

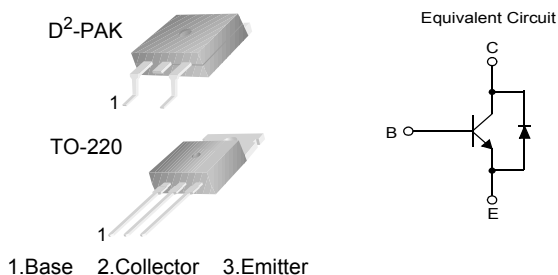


# KSC5338D/KSC5338DW

## NPN Triple Diffused Planar Silicon Transistor

### Features

- High Voltage Power Switch Switching Application
- Wide Safe Operating Area
- Built-in Free-Wheeling Diode
- Suitable for Electronic Ballast Application
- Small Variance in Storage Time
- Two Package Choices : TO-220 or D<sup>2</sup>-PAK



### Absolute Maximum Ratings $T_a=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Value	Units
$V_{\text{CBO}}$	Collector-Base Voltage	1000	V
$V_{\text{CEO}}$	Collector-Emitter Voltage	450	V
$V_{\text{EBO}}$	Emitter-Base Voltage	12	V
$I_{\text{C}}$	Collector Current (DC)	5	A
$I_{\text{CP}}$	*Collector Current (Pulse)	10	A
$I_{\text{B}}$	Base Current (DC)	2	A
$I_{\text{BP}}$	*Base Current (Pulse)	4	A
$P_{\text{C}}$	Power Dissipation ( $T_{\text{C}}=25^{\circ}\text{C}$ )	75	W
$T_{\text{J}}$	Junction Temperature	150	$^{\circ}\text{C}$
$T_{\text{STG}}$	Storage Temperature	- 55 to 150	$^{\circ}\text{C}$

\* Pulse Test : Pulse Width = 5ms, Duty Cycle  $\leq$  10%

### Thermal Characteristics

Symbol	Parameter	Rating	Units	
$R_{\theta\text{jc}}$	Thermal Resistance	Junction to Case	1.65	$^{\circ}\text{C}/\text{W}$
$R_{\theta\text{ja}}$		Junction to Ambient	62.5	$^{\circ}\text{C}/\text{W}$
$T_{\text{L}}$	Maximum Lead Temperature for Soldering	270	$^{\circ}\text{C}$	

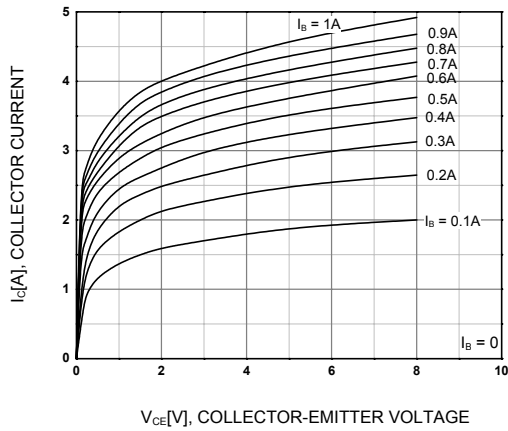
**Electrical Characteristics**  $T_a=25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Units	
$BV_{CBO}$	Collector-Base Breakdown Voltage	$I_C=1\text{mA}, I_E=0$	1000			V	
$BV_{CEO}$	Collector-Emitter Breakdown Voltage	$I_C=5\text{mA}, I_B=0$	450			V	
$BV_{EBO}$	Emitter-Base Breakdown Voltage	$I_E=1\text{mA}, I_C=0$	12			V	
$I_{CBO}$	Collector Cut-off Current	$V_{CB}=800\text{V}, I_E=0$			10	$\mu\text{A}$	
$I_{CES}$	Collector Cut-off Current	$V_{CES}=1000\text{V}, I_{EB}=0$	$T_a=25^\circ\text{C}$		100	$\mu\text{A}$	
			$T_a=125^\circ\text{C}$		500	$\mu\text{A}$	
$I_{CEO}$	Collector Cut-off Current	$V_{CE}=450\text{V}, I_B=0$	$T_a=25^\circ\text{C}$		100	$\mu\text{A}$	
			$T_a=125^\circ\text{C}$		500	$\mu\text{A}$	
$I_{EBO}$	Emitter Cut-off Current	$V_{EB}=10\text{V}, I_C=0$			10	$\mu\text{A}$	
$h_{FE}$	DC Current Gain	$V_{CE}=1\text{V}, I_C=0.8\text{A}$	$T_a=25^\circ\text{C}$	15	25		
			$T_a=125^\circ\text{C}$	10	14		
		$V_{CE}=1\text{V}, I_C=2\text{A}$	$T_a=25^\circ\text{C}$	6	9		
			$T_a=125^\circ\text{C}$	4	6		
		$V_{CE}=2.5\text{V}, I_C=1\text{A}$	$T_a=25^\circ\text{C}$	18	25		
			$T_a=125^\circ\text{C}$	14	18		
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C=0.8\text{A}, I_B=0.08\text{A}$	$T_a=25^\circ\text{C}$		0.35	0.5	V
			$T_a=125^\circ\text{C}$		0.55	0.75	V
		$I_C=2\text{A}, I_B=0.4\text{A}$	$T_a=25^\circ\text{C}$		0.47	0.75	V
			$T_a=125^\circ\text{C}$		0.9	1.1	V
		$I_C=0.8\text{A}, I_B=0.04\text{A}$	$T_a=25^\circ\text{C}$		0.9	1.5	V
			$T_a=125^\circ\text{C}$		1.8	2.5	V
		$I_C=1\text{A}, I_B=0.2\text{A}$	$T_a=25^\circ\text{C}$		0.22	0.5	V
			$T_a=125^\circ\text{C}$		0.3	0.6	V
$V_{BE(sat)}$	Base-Emitter Saturation Voltage	$I_C=0.8\text{A}, I_B=0.08\text{A}$	$T_a=25^\circ\text{C}$		0.8	1.0	V
			$T_a=125^\circ\text{C}$		0.65	0.9	V
		$I_C=2\text{A}, I_B=0.4\text{A}$	$T_a=25^\circ\text{C}$		0.9	1.0	V
			$T_a=125^\circ\text{C}$		0.8	0.9	V
$C_{ib}$	Input Capacitance	$V_{EB}=10\text{V}, I_C=0.5\text{A}, f=1\text{MHz}$		550	750	pF	
$C_{ob}$	Output Capacitance	$V_{CB}=10\text{V}, I_E=0, f=1\text{MHz}$		60	100	pF	
$f_T$	Current Gain Bandwidth Product	$I_C=0.5\text{A}, V_{CE}=10\text{V}$		11		MHz	
$V_F$	Diode Forward Voltage	$I_F=1\text{A}, I_C=1\text{mA}, I_E=0$	$T_a=25^\circ\text{C}$		0.86	1.3	V
			$T_a=125^\circ\text{C}$		0.79		V
		$I_F=2\text{A}$	$T_a=25^\circ\text{C}$		0.95	1.5	V
			$T_a=125^\circ\text{C}$		0.88		V
$t_{fr}$	Diode Forward Recovery Time ( $di/dt=10\text{A}/\mu\text{s}$ )	$I_F=0.4\text{A}$		460		ns	
		$I_F=1\text{A}$		360		ns	
		$I_F=2\text{A}$		325		ns	
$V_{CE(DSAT)}$	Dynamic Saturation Voltage	$I_C=1\text{A}, I_{B1}=100\text{mA}$ $V_{CC}=300\text{V}$ at $1\mu\text{s}$	$T_a=25^\circ\text{C}$		8		V
			$T_a=125^\circ\text{C}$		15		V
		$I_C=1\text{A}, I_{B1}=100\text{mA}$ $V_{CC}=300\text{V}$ at $3\mu\text{s}$	$T_a=25^\circ\text{C}$		2.9		V
			$T_a=125^\circ\text{C}$		8		V
		$I_C=2\text{A}, I_{B1}=400\text{mA}$ $V_{CC}=300\text{V}$ at $1\mu\text{s}$	$T_a=25^\circ\text{C}$		9		V
			$T_a=125^\circ\text{C}$		17		V
		$I_C=2\text{A}, I_{B1}=400\text{mA}$ $V_{CC}=300\text{V}$ at $3\mu\text{s}$	$T_a=25^\circ\text{C}$		1.9		V
			$T_a=125^\circ\text{C}$		8.5		V

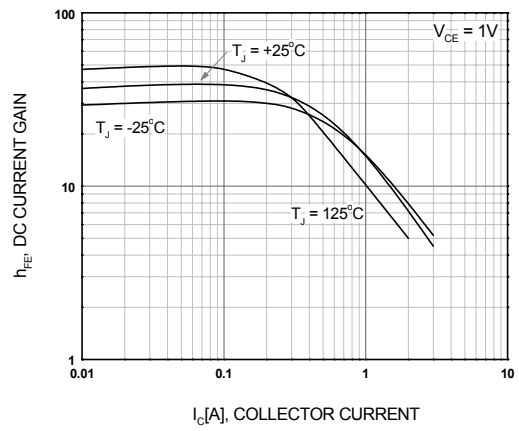
**Electrical Characteristics** (Continued)  $T_a=25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Condition	Min	Typ.	Max.	Units	
RESISTIVE LOAD SWITCHING (D.C. $\leq$ 10%, Pulse Width=40 $\mu$ s)							
$t_{ON}$	Turn On Time	$I_C=2.5\text{A}$ , $I_{B1}=500\text{mA}$ , $I_{B2}=-1\text{A}$ , $V_{CC}=250\text{V}$ , $R_L = 100\Omega$		500	750	ns	
$t_{STG}$	Storage Time		1.2		1.5	$\mu$ s	
$t_F$	Fall Time			100	200	ns	
$t_{ON}$	Turn On Time	$I_C=2\text{A}$ , $I_{B1}=400\text{mA}$ , $I_{B2}=-1\text{A}$ , $V_{CC}=300\text{V}$ , $R_L = 150\Omega$	$T_a=25^\circ\text{C}$	100	150	ns	
			$T_a=125^\circ\text{C}$		150	ns	
$t_{STG}$	Storage Time		$T_a=25^\circ\text{C}$	1.4	2.2	$\mu$ s	
			$T_a=125^\circ\text{C}$		1.7	$\mu$ s	
$t_F$	Fall Time		$T_a=25^\circ\text{C}$		90	150	ns
			$T_a=125^\circ\text{C}$		150	ns	
$t_{ON}$	Turn On Time	$I_C=2.5\text{A}$ , $I_{B1}=500\text{mA}$ , $I_{B2}=-5\text{mA}$ , $V_{CC}=300\text{V}$ , $R_L = 120\Omega$	$T_a=25^\circ\text{C}$		120	150	ns
			$T_a=125^\circ\text{C}$		150	ns	
$t_{STG}$	Storage Time		$T_a=25^\circ\text{C}$	1.8		2.1	$\mu$ s
			$T_a=125^\circ\text{C}$		2.6	$\mu$ s	
$t_F$	Fall Time		$T_a=25^\circ\text{C}$		110	150	ns
			$T_a=125^\circ\text{C}$		160	ns	
INDUCTIVE LOAD SWITCHING ( $V_{CC}=15\text{V}$ )							
$t_{STG}$	Storage Time	$I_C=2.5\text{A}$ , $I_{B1}=500\text{mA}$ , $I_{B2}=-0.5\text{A}$ , $V_Z=350\text{V}$ , $L_C=300\mu\text{H}$	$T_a=25^\circ\text{C}$		1.9	2.2	$\mu$ s
			$T_a=125^\circ\text{C}$		2.4	$\mu$ s	
$t_F$	Fall Time		$T_a=25^\circ\text{C}$		160	200	ns
			$T_a=125^\circ\text{C}$		330	ns	
$t_C$	Cross-over Time		$T_a=25^\circ\text{C}$		350	500	ns
			$T_a=125^\circ\text{C}$		750	ns	
$t_{STG}$	Storage Time	$I_C=2\text{A}$ , $I_{B1}=400\text{mA}$ , $I_{B2}=-0.4\text{A}$ , $V_Z=300\text{V}$ , $L_C=200\mu\text{H}$	$T_a=25^\circ\text{C}$	1.95		2.25	$\mu$ s
			$T_a=125^\circ\text{C}$		2.9	$\mu$ s	
$t_F$	Fall Time		$T_a=25^\circ\text{C}$		120	150	ns
			$T_a=125^\circ\text{C}$		270	ns	
$t_C$	Cross-over Time		$T_a=25^\circ\text{C}$		300	450	ns
			$T_a=125^\circ\text{C}$		700	ns	
$t_{STG}$	Storage Time	$I_C=1\text{A}$ , $I_{B1}=100\text{mA}$ , $I_{B2}=-0.5\text{A}$ , $V_Z=300\text{V}$ , $L_C=200\mu\text{H}$	$T_a=25^\circ\text{C}$		0.6	0.8	$\mu$ s
			$T_a=125^\circ\text{C}$		1.0	$\mu$ s	
$t_F$	Fall Time		$T_a=25^\circ\text{C}$		70	ns	
			$T_a=125^\circ\text{C}$		110	ns	
$t_C$	Cross-over Time		$T_a=25^\circ\text{C}$		80	130	ns
			$T_a=125^\circ\text{C}$		170	ns	

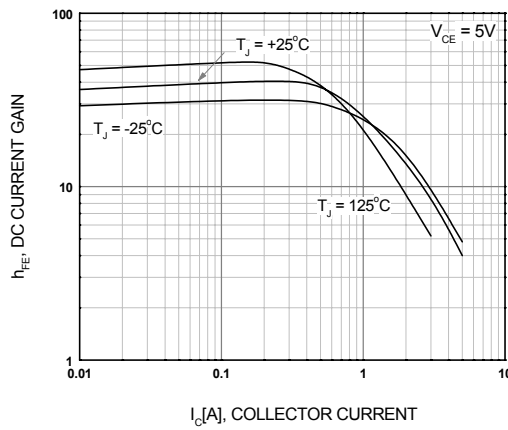
## Typical Characteristics



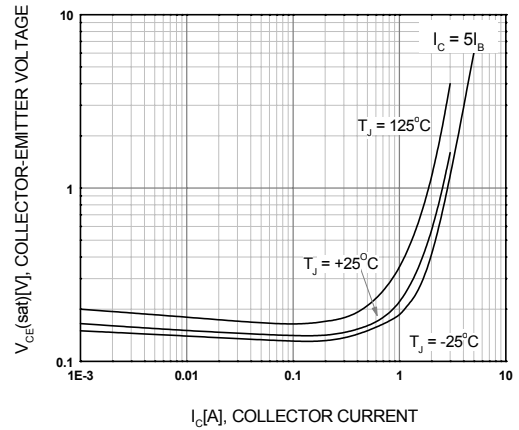
**Figure 1. Static Characteristic**



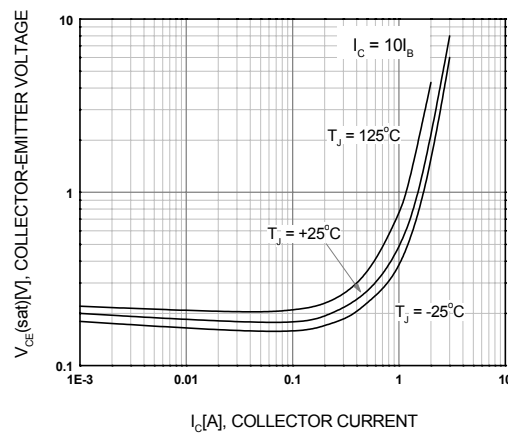
**Figure 2. DC current Gain**



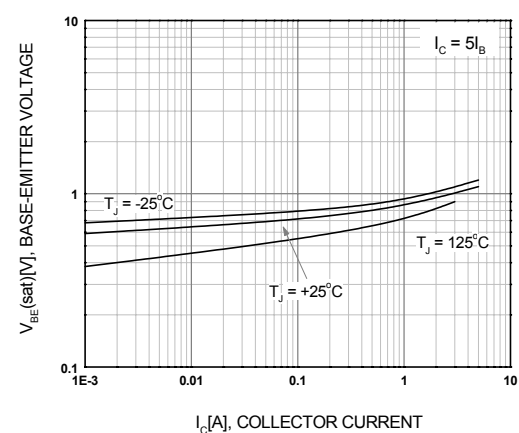
**Figure 3. DC current Gain**



**Figure 4. Collector-Emitter Saturation Voltage**

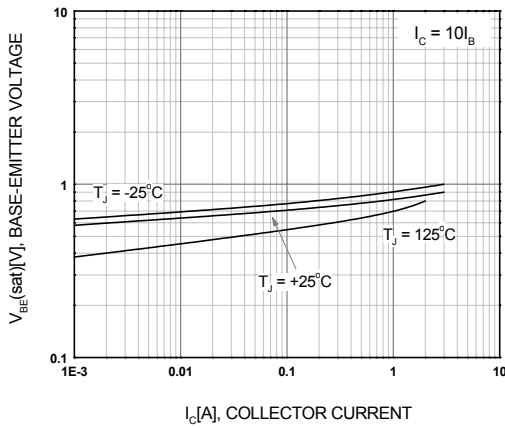


**Figure 5. Collector-Emitter Saturation Voltage**

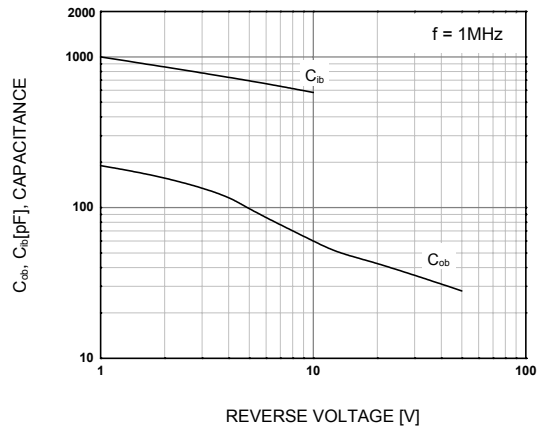


**Figure 6. Base-Emitter Saturation Voltage**

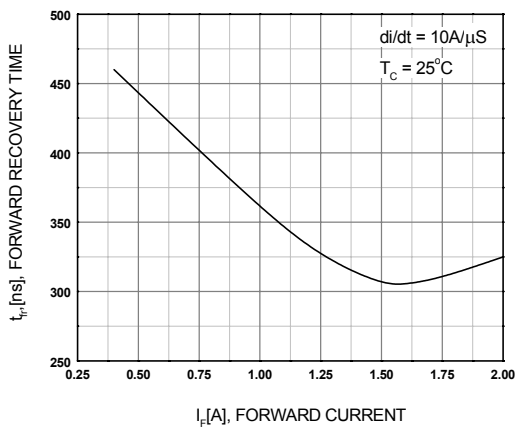
### Typical Characteristics (Continued)



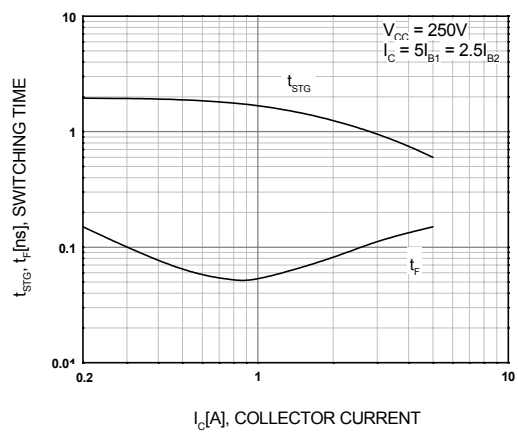
**Figure 7. Base-Emitter Saturation Voltage**



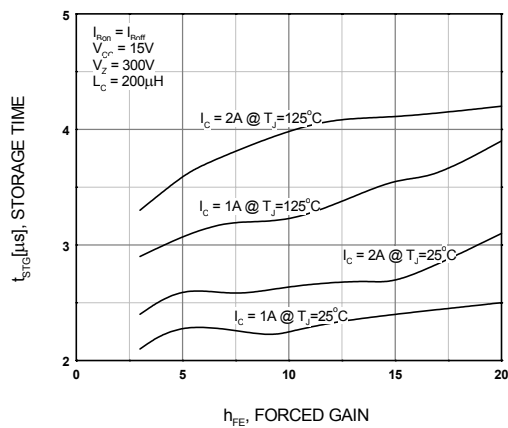
**Figure 8. Collector Output Capacitance**



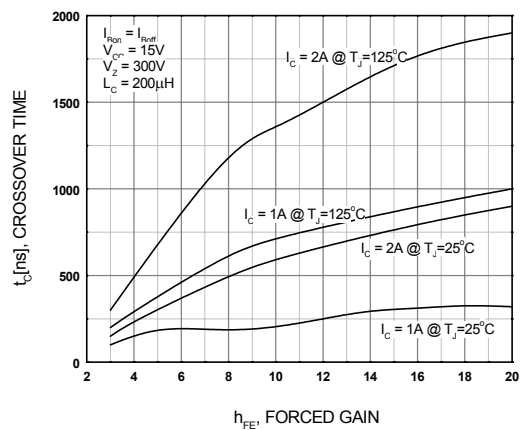
**Figure 9. Forward Recovery Time**



**Figure 10. Switching Time**

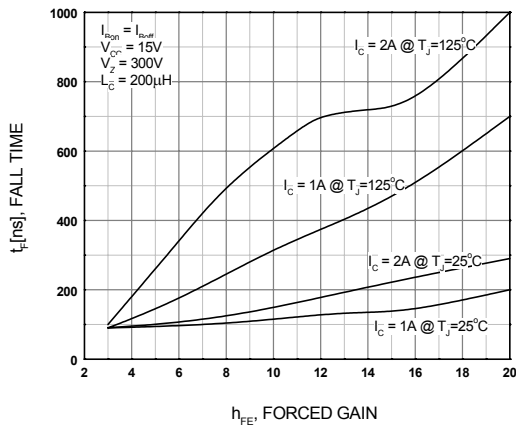


**Figure 11. Induction Storage Time**

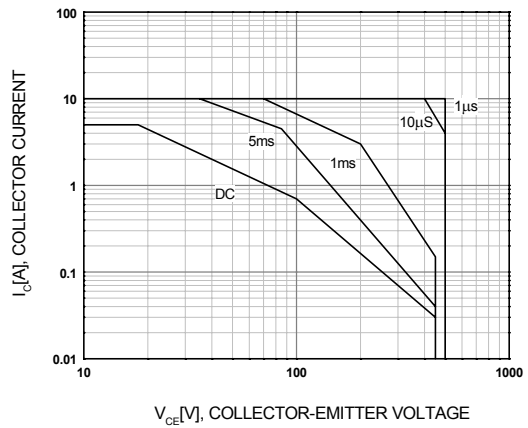


**Figure 12. Inductive Crossover Time**

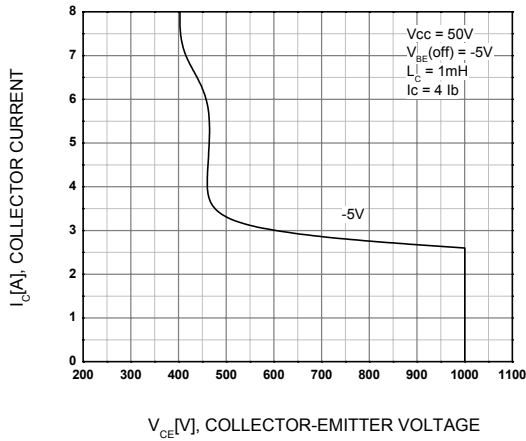
**Typical Characteristics (Continued)**



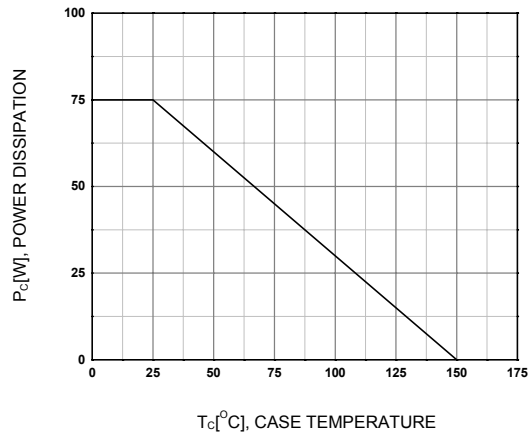
**Figure 13. Inductive Fall Time**



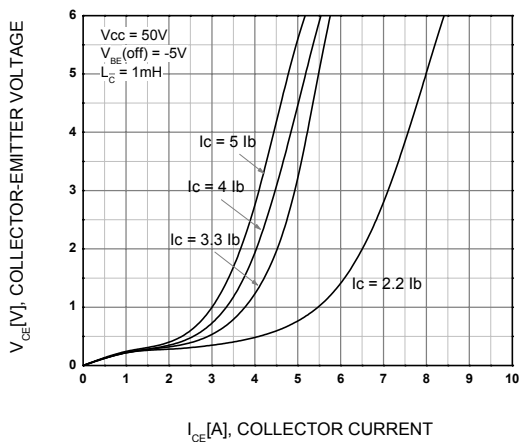
**Figure 14. Safe Operating Area**



**Figure 15. Reverse Bias Safe Operating**



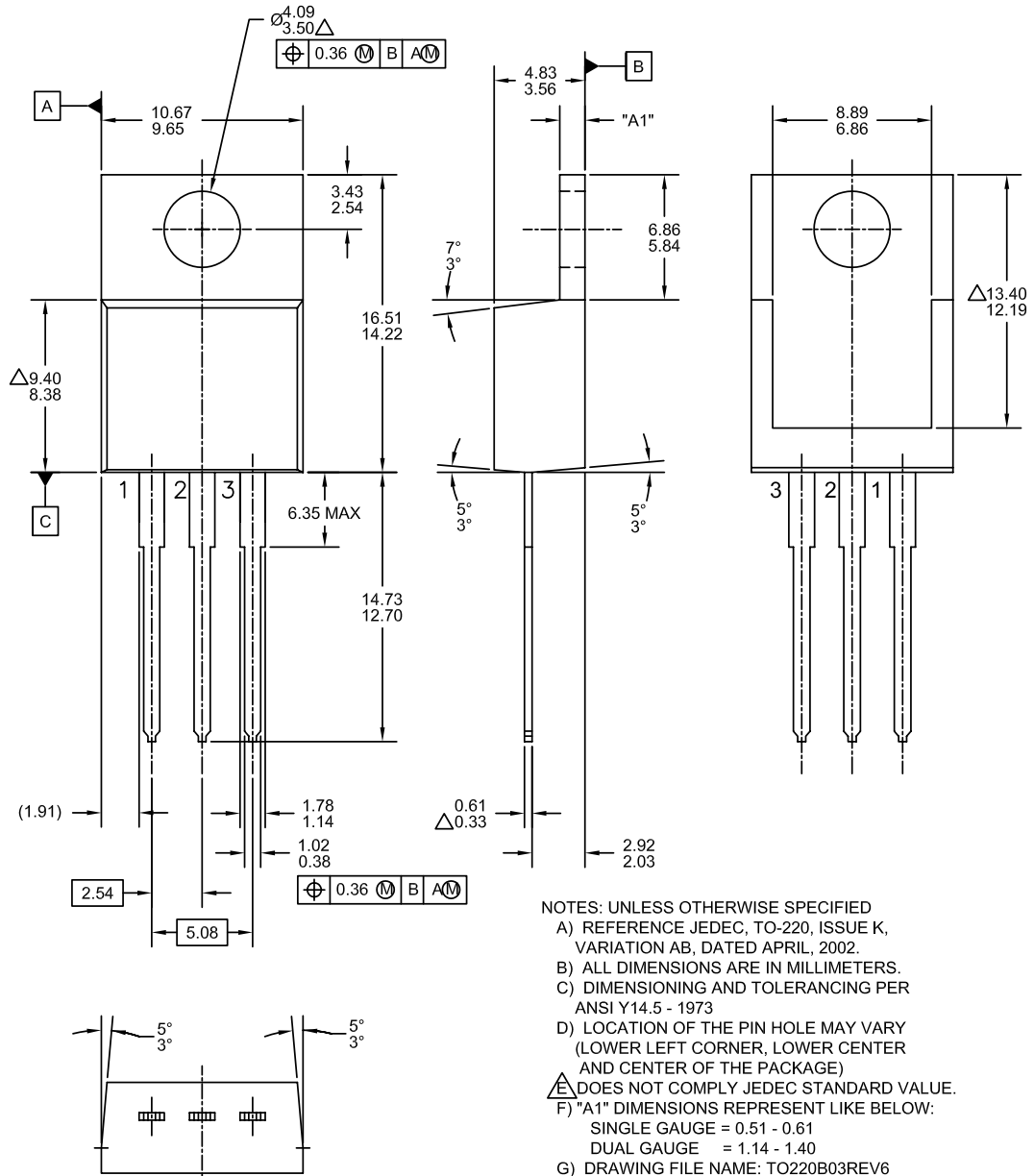
**Figure 16. Power Derating**



**Figure 17. RBSOA Saturation**

**Physical Dimensions**

**TO-220**



- NOTES: UNLESS OTHERWISE SPECIFIED  
 A) REFERENCE JEDEC, TO-220, ISSUE K, VARIATION AB, DATED APRIL, 2002.  
 B) ALL DIMENSIONS ARE IN MILLIMETERS.  
 C) DIMENSIONING AND TOLERANCING PER ANSI Y14.5 - 1973  
 D) LOCATION OF THE PIN HOLE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE)  
 E)  $\Delta$  DOES NOT COMPLY JEDEC STANDARD VALUE.  
 F) "A1" DIMENSIONS REPRESENT LIKE BELOW:  
 SINGLE GAUGE = 0.51 - 0.61  
 DUAL GAUGE = 1.14 - 1.40  
 G) DRAWING FILE NAME: TO220B03REV6

Dimensions in Millimeters



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**Definition of Terms**

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
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