

# Silicon Power Transistors

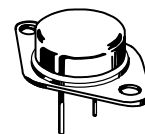
The MJ21193 and MJ21194 utilize Perforated Emitter technology and are specifically designed for high power audio output, disk head positioners and linear applications.

- Total Harmonic Distortion Characterized
- High DC Current Gain –  $h_{FE} = 25$  Min @  $I_C = 8$  Adc
- Excellent Gain Linearity
- High SOA: 2.5 A, 80 V, 1 Second

**PNP**  
**MJ21193\***  
**NPN**  
**MJ21194\***

\*Motorola Preferred Device

**16 AMPERE**  
**COMPLEMENTARY**  
**SILICON POWER**  
**TRANSISTORS**  
**250 VOLTS**  
**250 WATTS**



**CASE 1-07**  
**TO-204AA**  
**(TO-3)**

## MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CEO}$	250	Vdc
Collector-Base Voltage	$V_{CBO}$	400	Vdc
Emitter-Base Voltage	$V_{EBO}$	5	Vdc
Collector-Emitter Voltage – 1.5 V	$V_{CEX}$	400	Vdc
Collector Current — Continuous Peak (1)	$I_C$	16 30	Adc
Base Current — Continuous	$I_B$	5	Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate Above $25^\circ\text{C}$	$P_D$	250 1.43	Watts W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	– 65 to +200	$^\circ\text{C}$

## THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.7	$^\circ\text{C/W}$

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

Characteristic	Symbol	Min	Typical	Max	Unit
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## OFF CHARACTERISTICS

Collector-Emitter Sustaining Voltage ( $I_C = 100$ mAdc, $I_B = 0$ )	$V_{CEO(sus)}$	250	—	—	Vdc
Collector Cutoff Current ( $V_{CE} = 200$ Vdc, $I_B = 0$ )	$I_{CEO}$	—	—	100	$\mu\text{Adc}$

(1) Pulse Test: Pulse Width = 5  $\mu\text{s}$ , Duty Cycle  $\leq 10\%$ .

(continued)

Preferred devices are Motorola recommended choices for future use and best overall value.

REV 1

# MJ21193 MJ21194

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

Characteristic	Symbol	Min	Typical	Max	Unit
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### OFF CHARACTERISTICS

Emitter Cutoff Current ( $V_{CE} = 5 \text{ Vdc}$ , $I_C = 0$ )	$I_{EBO}$	—	—	100	$\mu\text{Adc}$
Collector Cutoff Current ( $V_{CE} = 250 \text{ Vdc}$ , $V_{BE(\text{off})} = 1.5 \text{ Vdc}$ )	$I_{CEX}$	—	—	100	$\mu\text{Adc}$

### SECOND BREAKDOWN

Second Breakdown Collector Current with Base Forward Biased ( $V_{CE} = 50 \text{ Vdc}$ , $t = 1 \text{ s}$ (non-repetitive)) ( $V_{CE} = 80 \text{ Vdc}$ , $t = 1 \text{ s}$ (non-repetitive))	$I_{S/b}$	5 2.5	— —	— —	$\text{Adc}$
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### ON CHARACTERISTICS

DC Current Gain ( $I_C = 8 \text{ Adc}$ , $V_{CE} = 5 \text{ Vdc}$ ) ( $I_C = 16 \text{ Adc}$ , $I_B = 5 \text{ Adc}$ )	$h_{FE}$	25 8	— —	75	
Base-Emitter On Voltage ( $I_C = 8 \text{ Adc}$ , $V_{CE} = 5 \text{ Vdc}$ )	$V_{BE(\text{on})}$	—	—	2.2	$\text{Vdc}$
Collector-Emitter Saturation Voltage ( $I_C = 8 \text{ Adc}$ , $I_B = 0.8 \text{ Adc}$ ) ( $I_C = 16 \text{ Adc}$ , $I_B = 3.2 \text{ Adc}$ )	$V_{CE(\text{sat})}$	— —	— —	1.4 4	$\text{Vdc}$

### DYNAMIC CHARACTERISTICS

Total Harmonic Distortion at the Output $V_{RMS} = 28.3 \text{ V}$ , $f = 1 \text{ kHz}$ , $P_{LOAD} = 100 \text{ W}_{RMS}$ (Matched pair $h_{FE} = 50 @ 5 \text{ A/5 V}$ )	$T_{HD}$	— —	0.8 0.08	— —	%
Current Gain Bandwidth Product ( $I_C = 1 \text{ Adc}$ , $V_{CE} = 10 \text{ Vdc}$ , $f_{\text{test}} = 1 \text{ MHz}$ )	$f_T$	4	—	—	$\text{MHz}$
Output Capacitance ( $V_{CB} = 10 \text{ Vdc}$ , $I_E = 0$ , $f_{\text{test}} = 1 \text{ MHz}$ )	$C_{ob}$	—	—	500	$\text{pF}$

(1) Pulse Test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle  $\leq 2\%$

PNP MJ21193

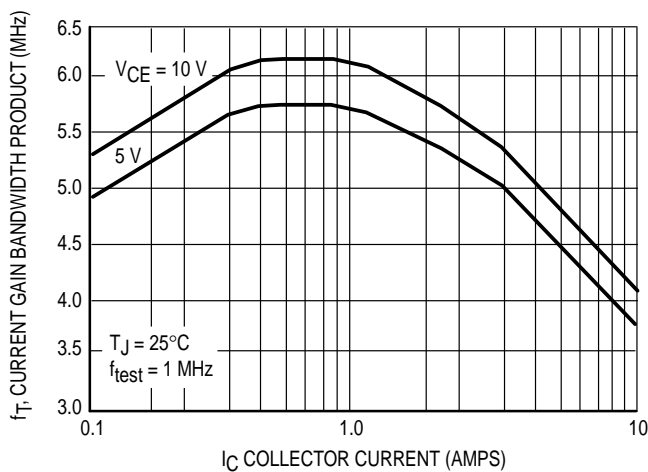


Figure 1. Typical Current Gain Bandwidth Product

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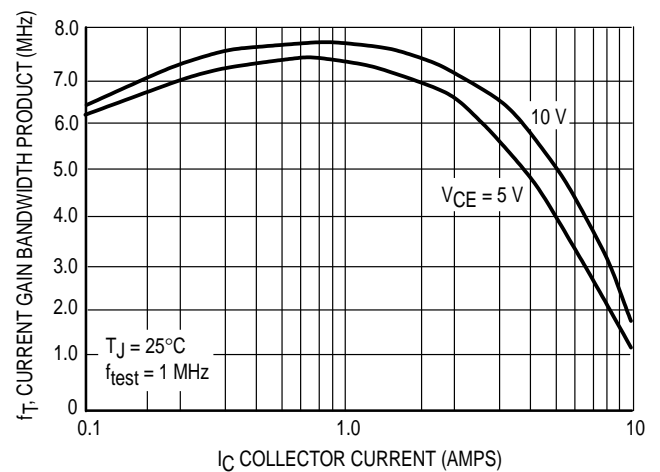


Figure 2. Typical Current Gain Bandwidth Product

# TYPICAL CHARACTERISTICS

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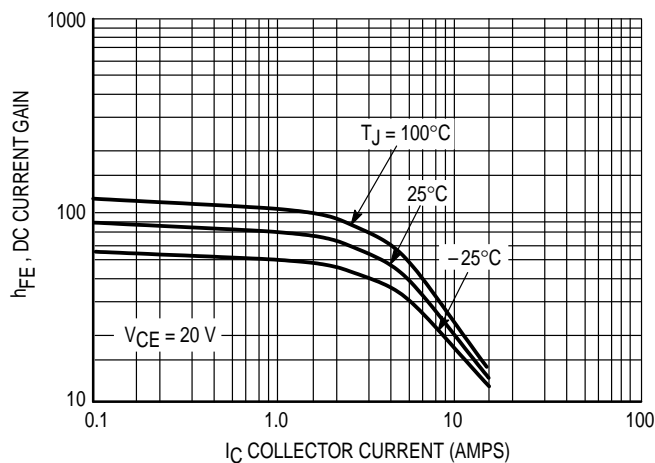


Figure 3. DC Current Gain,  $V_{CE} = 20\text{ V}$

NPN MJ21194

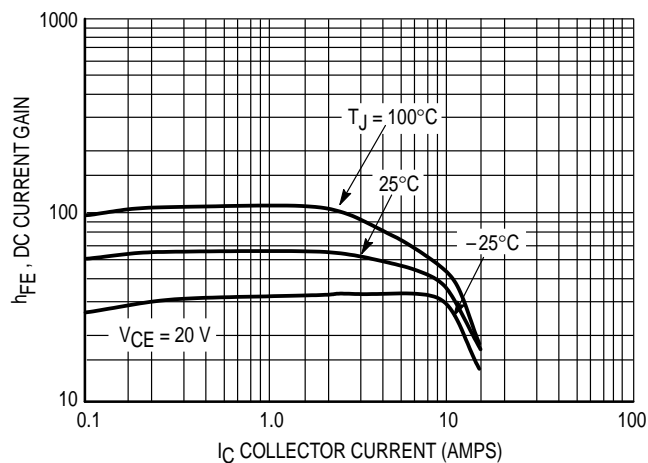


Figure 4. DC Current Gain,  $V_{CE} = 20\text{ V}$

PNP MJ21193

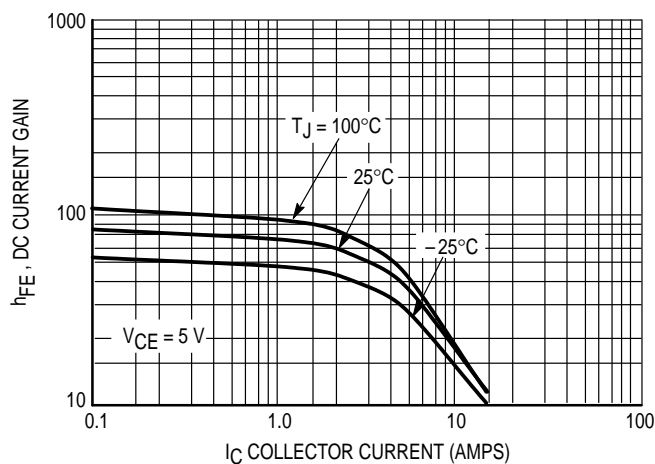


Figure 5. DC Current Gain,  $V_{CE} = 5\text{ V}$

NPN MJ21194

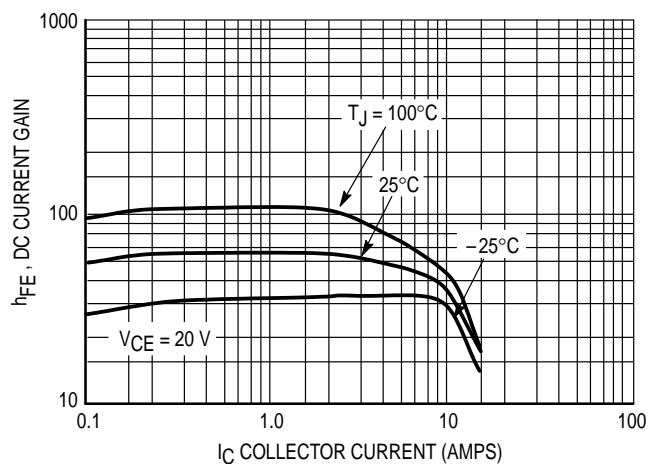


Figure 6. DC Current Gain,  $V_{CE} = 5\text{ V}$

PNP MJ21193

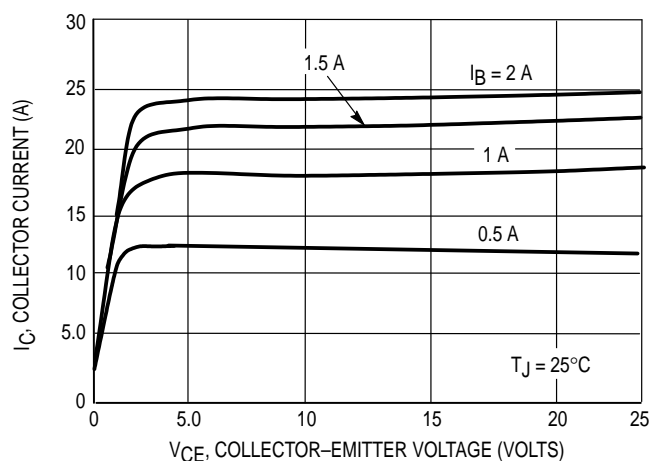


Figure 7. Typical Output Characteristics

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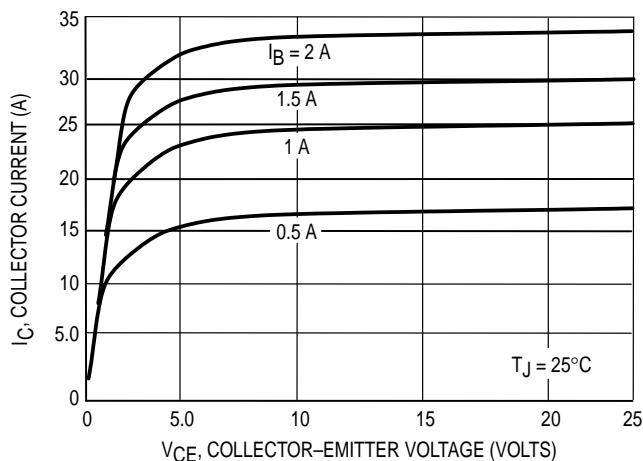


Figure 8. Typical Output Characteristics

## TYPICAL CHARACTERISTICS

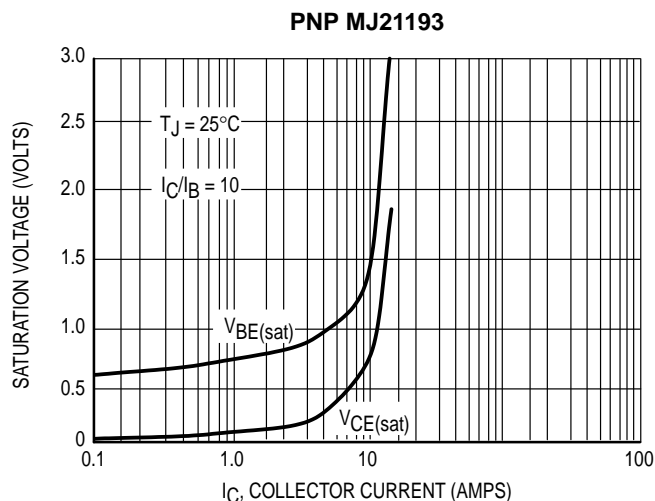


Figure 9. Typical Saturation Voltages

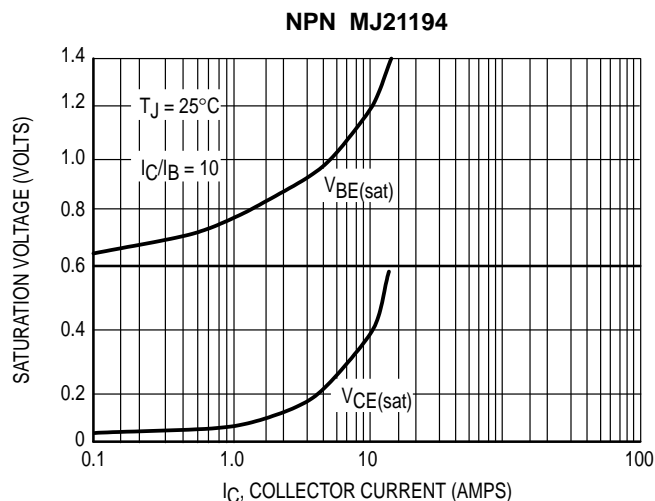


Figure 10. Typical Saturation Voltages

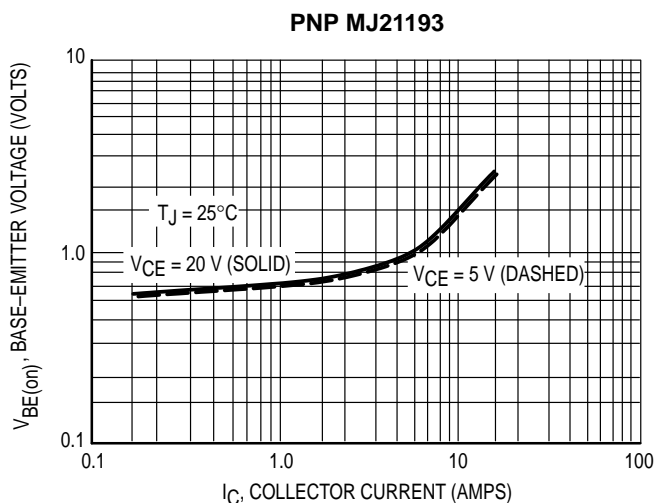


Figure 11. Typical Base-Emitter Voltage

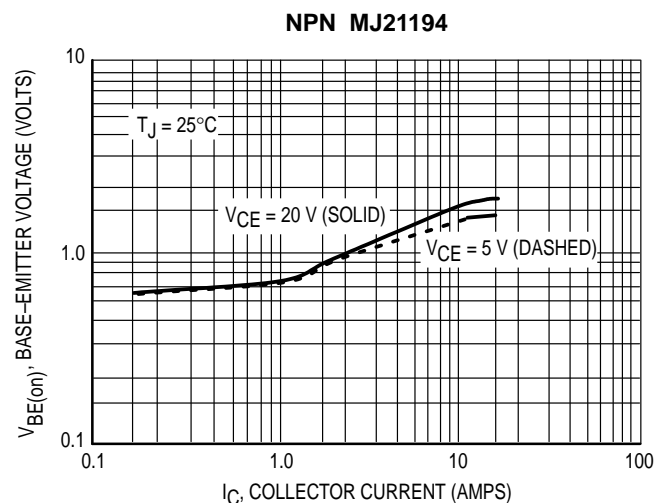


Figure 12. Typical Base-Emitter Voltage

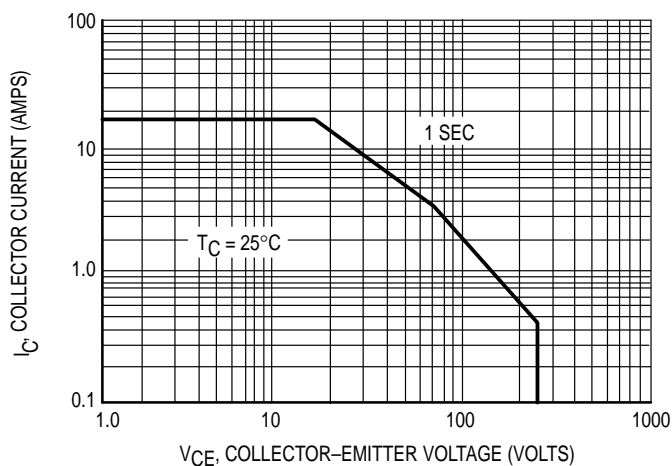


Figure 13. Active Region Safe Operating Area

There are two limitations on the power handling ability of a transistor; average junction temperature and secondary 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 13 is based on  $T_{J(pk)} = 200^\circ\text{C}$ ;  $T_C$  is variable depending on conditions. At high case temperatures, thermal limitations will reduce the power than can be handled to values less than the limitations imposed by second breakdown.

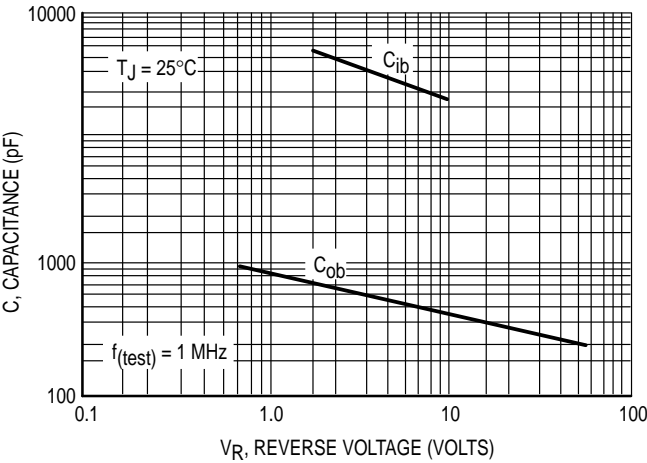


Figure 14. MJ21193 Typical Capacitance

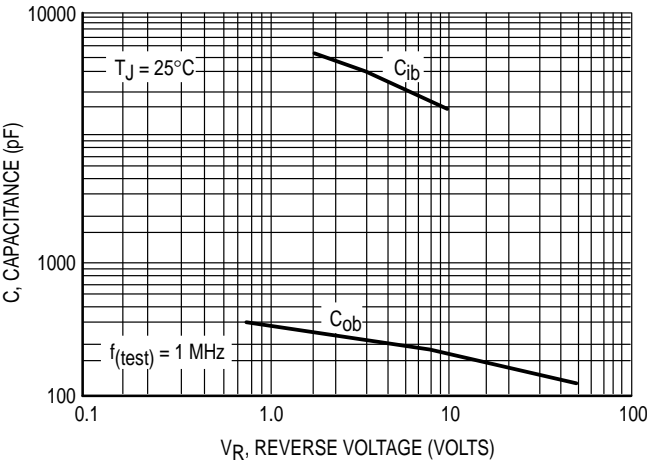


Figure 15. MJ21194 Typical Capacitance

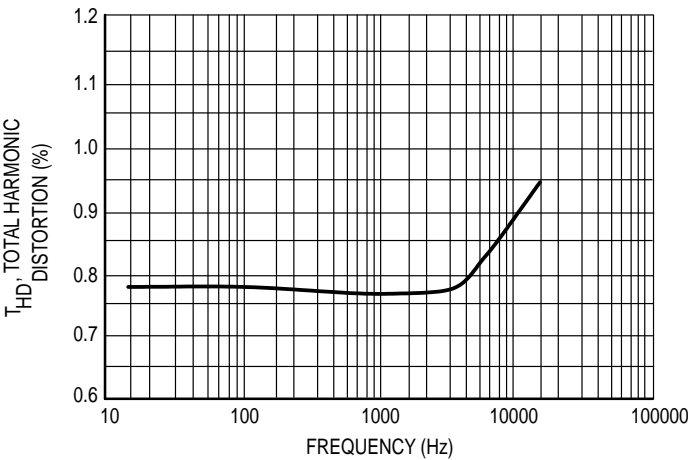


Figure 16. Typical Total Harmonic Distortion

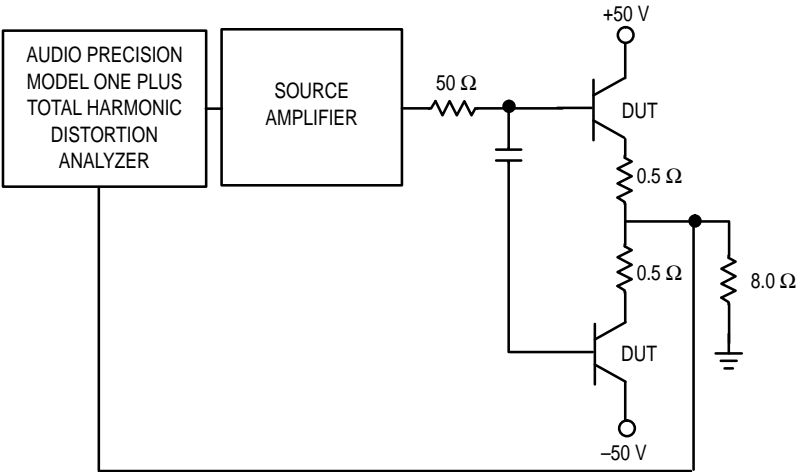
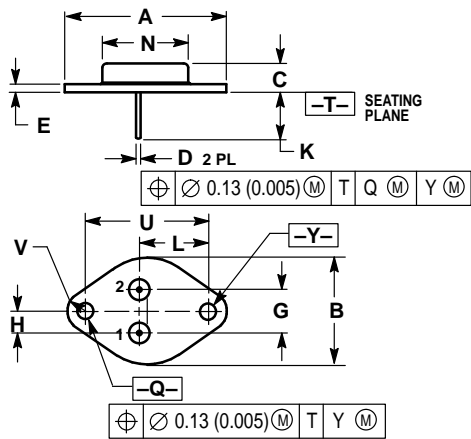


Figure 17. Total Harmonic Distortion Test Circuit

PACKAGE DIMENSIONS




- NOTES:
- 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  - 2. CONTROLLING DIMENSION: INCH.
  - 3. ALL RULES AND NOTES ASSOCIATED WITH REFERENCED TO-204AA OUTLINE SHALL APPLY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.550 REF		39.37 REF	
B	—	1.050	—	26.67
C	0.250	0.335	6.35	8.51
D	0.038	0.043	0.97	1.09
E	0.055	0.070	1.40	1.77
G	0.430 BSC		10.92 BSC	
H	0.215 BSC		5.46 BSC	
K	0.440	0.480	11.18	12.19
L	0.665 BSC		16.89 BSC	
N	—	0.830	—	21.08
Q	0.151	0.165	3.84	4.19
U	1.187 BSC		30.15 BSC	
V	0.131	0.188	3.33	4.77

STYLE 1:  
PIN 1: BASE  
2: EMITTER  
CASE: COLLECTOR

CASE 1-07  
TO-204AA (TO-3)  
ISSUE Z

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