

# 2N5655, 2N5657

## Plastic NPN Silicon High-Voltage Power Transistor

These devices are designed for use in line-operated equipment such as audio output amplifiers; low-current, high-voltage converters; and AC line relays.

### Features

- Excellent DC Current Gain –  
 $h_{FE} = 30-250 @ I_C = 100 \text{ mA}$
- Current-Gain – Bandwidth Product –  
 $f_T = 10 \text{ MHz (Min) @ } I_C = 50 \text{ mA}$
- Pb-Free Packages are Available\*

### MAXIMUM RATINGS (Note 1)

| Rating   | Symbol         | 2N5655      | 2N5657 | Unit                     |
|--|----------------|-------------|--------|--------------------------|
| Collector-Emitter Voltage  | $V_{CEO}$      | 250         | 350    | Vdc                      |
| Collector-Base Voltage   | $V_{CB}$       | 275         | 375    | Vdc                      |
| Emitter-Base Voltage   | $V_{EB}$       | 6.0         |        | Vdc                      |
| Collector Current – Continuous Peak  | $I_C$          | 0.5<br>1.0  |        | A dc                     |
| Base Current   | $I_B$          | 1.0         |        | A dc                     |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 20<br>0.16  |        | W<br>W/ $^\circ\text{C}$ |
| Operating and Storage Junction Temperature Range                                       | $T_J, T_{stg}$ | -65 to +150 |        | $^\circ\text{C/W}$       |

### THERMAL CHARACTERISTICS

| Characteristic                       | Symbol        | Max  | Unit               |
|--------------------------------------|---------------|------|--------------------|
| Thermal Resistance, Junction-to-Case | $\theta_{JC}$ | 6.25 | $^\circ\text{C/W}$ |

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.

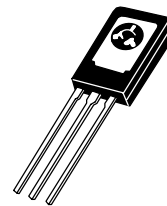
1. Indicates JEDEC registered data.



**ON Semiconductor®**

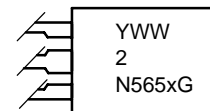
<http://onsemi.com>

**0.5 AMPERE  
POWER TRANSISTORS  
NPN SILICON  
250-350 VOLTS, 20 WATTS**



TO-225AA  
CASE 77-09  
STYLE 1

### MARKING DIAGRAM



Y = Year  
WW = Work Week  
2N565x = Device Code  
x = 5 or 7  
G = Pb-Free Package

### ORDERING INFORMATION

| Device  | Package             | Shipping         |
|---------|---------------------|------------------|
| 2N5655  | TO-225              | 500 Units / Bulk |
| 2N5655G | TO-225<br>(Pb-Free) | 500 Units / Bulk |
| 2N5657  | TO-225              | 500 Units / Bulk |
| 2N5657G | TO-225<br>(Pb-Free) | 500 Units / Bulk |

\*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 ( $T_C = 25^\circ\text{C}$ unless otherwise noted) (Note 2)

| Characteristic   |                                      | Symbol         | Min                   | Max                      | Unit            |
|--|--------------------------------------|----------------|-----------------------|--------------------------|-----------------|
| <b>OFF CHARACTERISTICS</b>   |                                      |                |                       |                          |                 |
| Collector–Emitter Sustaining Voltage<br>( $I_C = 100\text{ mAdc}$ (inductive), $L = 50\text{ mH}$ )  | 2N5655<br>2N5657                     | $V_{CEO(sus)}$ | 250<br>350            | –<br>–                   | Vdc             |
| Collector–Emitter Breakdown Voltage<br>( $I_C = 1.0\text{ mAdc}$ , $I_B = 0$ )   | 2N5655<br>2N5657                     | $V_{(BR)CEO}$  | 250<br>350            | –<br>–                   | Vdc             |
| Collector Cutoff Current<br>( $V_{CE} = 150\text{ Vdc}$ , $I_B = 0$ )<br>( $V_{CE} = 250\text{ Vdc}$ , $I_B = 0$ )   | 2N5655<br>2N5657                     | $I_{CEO}$      | –<br>–                | 0.1<br>0.1               | mAcd            |
| Collector Cutoff Current<br>( $V_{CE} = 250\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ )<br>( $V_{CE} = 350\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ )<br>( $V_{CE} = 150\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ , $T_C = 100^\circ\text{C}$ )<br>( $V_{CE} = 250\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ , $T_C = 100^\circ\text{C}$ ) | 2N5655<br>2N5657<br>2N5655<br>2N5657 | $I_{CEX}$      | –<br>–<br>–<br>–      | 0.1<br>0.1<br>1.0<br>1.0 | mAcd            |
| Collector Cutoff Current<br>( $V_{CB} = 275\text{ Vdc}$ , $I_E = 0$ )<br>( $V_{CB} = 375\text{ Vdc}$ , $I_E = 0$ )   | 2N5655<br>2N5657                     | $I_{CBO}$      | –<br>–                | 10<br>10                 | $\mu\text{Acd}$ |
| Emitter Cutoff Current ( $V_{EB} = 6.0\text{ Vdc}$ , $I_C = 0$ )   |                                      | $I_{EBO}$      | –                     | 10                       | $\mu\text{Acd}$ |
| <b>ON CHARACTERISTICS</b>  |                                      |                |                       |                          |                 |
| DC Current Gain (Note 3)<br>( $I_C = 50\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ )<br>( $I_C = 100\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ )<br>( $I_C = 250\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ )<br>( $I_C = 500\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ )  |                                      | $h_{FE}$       | 25<br>30<br>15<br>5.0 | –<br>250<br>–<br>–       | –               |
| Collector–Emitter Saturation Voltage (Note 3)<br>( $I_C = 100\text{ mAdc}$ , $I_B = 10\text{ mAcd}$ )<br>( $I_C = 250\text{ mAdc}$ , $I_B = 25\text{ mAcd}$ )<br>( $I_C = 500\text{ mAdc}$ , $I_B = 100\text{ mAcd}$ )   |                                      | $V_{CE(sat)}$  | –<br>–<br>–           | 1.0<br>2.5<br>10         | Vdc             |
| Base–Emitter Voltage ( $I_C = 100\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ ) (Note 3)   |                                      | $V_{BE}$       | –                     | 1.0                      | Vdc             |
| <b>DYNAMIC CHARACTERISTICS</b>   |                                      |                |                       |                          |                 |
| Current–Gain – Bandwidth Product ( $I_C = 50\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 10\text{ MHz}$ ) (Note 4)  |                                      | $f_T$          | 10                    | –                        | MHz             |
| Output Capacitance ( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 100\text{ kHz}$ )   |                                      | $C_{ob}$       | –                     | 25                       | pF              |
| Small–Signal Current Gain ( $I_C = 100\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )  |                                      | $h_{fe}$       | 20                    | –                        | –               |

2. Indicates JEDEC registered data for 2N5655 Series.
3. Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .
4.  $f_T$  is defined as the frequency at which  $|h_{fe}|$  extrapolates to unity.

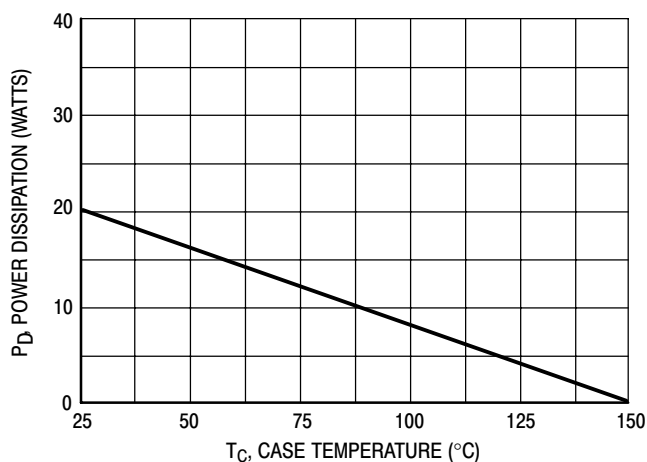


Figure 1. Power Derating

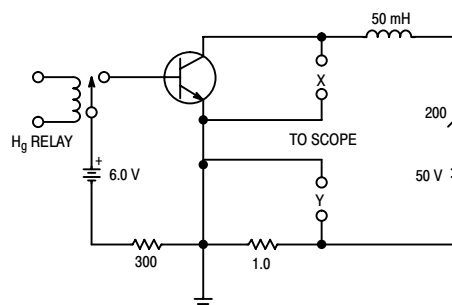


Figure 2. Sustaining Voltage Test Circuit

Safe Area Limits are indicated by Figures 3 and 4. Both limits are applicable and must be observed.

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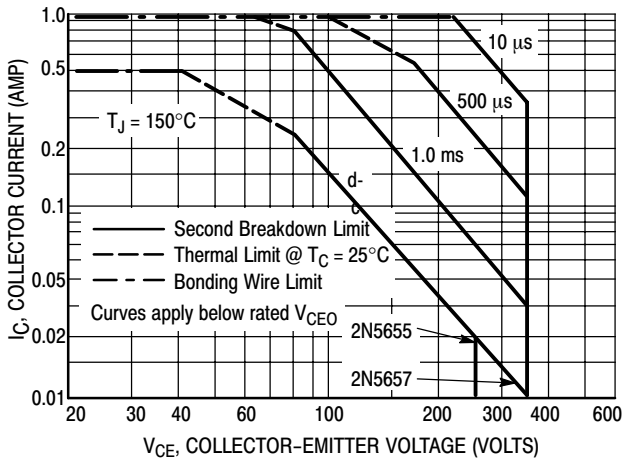


Figure 3. Active-Region Safe Operating Area

There are two limitations on the power handling ability of a transistor: average junction temperature and second 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 3 is based on  $T_{J(pk)} = 150^\circ\text{C}$ ;  $T_C$  is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided  $T_{J(pk)} \leq 150^\circ\text{C}$ . At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

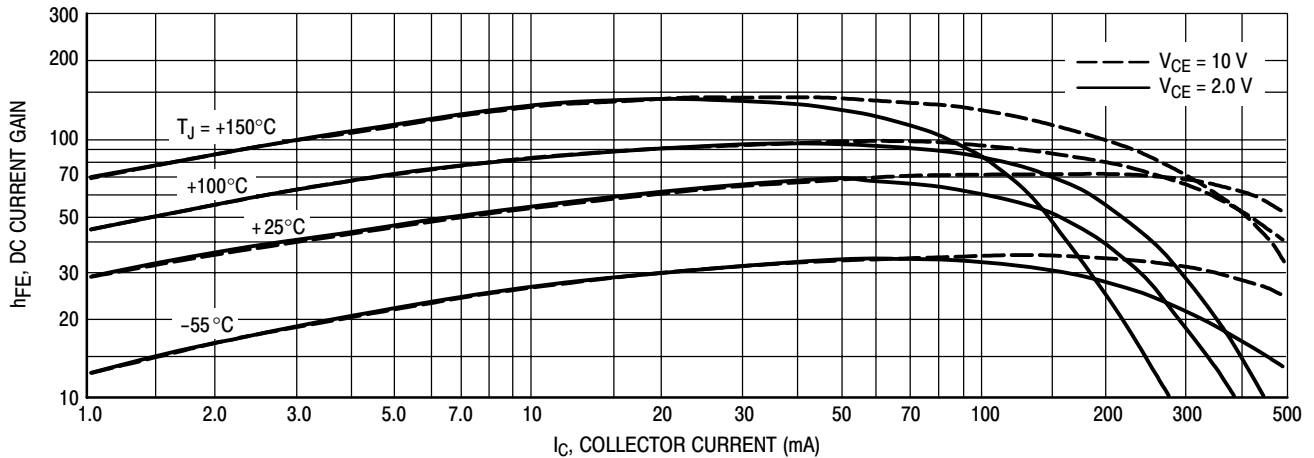


Figure 4. Current Gain

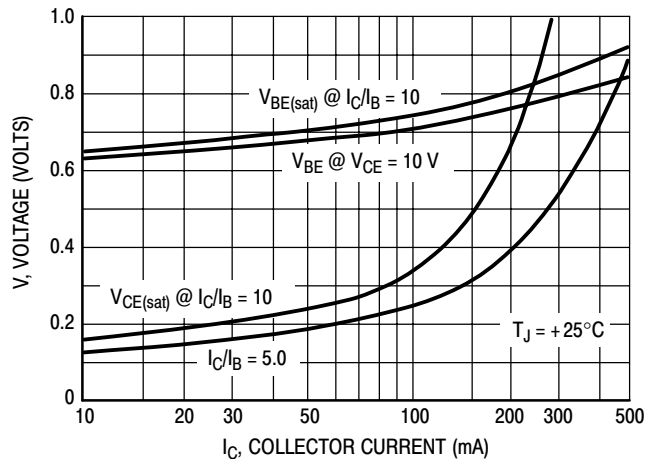


Figure 5. "On" Voltages

## 2N5655, 2N5657

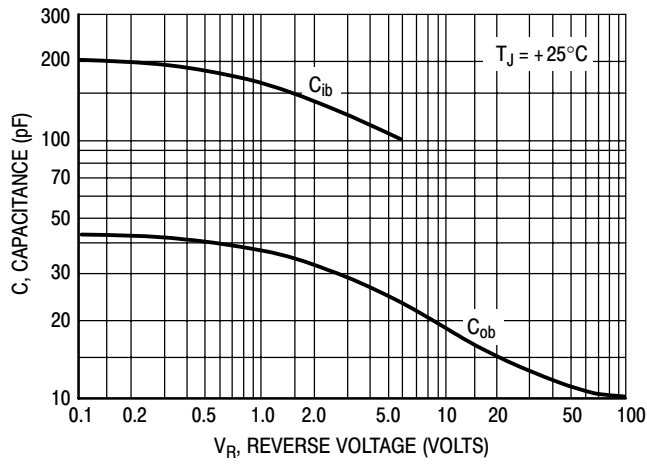


Figure 6. Capacitance

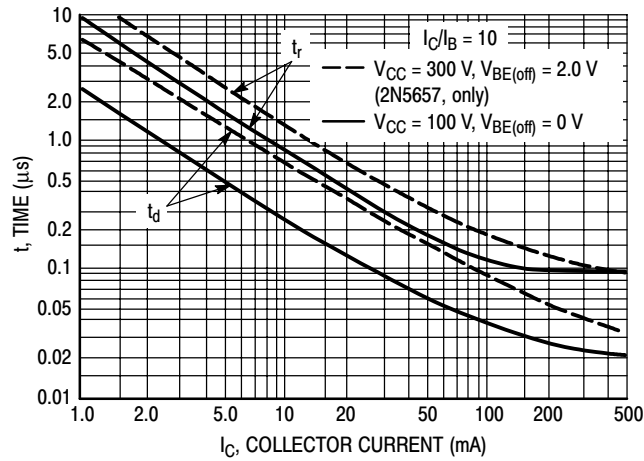


Figure 7. Turn-On Time

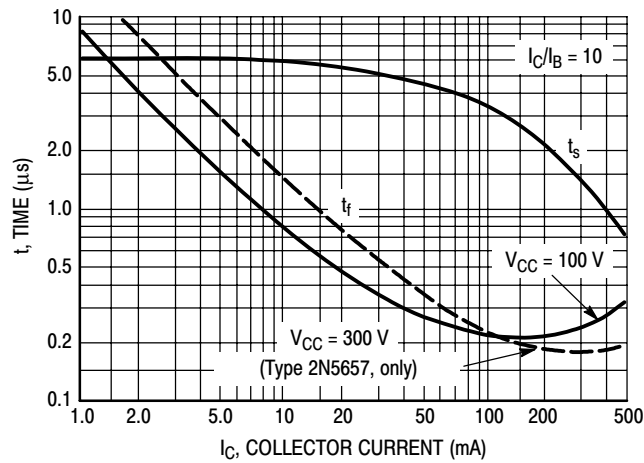
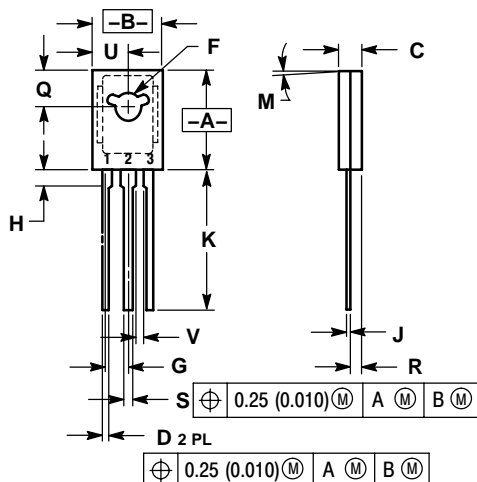


Figure 8. Turn-Off Time

# 2N5655, 2N5657

## PACKAGE DIMENSIONS

TO-225  
CASE 77-09  
ISSUE Z



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 077-01 THRU -08 OBSOLETE, NEW STANDARD 077-09.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.425     | 0.435 | 10.80       | 11.04 |
| B   | 0.295     | 0.305 | 7.50        | 7.74  |
| C   | 0.095     | 0.105 | 2.42        | 2.66  |
| D   | 0.020     | 0.026 | 0.51        | 0.66  |
| F   | 0.115     | 0.130 | 2.93        | 3.30  |
| G   | 0.094 BSC |       | 2.39 BSC    |       |
| H   | 0.050     | 0.095 | 1.27        | 2.41  |
| J   | 0.015     | 0.025 | 0.39        | 0.63  |
| K   | 0.575     | 0.655 | 14.61       | 16.63 |
| M   | 5° TYP    |       | 5° TYP      |       |
| Q   | 0.148     | 0.158 | 3.76        | 4.01  |
| R   | 0.045     | 0.065 | 1.15        | 1.65  |
| S   | 0.025     | 0.035 | 0.64        | 0.88  |
| U   | 0.145     | 0.155 | 3.69        | 3.93  |
| V   | 0.040     | ---   | 1.02        | ---   |

**STYLE 1:**

- PIN 1. EMITTER
2. COLLECTOR
3. BASE

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