

# 2N5302

## High-Power NPN Silicon Transistor

High-power NPN silicon transistors are for use in power amplifier and switching circuits applications.

### Features

- Low Collector–Emitter Saturation Voltage –  
 $V_{CE(sat)} = 0.75 \text{ Vdc (Max) @ } I_C = 10 \text{ Adc}$
- Pb–Free Package is Available\*

### MAXIMUM RATINGS (Note 1) ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	$V_{CEO}$	60	Vdc
Collector–Base Voltage	$V_{CB}$	60	Vdc
Collector Current – Continuous (Note 2)	$I_C$	30	Adc
Base Current	$I_B$	7.5	Adc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	200 1.14	W 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	$\theta_{JC}$	0.875	$^\circ\text{C/W}$
Thermal Resistance, Case–to–Ambient	$\theta_{CA}$	34	$^\circ\text{C/W}$

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.

1. Indicates JEDEC Registered Data.
2. Pulse Test: Pulse Width = 5  $\mu\text{s}$ , Duty Cycle  $\leq 10\%$ .

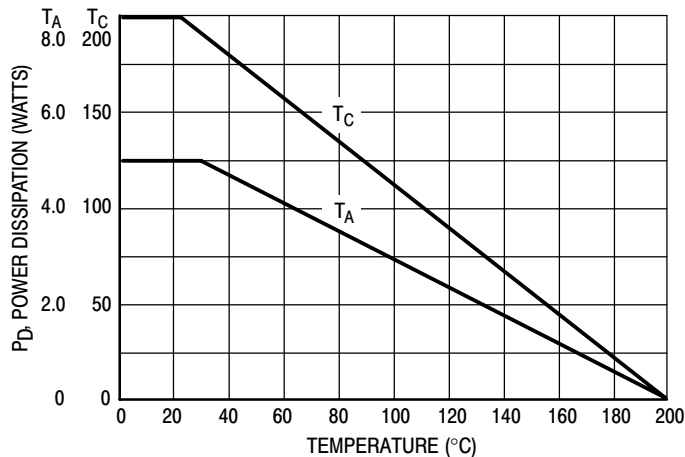


Figure 1. Power Temperature Derating Curve

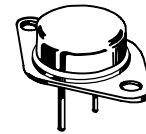
\*For additional information on our Pb–Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



**ON Semiconductor®**

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**30 AMPERES  
POWER TRANSISTOR  
NPN SILICON  
60 VOLTS, 200 WATTS**



**TO–204AA (TO–3)  
CASE 1–07  
STYLE 1**

### MARKING DIAGRAM



2N5302 = Device Code  
 G = Pb–Free Package  
 A = Location Code  
 YY = Year  
 WW = Work Week  
 MEX = Country of Origin

### ORDERING INFORMATION

Device	Package	Shipping
2N5302	TO–204	100 Units/Tray
2N5302G	TO–204 (Pb–Free)	100 Units/Tray

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

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b> (Note 3)				
Collector–Emitter Sustaining Voltage (Note 4) ( $I_C = 200\text{ mA}$ , $I_B = 0$ )	$V_{CEO(sus)}$	60	–	Vdc
Collector Cutoff Current ( $V_{CE} = 60\text{ Vdc}$ , $I_B = 0$ )	$I_{CEO}$	–	5.0	mAdc
Collector Cutoff Current ( $V_{CE} = 60\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ )	$I_{CEX}$	–	1.0	mAdc
Collector Cutoff Current ( $V_{CE} = 60\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ )	$I_{CEX}$	–	10	mAdc
Collector Cutoff Current ( $V_{CB} = 80\text{ Vdc}$ , $I_E = 0$ )	$I_{CBO}$	–	1.0	mAdc
Emitter Cutoff Current ( $V_{BE} = 5.0\text{ Vdc}$ , $I_C = 0$ )	$I_{EBO}$	–	5.0	mAdc

**ON CHARACTERISTICS**

DC Current Gain (Note 4) *( $I_C = 1.0\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ ) *( $I_C = 15\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ ) ( $I_C = 30\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ )	$h_{FE}$	40 15 5.0	– 60 –	–
*Collector–Emitter Saturation Voltage (Note 4) ( $I_C = 10\text{ Adc}$ , $I_B = 1.0\text{ Adc}$ ) ( $I_C = 20\text{ Adc}$ , $I_B = 2.0\text{ Adc}$ ) <sup>2</sup> ( $I_C = 30\text{ Adc}$ , $I_B = 6.0\text{ Adc}$ )	$V_{CE(sat)}$	– – –	0.75 2.0 3.0	Vdc
*Base Emitter Saturation Voltage (Note 4) ( $I_C = 10\text{ Adc}$ , $I_B = 1.0\text{ Adc}$ ) ( $I_C = 15\text{ Adc}$ , $I_B = 1.5\text{ Adc}$ ) ( $I_C = 20\text{ Adc}$ , $I_B = 2.0\text{ Adc}$ )	$V_{BE(sat)}$	– – –	1.7 1.8 2.5	Vdc
*Base–Emitter On Voltage (Note 4) ( $I_C = 15\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ ) ( $I_C = 30\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ )	$V_{BE(on)}$	– –	1.7 3.0	Vdc

**DYNAMIC CHARACTERISTICS** (Note 3)

Current–Gain – Bandwidth Product ( $I_C = 1.0\text{ Adc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ MHz}$ )	$f_T$	2.0	–	MHz
Small–Signal Current Gain ( $I_C = 1.0\text{ Adc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	$h_{fe}$	40	–	–

**SWITCHING CHARACTERISTICS** (Note 3)

Rise Time	$(V_{CC} = 30\text{ Vdc}$ , $I_C = 10\text{ Adc}$ , $I_{B1} = I_{B2} = 1.0\text{ Adc}$ )	$t_r$	–	1.0	$\mu\text{s}$
Storage Time		$t_s$	–	2.0	$\mu\text{s}$
Fall Time		$t_f$	–	1.0	$\mu\text{s}$

- 3. Indicates JEDEC Registered Data.
- 4. Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

**SWITCHING TIME EQUIVALENT TEST CIRCUITS**

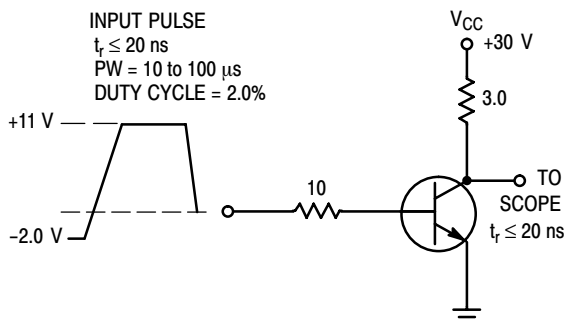


Figure 2. Turn–On time

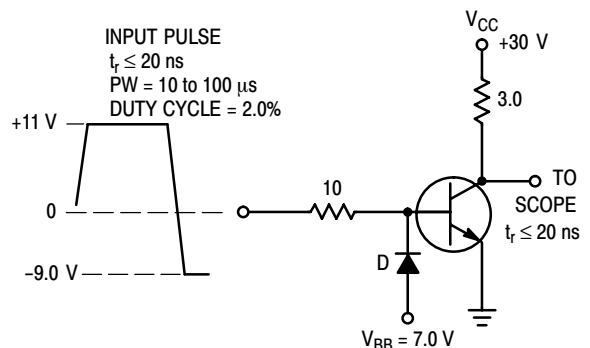


Figure 3. Turn–Off time

# 2N5302

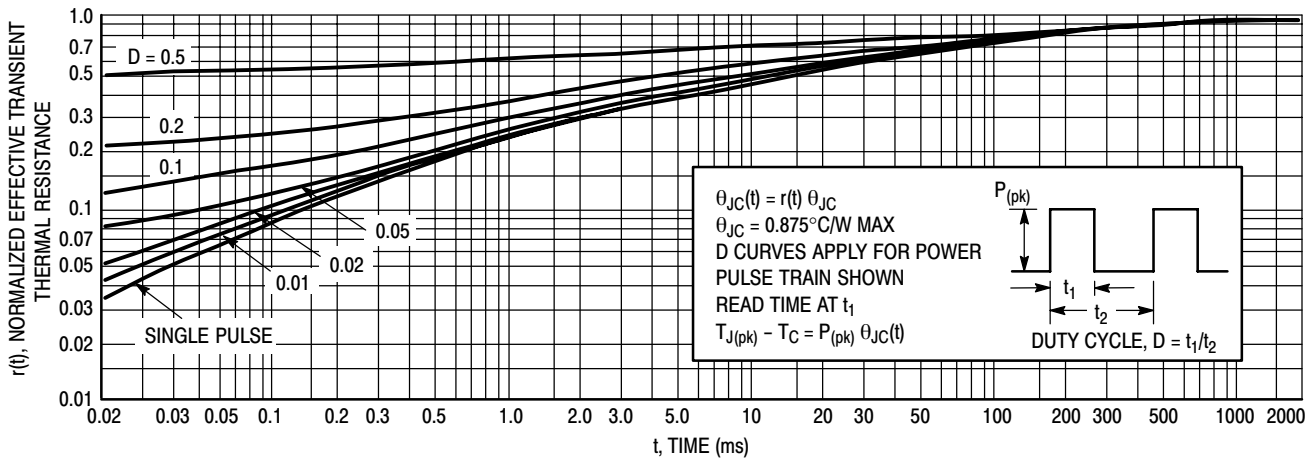


Figure 4. Thermal Response

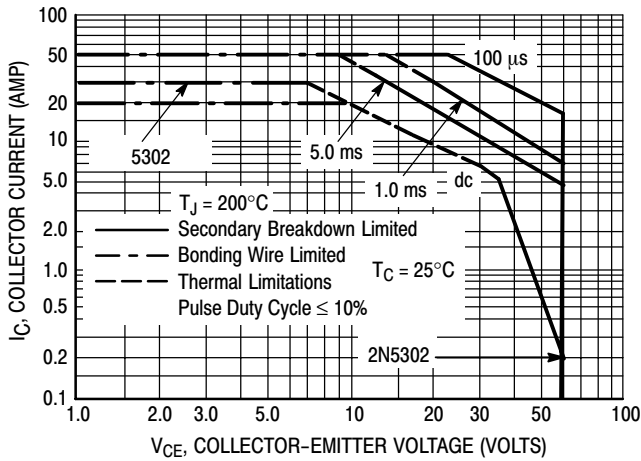


Figure 5. Active-Region Safe Operating Area

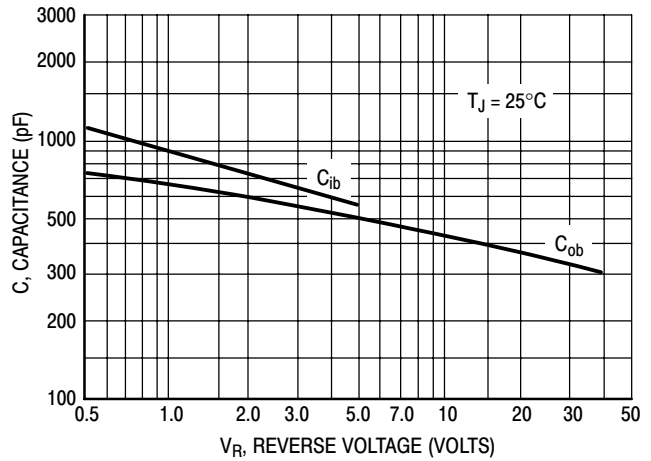


Figure 6. Capacitance versus Voltage

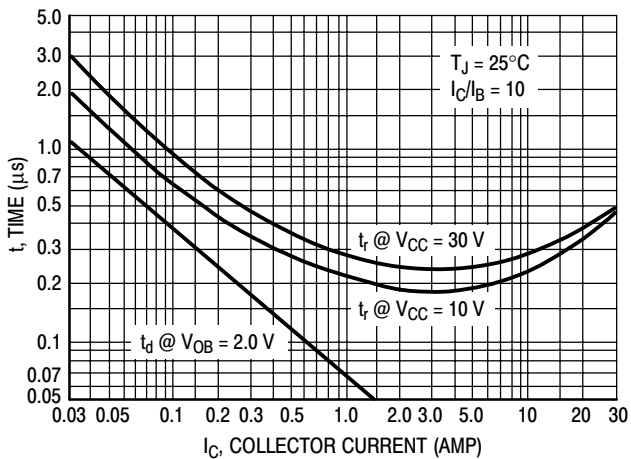


Figure 7. Turn-On Time

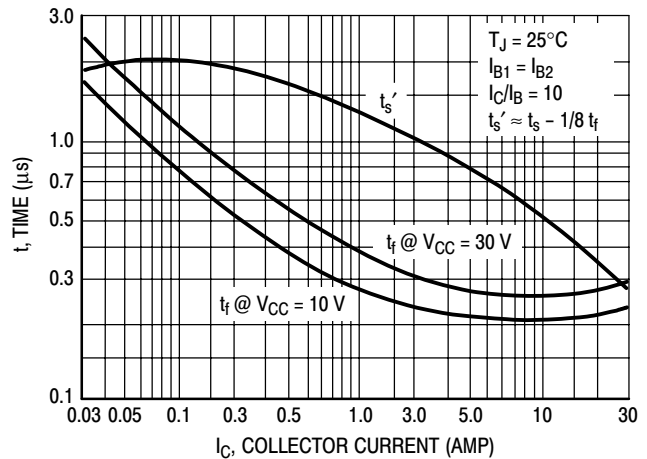


Figure 8. Turn-Off Time

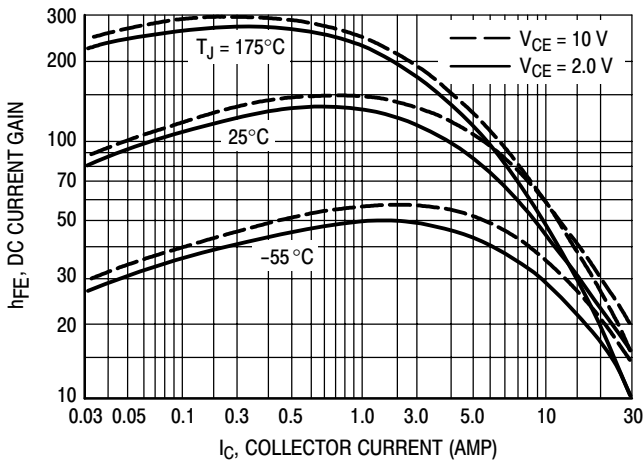


Figure 9. DC Current Gain

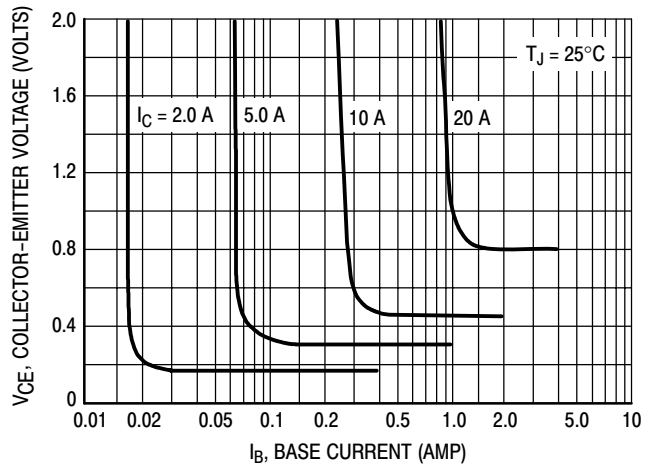


Figure 10. Collector Saturation Region

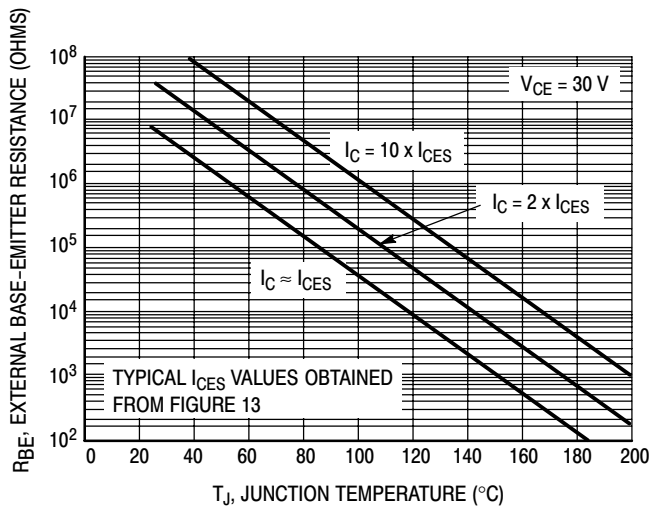


Figure 11. Effects of Base-Emitter Resistance

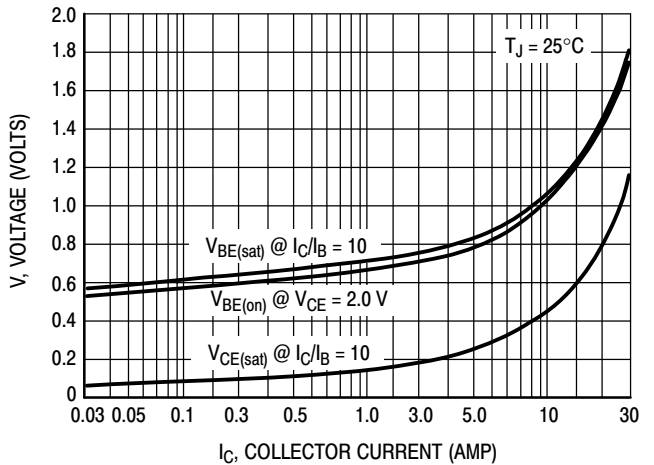


Figure 12. "On" Voltages

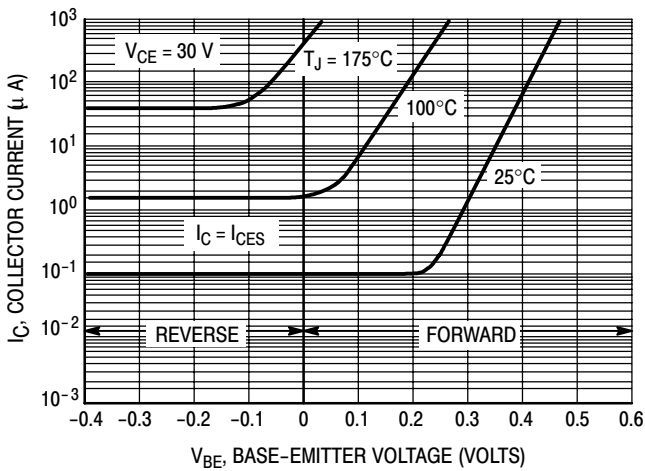


Figure 13. Collector Cut-Off Region

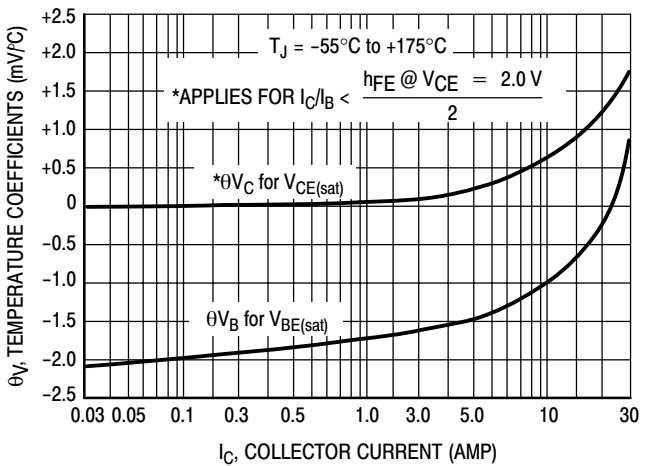
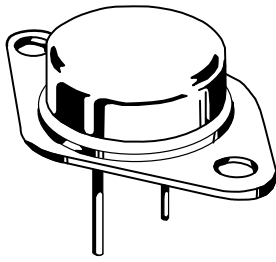


Figure 14. Temperature Coefficients

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

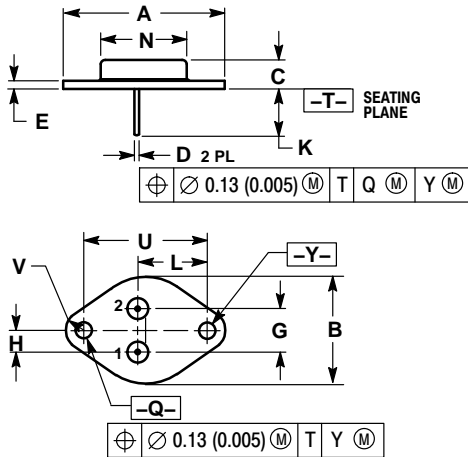
ON Semiconductor



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

DATE 05/18/1988

SCALE 1:1



- 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

- |  |  |   |   |   |
|--|--|---|---|---|
| <p>STYLE 1:<br/>PIN 1. BASE<br/>2. EMITTER<br/>CASE: COLLECTOR</p> | <p>STYLE 2:<br/>PIN 1. BASE<br/>2. COLLECTOR<br/>CASE: EMITTER</p> | <p>STYLE 3:<br/>PIN 1. GATE<br/>2. SOURCE<br/>CASE: DRAIN</p>           | <p>STYLE 4:<br/>PIN 1. GROUND<br/>2. INPUT<br/>CASE: OUTPUT</p>       | <p>STYLE 5:<br/>PIN 1. CATHODE<br/>2. EXTERNAL TRIP/DELAY<br/>CASE: ANODE</p> |
| <p>STYLE 6:<br/>PIN 1. GATE<br/>2. EMITTER<br/>CASE: COLLECTOR</p> | <p>STYLE 7:<br/>PIN 1. ANODE<br/>2. OPEN<br/>CASE: CATHODE</p>     | <p>STYLE 8:<br/>PIN 1. CATHODE #1<br/>2. CATHODE #2<br/>CASE: ANODE</p> | <p>STYLE 9:<br/>PIN 1. ANODE #1<br/>2. ANODE #2<br/>CASE: CATHODE</p> |   |

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