

# MJL21193 (PNP), MJL21194 (NPN)

## Silicon Power Transistors

The MJL21193 and MJL21194 utilize Perforated Emitter technology and are specifically designed for high power audio output, disk head positioners and linear applications.

### Features

- Total Harmonic Distortion Characterized
- High DC Current Gain
- Excellent Gain Linearity
- High SOA
- These Devices are Pb-Free and are RoHS Compliant\*

### 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	$I_C$	16	Adc
Collector Current - Peak (Note 1)	$I_{CM}$	30	Adc
Base Current - Continuous	$I_B$	5	Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	200 1.43	W W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-65 to +150	$^\circ\text{C}$

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.

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

### THERMAL CHARACTERISTICS

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

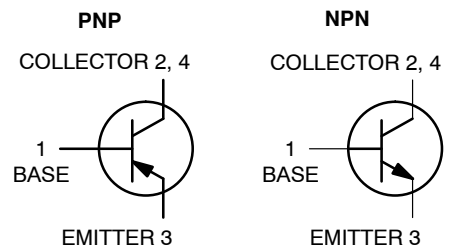
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



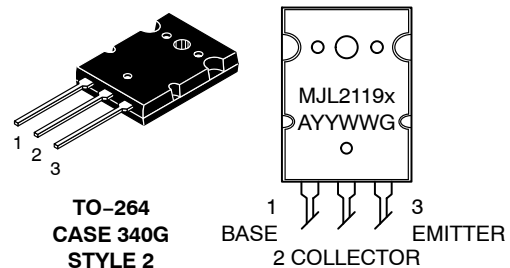
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## 16 AMPERE COMPLEMENTARY SILICON POWER TRANSISTORS 250 VOLTS, 200 WATTS



### MARKING DIAGRAM



x = 3 or 4  
A = Assembly Location  
YY = Year  
WW = Work Week  
G = Pb-Free Package

### ORDERING INFORMATION

Device	Package	Shipping†
MJL21193G	TO-264 (Pb-Free)	25 Units / Rail
MJL21194G	TO-264 (Pb-Free)	25 Units / Rail

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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

Characteristic	Symbol	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Collector–Emitter Sustaining Voltage ( $I_C = 100\text{ mA}$ , $I_B = 0$ )	$V_{CE(sus)}$	250	–	–	Vdc
Collector Cutoff Current ( $V_{CE} = 200\text{ Vdc}$ , $I_B = 0$ )	$I_{CEO}$	–	–	100	$\mu\text{A}$ dc
Emitter Cutoff Current ( $V_{CE} = 5\text{ Vdc}$ , $I_C = 0$ )	$I_{EBO}$	–	–	100	$\mu\text{A}$ dc
Collector Cutoff Current ( $V_{CE} = 250\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ )	$I_{CEX}$	–	–	100	$\mu\text{A}$ dc

### 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))	$I_{S/b}$	4.0 2.25	– –	– –	A
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### ON CHARACTERISTICS

DC Current Gain ( $I_C = 8\text{ A}$ , $V_{CE} = 5\text{ Vdc}$ ) ( $I_C = 16\text{ A}$ , $I_B = 5\text{ A}$ )	$h_{FE}$	25 8	– –	75 –	
Base–Emitter On Voltage ( $I_C = 8\text{ A}$ , $V_{CE} = 5\text{ Vdc}$ )	$V_{BE(on)}$	–	–	2.2	Vdc
Collector–Emitter Saturation Voltage ( $I_C = 8\text{ A}$ , $I_B = 0.8\text{ A}$ ) ( $I_C = 16\text{ A}$ , $I_B = 3.2\text{ A}$ )	$V_{CE(sat)}$	– –	– –	1.4 4	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 $h_{FE} = 50 @ 5\text{ A}/5\text{ V}$ )	$T_{HD}$				%
$h_{FE}$ unmatched		–	0.8	–	
$h_{FE}$ matched		–	0.08	–	
Current Gain Bandwidth Product ( $I_C = 1\text{ A}$ , $V_{CE} = 10\text{ Vdc}$ , $f_{test} = 1\text{ MHz}$ )	$f_T$	4	–	–	MHz
Output Capacitance ( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f_{test} = 1\text{ MHz}$ )	$C_{ob}$	–	–	500	pF

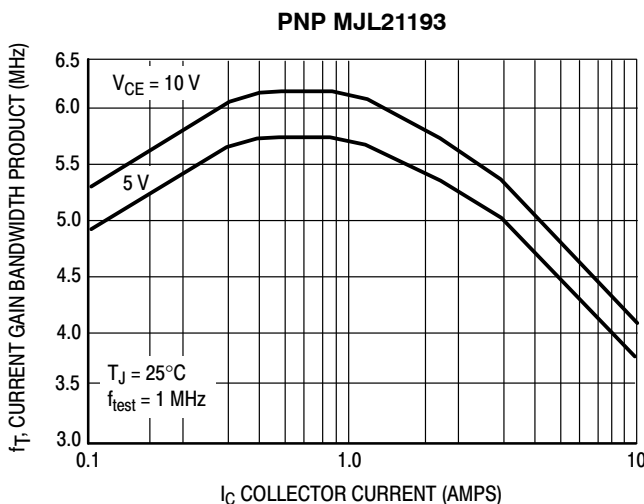


Figure 1. Typical Current Gain Bandwidth Product

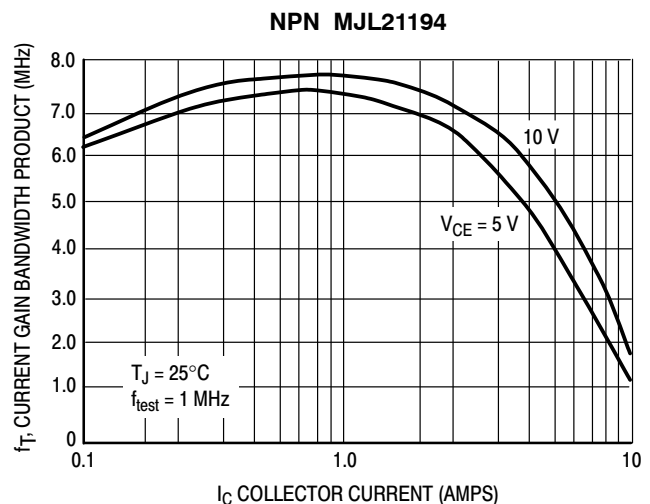
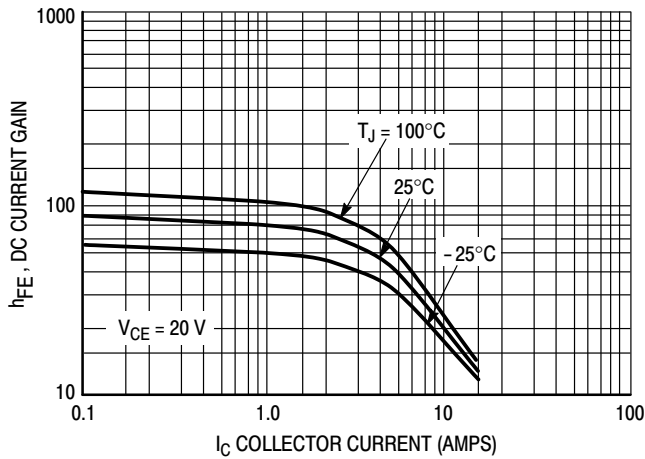


Figure 2. Typical Current Gain Bandwidth Product

# MJL21193 (PNP), MJL21194 (NPN)

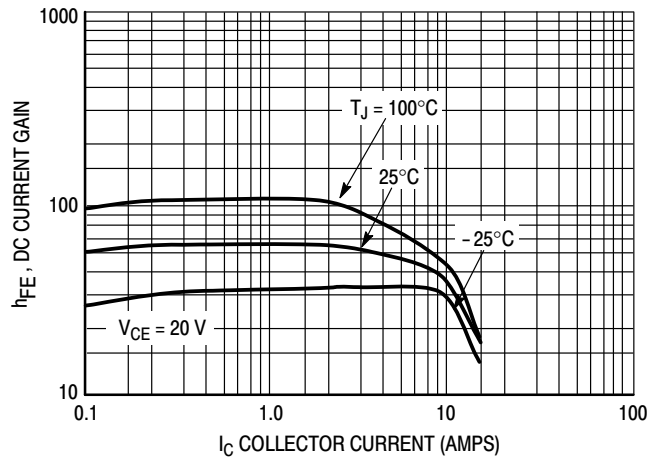
## TYPICAL CHARACTERISTICS

**PNP MJL21193**



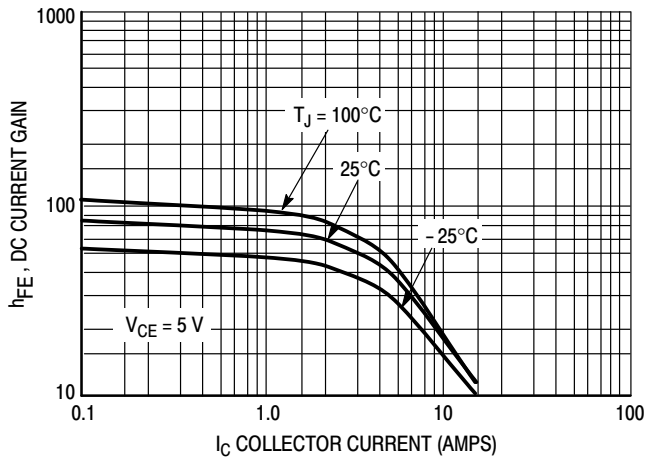
**Figure 3. DC Current Gain,  $V_{CE} = 20\text{ V}$**

**NPN MJL21194**



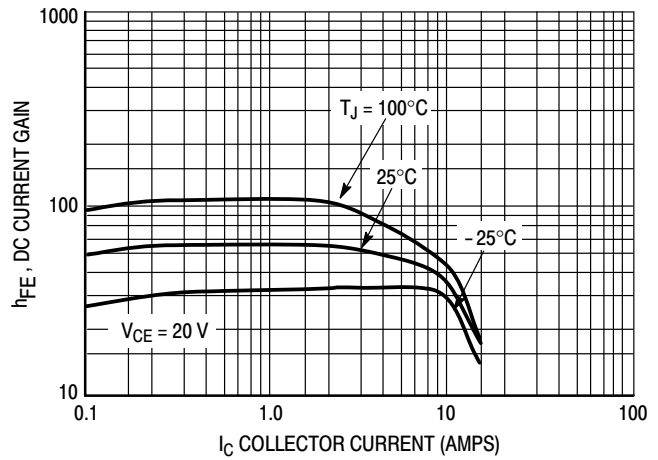
**Figure 4. DC Current Gain,  $V_{CE} = 20\text{ V}$**

**PNP MJL21193**



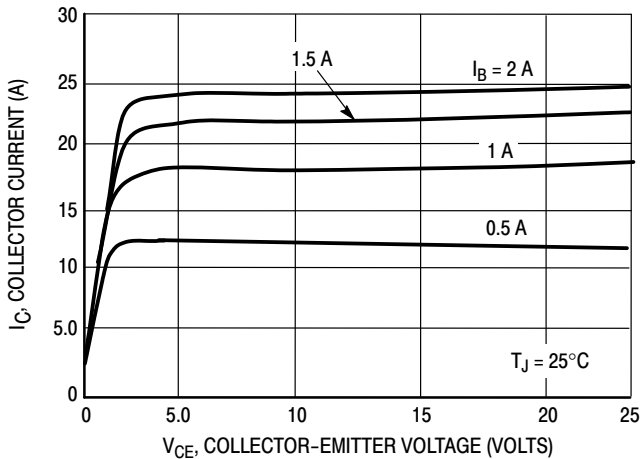
**Figure 5. DC Current Gain,  $V_{CE} = 5\text{ V}$**

**NPN MJL21194**



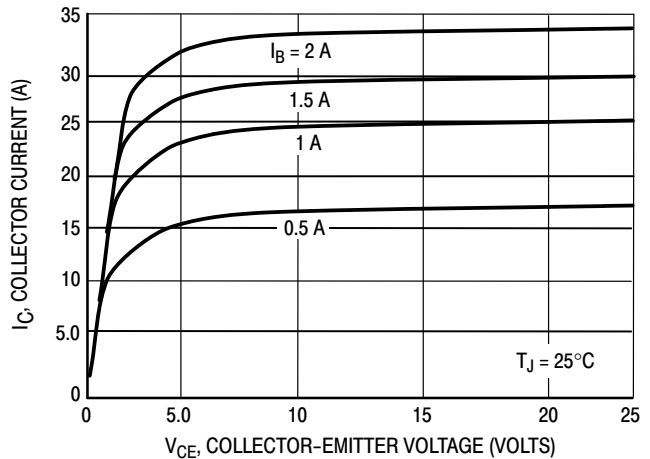
**Figure 6. DC Current Gain,  $V_{CE} = 5\text{ V}$**

**PNP MJL21193**



**Figure 7. Typical Output Characteristics**

**NPN MJL21194**



**Figure 8. Typical Output Characteristics**

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## TYPICAL CHARACTERISTICS

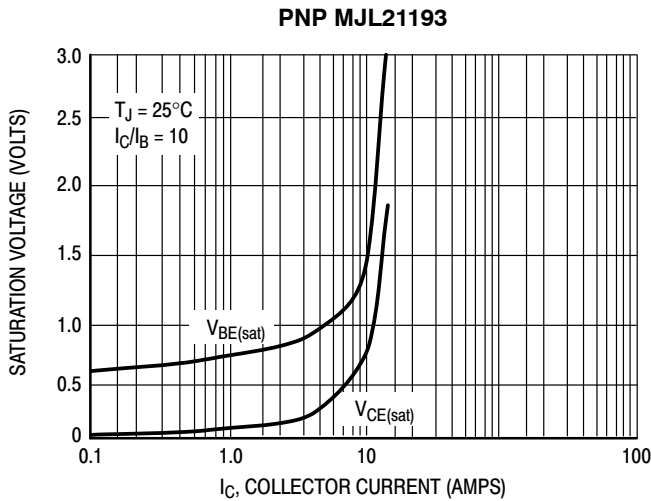


Figure 9. Typical Saturation Voltages

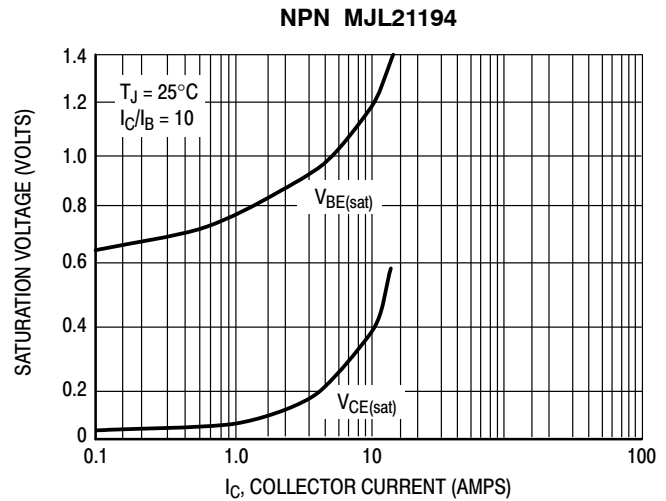


Figure 10. Typical Saturation Voltages

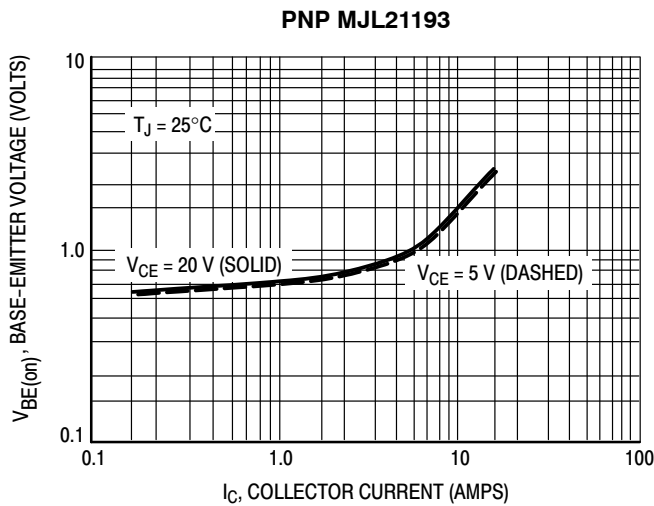


Figure 11. Typical Base-Emitter Voltage

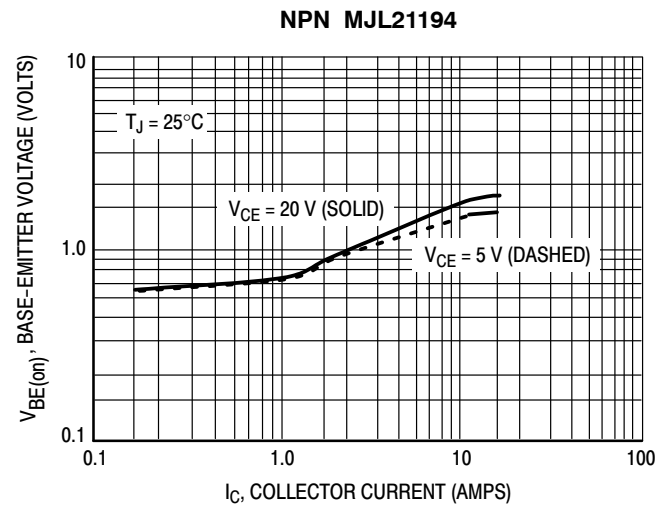


Figure 12. Typical Base-Emitter Voltage

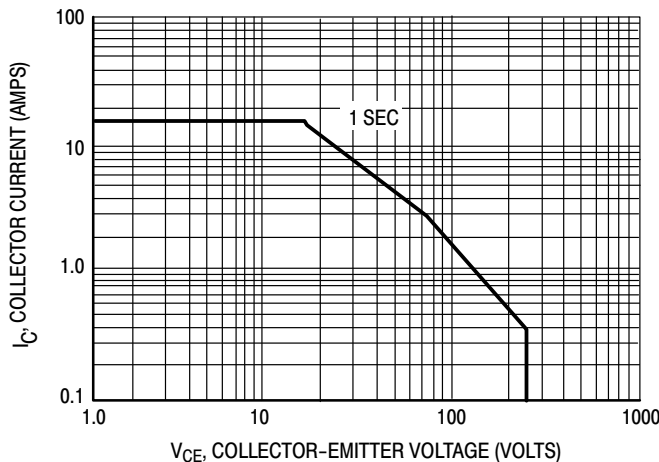


Figure 13. Active Region Safe Operating Area

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  $T_{J(pk)} = 150^\circ\text{C}$ ;  $T_C$  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.

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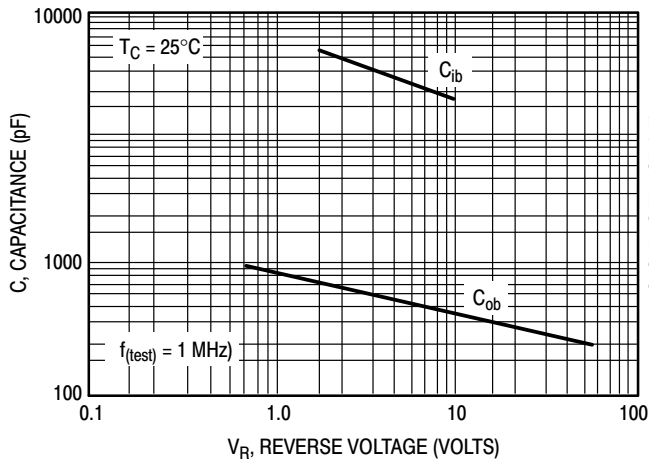


Figure 14. MJL21193 Typical Capacitance

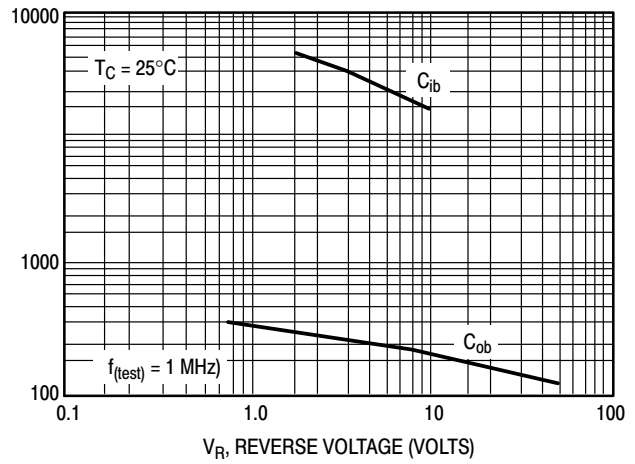


Figure 15. MJL21194 Typical Capacitance

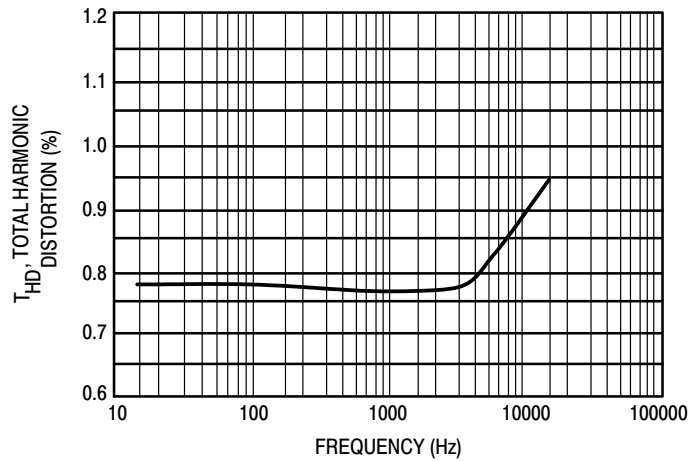


Figure 16. Typical Total Harmonic Distortion

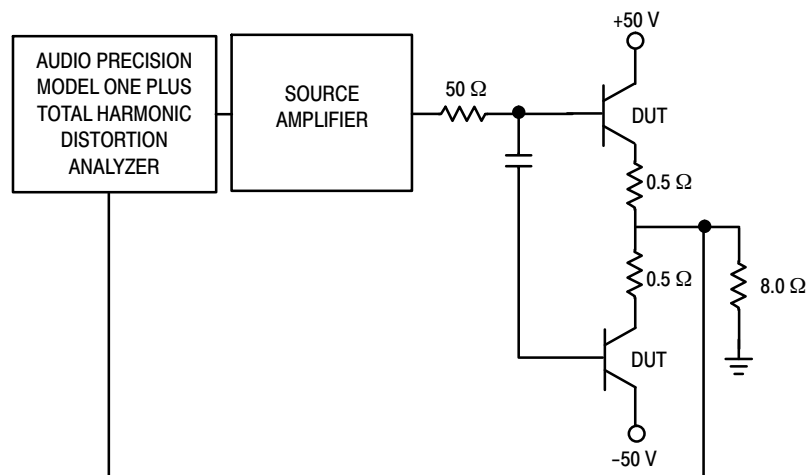
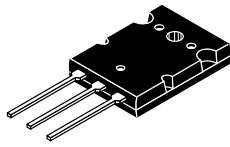


Figure 17. Total Harmonic Distortion Test Circuit

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

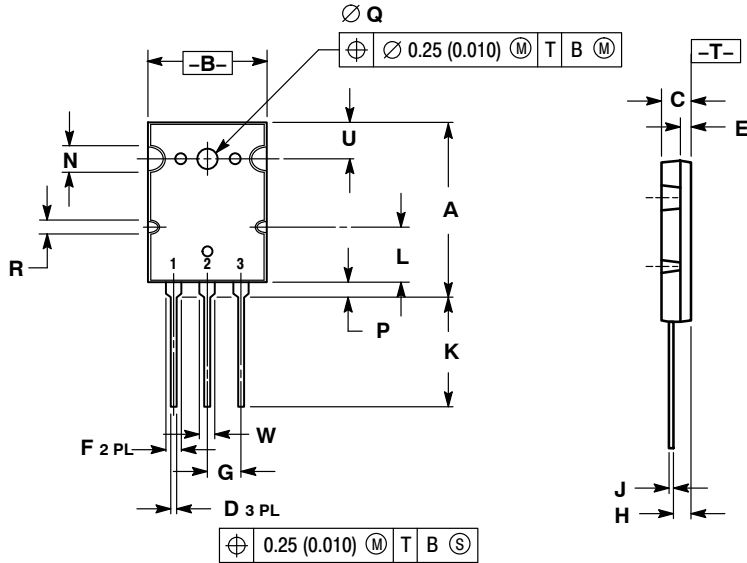
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**TO-3BPL (TO-264)**  
**CASE 340G-02**  
**ISSUE J**

DATE 17 DEC 2004

SCALE 1:2

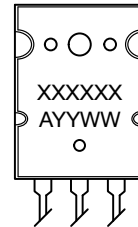


- NOTES:  
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
 2. CONTROLLING DIMENSION: MILLIMETER.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	28.0	29.0	1.102	1.142
B	19.3	20.3	0.760	0.800
C	4.7	5.3	0.185	0.209
D	0.93	1.48	0.037	0.058
E	1.9	2.1	0.075	0.083
F	2.2	2.4	0.087	0.102
G	5.45 BSC		0.215 BSC	
H	2.6	3.0	0.102	0.118
J	0.43	0.78	0.017	0.031
K	17.6	18.8	0.693	0.740
L	11.2 REF		0.411 REF	
N	4.35 REF		0.172 REF	
P	2.2	2.6	0.087	0.102
Q	3.1	3.5	0.122	0.137
R	2.25 REF		0.089 REF	
U	6.3 REF		0.248 REF	
W	2.8	3.2	0.110	0.125

### GENERIC MARKING DIAGRAM\*

- |   |  |   |   |  |
|---|--|---|---|--|
| <p>STYLE 1:<br/>                 PIN 1. GATE<br/>                 2. DRAIN<br/>                 3. SOURCE</p> | <p>STYLE 2:<br/>                 PIN 1. BASE<br/>                 2. COLLECTOR<br/>                 3. EMITTER</p> | <p>STYLE 3:<br/>                 PIN 1. GATE<br/>                 2. SOURCE<br/>                 3. DRAIN</p> | <p>STYLE 4:<br/>                 PIN 1. DRAIN<br/>                 2. SOURCE<br/>                 3. GATE</p> | <p>STYLE 5:<br/>                 PIN 1. GATE<br/>                 2. COLLECTOR<br/>                 3. EMITTER</p> |
|---|--|---|---|--|



- XXXXXX = Specific Device Code
- A = Location Code
- YY = Year
- WW = Work Week

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present.

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