

# ON Semiconductor

## Is Now



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# NJL3281D (NPN) NJL1302D (PNP)

## Complementary ThermalTrak™ Transistors

The ThermalTrak family of devices has been designed to eliminate thermal equilibrium lag time and bias trimming in audio amplifier applications. They can also be used in other applications as transistor die protection devices.

### Features

- Thermally Matched Bias Diode
- Instant Thermal Bias Tracking
- Absolute Thermal Integrity
- High Safe Operating Area
- Pb-Free Packages are Available\*

### Benefits

- Eliminates Thermal Equilibrium Lag Time and Bias Trimming
- Superior Sound Quality Through Improved Dynamic Temperature Response
- Significantly Improved Bias Stability
- Simplified Assembly
  - ♦ Reduced Labor Costs
  - ♦ Reduced Component Count
- High Reliability

### Applications

- High-End Consumer Audio Products
  - ♦ Home Amplifiers
  - ♦ Home Receivers
- Professional Audio Amplifiers
  - ♦ Theater and Stadium Sound Systems
  - ♦ Public Address Systems (PAs)

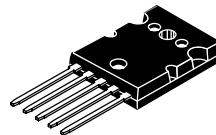


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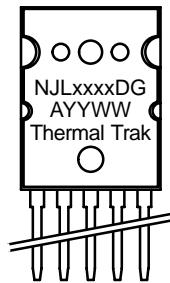
### BIPOLAR POWER TRANSISTORS

15 AMP, 260 VOLT, 200 WATT

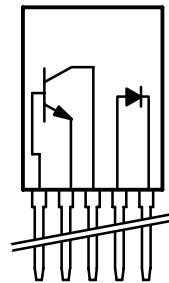


TO-264, 5 LEAD  
CASE 340AA  
STYLE 1

### MARKING DIAGRAM



### SCHEMATIC



NJLxxxxD = Device Code  
xxxx = 3281 or 1302  
G = Pb-Free Package  
A = Assembly Location  
YY = Year  
WW = Work Week

### ORDERING INFORMATION

Device	Package	Shipping
NJL3281D	TO-264	25 Units / Rail
NJL3281DG	TO-264 (Pb-Free)	25 Units / Rail
NJL1302D	TO-264	25 Units / Rail
NJL1302DG	TO-264 (Pb-Free)	25 Units / Rail

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

# NJL3281D (NPN) NJL1302D (PNP)

**MAXIMUM RATINGS** ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CEO}$	260	Vdc
Collector-Base Voltage	$V_{CBO}$	260	Vdc
Emitter-Base Voltage	$V_{EBO}$	5	Vdc
Collector-Emitter Voltage – 1.5 V	$V_{CEX}$	260	Vdc
Collector Current – Continuous – Peak (Note 1)	$I_C$	15 25	Adc
Base Current – Continuous	$I_B$	1.5	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	$^\circ\text{C}$
DC Blocking Voltage	$V_R$	200	V
Average Rectified Forward Current	$I_{F(AV)}$	1.0	A

## **THERMAL CHARACTERISTICS**

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	0.625	$^\circ\text{C}/\text{W}$

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.

1. Pulse Test: Pulse Width = 5 ms, Duty Cycle < 10%.

## **ATTRIBUTES**

Characteristic	Value
ESD Protection	Human Body Model Machine Model
Flammability Rating	UL 94 V-0 @ 0.125 in

# NJL3281D (NPN) NJL1302D (PNP)

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

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector-Emitter Sustaining Voltage ( $I_C = 100 \text{ mA}_\text{dc}$ , $I_B = 0$ )	$V_{\text{CEO}(\text{sus})}$	260	–	$\text{V}_\text{dc}$
Collector Cutoff Current ( $V_{\text{CB}} = 260 \text{ V}_\text{dc}$ , $I_E = 0$ )	$I_{\text{CBO}}$	–	50	$\mu\text{A}_\text{dc}$
Emitter Cutoff Current ( $V_{\text{EB}} = 5 \text{ V}_\text{dc}$ , $I_C = 0$ )	$I_{\text{EBO}}$	–	5	$\mu\text{A}_\text{dc}$
<b>ON CHARACTERISTICS</b>				
DC Current Gain ( $I_C = 500 \text{ mA}_\text{dc}$ , $V_{\text{CE}} = 5 \text{ V}_\text{dc}$ ) ( $I_C = 1 \text{ Adc}$ , $V_{\text{CE}} = 5 \text{ V}_\text{dc}$ ) ( $I_C = 3 \text{ Adc}$ , $V_{\text{CE}} = 5 \text{ V}_\text{dc}$ ) ( $I_C = 5 \text{ Adc}$ , $V_{\text{CE}} = 5 \text{ V}_\text{dc}$ ) ( $I_C = 8 \text{ Adc}$ , $V_{\text{CE}} = 5 \text{ V}_\text{dc}$ )	$h_{\text{FE}}$	75 75 75 75 45	150 150 150 150 –	
Collector-Emitter Saturation Voltage ( $I_C = 10 \text{ Adc}$ , $I_B = 1 \text{ Adc}$ )	$V_{\text{CE}(\text{sat})}$	–	3	$\text{V}_\text{dc}$
<b>DYNAMIC CHARACTERISTICS</b>				
Current-Gain – Bandwidth Product ( $I_C = 1 \text{ Adc}$ , $V_{\text{CE}} = 5 \text{ V}_\text{dc}$ , $f_{\text{test}} = 1 \text{ MHz}$ )	$f_T$	30	–	MHz
Output Capacitance ( $V_{\text{CB}} = 10 \text{ V}_\text{dc}$ , $I_E = 0$ , $f_{\text{test}} = 1 \text{ MHz}$ )	$C_{\text{ob}}$	–	600	pF
Maximum Instantaneous Forward Voltage (Note 2) ( $i_F = 1.0 \text{ A}$ , $T_J = 25^\circ\text{C}$ ) ( $i_F = 1.0 \text{ A}$ , $T_J = 150^\circ\text{C}$ )	$V_F$		1.1 0.93	V
Maximum Instantaneous Reverse Current (Note 2) (Rated dc Voltage, $T_J = 25^\circ\text{C}$ ) (Rated dc Voltage, $T_J = 150^\circ\text{C}$ )	$i_R$		10 100	$\mu\text{A}$
Maximum Reverse Recovery Time ( $i_F = 1.0 \text{ A}$ , $di/dt = 50 \text{ A}/\mu\text{s}$ )	$t_{\text{rr}}$	100		ns

2. Diode Pulse Test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

# NJL3281D (NPN) NJL1302D (PNP)

## TYPICAL CHARACTERISTICS

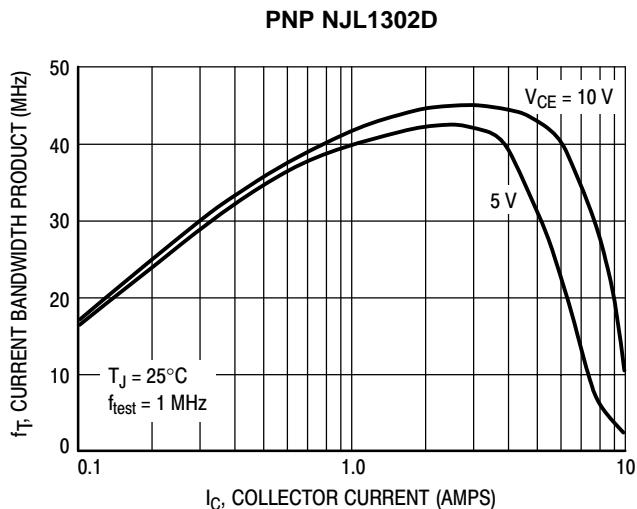


Figure 1. Typical Current Gain Bandwidth Product

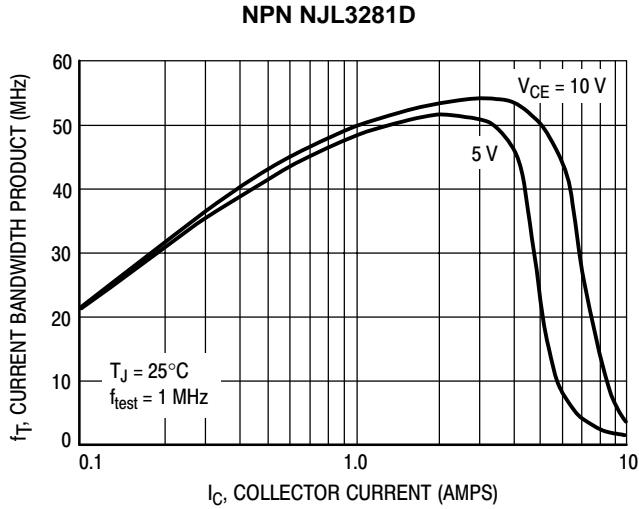


Figure 2. Typical Current Gain Bandwidth Product

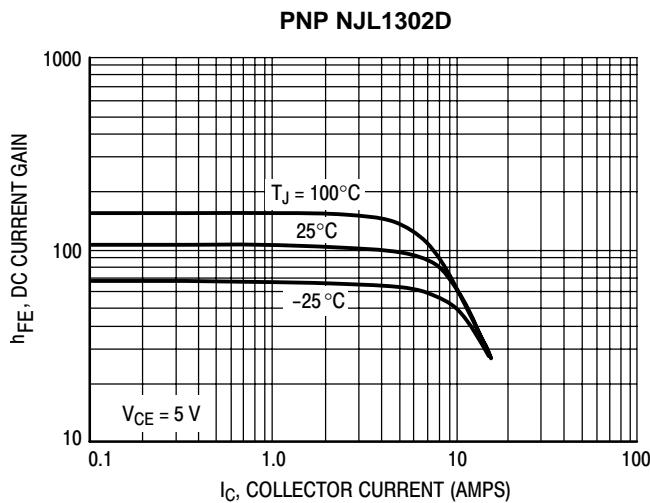


Figure 3. DC Current Gain,  $V_{CE} = 5\text{ V}$

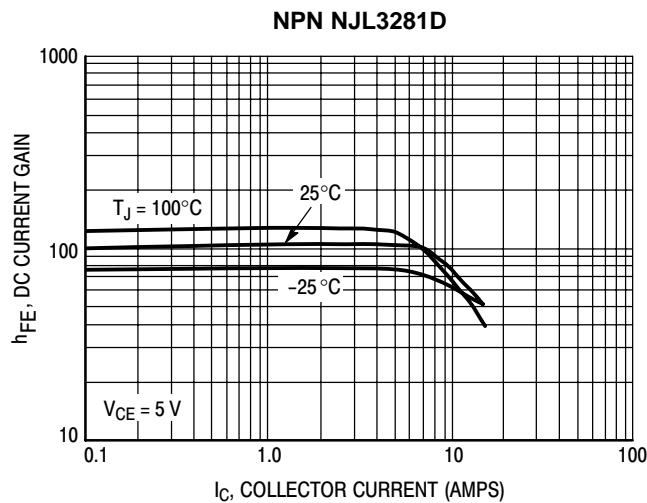


Figure 4. DC Current Gain,  $V_{CE} = 5\text{ V}$

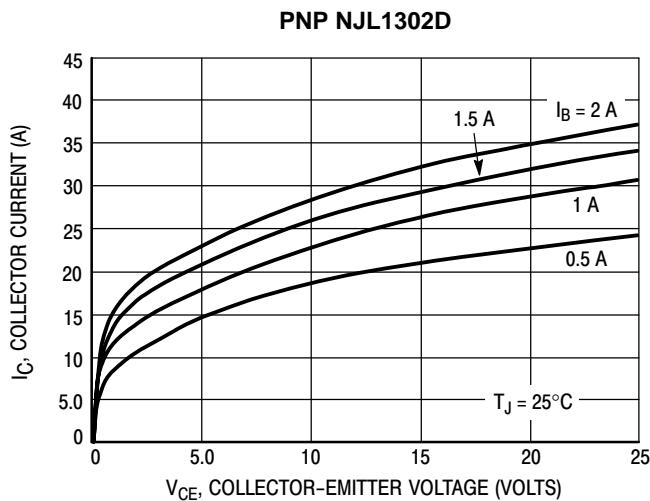


Figure 5. Typical Output Characteristics

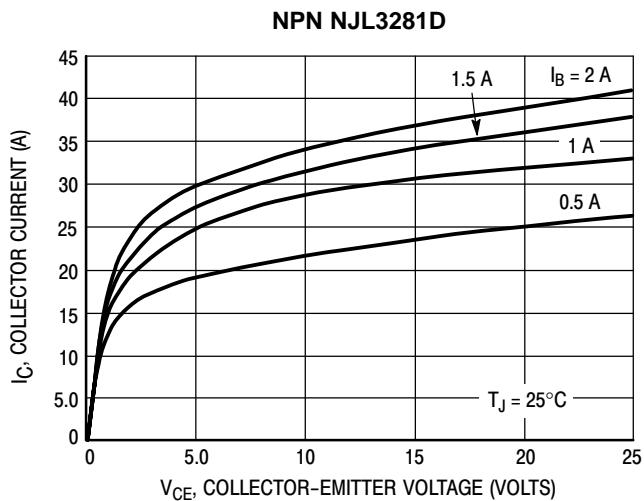


Figure 6. Typical Output Characteristics

# NJL3281D (NPN) NJL1302D (PNP)

## TYPICAL CHARACTERISTICS

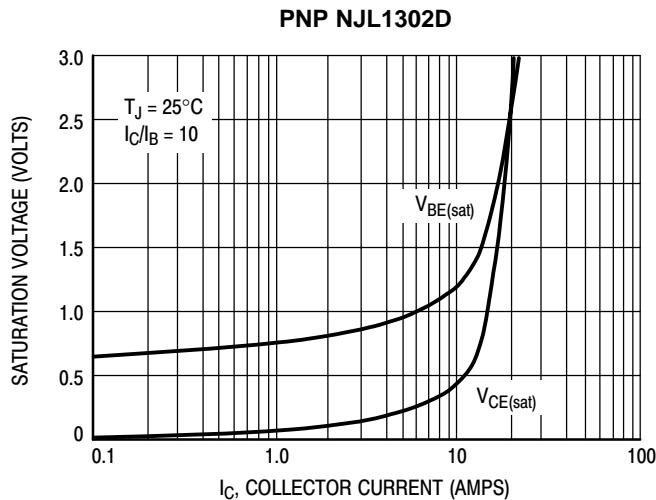


Figure 7. Typical Saturation Voltages

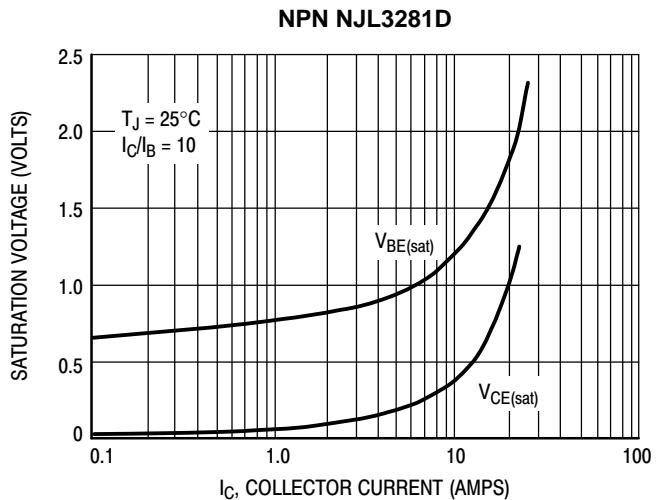


Figure 8. Typical Saturation Voltages

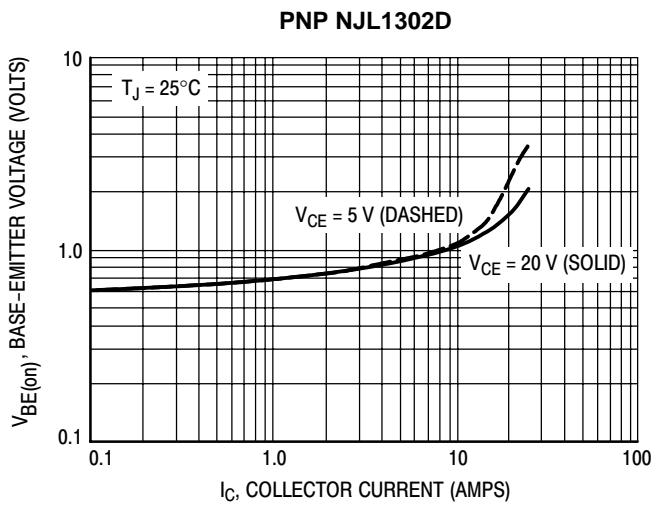


Figure 9. Typical Base-Emitter Voltage

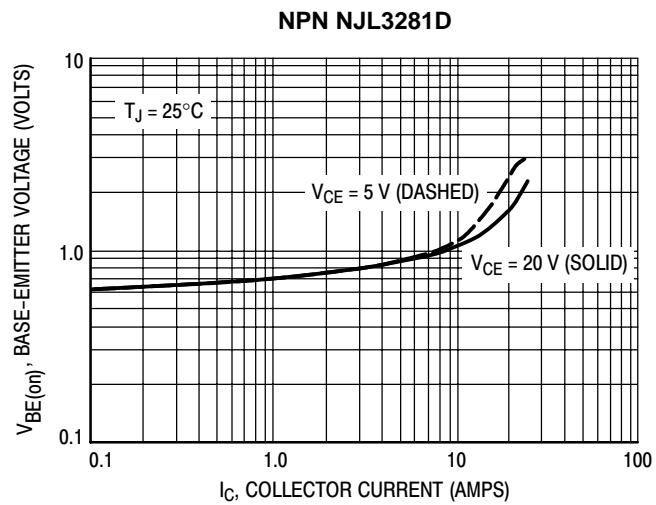


Figure 10. Typical Base-Emitter Voltage

# NJL3281D (NPN) NJL1302D (PNP)

## TYPICAL CHARACTERISTICS

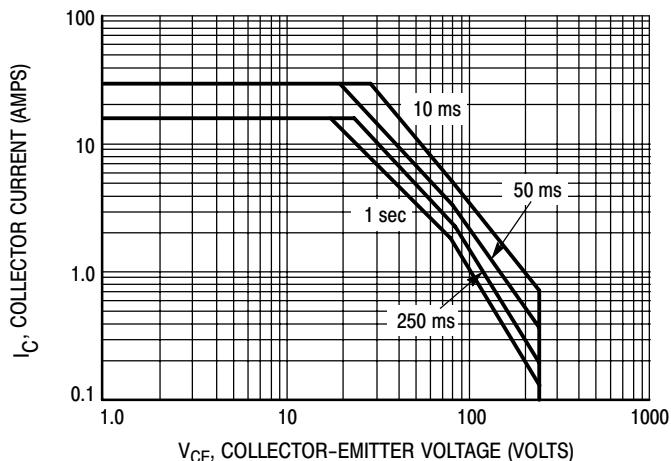


Figure 11. Active Region Safe Operating Area

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 11 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.

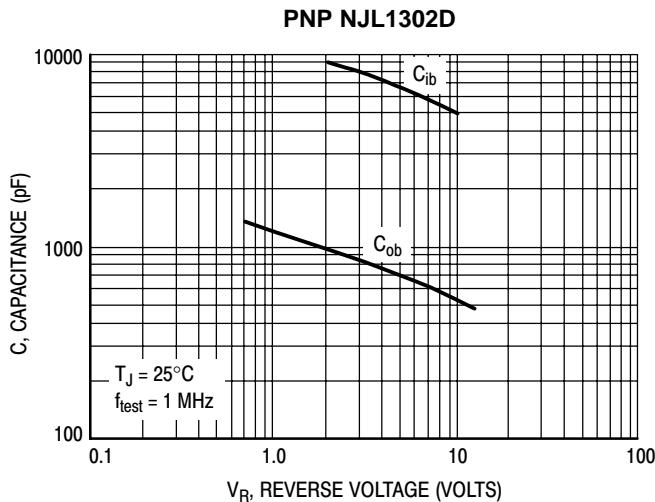


Figure 12. NJL1302D Typical Capacitance

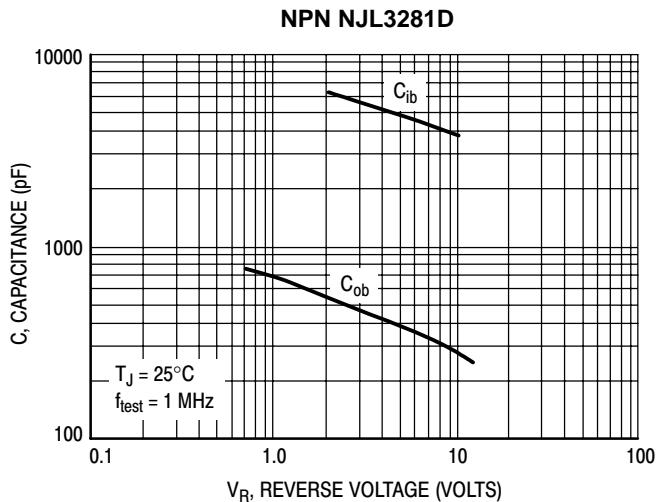


Figure 13. NJL3281D Typical Capacitance

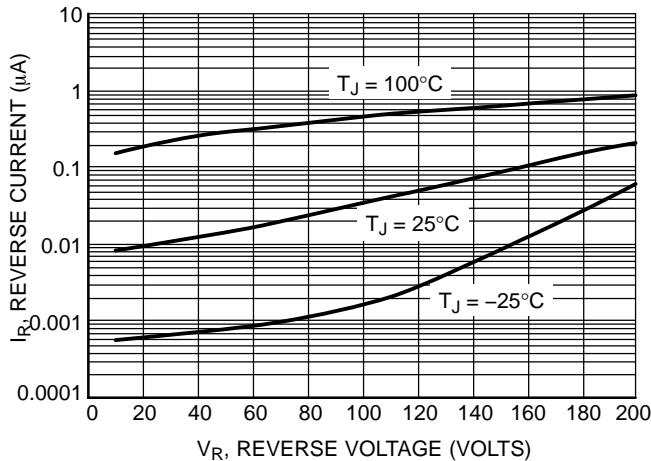


Figure 14. Typical Reverse Current

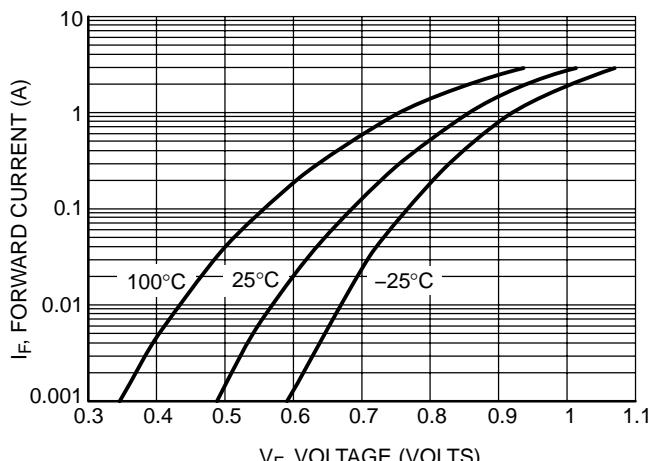
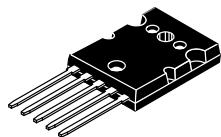


Figure 15. Typical Forward Voltage

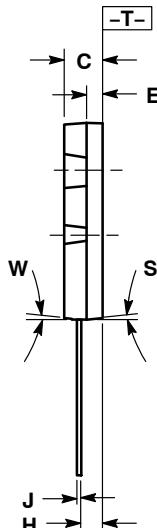
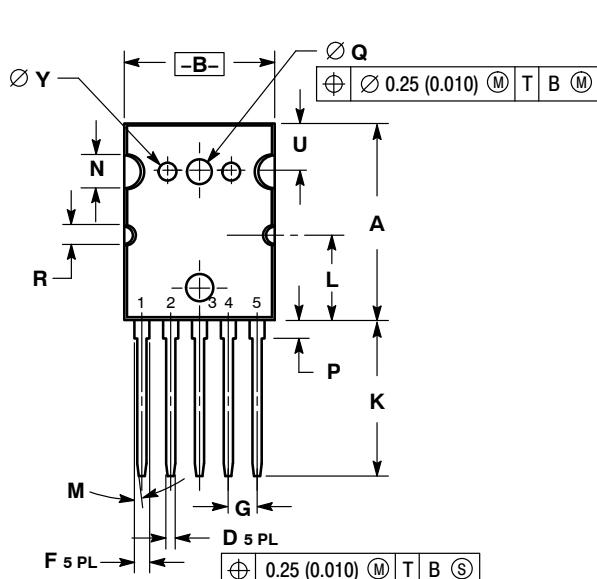
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**TO-264, 5 LEAD**  
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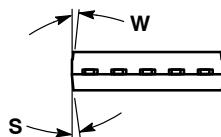
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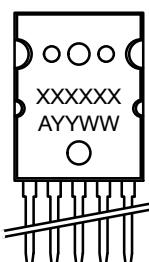
NOTES:  
1. DIMENSIONING AND TOLERANCING PER  
ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: MILLIMETER.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	25.857	25.984	26.111	1.018	1.023	1.028
B	19.761	19.888	20.015	0.778	0.783	0.788
C	4.699	4.890	5.182	0.185	0.199	0.204
D	1.219	BSC		0.0480	BSC	
E	1.890	2.042	2.184	0.0748	0.0804	0.0860
F	1.981	BSC		0.0780	BSC	
G	3.81	BSC		0.150	BSC	
H	2.667	2.718	2.769	0.1050	0.1070	0.1090
J	0.584	BSC		0.0230	BSC	
K	20.422	20.549	20.676	0.804	0.809	0.814
L	11.28	REF		0.444	REF	
M	0 °	---	7 °	0 °	---	7 °
N	4.57	REF		0.180	REF	
P	2.259	2.386	2.513	0.0889	0.0939	0.0989
Q	3.480	BSC		0.1370	BSC	
R	2.54	REF		0.100	REF	
S	0 °	---	8 °	0 °	---	8 °
U	6.17	REF		0.243	REF	
W	0 °	---	6 °	0 °	---	6 °
Y	2.388	BSC		0.0940	BSC	

STYLE 1:  
PIN 1. BASE  
2. Emitter  
3. Collector  
4. Anode  
5. Cathode



**GENERIC  
MARKING DIAGRAM\***



XXXXXX = Specific Device Code

A = Assembly Location

YY = Year

WW = Work Week

G or ■ = Pb-Free Package

\*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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