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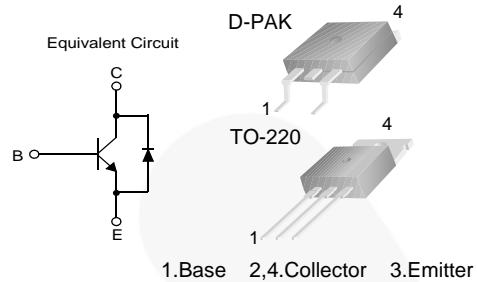
July 2014



# KSC5502D / KSC5502DT 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 : D-PAK or TO-220



## Ordering Information

Part Number	Top Mark	Package	Packing Method
KSC5502DTM	C5502D	TO-252 3L (DPAK)	Tape and Reel
KSC5502DTTU	C5502D	TO-220 3L	Rail

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Values are at  $T_C = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	Value	Unit
$V_{CBO}$	Collector-Base Voltage	1200	V
$V_{CEO}$	Collector-Emitter Voltage	600	V
$V_{EBO}$	Emitter-Base Voltage	12	V
$I_C$	Collector Current (DC)	2	A
$I_{CP}$	Collector Current (Pulse) <sup>(1)</sup>	4	A
$I_B$	Base Current (DC)	1	A
$I_{BP}$	Base Current (Pulse) <sup>(1)</sup>	2	A
$T_J$	Junction Temperature	150	$^\circ\text{C}$
$T_{STG}$	Storage Temperature Range	-65 to 150	$^\circ\text{C}$
EAS	Avalanche Energy ( $T_J = 25^\circ\text{C}$ )	2.5	mJ

### Note:

1. Pulse test: Pulse width = 5 ms, duty cycle  $\leq 10\%$ .

KSC5502D / KSC5502DT — NPN Triple Diffused Planar Silicon Transistor

## Thermal Characteristics

Values are at  $T_C = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	KSC5502D (D-PAK)	KSC5502DT (TO-220)	Unit
$P_C$	Collector Dissipation ( $T_C = 25^\circ\text{C}$ )	87.83	118.16	W
$R_{\theta JC}$	Thermal Resistance, Junction to Case	1.42	1.06	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	111.0	62.5	$^\circ\text{C}/\text{W}$
$T_L$	Maximum Lead Temperature for Soldering Purpose: 1/8 inch from Case for 5 seconds	270		$^\circ\text{C}$

## Electrical Characteristics

Values are at  $T_C = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit	
$BV_{CBO}$	Collector-Base Breakdown Voltage	$I_C = 1\text{ mA}, I_E = 0$	1200	1350		V	
$BV_{CEO}$	Collector-Emitter Breakdown Voltage	$I_C = 5\text{ mA}, I_B = 0$	600	750		V	
$BV_{EBO}$	Emitter-Base Breakdown Voltage	$I_E = 500\text{ }\mu\text{A}, I_C = 0$	12.0	13.7		V	
$I_{CES}$	Collector Cut-off Current	$V_{CES} = 1200\text{ V}, V_{BE} = 0$	$T_C = 25^\circ\text{C}$		100	$\mu\text{A}$	
			$T_C = 125^\circ\text{C}$		500		
$I_{CEO}$	Collector Cut-off Current	$V_{CE} = 600\text{ V}, I_B = 0$	$T_C = 25^\circ\text{C}$		100	$\mu\text{A}$	
			$T_C = 125^\circ\text{C}$		500		
$I_{EBO}$	Emitter Cut-off Current	$V_{EB} = 12\text{ V}, I_C = 0$	$T_C = 25^\circ\text{C}$		10	$\mu\text{A}$	
$h_{FE}$	DC Current Gain	$V_{CE} = 1\text{ V}, I_C = 0.2\text{ A}$	$T_C = 25^\circ\text{C}$	15	28	40	
			$T_C = 125^\circ\text{C}$	8	18		
		$V_{CE} = 1\text{ V}, I_C = 1\text{ A}$	$T_C = 25^\circ\text{C}$	4.0	6.4		
			$T_C = 125^\circ\text{C}$	3.0	4.7		
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C = 0.2\text{ A}, I_B = 0.02\text{ A}$	$T_C = 25^\circ\text{C}$		0.31	0.80	V
			$T_C = 125^\circ\text{C}$		0.54	1.10	
		$I_C = 0.4\text{ A}, I_B = 0.08\text{ A}$	$T_C = 25^\circ\text{C}$		0.15	0.60	
			$T_C = 125^\circ\text{C}$		0.23	1.00	
$V_{BE(sat)}$	Base-Emitter Saturation Voltage	$I_C = 0.4\text{ A}, I_B = 0.08\text{ A}$	$T_C = 25^\circ\text{C}$		0.77	1.00	V
			$T_C = 125^\circ\text{C}$		0.60	0.90	
		$I_C = 1\text{ A}, I_B = 0.2\text{ A}$	$T_C = 25^\circ\text{C}$		0.83	1.20	
			$T_C = 125^\circ\text{C}$		0.70	1.00	
$C_{ib}$	Input Capacitance	$V_{EB} = 8\text{ V}, I_C = 0, f = 1\text{ MHz}$		385	500	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	$I_F = 0.2\text{ A}$	$T_C = 25^\circ\text{C}$		0.75	1.20	V
			$T_C = 125^\circ\text{C}$		0.59		
		$I_F = 0.4\text{ A}$	$T_C = 25^\circ\text{C}$		0.80	1.30	
			$T_C = 125^\circ\text{C}$		0.64		
		$I_F = 1\text{ A}$	$T_C = 25^\circ\text{C}$		0.90	1.50	

## Electrical Characteristics

Values are at  $T_C = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ.	Max.	Unit	
$t_{fr}$	Diode Forward Recovery Time ( $di/dt=10\text{ A}/\mu\text{s}$ )	$I_F = 0.2\text{ A}$		650		ns	
		$I_F = 0.4\text{ A}$		740			
		$I_F = 1\text{ A}$		785			
$V_{CE(DSAT)}$	Dynamic Saturation Voltage	$I_C = 0.4\text{ A}, I_{B1} = 80\text{ mA}, V_{CC} = 300\text{ V}$	at $1\ \mu\text{s}$	7.2		V	
			at $3\ \mu\text{s}$	1.8			
		$I_C = 1\text{ A}, I_{B1} = 200\text{ mA}, V_{CC} = 300\text{ V}$	at $1\ \mu\text{s}$	18.0			
			at $3\ \mu\text{s}$	6.0			
<b>Resistive Load Switching (<math>D.C &lt; 10\%</math>, Pulse Width = 20 s)</b>							
$t_{ON}$	Turn-On Time	$I_C = 0.4\text{ A}, I_{B1} = 80\text{ mA}, I_{B2} = 0.2\text{ A}, V_{CC} = 300\text{ V}, R_L = 750\ \Omega$	$T_C = 25^\circ\text{C}$		175	350	ns
			$T_C = 125^\circ\text{C}$		185		
$t_{OFF}$	Turn-Off Time	$I_C = 0.4\text{ A}, I_{B1} = 80\text{ mA}, I_{B2} = 0.2\text{ A}, V_{CC} = 300\text{ V}, R_L = 750\ \Omega$	$T_C = 25^\circ\text{C}$		2.1	3.0	$\mu\text{s}$
			$T_C = 125^\circ\text{C}$		2.6		
$t_{ON}$	Turn-On Time	$I_C = 1\text{ A}, I_{B1} = 160\text{ mA}, I_{B2} = 160\text{ mA}, V_{CC} = 300\text{ V}, R_L = 300\ \Omega$	$T_C = 25^\circ\text{C}$		240	450	ns
			$T_C = 125^\circ\text{C}$		310		
$t_{OFF}$	Turn-Off Time	$I_C = 1\text{ A}, I_{B1} = 160\text{ mA}, I_{B2} = 160\text{ mA}, V_{CC} = 300\text{ V}, R_L = 300\ \Omega$	$T_C = 25^\circ\text{C}$		3.7	5.0	$\mu\text{s}$
			$T_C = 125^\circ\text{C}$		4.5		
<b>Inductive Load Switching (<math>V_{CC} = 15\text{ V}</math>)</b>							
$t_{STG}$	Storage Time	$I_C = 0.4\text{ A}, I_{B1} = 80\text{ mA}, I_{B2} = 0.2\text{ A}, V_Z = 300\text{ V}, L_C = 200\text{ H}$	$T_C = 25^\circ\text{C}$		1.2	2.0	$\mu\text{s}$
			$T_C = 125^\circ\text{C}$		1.5		
$t_F$	Fall Time	$I_C = 0.4\text{ A}, I_{B1} = 80\text{ mA}, I_{B2} = 0.2\text{ A}, V_Z = 300\text{ V}, L_C = 200\text{ H}$	$T_C = 25^\circ\text{C}$		90	200	ns
			$T_C = 125^\circ\text{C}$		65		
$t_C$	Cross-Over Time	$I_C = 0.4\text{ A}, I_{B1} = 80\text{ mA}, I_{B2} = 0.2\text{ A}, V_Z = 300\text{ V}, L_C = 200\text{ H}$	$T_C = 25^\circ\text{C}$		185	350	ns
			$T_C = 125^\circ\text{C}$		145		
$t_{STG}$	Storage Time	$I_C = 0.8\text{ A}, I_{B1} = 160\text{ mA}, I_{B2} = 160\text{ mA}, V_{CC} = 300\text{ V}, L_C = 200\text{ H}$	$T_C = 25^\circ\text{C}$		3.30	4.50	$\mu\text{s}$
			$T_C = 125^\circ\text{C}$		3.75		
$t_F$	Fall Time	$I_C = 0.8\text{ A}, I_{B1} = 160\text{ mA}, I_{B2} = 160\text{ mA}, V_{CC} = 300\text{ V}, L_C = 200\text{ H}$	$T_C = 25^\circ\text{C}$		90	250	ns
			$T_C = 125^\circ\text{C}$		160		
$t_C$	Cross-over Time	$I_C = 0.8\text{ A}, I_{B1} = 160\text{ mA}, I_{B2} = 160\text{ mA}, V_{CC} = 300\text{ V}, L_C = 200\text{ H}$	$T_C = 25^\circ\text{C}$		300	600	ns
			$T_C = 125^\circ\text{C}$		570		

## Typical Performance Characteristics

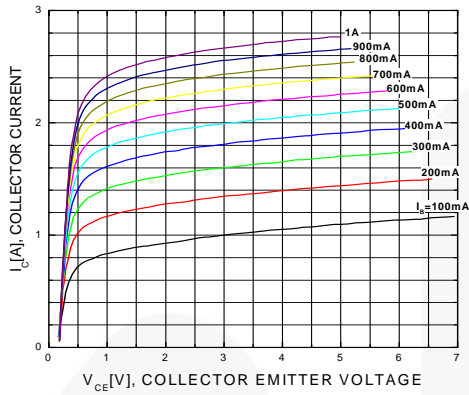


Figure 1. Static Characteristic

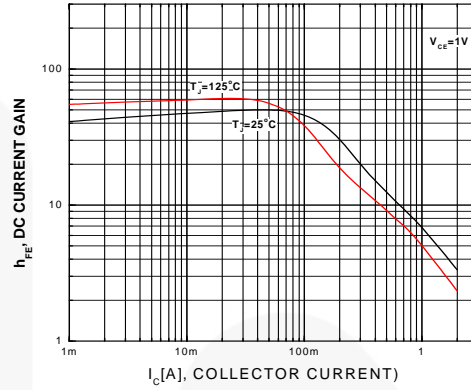


Figure 2. DC Current Gain

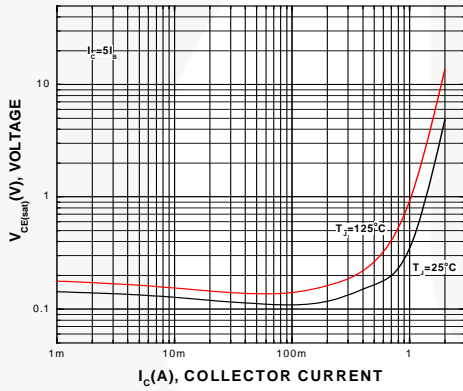


Figure 3. Collector-Emitter Saturation Voltage

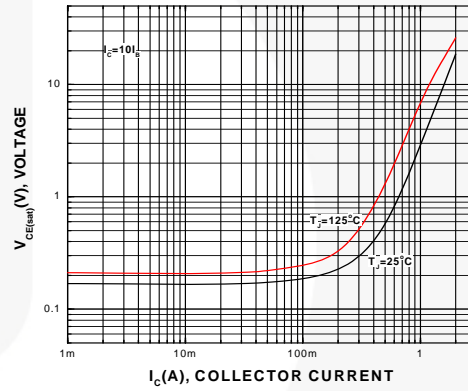


Figure 4. Collector-Emitter Saturation Voltage

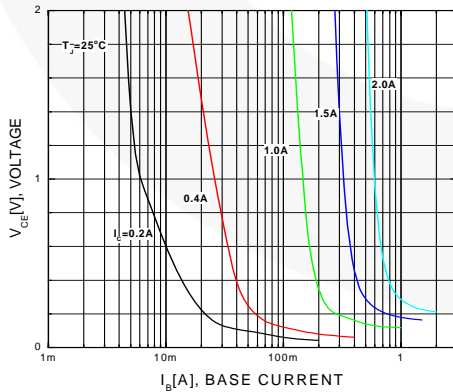


Figure 5. Typical Collector Saturation Voltage

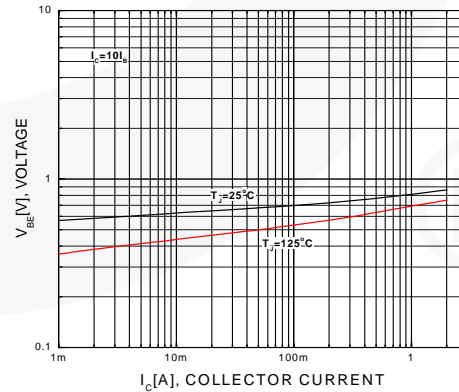
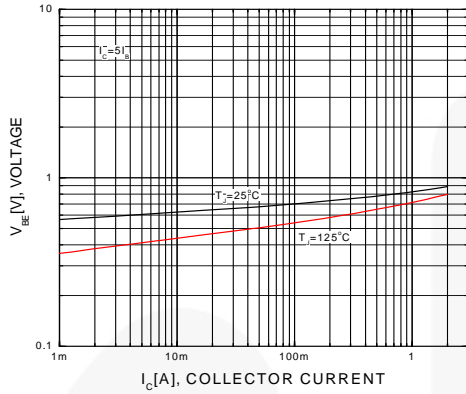
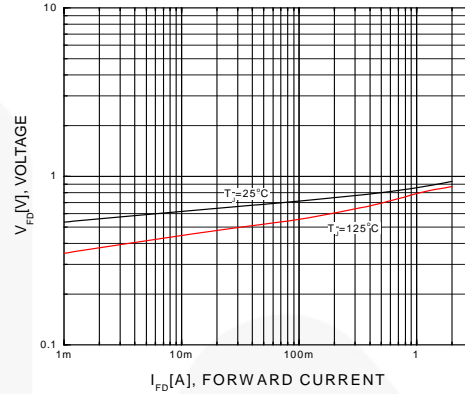


Figure 6. Base-Emitter Saturation Voltage

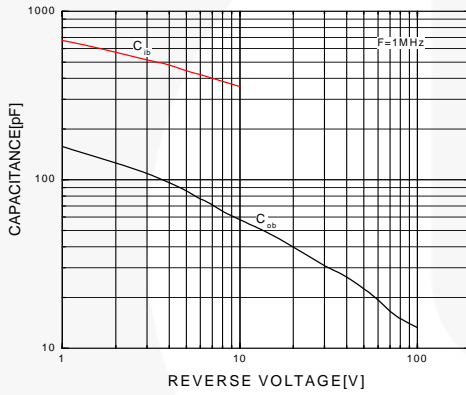
**Typical Performance Characteristics (Continued)**



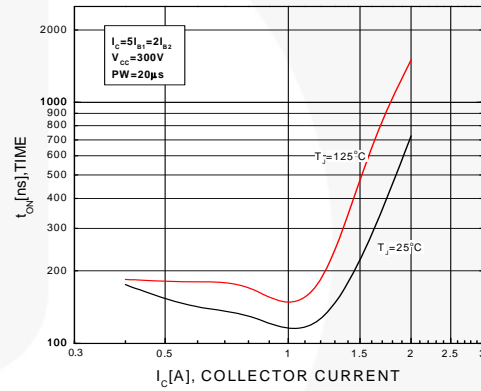
**Figure 7. Base-Emitter Saturation Voltage**



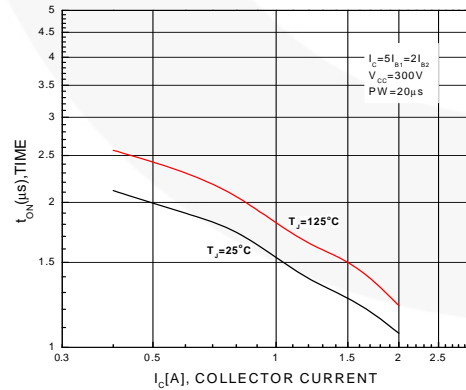
**Figure 8. Diode Forward Voltage**



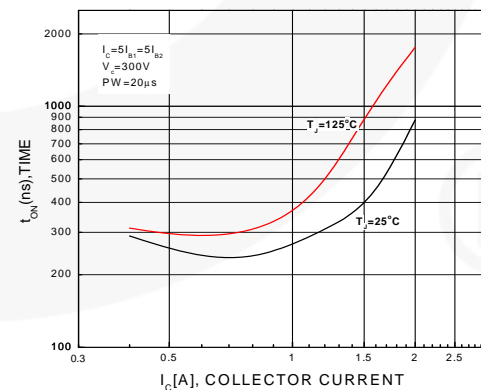
**Figure 9. Collector Output Capacitance**



**Figure 10. Resistive Switching Time,  $t_{on}$**

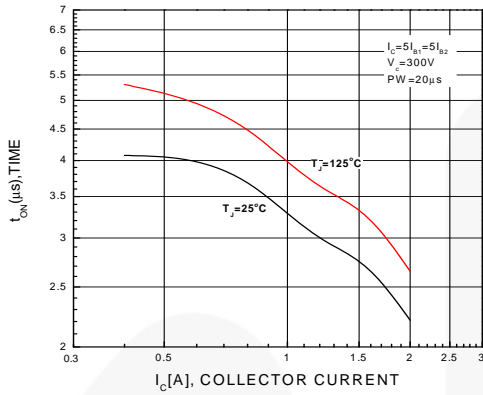


**Figure 11. Resistive Switching Time,  $t_{off}$**

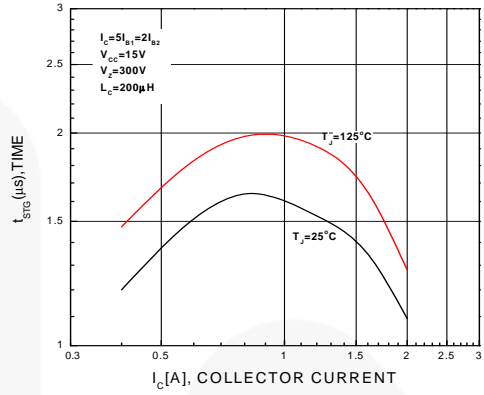


**Figure 12. Resistive Switching Time,  $t_{on}$**

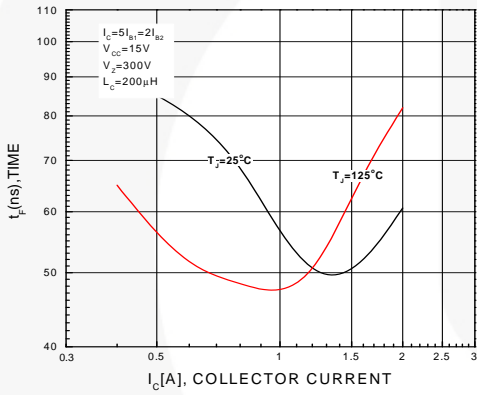
**Typical Performance Characteristics (Continued)**



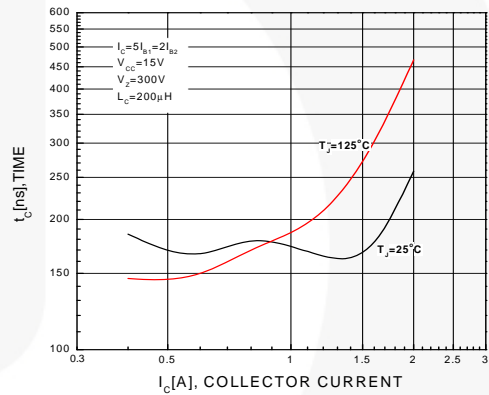
**Figure 13. Resistive Switching Time,  $t_{off}$**



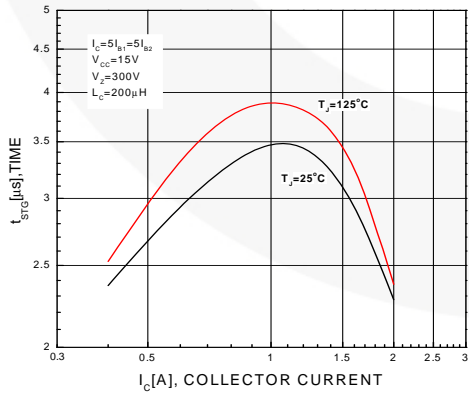
**Figure 14. Inductive Switching Time,  $t_{STG}$**



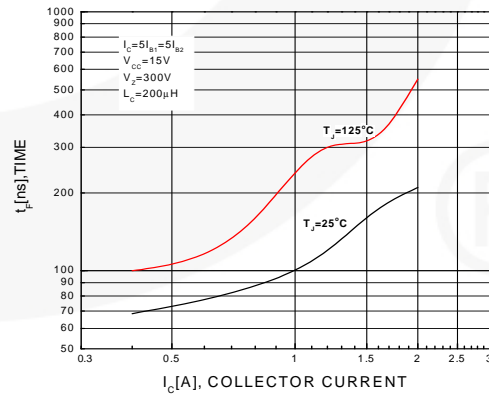
**Figure 15. Inductive Switching Time,  $t_f$**



**Figure 16. Inductive Switching Time,  $t_c$**

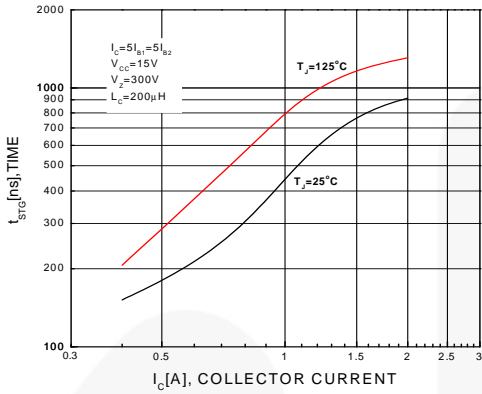


**Figure 17. Inductive Switching Time,  $t_{STG}$**

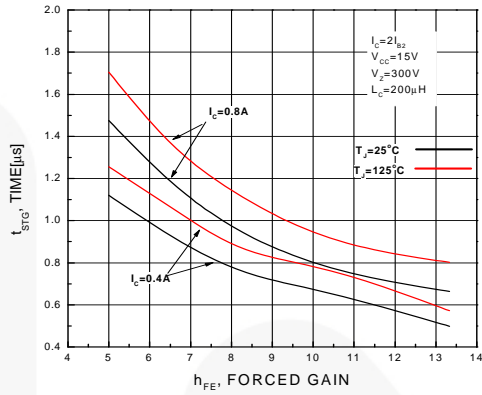


**Figure 18. Inductive Switching Time,  $t_f$**

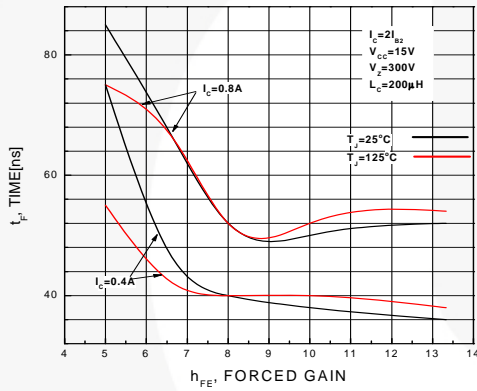
**Typical Performance Characteristics (Continued)**



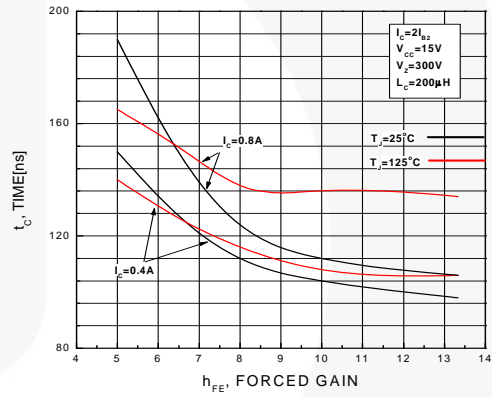
**Figure 19. Inductive Switching Time,  $t_{STG}$**



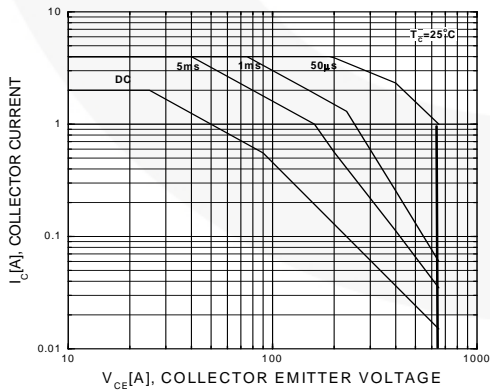
**Figure 20. Inductive Switching Time,  $t_{STG}$**



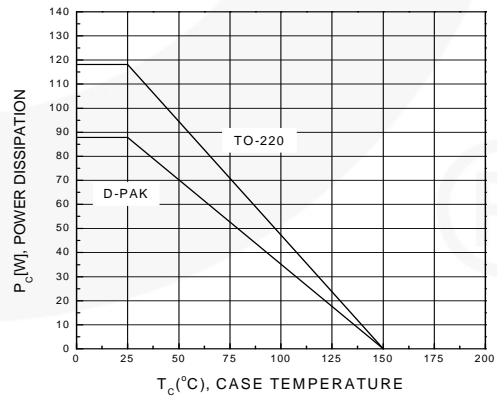
**Figure 21. Inductive Switching Time,  $t_F$**



**Figure 22. Inductive Switching Time,  $t_C$**



**Figure 23. Forward Bias Safe Operating Area**



**Figure 24. Power Derating**



Typical Performance Characteristics (Continued)

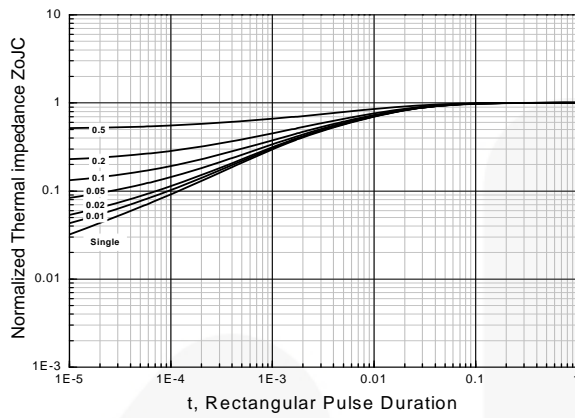


Figure 25. ZoJC, Transient Thermal Impedance (D-PAK)

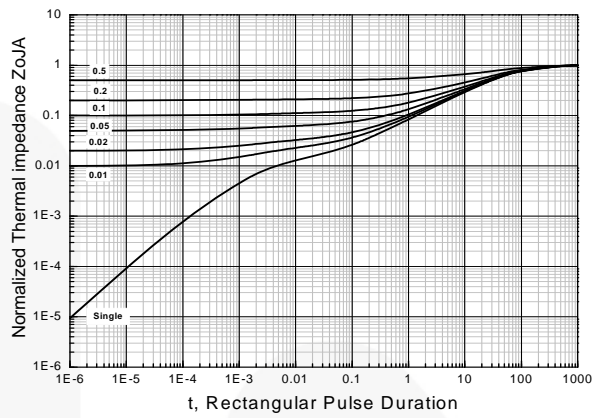


Figure 26. ZoJA, Transient Thermal Impedance (D-PAK)

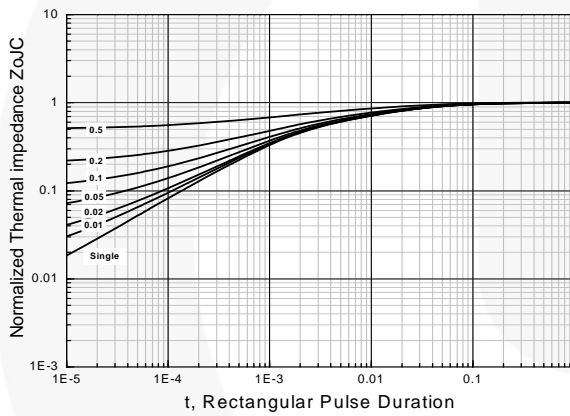


Figure 27. ZoJC, Transient Thermal Impedance (TO-220)

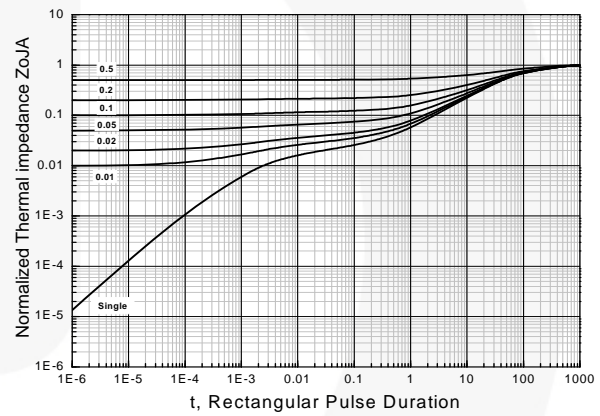


Figure 28. ZoJA, Transient Thermal Impedance (TO-220)

Physical Dimensions

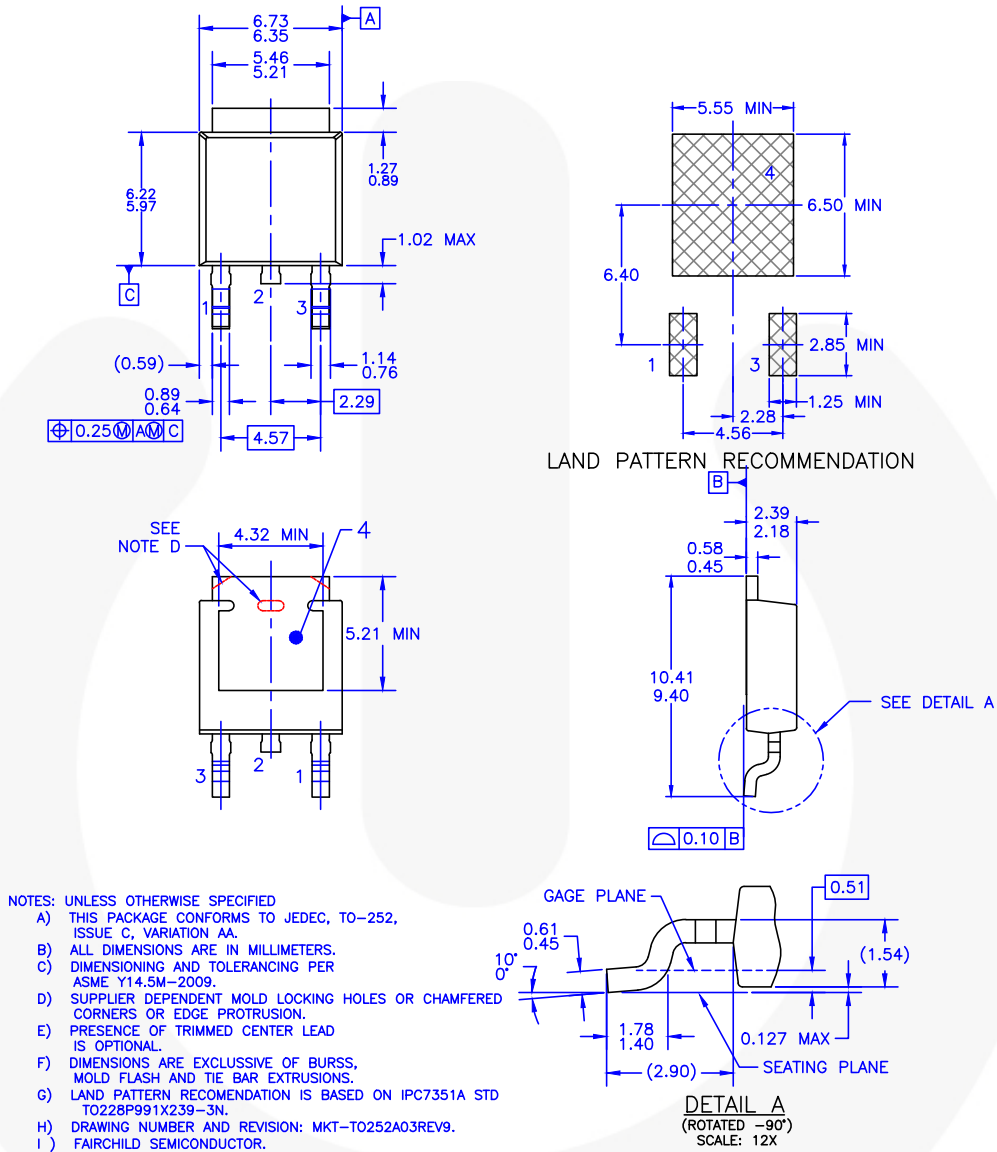


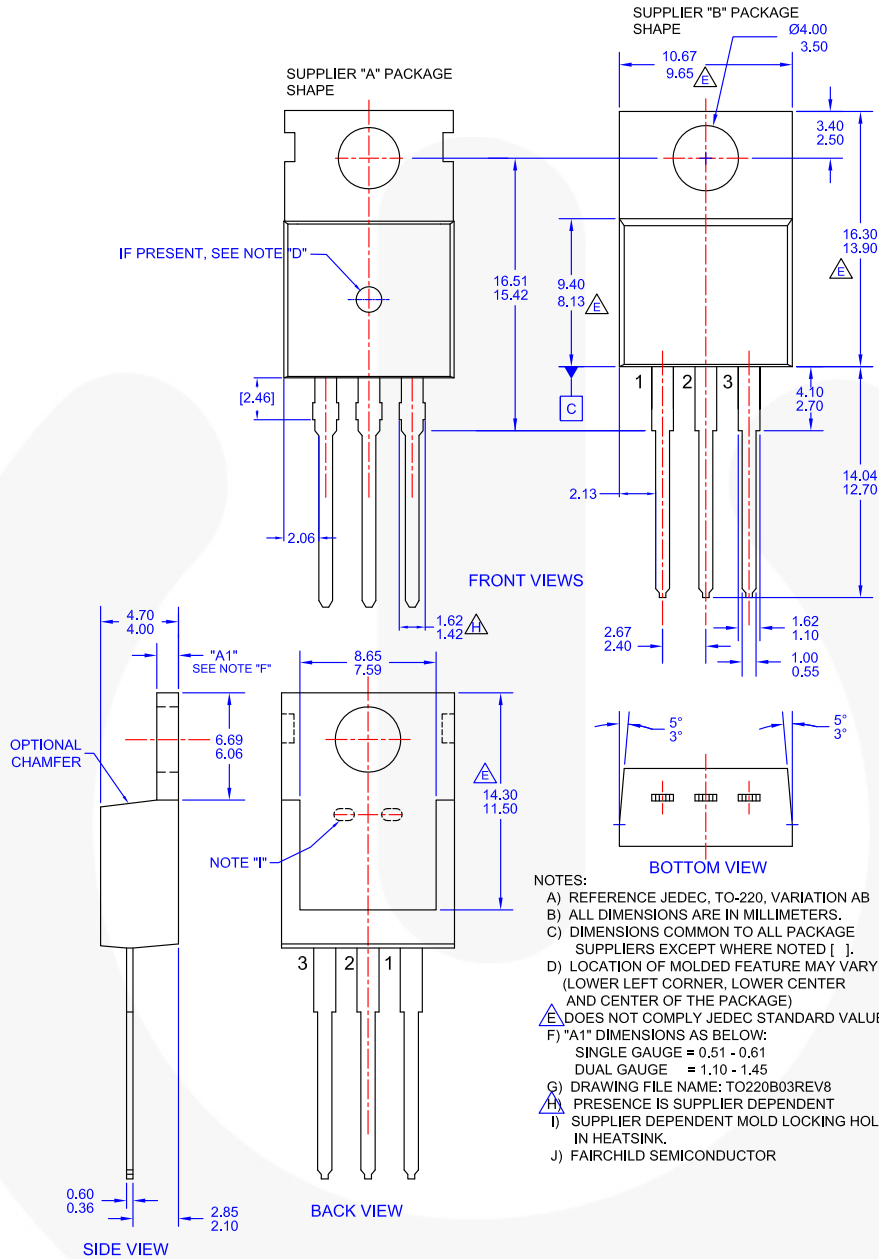
Figure 29. TO-252 (D-PAK), MOLDED, 3-LEAD, OPTION AA & AB

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## Physical Dimensions



**Figure 30. TO-220, MOLDED, 3LEAD, JEDEC VARIATION AB**

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| Build it Now™   | GreenBridge™                                   | Programmable Active Droop™  | TinyCalc™   |
| CorePLUS™   | Green FPS™                                     | QFET®   | TinyLogic®  |
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| Current Transfer Logic™   | IntelliMAX™                                    |  | TinyWire™   |
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