

## IKD04N60RC2-VB Datasheet

### 600V Trench and Fieldstop IGBT

PRODUCT SUMMARY		
V <sub>CE</sub> (V)	600	
I <sub>C</sub> (A)	14 (TC=25 °C)	7 (TC=100 °C)
V <sub>CE (sat)</sub> (V)	1.6	
I <sub>CM</sub> (A)	21	

#### FEATURES

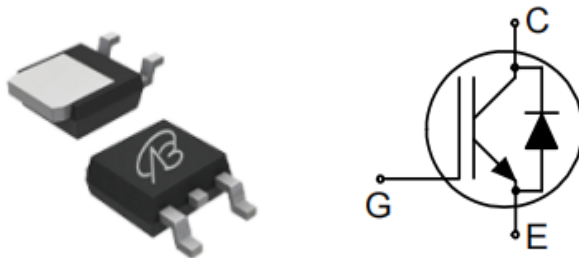
- Very Low V<sub>CEsat</sub>
- Low turn-off losses
- High speed switching
- Maximum junction temperature 175°C
- Ultra low gate charge (Q<sub>g</sub>)
- Avalanche energy rated (UIS)



#### APPLICATIONS

- Telecommunications
  - Server and telecom power supplies
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting
- Consumer and computing
  - ATX power supplies
- Industrial
  - Welding
  - Battery chargers
  - Renewable energy
    - Solar (PV inverters)
  - Switch mode power supplies (SMPS)

TO-252



Top View

#### Package pin definition

- Pin1 G - Gate
- Pin2 C & backside - Collector
- Pin3 E - Emitter

ABSOLUTE MAXIMUM RATINGS (T <sub>C</sub> = 25 °C, unless otherwise noted)				
PARAMETER		SYMBOL	LIMIT	UNIT
Collector-Emitter Voltage		V <sub>CE</sub>	600	V
Gate-Emitter Voltage		V <sub>GE</sub>	±30	
Continuous Collector Current (T <sub>J</sub> = 150 °C)	V <sub>GE</sub> at 15 V	I <sub>C</sub>	T <sub>C</sub> = 25 °C	14
			T <sub>C</sub> = 100 °C	7
Pulsed Collector Current <sup>a</sup>		I <sub>CM</sub>	21	A
Diode Forward Current <sup>b</sup>		I <sub>F</sub>	7	A
Maximum Power Dissipation		P <sub>D</sub>	T <sub>C</sub> = 25 °C	55
			T <sub>C</sub> = 100 °C	43
Operating Junction and Storage Temperature Range		T <sub>J</sub> , T <sub>stg</sub>	-55 to +175	°C
Short Circuit Withstand Time <sup>TC=150</sup>	V <sub>GE</sub> = 15V, V <sub>CE</sub> 400V	t <sub>sc</sub>	3	µs
Short Circuit Withstand Time <sup>TC=100</sup>	V <sub>GE</sub> = 15V, V <sub>CE</sub> 330V		5	
Soldering Recommendations (Peak Temperature) <sup>c</sup>	for 10 s		260	°C

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- Current limited by maximum junction temperature.
- 1.6 mm from case.

<b>THERMAL RESISTANCE RATINGS</b>				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	40	°C/W
Maximum Junction-to-Case	$R_{thJC}$	-	1.5	

<b>SPECIFICATIONS</b> ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
<b>Static</b>							
Collector-Emitter Breakdown Voltage	$BV_{CE}$	$V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$ $V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$		600 600	- -	- -	V
Gate-Source Threshold Voltage (N)	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_D = 250\text{ }\mu\text{A}$		4	5	6	V
Zero Gate Voltage Collector Current	$I_{CES}$	$V_{CE} = 600\text{ V}, V_{GE} = 0\text{ V}, T_J = 25\text{ }^\circ\text{C}$		-	1	20	$\mu\text{A}$
		$V_{CE} = 600\text{ V}, V_{GE} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$		-	1000	-	$\mu\text{A}$
Gate-Emitter Leakage Current	$I_{GES}$	$V_{CE} = 0\text{ V}, V_{GS} = \pm 2.0\text{ V}$		-	-	100	nA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = 15\text{ V}$	$I_C = 7\text{ A}$	-	1.7	2.1	V
Forward Transconductance	$g_{fs}$	$V_{CE} = 20\text{ V}, I_C = 7\text{ A}$		-	40	-	S
<b>Dynamic</b>							
Input Capacitance	$C_{ies}$	$V_{GE} = 0\text{ V}, V_{CE} = 25\text{ V},$ $f = 500\text{ KHz}$		-	1400	-	pF
Output Capacitance	$C_{oes}$			-	76	-	
Reverse Transfer Capacitance	$C_{res}$			-	21	-	
Turn-on Energy	$E_{on}$	$V_{CE} = 400\text{ V}, V_{GE} = 0/15\text{V},$ $I_C = 7\text{ A}, R_g = 10\Omega$		-	0.81	-	nJ
Turn-off Energy	$E_{off}$			-	0.26	-	
Total Gate Charge	$Q_g$	$V_{GE} = 15\text{ V}$	$I_C = 7\text{ A}, V_{CE} = 400\text{ V}$	-	18	-	nC
Gate-Emitter Charge	$Q_{ge}$			-	15	-	
Gate to Collector Charge	$Q_{gc}$			-	33	-	
Turn-On Delay Time	$t_{d(on)}$	$V_{CE} = 400\text{ V}, V_{GE} = 0/15\text{V},$ $I_C = 7\text{ A}, R_g = 10\Omega$		-	45	-	ns
Rise Time	$t_r$			-	25	-	
Turn-Off Delay Time	$t_{d(off)}$			-	115	-	
Fall Time	$t_f$			-	24	-	
Internal emitter inductance measured 5 mm	$L_E$			-	13	-	nH
<b>Diode Characteristics</b>							
Diode Forward Current	$I_F$	IGBT symbol showing the integral reverse junction diode		-	-	7	A
Pulsed Diode Forward Current	$I_{FM}$			-	-	21	
Diode Forward Voltage	$V_F$	$I_F = 7\text{ A}$		-	1.75	2.0	V
Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = 7\text{ A},$ $di_F/dt = 200\text{ A}/\mu\text{s}, V_R = 400\text{ V}$		-	70	-	ns
Reverse Recovery Charge	$Q_{rr}$			-	0.26	-	$\mu\text{C}$
Reverse Recovery Current	$I_{RRM}$			-	9	-	A



Figure 1. **Forward bias safe operating area**  
( $D=0$ ,  $T_C=25^\circ\text{C}$ ,  $T_{vj}\leq 175^\circ\text{C}$ ;  $V_{GE}=15\text{V}$ .  
Recommended use at  $V_{GE}\geq 7.5\text{V}$ )



Figure 2. **Power dissipation as a function of case temperature**  
( $T_{vj}\leq 175^\circ\text{C}$ )



Figure 3. **Collector current as a function of case temperature**



Figure 4. **Typical output characteristic**

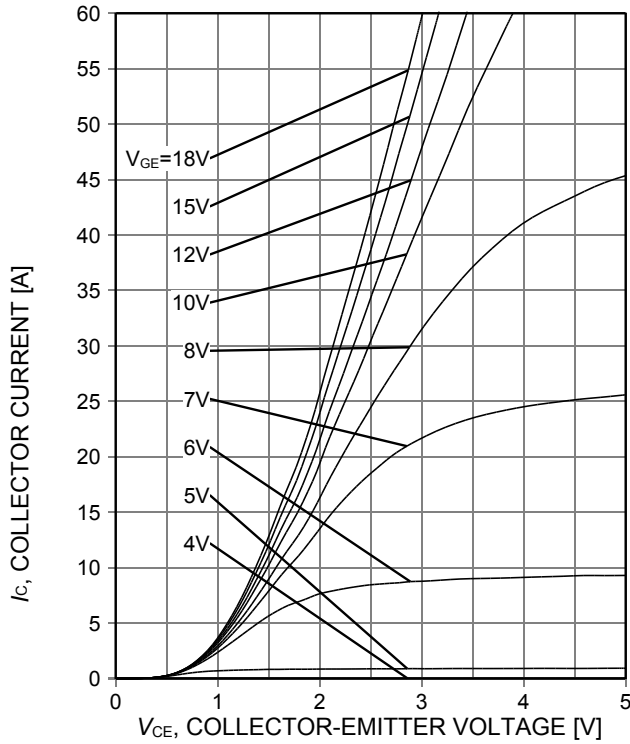


Figure 5. Typical output characteristic ( $T_{vj}=150^{\circ}\text{C}$ )

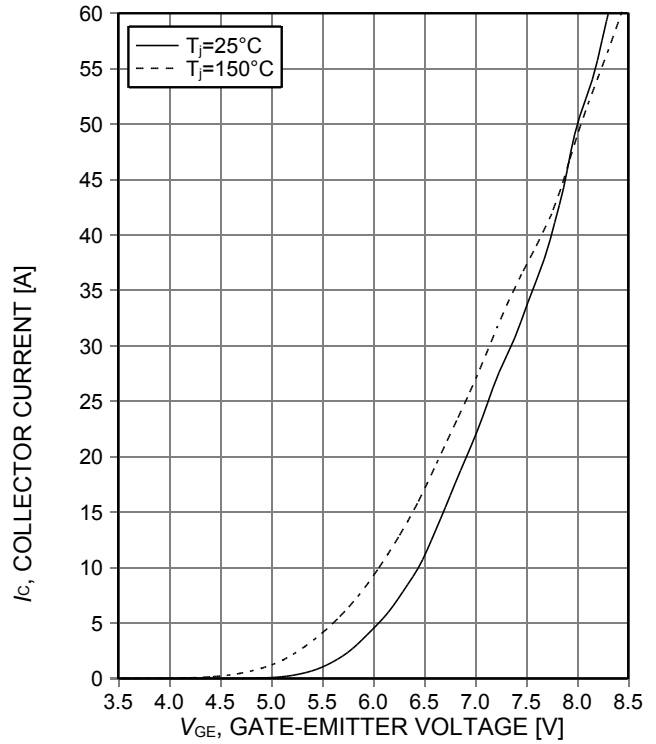


Figure 6. Typical transfer characteristic ( $V_{CE}=20\text{V}$ )



Figure 7. Typical collector-emitter saturation voltage as a function of junction temperature



Figure 8. Typical switching times as a function of collector current

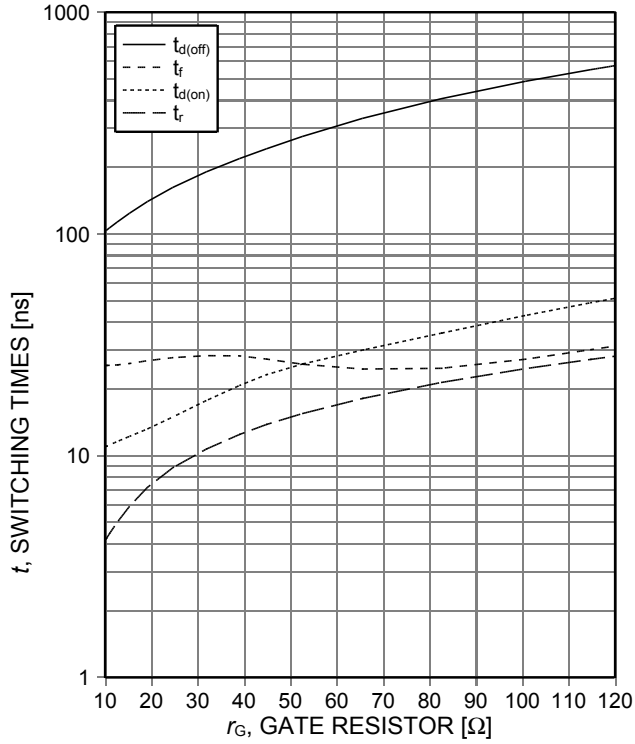


Figure 9. Typical switching times as a function of gate resistor



Figure 10. Typical switching times as a function of junction temperature



Figure 11. Gate-emitter threshold voltage as a function of junction temperature



Figure 12. Typical switching energy losses as a function of collector current

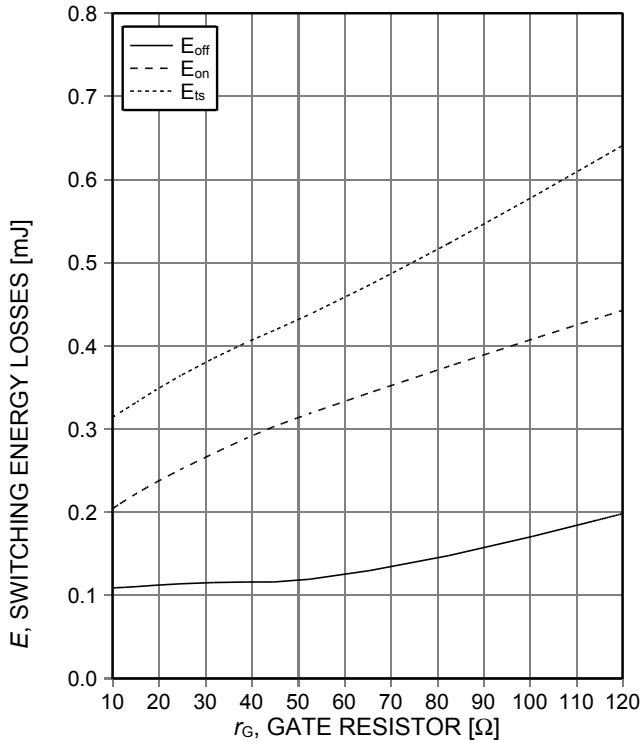


Figure 13. Typical switching energy losses as a function of gate resistor

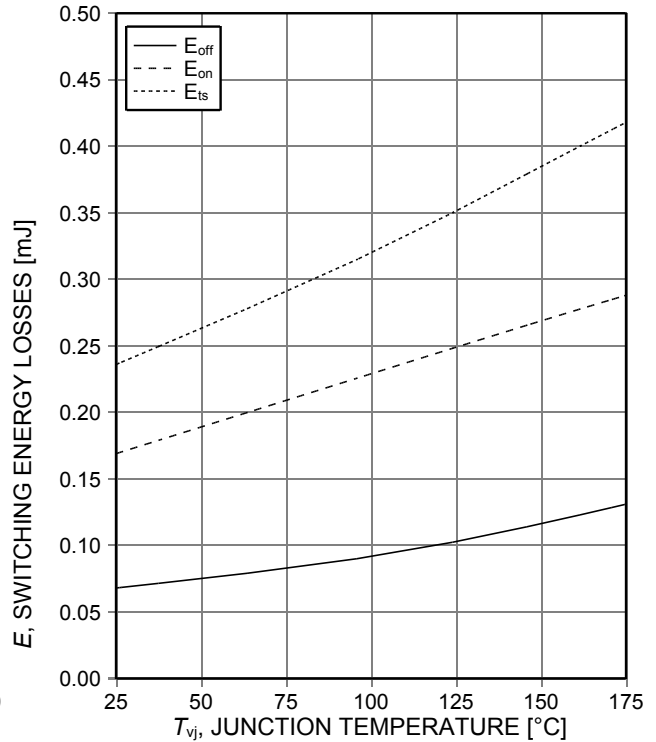


Figure 14. Typical switching energy losses as a function of junction temperature

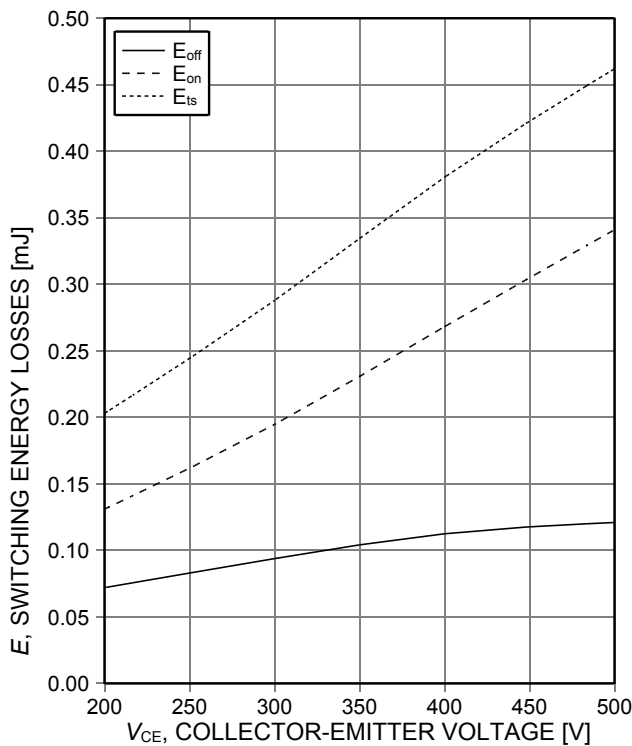


Figure 15. Typical switching energy losses as a function of collector emitter voltage

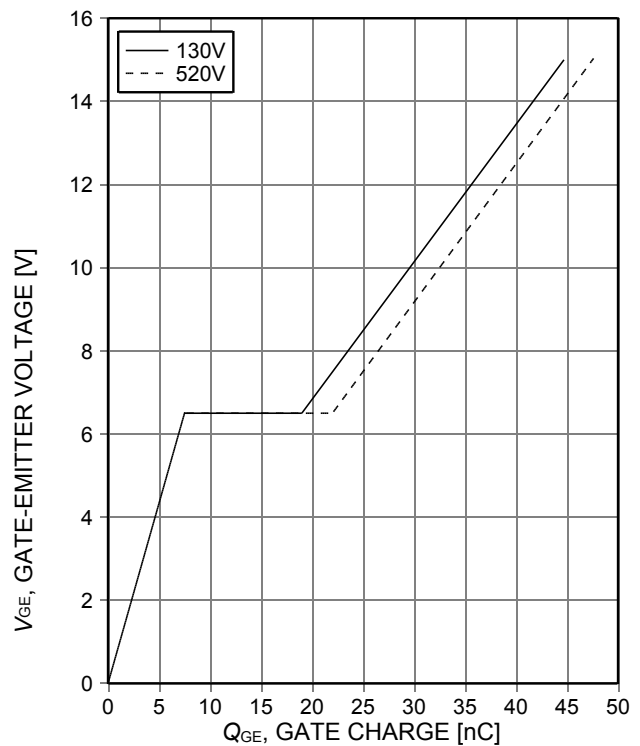


Figure 16. Typical gate charge



Figure 17. Typical capacitance as a function of collector-emitter voltage

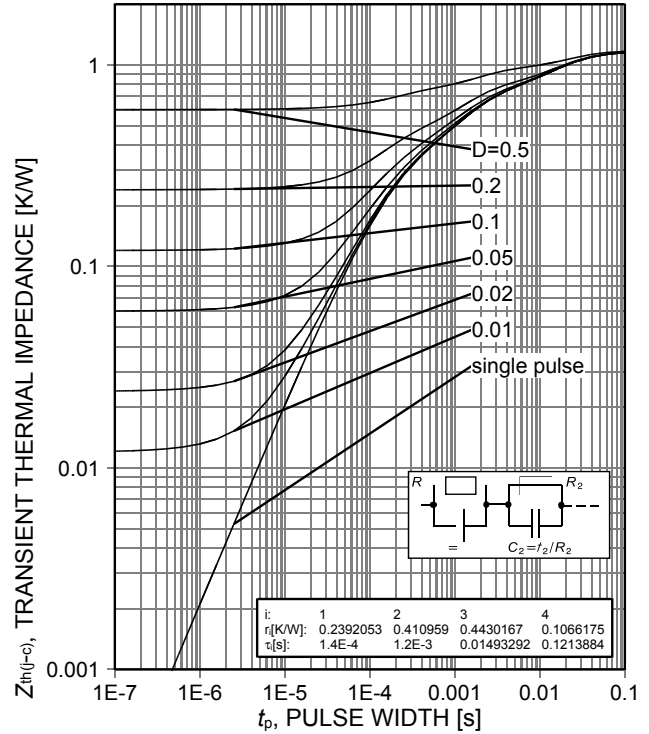


Figure 18. IGBT transient thermal impedance

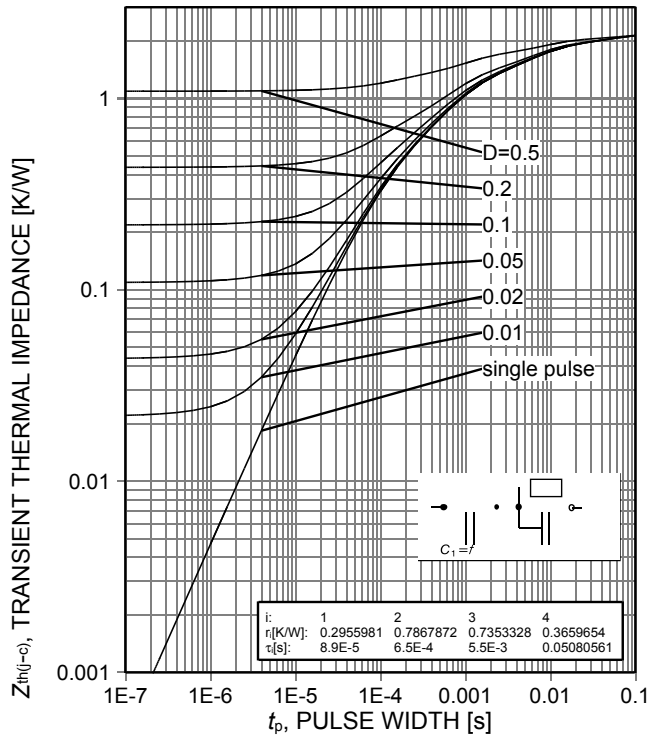


Figure 19. Diode transient thermal impedance as a function of pulse width

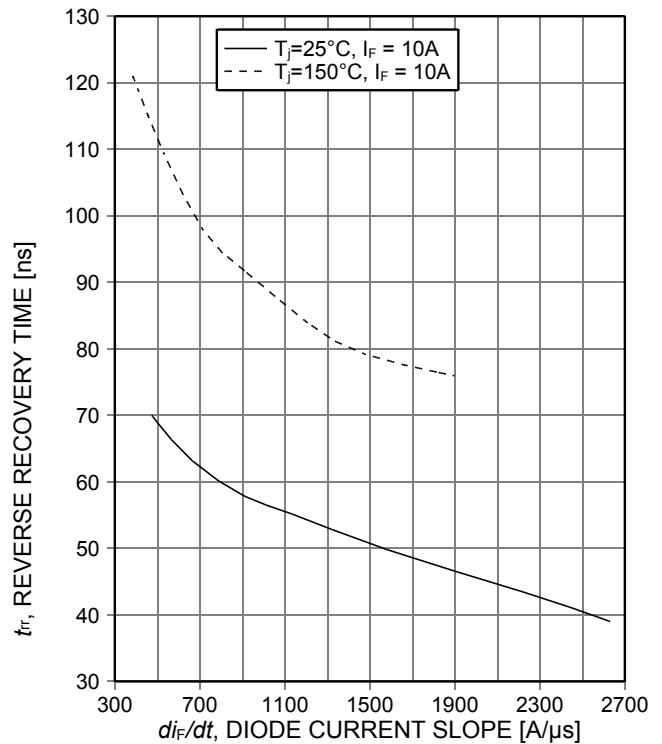
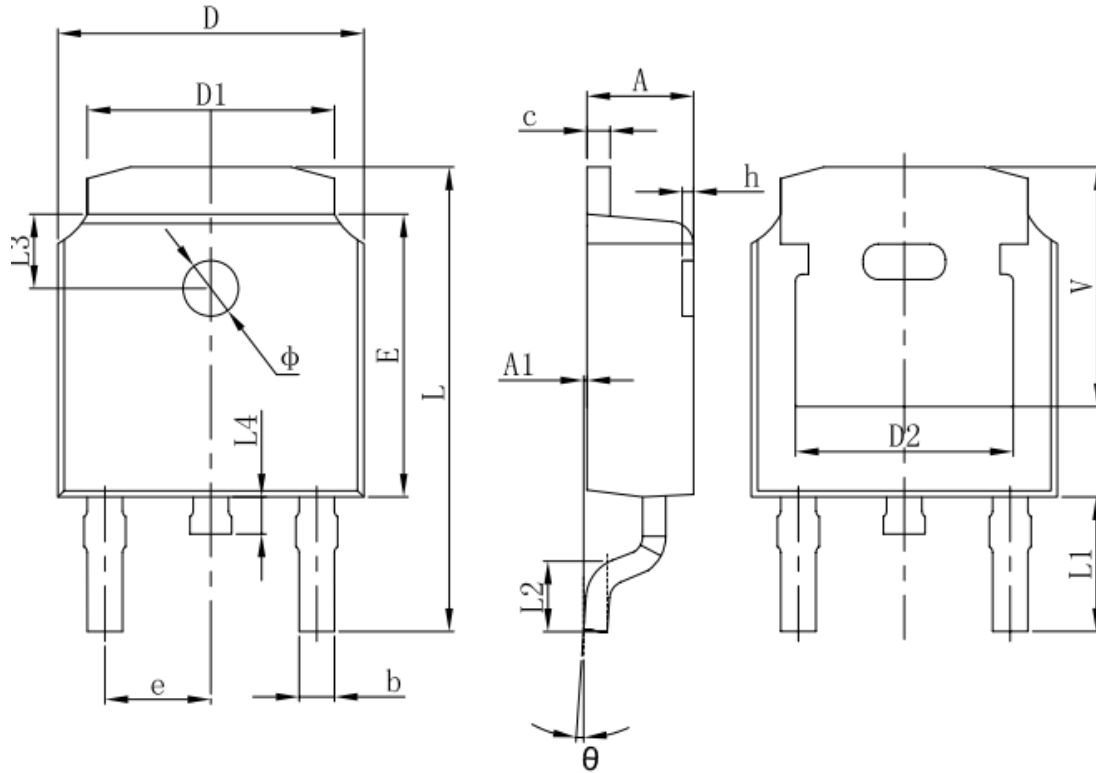


Figure 20. Typical reverse recovery time as a function of diode current slope

# TO252 Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.200	2.400	0.087	0.094
A1	0.000	0.127	0.000	0.005
b	0.635	0.770	0.025	0.030
c	0.460	0.580	0.018	0.023
D	6.500	6.700	0.256	0.264
D1	5.100	5.460	0.201	0.215
D2	4.830 REF.		0.190 REF.	
E	6.000	6.200	0.236	0.244
e	2.186	2.386	0.086	0.094
L	9.712	10.312	0.382	0.406
L1	2.900 REF.		0.114 REF.	
L2	1.400	1.700	0.055	0.067
L3	1.600 REF.		0.063 REF.	
L4	0.600	1.000	0.024	0.039
$\phi$	1.100	1.300	0.043	0.051
$\theta$	0°	8°	0°	8°
h	0.000	0.300	0.000	0.012
V	5.250 REF.		0.207 REF.	

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