

# 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 1.0		Adc
Base Current	$I_B$	1.0		Adc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	20 0.16		W 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.

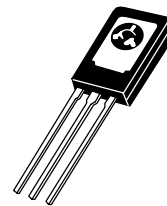
1. Indicates JEDEC registered data.



**ON Semiconductor®**

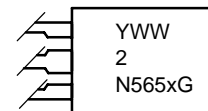
<http://onsemi.com>

**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 (Pb-Free)	500 Units / Bulk
2N5657	TO-225	500 Units / Bulk
2N5657G	TO-225 (Pb-Free)	500 Units / Bulk

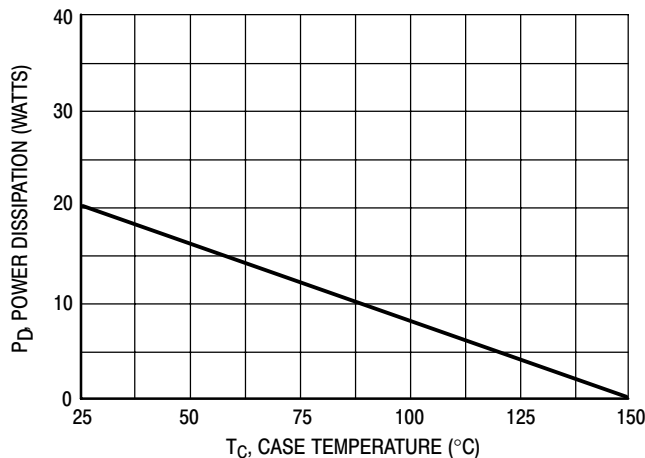
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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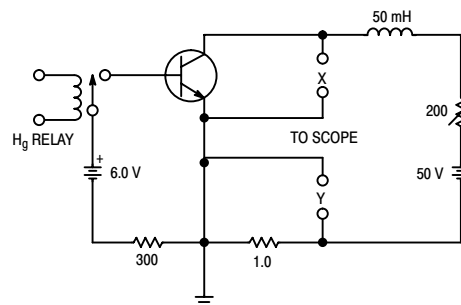
### ELECTRICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ unless otherwise noted) (Note 2)

Characteristic	Symbol	Min	Max	Unit	
<b>OFF CHARACTERISTICS</b>					
Collector–Emitter Sustaining Voltage ( $I_C = 100\text{ mAdc}$ (inductive), $L = 50\text{ mH}$ )	2N5655 2N5657	$V_{CEO(sus)}$	250 350	– –	Vdc
Collector–Emitter Breakdown Voltage ( $I_C = 1.0\text{ mAdc}$ , $I_B = 0$ )	2N5655 2N5657	$V_{(BR)CEO}$	250 350	– –	Vdc
Collector Cutoff Current ( $V_{CE} = 150\text{ Vdc}$ , $I_B = 0$ ) ( $V_{CE} = 250\text{ Vdc}$ , $I_B = 0$ )	2N5655 2N5657	$I_{CEO}$	– –	0.1 0.1	mAdc
Collector Cutoff Current ( $V_{CE} = 250\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ ) ( $V_{CE} = 350\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ ) ( $V_{CE} = 150\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ , $T_C = 100^\circ\text{C}$ ) ( $V_{CE} = 250\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ , $T_C = 100^\circ\text{C}$ )	2N5655 2N5657 2N5655 2N5657	$I_{CEX}$	– – – –	0.1 0.1 1.0 1.0	mAdc
Collector Cutoff Current ( $V_{CB} = 275\text{ Vdc}$ , $I_E = 0$ ) ( $V_{CB} = 375\text{ Vdc}$ , $I_E = 0$ )	2N5655 2N5657	$I_{CBO}$	– –	10 10	$\mu\text{A}$ dc
Emitter Cutoff Current ( $V_{EB} = 6.0\text{ Vdc}$ , $I_C = 0$ )		$I_{EBO}$	–	10	$\mu\text{A}$ dc
<b>ON CHARACTERISTICS</b>					
DC Current Gain (Note 3) ( $I_C = 50\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ ) ( $I_C = 100\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ ) ( $I_C = 250\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ ) ( $I_C = 500\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ )		$h_{FE}$	25 30 15 5.0	– 250 – –	–
Collector–Emitter Saturation Voltage (Note 3) ( $I_C = 100\text{ mAdc}$ , $I_B = 10\text{ mAdc}$ ) ( $I_C = 250\text{ mAdc}$ , $I_B = 25\text{ mAdc}$ ) ( $I_C = 500\text{ mAdc}$ , $I_B = 100\text{ mAdc}$ )		$V_{CE(sat)}$	– – –	1.0 2.5 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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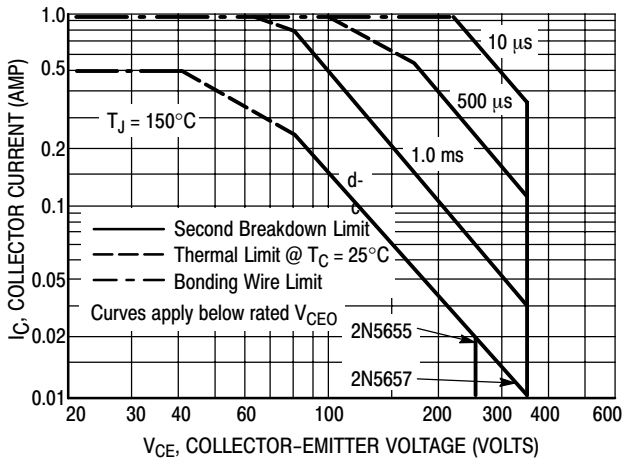


Figure 3. Active-Region Safe Operating Area

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.

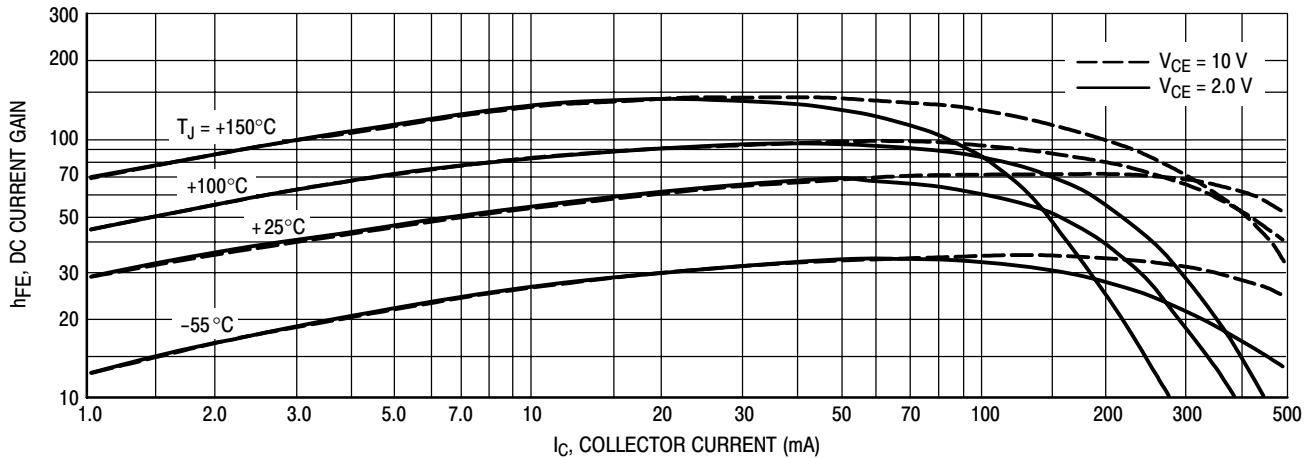


Figure 4. Current Gain

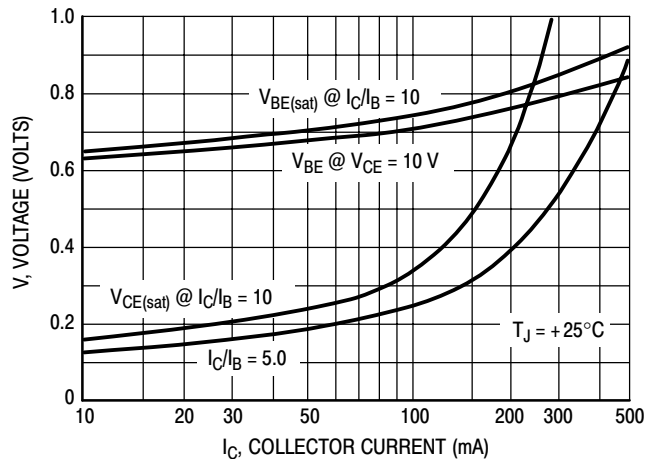
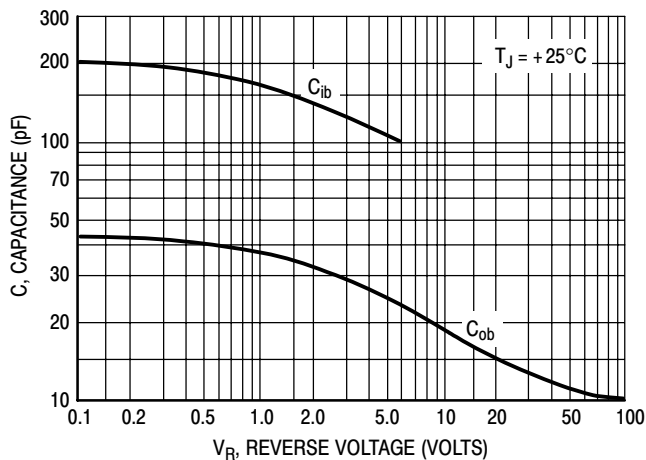
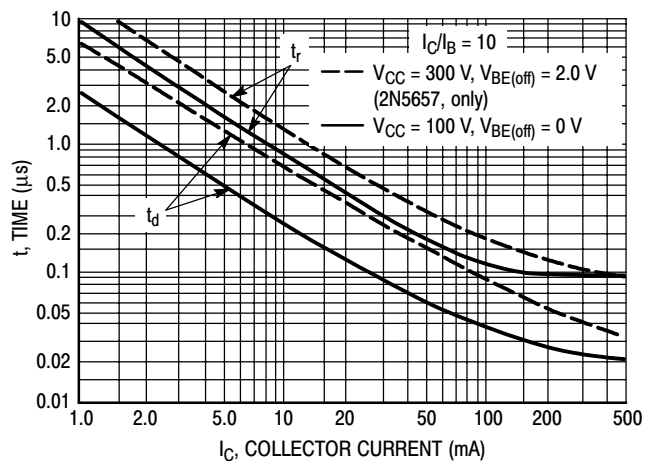


Figure 5. "On" Voltages

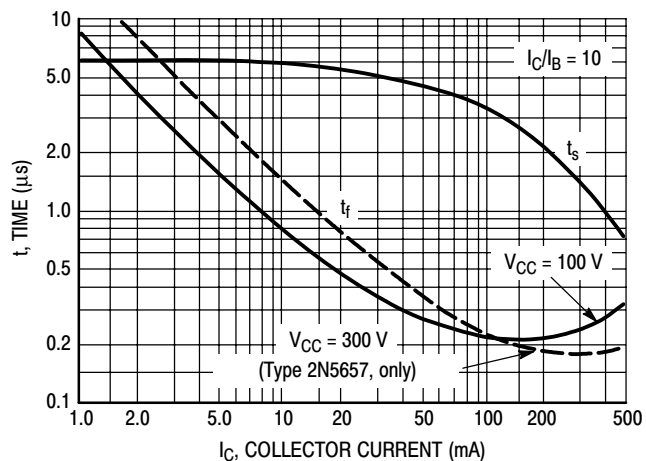
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**Figure 6. Capacitance**



**Figure 7. Turn-On Time**

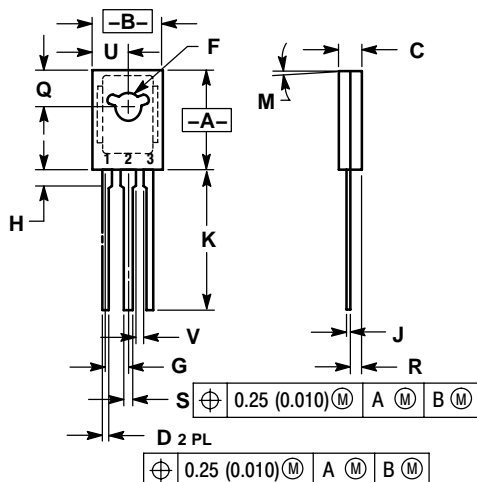


**Figure 8. Turn-Off Time**

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## 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:
1. EMITTER
  2. COLLECTOR
  3. BASE

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