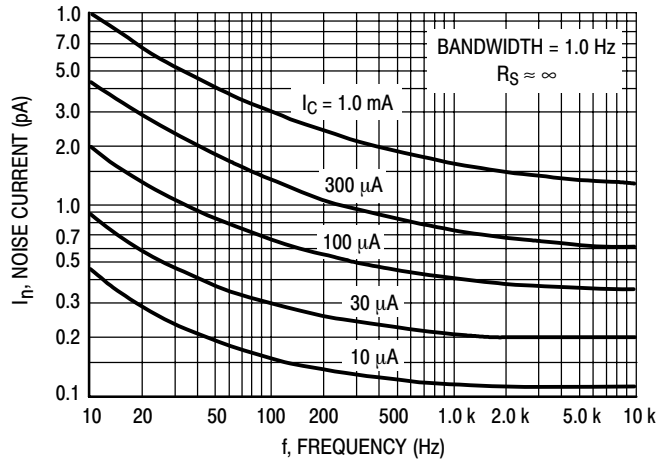


Figure 2. Noise Current

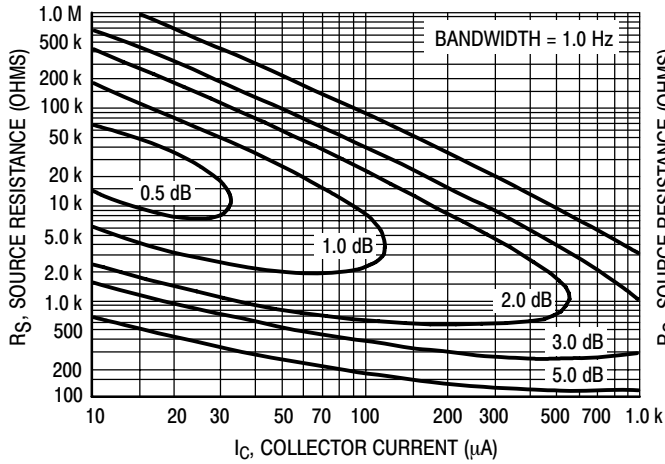


Figure 3. Narrow Band, 100 Hz

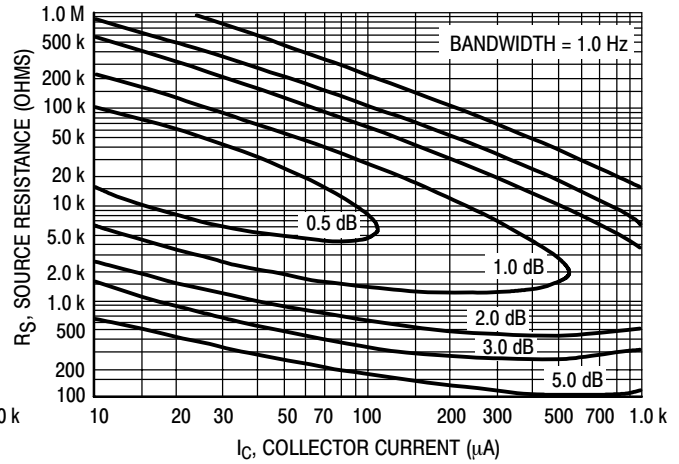


Figure 4. Narrow Band, 1.0 kHz

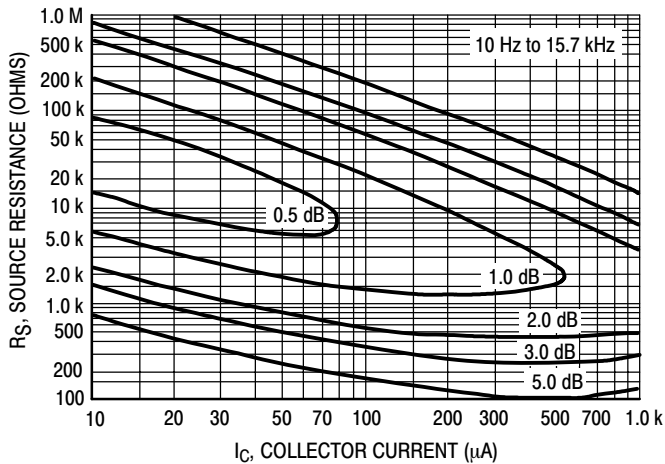


Figure 5. Wideband

Noise Figure is Defined as:

$$NF = 20 \log_{10} \left[ \frac{e_n^2 + 4KTR_S + I_n^2 R_S^2}{4KTR_S} \right]^{1/2}$$

$e_n$  = Noise Voltage of the Transistor referred to the input. (Figure 3)

$I_n$  = Noise Current of the Transistor referred to the input. (Figure 4)

$K$  = Boltzman's Constant ( $1.38 \times 10^{-23}$  J/°K)

$T$  = Temperature of the Source Resistance (°K)

$R_S$  = Source Resistance (Ohms)

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## TYPICAL STATIC CHARACTERISTICS

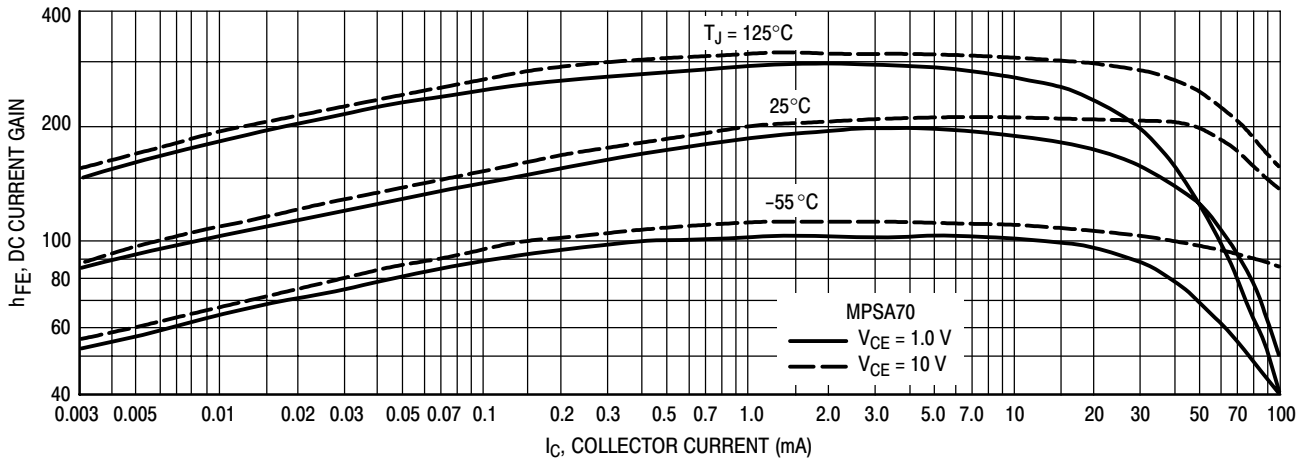


Figure 6. DC Current Gain

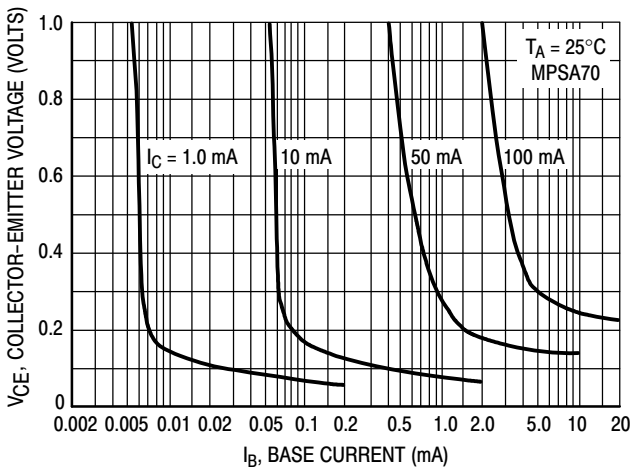


Figure 7. Collector Saturation Region

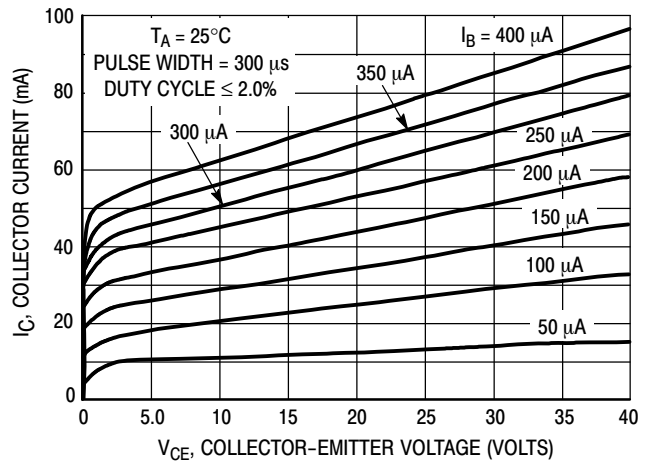


Figure 8. Collector Characteristics

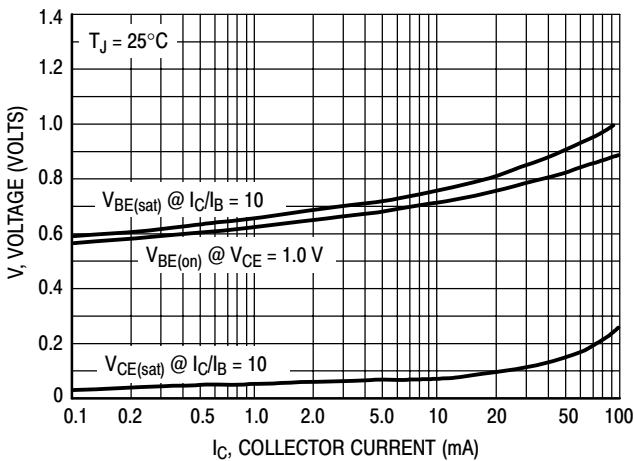


Figure 9. "On" Voltages

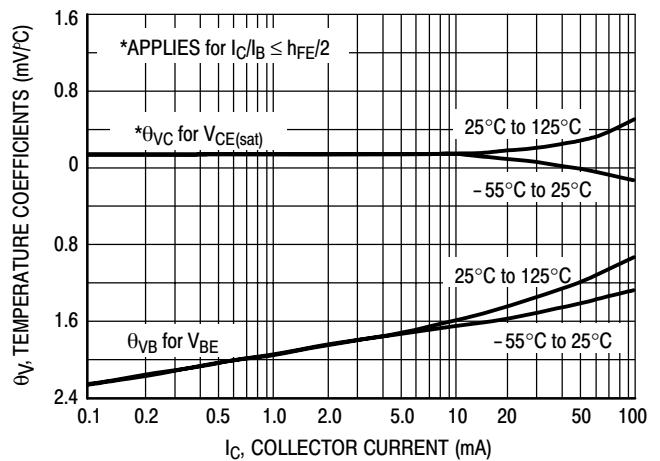


Figure 10. Temperature Coefficients

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## TYPICAL DYNAMIC CHARACTERISTICS

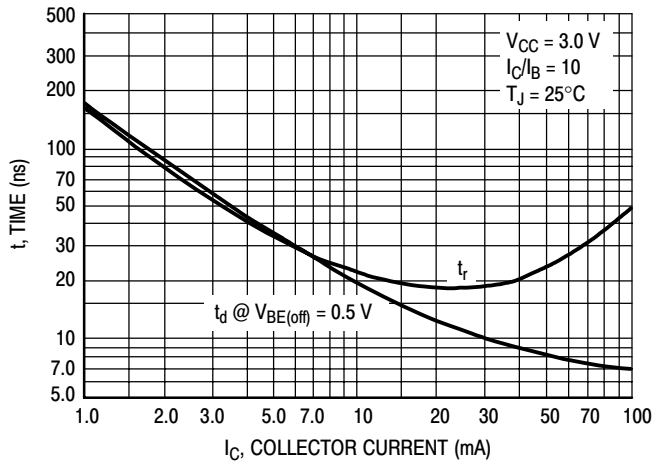


Figure 11. Turn-On Time

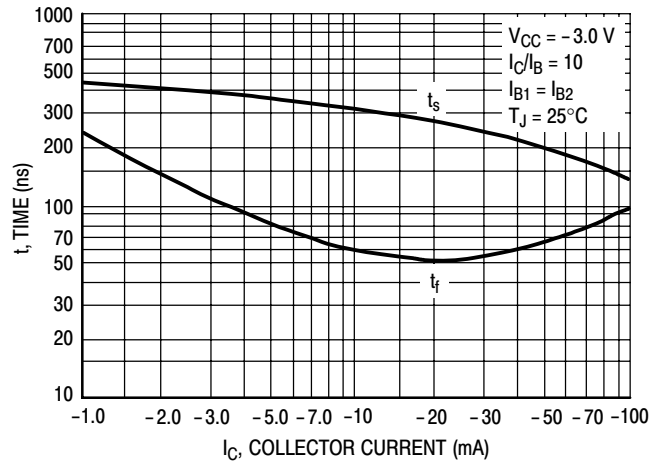


Figure 12. Turn-Off Time

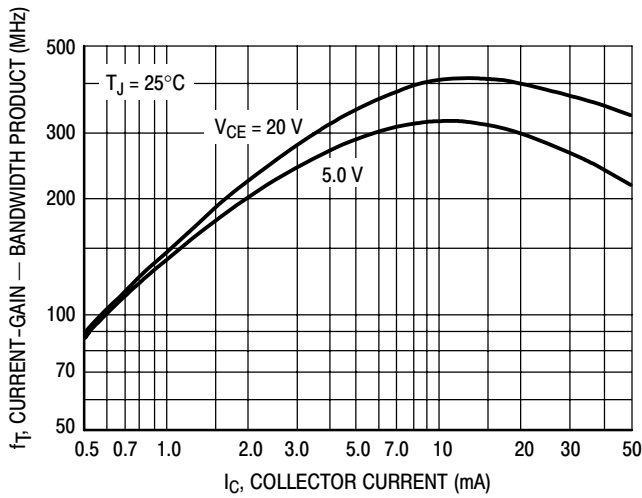


Figure 13. Current-Gain - Bandwidth Product

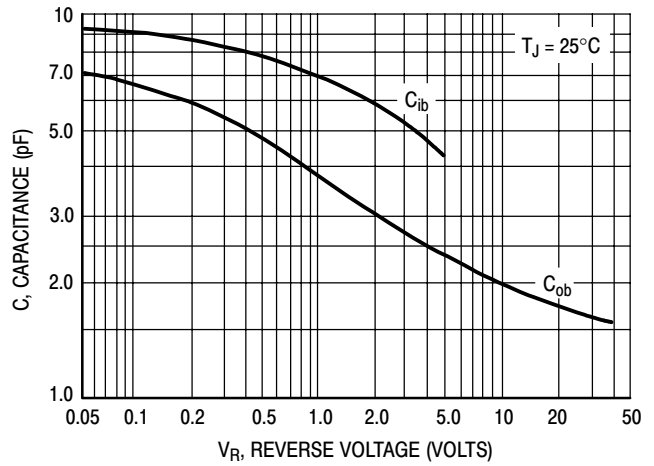


Figure 14. Capacitance

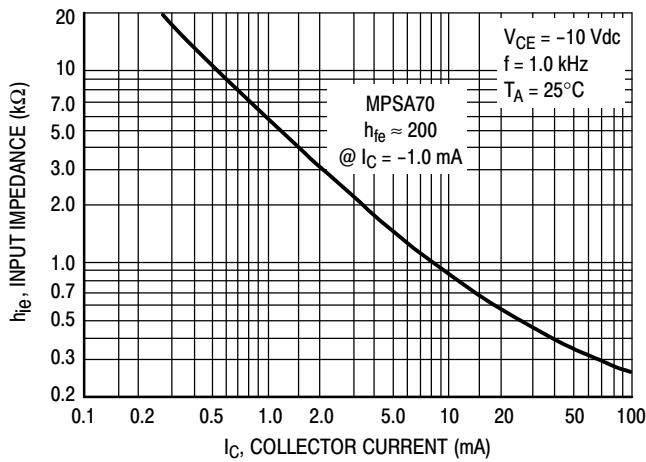


Figure 15. Input Impedance

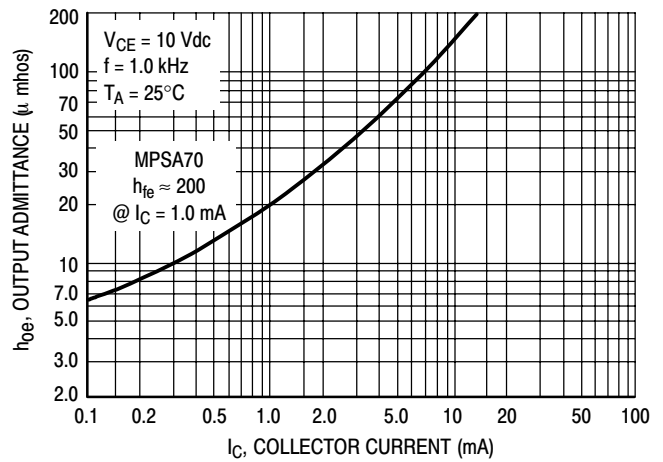


Figure 16. Output Admittance

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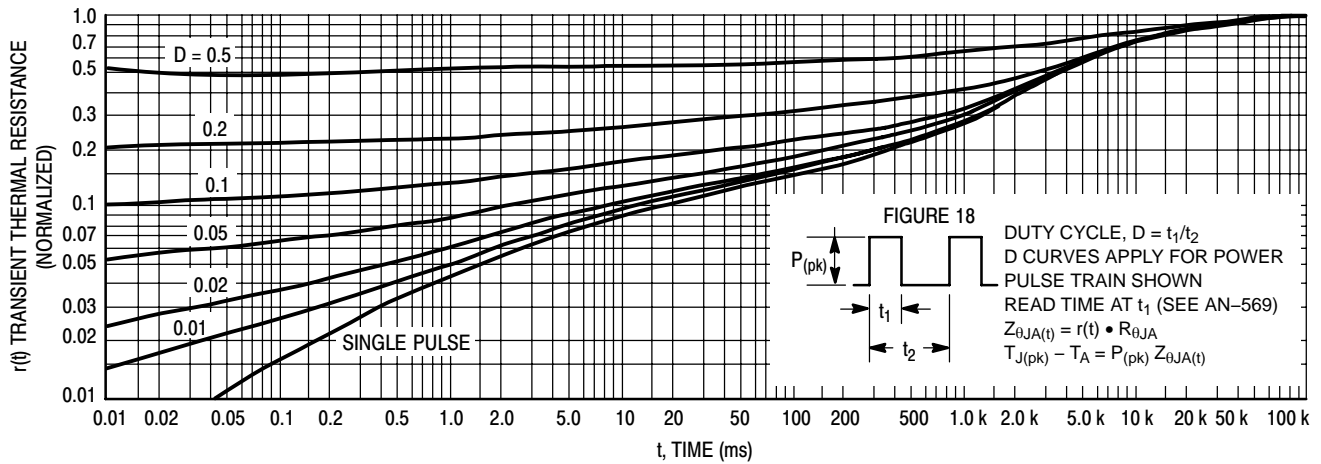


Figure 17. Thermal Response

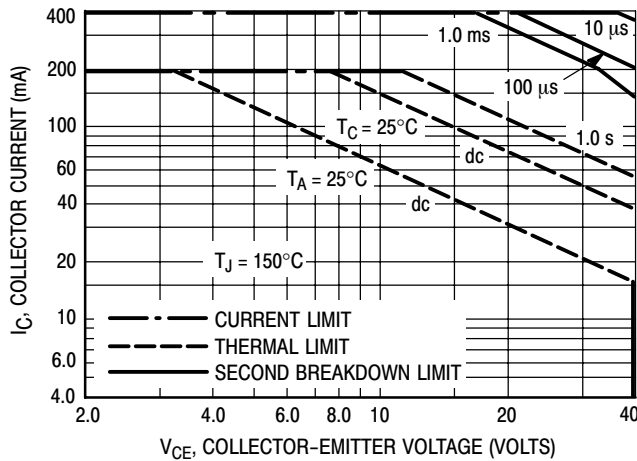


Figure 19. Active-Region Safe Operating Area

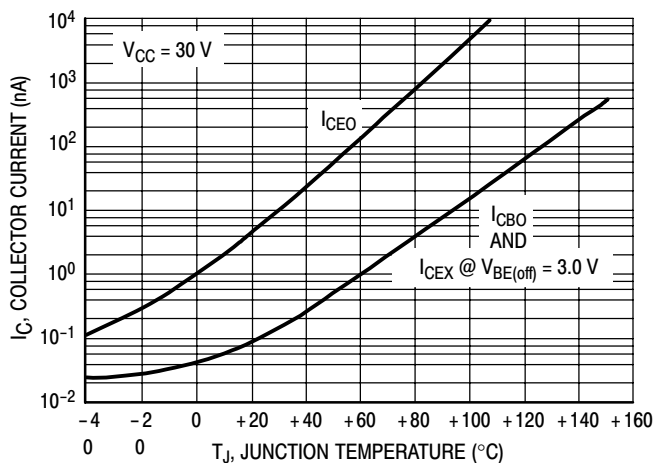


Figure 20. Typical Collector Leakage Current

The safe operating area curves indicate  $I_C$ - $V_{CE}$  limits of the transistor that must be observed for reliable operation. Collector load lines for specific circuits must fall below the limits indicated by the applicable curve.

The data of Figure 18 is based upon  $T_{J(pk)} = 150^\circ\text{C}$ ;  $T_C$  or  $T_A$  is variable depending upon conditions. Pulse curves are valid for duty cycles to 10% provided  $T_{J(pk)} \leq 150^\circ\text{C}$ .  $T_{J(pk)}$  may be calculated from the data in Figure 17. At high case or ambient temperatures, thermal limitations will reduce the power than can be handled to values less than the limitations imposed by second breakdown.

## DESIGN NOTE: USE OF THERMAL RESPONSE DATA

A train of periodical power pulses can be represented by the model as shown in Figure 19. Using the model and the device thermal response the normalized effective transient thermal resistance of Figure 17 was calculated for various duty cycles.

To find  $Z_{\theta JA(t)}$ , multiply the value obtained from Figure 17 by the steady state value  $R_{\theta JA}$ .

Example:

Dissipating 2.0 watts peak under the following conditions:

$$t_1 = 1.0 \text{ ms}, t_2 = 5.0 \text{ ms} (D = 0.2)$$

Using Figure 17 at a pulse width of 1.0 ms and  $D = 0.2$ , the reading of  $r(t)$  is 0.22.

The peak rise in junction temperature is therefore

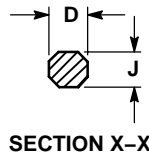
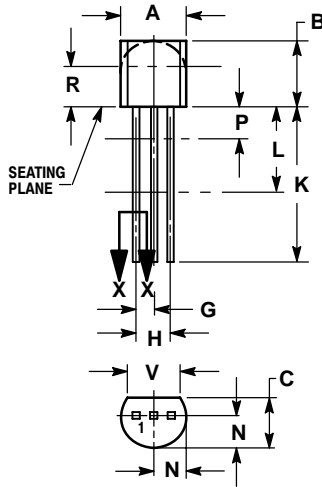
$$\Delta T = r(t) \times P_{(pk)} \times R_{\theta JA} = 0.22 \times 2.0 \times 200 = 88^\circ\text{C}.$$

For more information, see AN569/D.

# MPSA70

## PACKAGE DIMENSIONS

TO-92 (TO-226)  
CASE 29-11  
ISSUE AL




### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.175	0.205	4.45	5.20
B	0.170	0.210	4.32	5.33
C	0.125	0.165	3.18	4.19
D	0.016	0.021	0.407	0.533
G	0.045	0.055	1.15	1.39
H	0.095	0.105	2.42	2.66
J	0.015	0.020	0.39	0.50
K	0.500	---	12.70	---
L	0.250	---	6.35	---
N	0.080	0.105	2.04	2.66
P	---	0.100	---	2.54
R	0.115	---	2.93	---
V	0.135	---	3.43	---

### STYLE 1:

1. PIN 1. EMITTER
2. BASE
3. COLLECTOR

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