

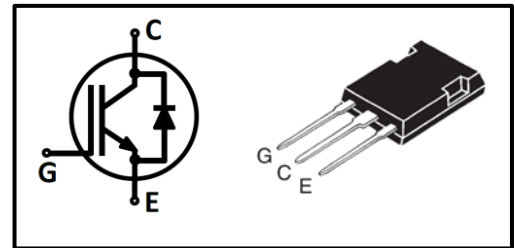
## Features

- Easy parallel switching capability due to positive temperature coefficient in  $V_{CEsat}$
- Low  $V_{CEsat}$ , fast switching
- High ruggedness, good thermal stability
- Very tight parameter distribution

Type	Marking	Package Code
MPBQ75N120E	MP75N120E	TO-247-3L Plus

## Applications

- Industrial UPS
- Charger
- EnergyStorage
- Welding



## Maximum Rated Values

Parameter	Symbol	Value	Unit
Collector-emitter voltage	$V_{CE}$	1200	V
DC collector current, limited by $T_{jmax}$ $T_C=25^\circ C$ $T_C=100^\circ C$	$I_C$	150 75	A
Pulsed collector current, $t_p$ limited by $T_{jmax}^{1)}$	$I_{Cpuls}$	225	
Diode forward current, limited by $T_{jmax}$ $T_C=25^\circ C$ $T_C=100^\circ C$	$I_F$	150 75	
Diode pulsed current, $t_p$ limited by $T_{jmax}^{1)}$	$I_{Fpuls}$	300	V
Gate-emitter voltage	$V_{GE}$	$\pm 20$	
Transient Gate-emitter voltage ( $t_p \leq 10\mu s, D < 0.01$ )		$\pm 30$	
Short circuit withstand time $V_{GE}=15V, V_{CC}=600V, T_j \leq 175^\circ C$ Allowed number of short circuits < 1000 Time between short circuits: $\geq 1.0s$	$t_{SC}$	10	$\mu s$
Power dissipation $T_C=25^\circ C$	$P_{tot}$	833	W
Power dissipation $T_C=100^\circ C$		416	
Operating junction temperature	$T_j$	-40~175	$^\circ C$
Storage temperature	$T_{stg}$	-55~150	
Soldering temperature, wave soldering 1.6mm (0.063in.) from case for 10s		260	

<sup>1)</sup> Defined by design. Not subject to production test.



## Thermal Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
IGBT thermal resistance, junction-case	$R_{thJC}$	-	-	0.18	K/W
Diode thermal resistance, junction-case	$R_{thJCD}$	-	-	0.30	
Thermal Resistance, junction-ambient	$R_{thJA}$	-	-	40	

## Electrical Characteristics (at $T_j=25^\circ\text{C}$ , unless otherwise specified) Static Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE}=0V, I_C=0.25mA$	1200	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_{GE}=15V, I_C=75A$ $T_j=25^\circ\text{C}$	-	1.58	1.80	
		$T_j=125^\circ\text{C}$	-	2.09	-	
		$T_j=150^\circ\text{C}$	-	2.21	-	
		$T_j=175^\circ\text{C}$	-	2.34	-	
G-E threshold voltage	$V_{GE(th)}$	$I_C=2.4mA, V_{CE}=V_{GE}$	5.0	5.6	6.2	
C-E leakage current	$I_{CES}$	$V_{CE}=1200V, V_{GE}=0V$ $T_j=25^\circ\text{C}$	-	-	0.1	mA
		$T_j=175^\circ\text{C}$	-	-	4.0	
G-E leakage current	$I_{GES}$	$V_{CE}=0V, V_{GE}=20V$	-	-	250	nA
Transconductance	$g_{fs}$	$V_{CE}=20V, I_C=75A$	-	30	-	S

## Dynamic Characteristics

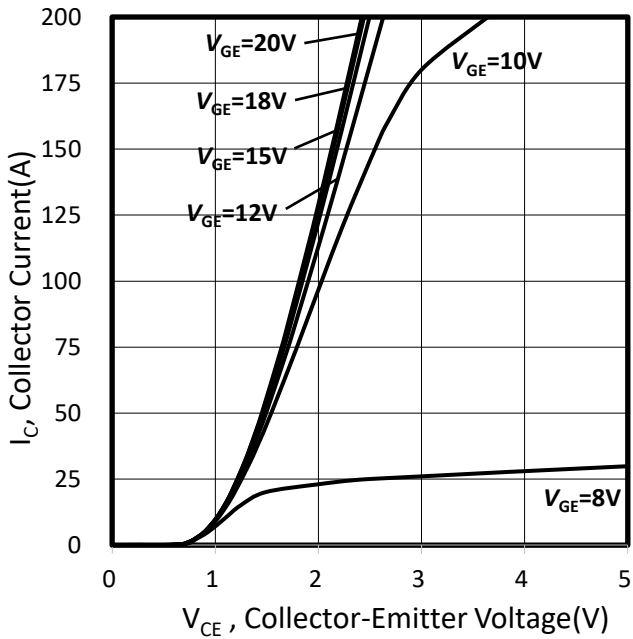
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input capacitance	$C_{ies}$	$V_{CE}=25V,$ $V_{GE}=0V,$ $f=1MHz$	-	11533	-	pF
Output capacitance	$C_{oes}$		-	253	-	
Reverse transfer capacitance	$C_{res}$		-	60	-	
Gate charge	$Q_G$	$V_{CC}=600V, I_C=75A,$ $V_{GE}=15V$	-	750	-	nC
Short circuit collector current	$I_{C(SC)}$	$V_{GE}=15V,$ $V_{CC}\leq 600V,$ $t_{SC}\leq 10\mu s, T_j=175^\circ\text{C}$	-	350	-	A
Internal emitter inductance measured 5mm (0.197 in.) from case	$L_E$		-	13	-	nH

## IGBT Switching Characteristics

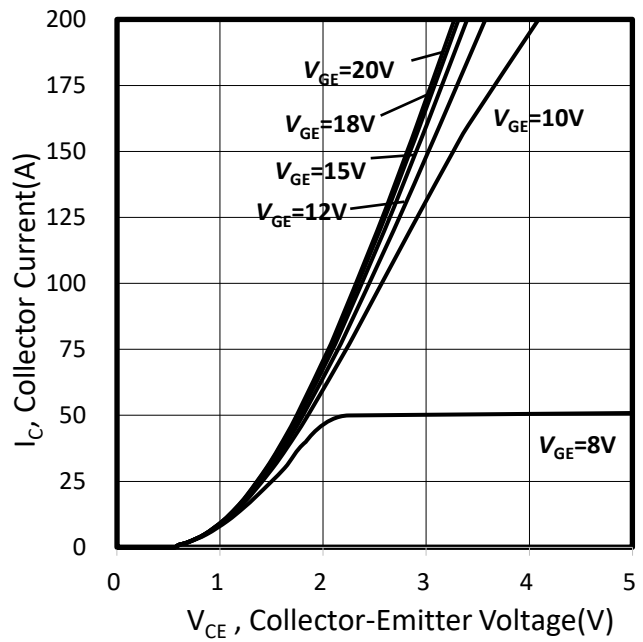
Parameter	Symbol	Conditions	Min	Typ	Max	Unit	
Turn-on delay time	$t_{d(on)}$	$T_j=25^{\circ}\text{C}$ , $V_{CC}=600\text{V}$ , $I_C=75\text{A}$ , $V_{GE}=0\text{V}/15\text{V}$ , $R_G=10\Omega$ , Inductive load	-	151	-	ns	
Rise time	$t_r$		-	86	-		
Turn-off delay time	$t_{d(off)}$		-	488	-		
Fall time	$t_f$		-	55.6	-		
Turn-on energy	$E_{on}$		$T_j=175^{\circ}\text{C}$ , $V_{CC}=600\text{V}$ , $I_C=75\text{A}$ , $V_{GE}=0\text{V}/15\text{V}$ , $R_G=10\Omega$ , Inductive load	-	4.97	-	mJ
Turn-off energy	$E_{off}$			-	3.42	-	
Total switching energy	$E_{ts}$			-	8.39	-	
Turn-on delay time	$t_{d(on)}$	$T_j=175^{\circ}\text{C}$ , $V_{CC}=600\text{V}$ , $I_C=75\text{A}$ , $V_{GE}=0\text{V}/15\text{V}$ , $R_G=10\Omega$ , Inductive load	-	145	-	ns	
Rise time	$t_r$		-	86	-		
Turn-off delay time	$t_{d(off)}$		-	525	-		
Fall time	$t_f$		-	81.2	-		
Turn-on energy	$E_{on}$		$T_j=175^{\circ}\text{C}$ , $V_{CC}=600\text{V}$ , $I_C=75\text{A}$ , $V_{GE}=0\text{V}/15\text{V}$ , $R_G=10\Omega$ , Inductive load	-	5.21	-	mJ
Turn-off energy	$E_{off}$			-	3.98	-	
Total switching energy	$E_{ts}$			-	9.19	-	

## Diode Characteristics

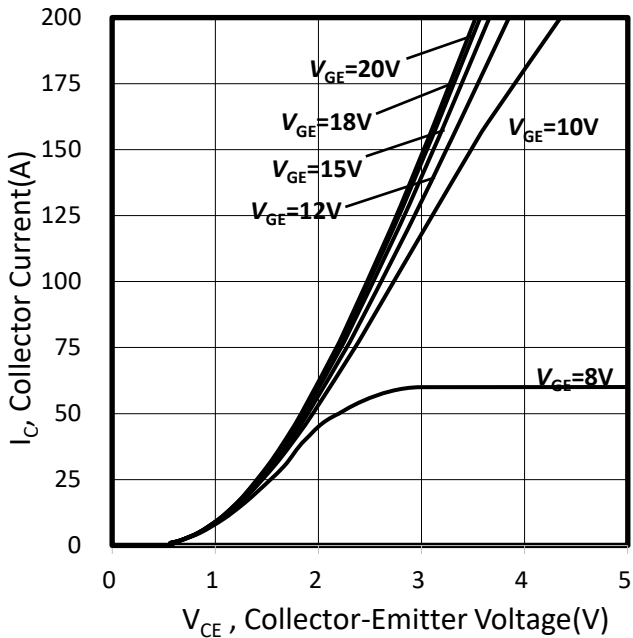
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Diode forward voltage	$V_F$	$V_{GE}=0\text{V}$ , $I_F=75\text{A}$ $T_j=25^{\circ}\text{C}$	-	2.4	-	V
		$T_j=150^{\circ}\text{C}$	-	2.2	-	
		$T_j=175^{\circ}\text{C}$	-	2.1	-	
Diode reverse recovery time	$t_{rr}$	$T_j=25^{\circ}\text{C}$ , $V_R=600\text{V}$ , $I_F=75\text{A}$ , $di_F/dt=500\text{A}/\mu\text{s}$	-	255	-	ns
Diode reverse recovery charge	$Q_{rr}$		-	3.0	-	$\mu\text{C}$
Diode peak reverse recovery current	$I_{rrm}$		-	25.5	-	A
Diode reverse recovery time	$t_{rr}$	$T_j=175^{\circ}\text{C}$ , $V_R=600\text{V}$ , $I_F=75\text{A}$ , $di_F/dt=500\text{A}/\mu\text{s}$	-	271	-	ns
Diode reverse recovery charge	$Q_{rr}$		-	3.2	-	$\mu\text{C}$
Diode peak reverse recovery current	$I_{rrm}$		-	26.5	-	A



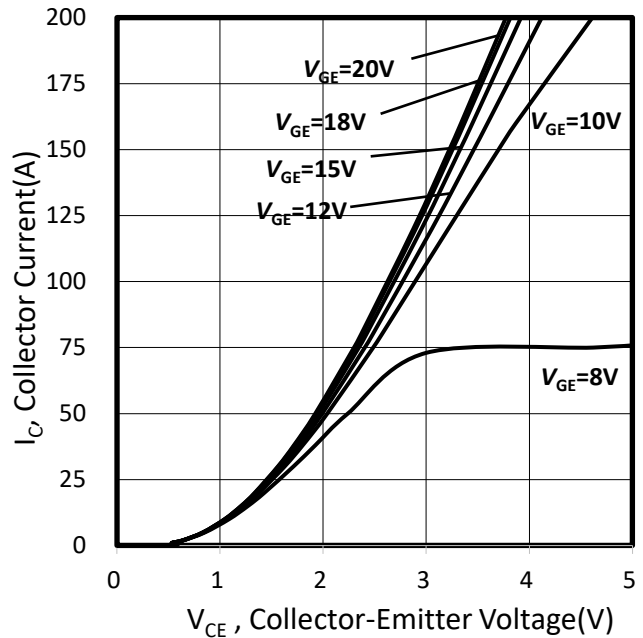
**Figure 1. Typical output characteristic**  
( $T_j=25^{\circ}\text{C}$ )



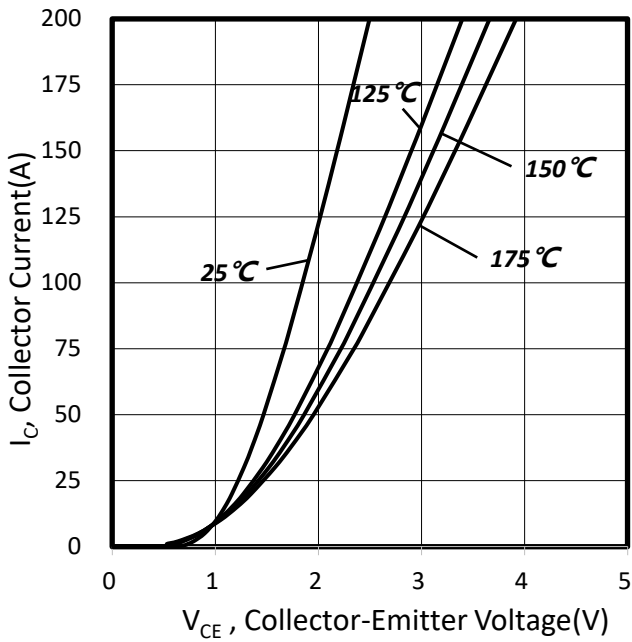
**Figure 2. Typical output characteristic**  
( $T_j=125^{\circ}\text{C}$ )



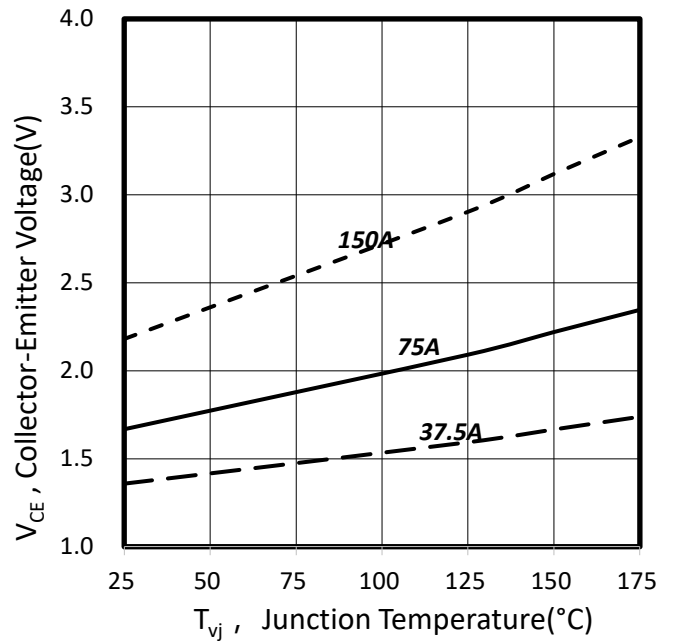
**Figure 3. Typical output characteristic**  
( $T_j=150^{\circ}\text{C}$ )



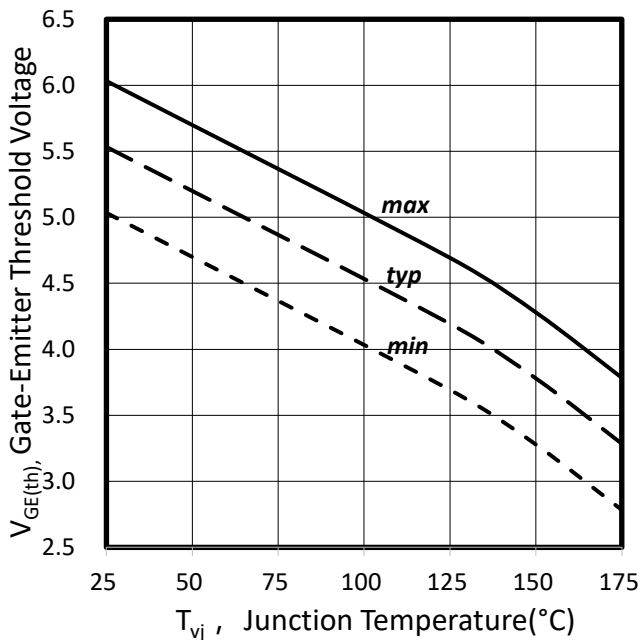
**Figure 4. Typical output characteristic**  
( $T_j=175^{\circ}\text{C}$ )



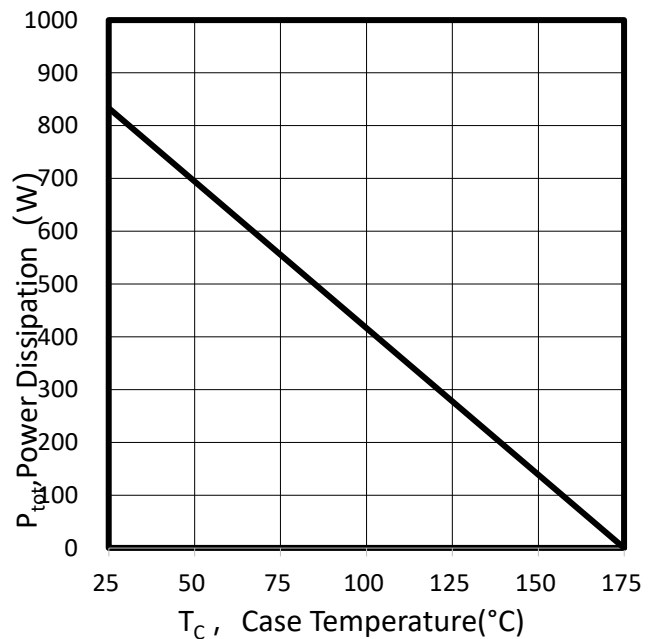
**Figure 5. Typical  $V_{CE(sat)}$ - $I_c$  characteristic ( $V_{GE}=15V$ )**



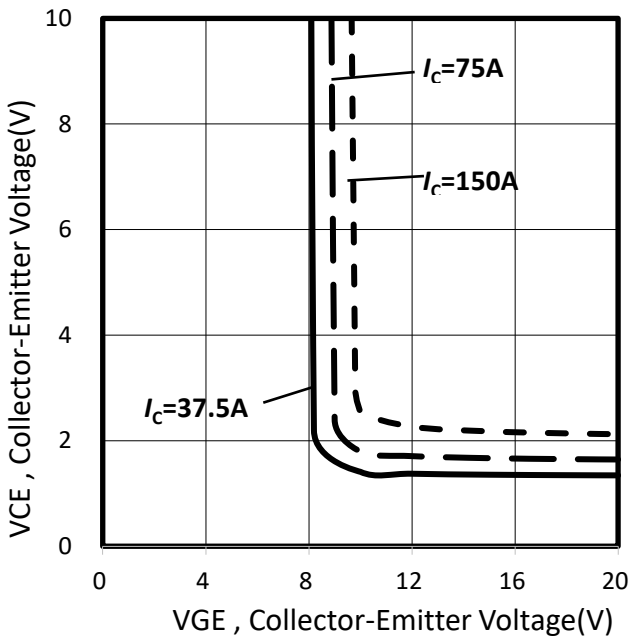
**Figure 6. Typical  $V_{CE(sat)}$ - $T_j$  characteristic ( $V_{GE}=15V$ )**



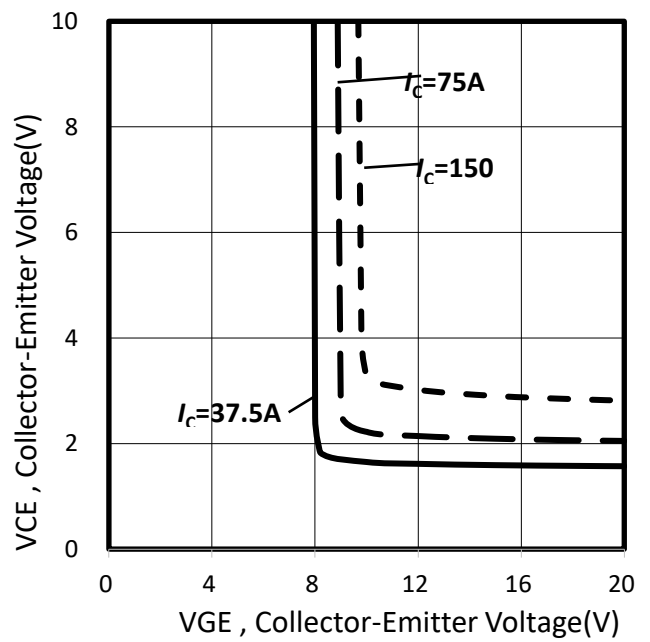
**Figure 7.  $V_{GE(th)}$ - $T_j$  characteristic ( $I_c=2.4mA$ )**



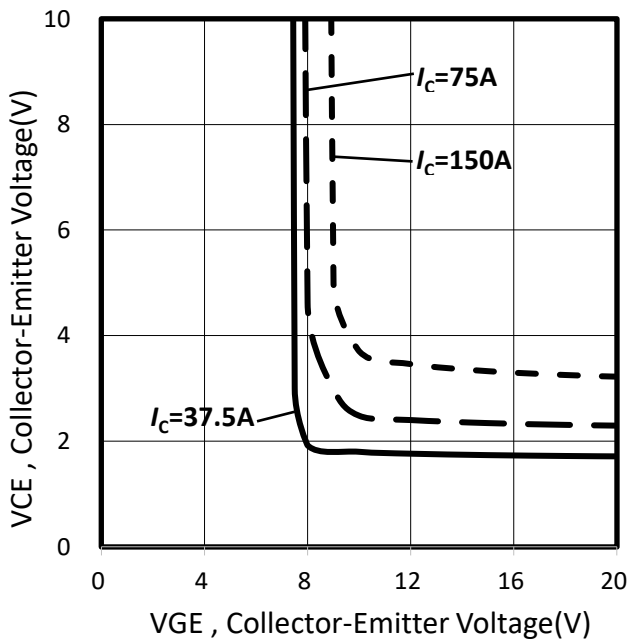
**Figure 8. Power dissipation as a function of case temperature ( $T_j \leq 175^\circ C$ )**



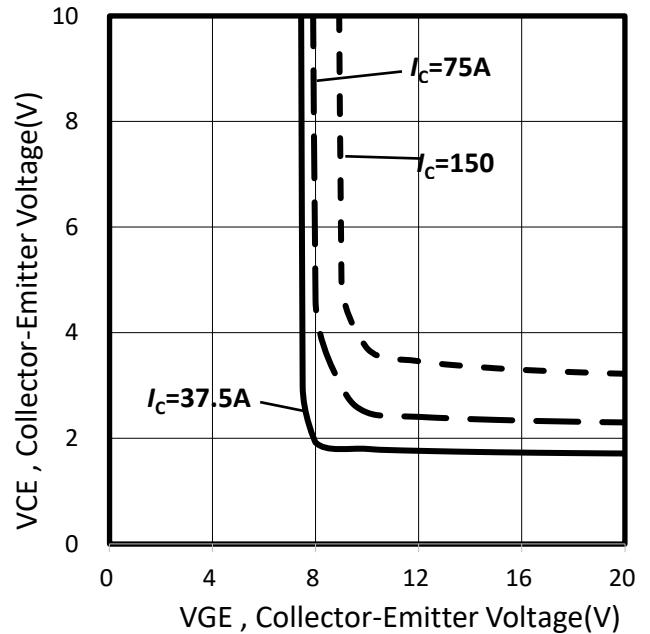
**Figure 9. Typical  $V_{CE(sat)}-V_{GE(th)}$  characteristic**  
( $T_{vj}=25^{\circ}C$ )



**Figure 10. Typical  $V_{CE(sat)}-V_{GE(th)}$  characteristic**  
( $T_{vj}=125^{\circ}C$ )



**Figure 11. Typical  $V_{CE(sat)}-V_{GE(th)}$  characteristic**  
( $T_{vj}=150^{\circ}C$ )



**Figure 12. Typical  $V_{CE(sat)}-V_{GE(th)}$  characteristic**  
( $T_{vj}=175^{\circ}C$ )

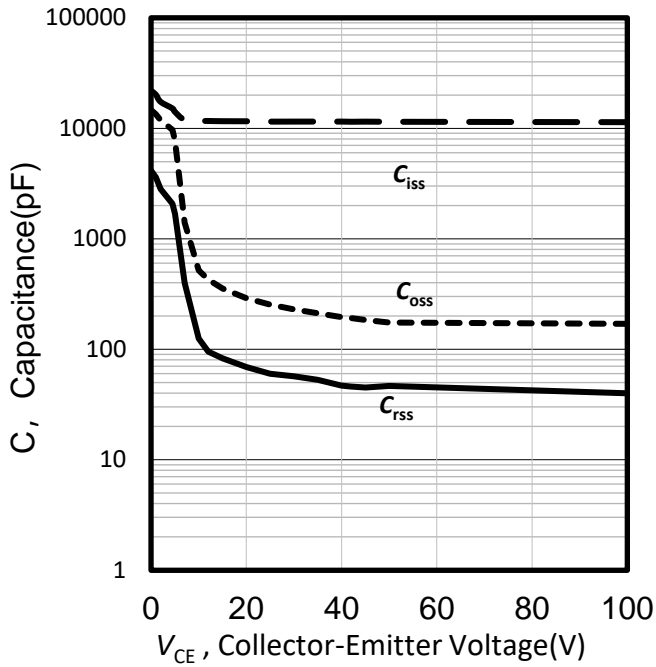


Figure 13. Typical capacitance as a function of collector-emitter voltage ( $V_{GE}=0V, f=1MHz$ )

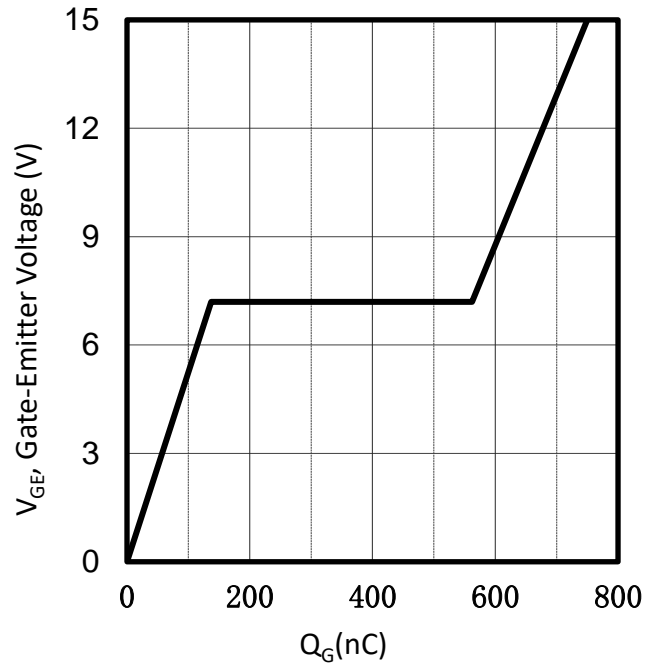


Figure 14. Typical gate charge ( $V_{CE}=600V$ )

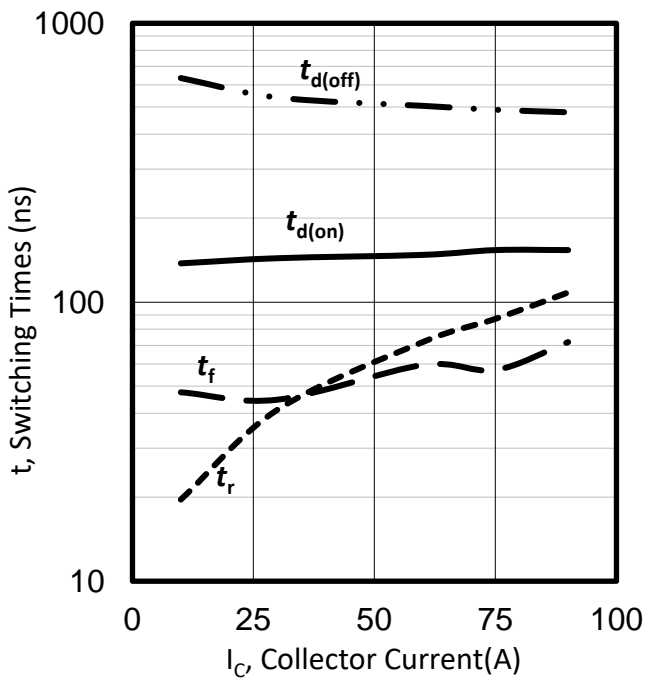


Figure 15. Typical switching times as a function of collector current (inductive load,  $T_{vj}=25^{\circ}C, V_{CE}=600V, V_{GE}=0/15V, R_G=10\Omega$ )

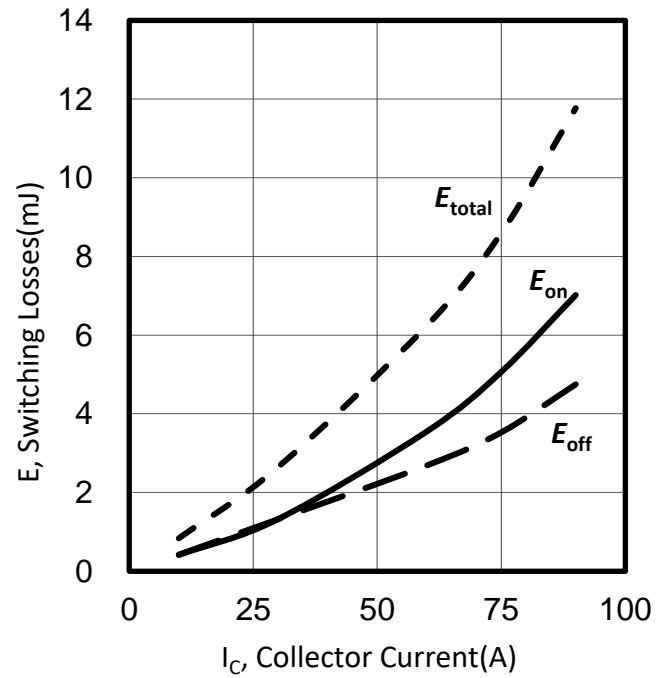
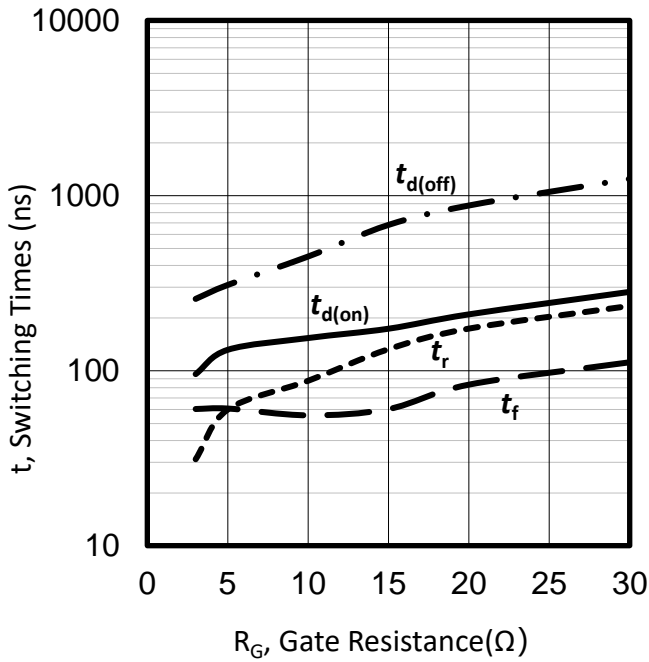
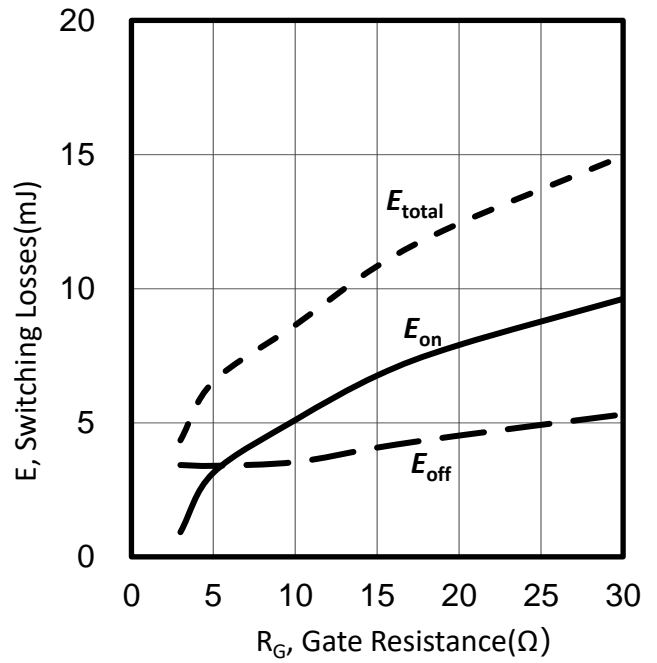


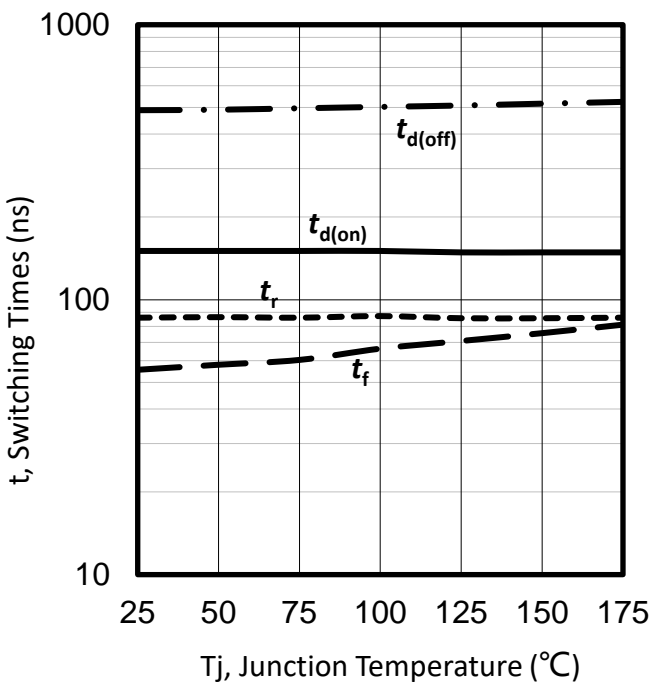
Figure 16. Typical switching times as a function of collector current (inductive load,  $T_{vj}=25^{\circ}C, V_{CE}=600V, V_{GE}=0/15V, R_G=10\Omega$ )



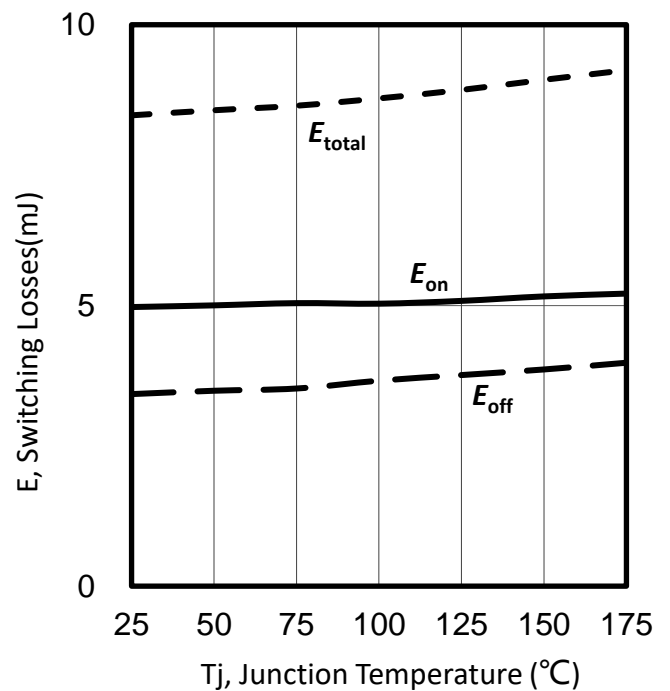
**Figure 17. Typical switching times as a function of gate resistor**  
 (inductive load,  $T_{vj}=25^{\circ}\text{C}$ ,  
 $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=75\text{A}$ )



**Figure 18. Typical switching energy losses as a function of gate resistor**  
 (inductive load,  $T_{vj}=25^{\circ}\text{C}$ ,  
 $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=75\text{A}$ )



**Figure 19. Typical switching times as a function of junction temperature**  
 (inductive load,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  
 $I_C=75\text{A}$ ,  $R_G=10\Omega$ )



**Figure 20. Typical switching energy losses as a function of junction temperature**  
 (inductive load,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  
 $I_C=75\text{A}$ ,  $R_G=10\Omega$ )



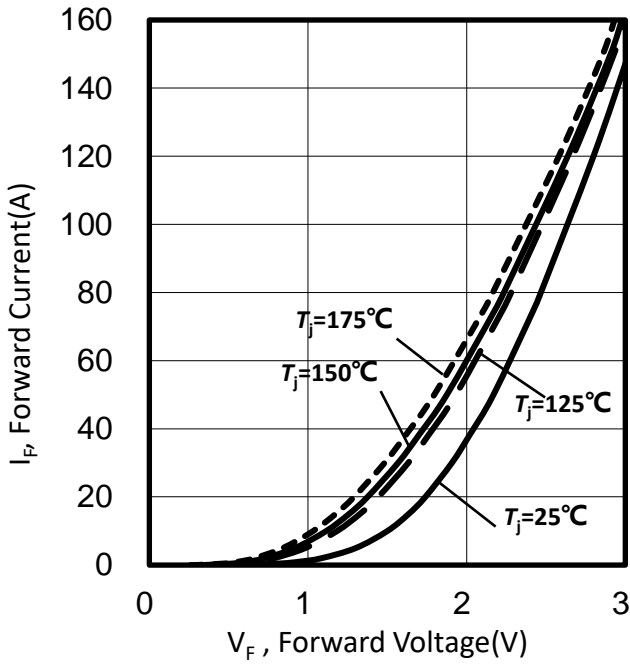


Figure 21. Typical diode forward current as a function of forward voltage

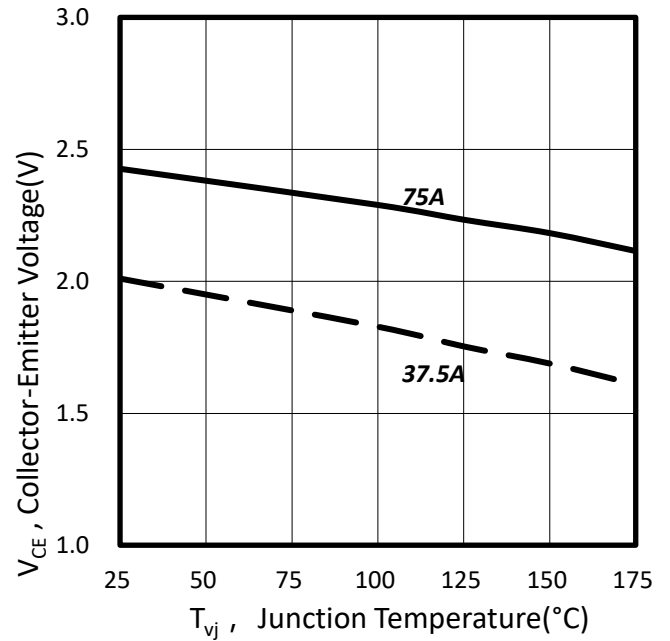


Figure 22. Typical diode forward voltage as a function of junction temperature

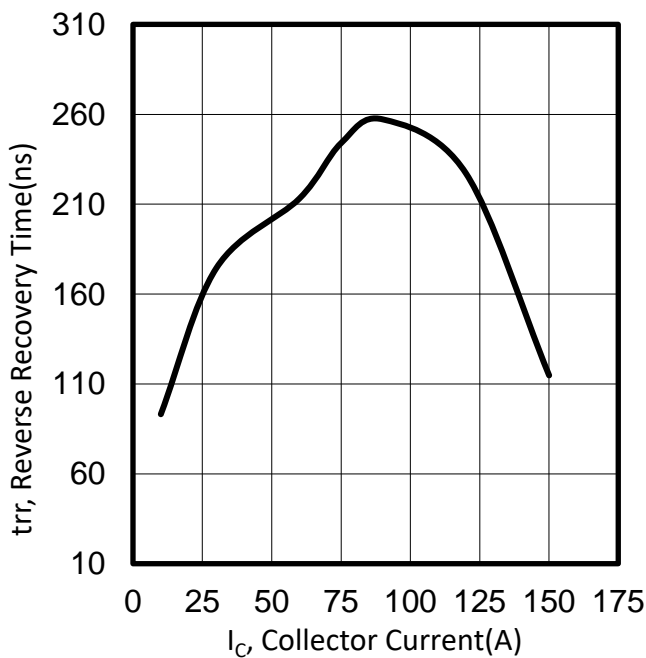


Figure 23. Typical reverse recovery time as a function of collector current  
(inductive load,  $T_{vj}=25^{\circ}\text{C}$   
 $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $R_G=10\Omega$ )

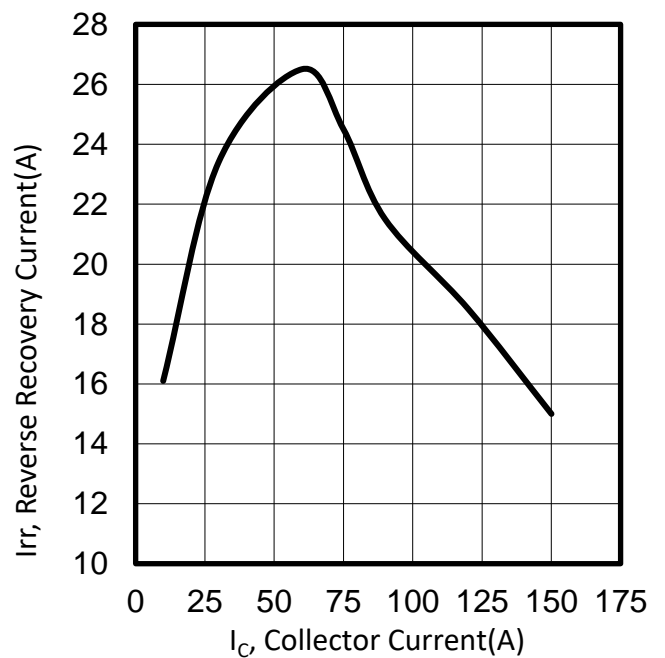
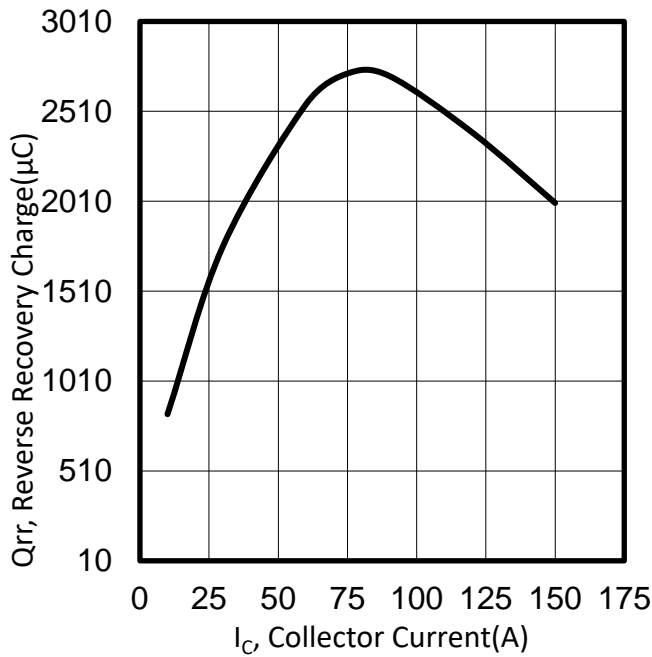
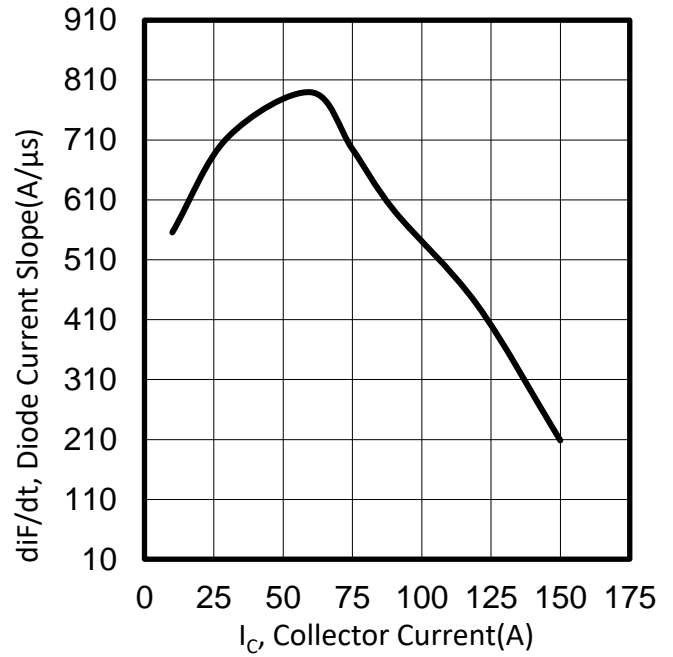


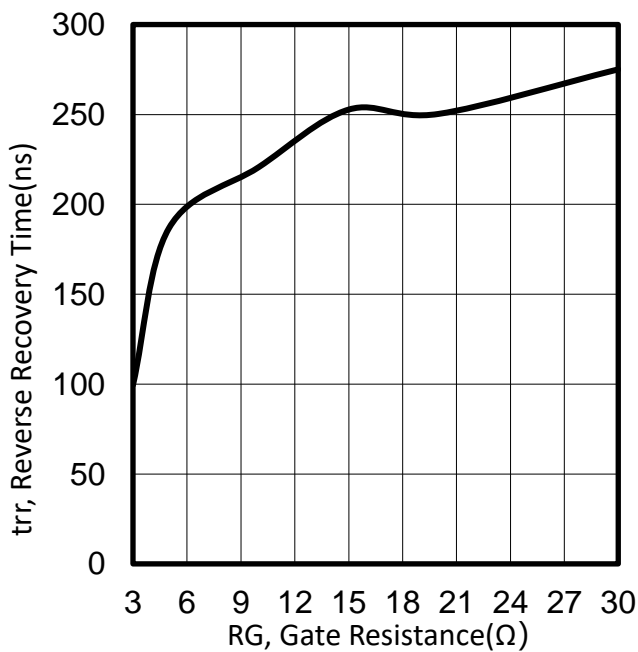
Figure 24. Typical reverse recovery current as a function of collector current  
(inductive load,  $T_{vj}=25^{\circ}\text{C}$   
 $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $R_G=10\Omega$ )



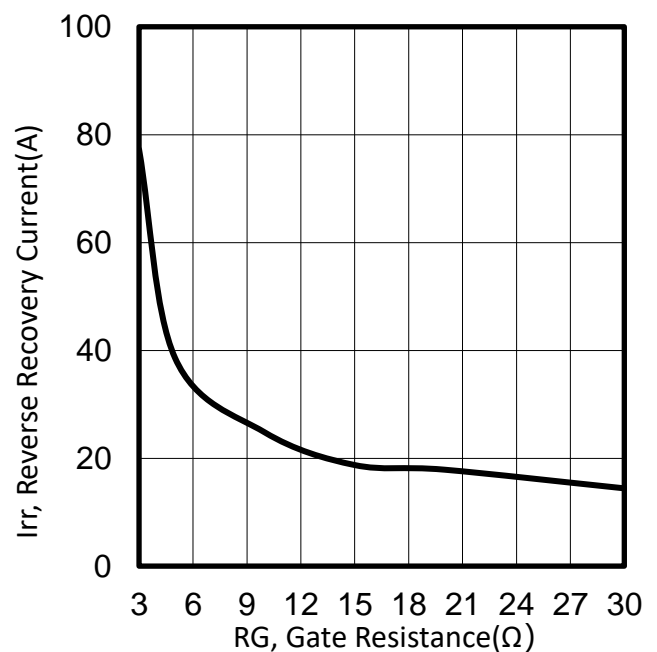
**Figure 25. Typical reverse recovery charge as a function of collector current**  
 (inductive load,  $T_{vj}=25^{\circ}\text{C}$   
 $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $R_G=10\Omega$ )



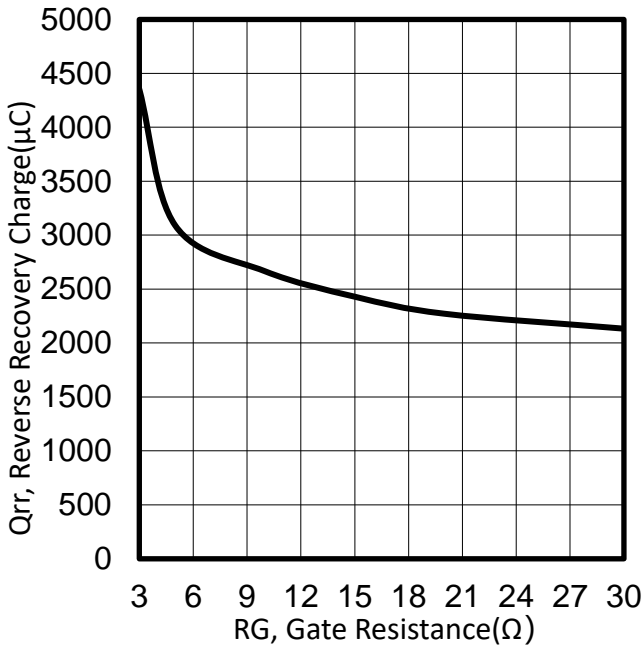
**Figure 26. Typical diode current slope as a function of collector current**  
 (inductive load,  $T_{vj}=25^{\circ}\text{C}$   
 $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $R_G=10\Omega$ )



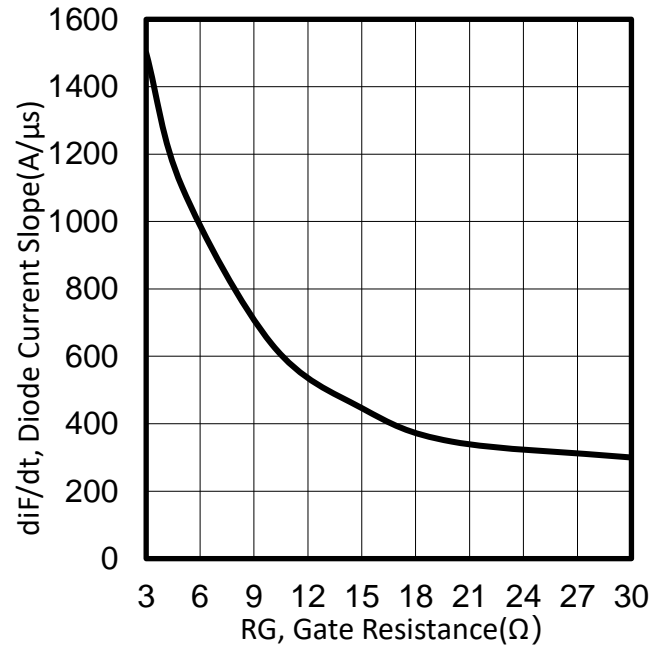
**Figure 27. Typical reverse recovery time as a function of gate resistor**  
 (inductive load,  $T_{vj}=25^{\circ}\text{C}$   
 $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=75\text{A}$ )



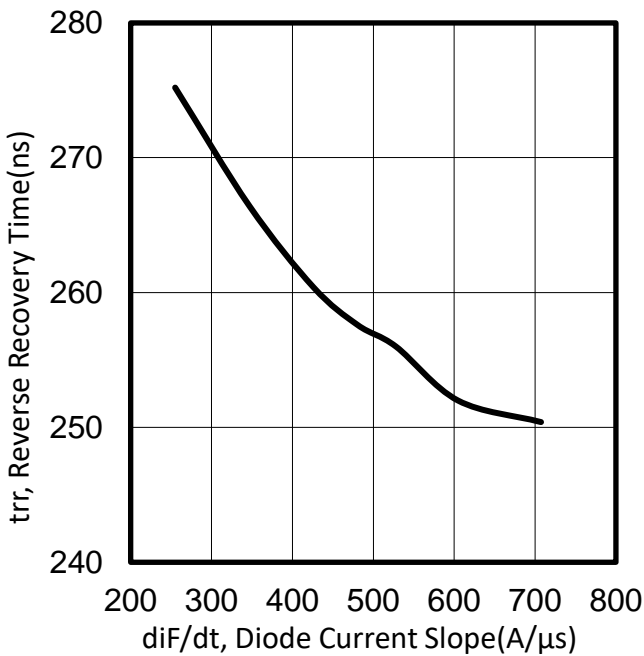
**Figure 28. Typical reverse recovery current as a function of gate resistor**  
 (inductive load,  $T_{vj}=25^{\circ}\text{C}$   
 $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=75\text{A}$ )



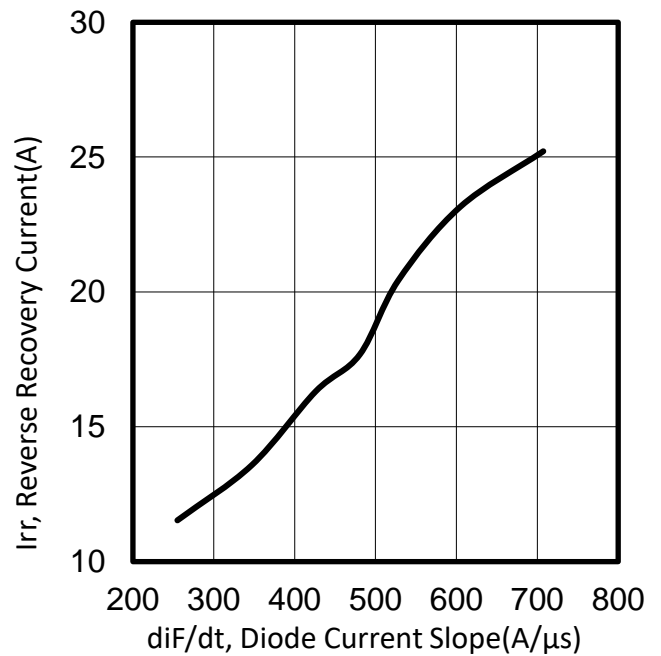
**Figure 29. Typical reverse recovery charge as a function of gate resistor**  
 (inductive load,  $T_{vj}=25^{\circ}\text{C}$   
 $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=75\text{A}$ )



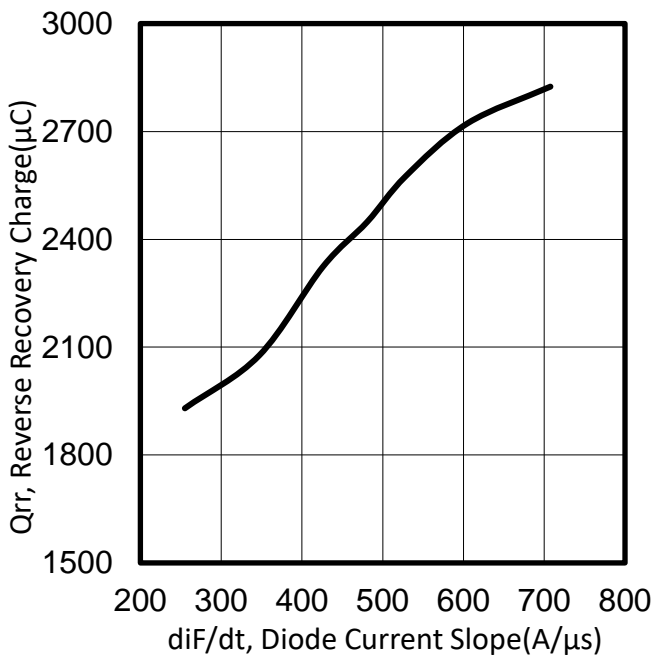
**Figure 30. Typical diode current slope as a function of gate resistor**  
 (inductive load,  $T_{vj}=25^{\circ}\text{C}$   
 $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=75\text{A}$ )



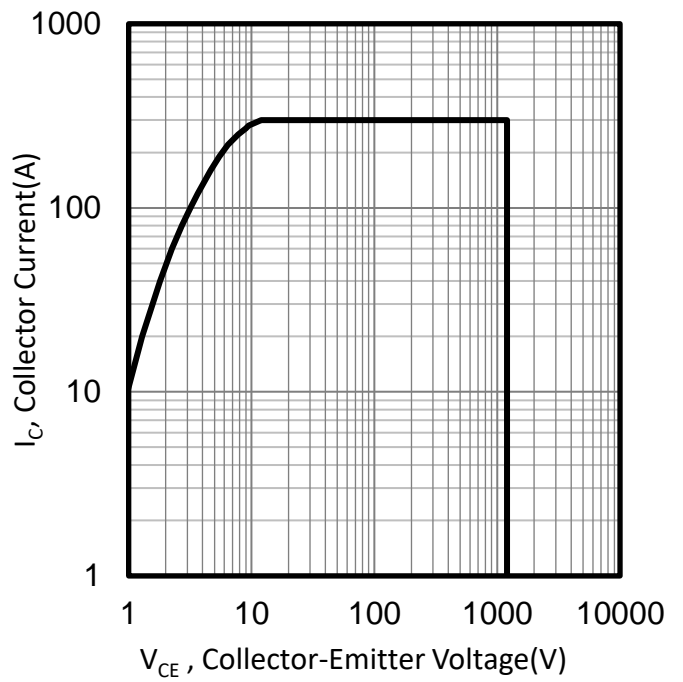
**Figure 31. Typical reverse recovery time as a function of diode current slope**  
 ( $V_R=600\text{V}$ ,  $I_F=75\text{A}$ ,  $T_{vj}=25^{\circ}\text{C}$ )



**Figure 32. Typical reverse recovery current as a function of diode current slope**  
 ( $V_R=600\text{V}$ ,  $I_F=75\text{A}$ ,  $T_{vj}=25^{\circ}\text{C}$ )



**Figure 33. Typical reverse recovery charge as a function of diode current slope**  
 ( $V_R=600V, I_F=75A, T_{vj}=25^{\circ}C$ )



**Figure 34. IGBT reverse bias safe operating area**  
 ( $T_{vj} \leq 175^{\circ}C, V_{GE}=15V$ )

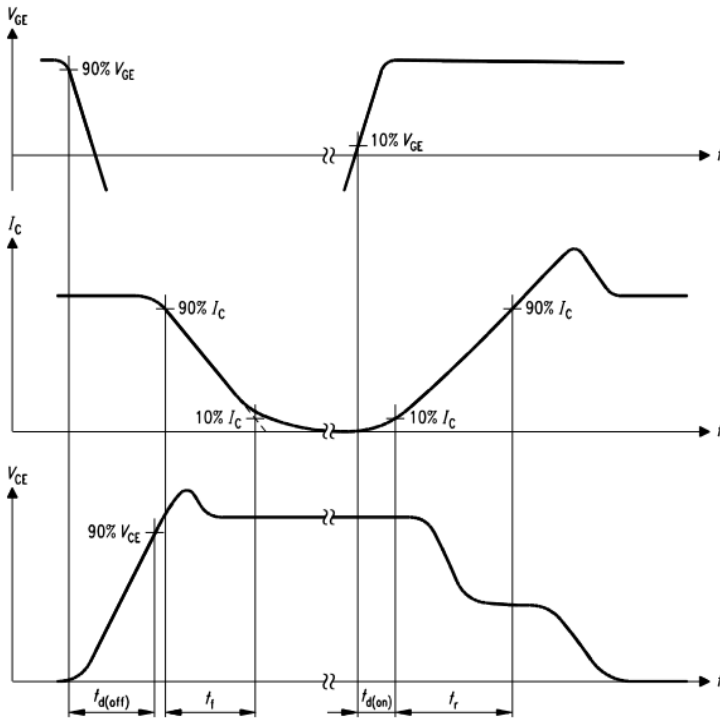


Figure A. Definition of switching times

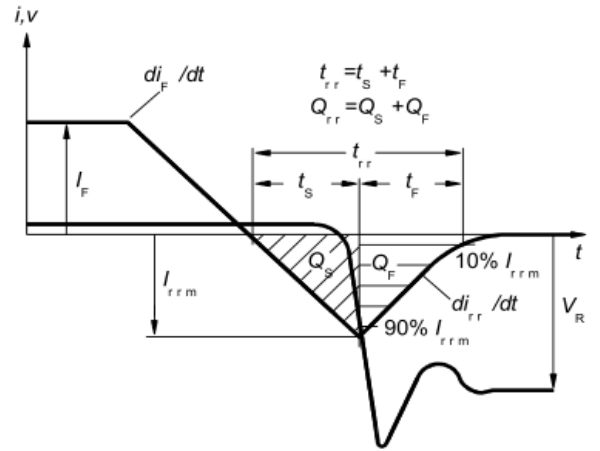


Figure C. Definition of diodes switching characteristics

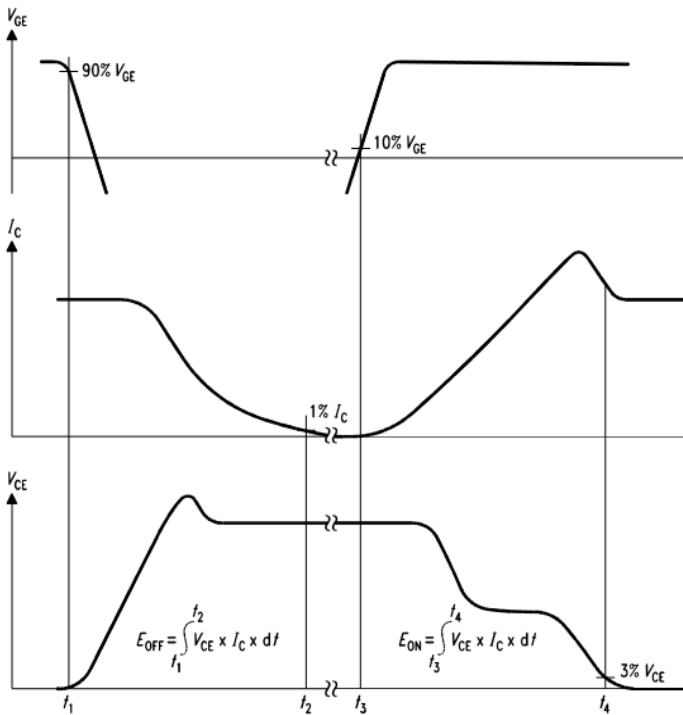


Figure B. Definition of switching losses

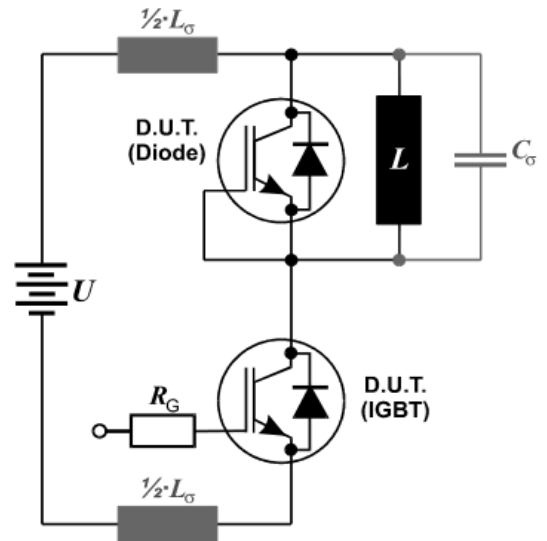
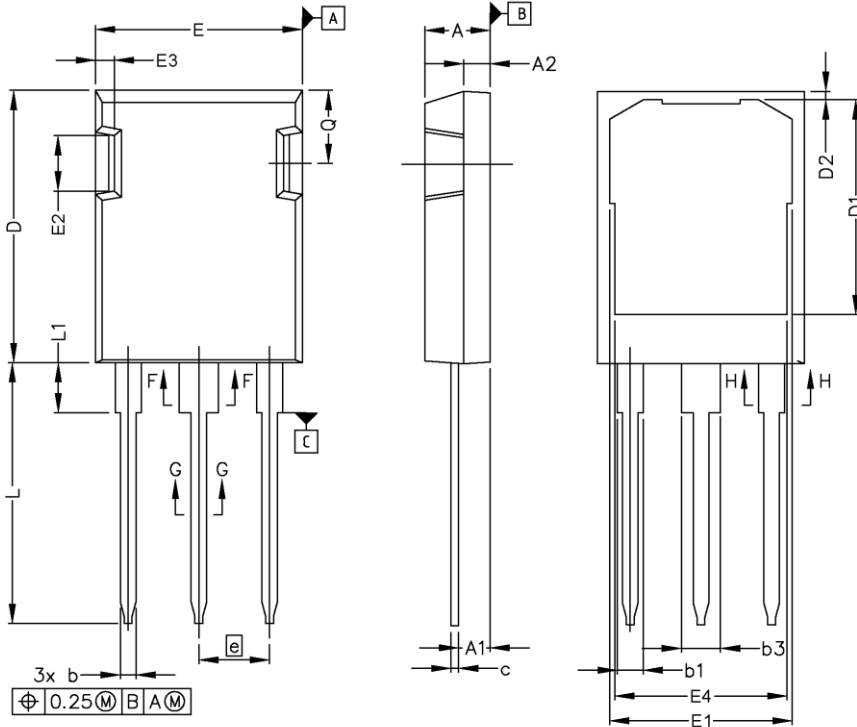


Figure D. Switching test circuit

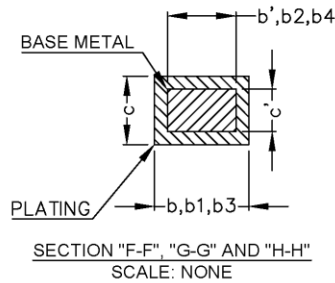
# TO-247-3L Plus



SYMBOL	MIN	MAX
A	4.83	5.21
A1	2.29	2.54
A2	1.91	2.16
b'	1.07	1.28
b	1.07	1.33
b1	1.91	2.41
b2	1.91	2.16
b3	2.87	3.38
b4	2.87	3.13
c'	0.55	0.65
c	0.55	0.68
D	20.80	21.10
D1	16.25	17.65
D2	0.50	0.80
E	15.75	16.13
E1	13.10	14.15
E2	3.68	5.10
E3	1.00	1.90
E4	12.38	13.43
e	5.44 BSC	
N	3	
L	19.81	20.32
L1	3.70	4.00
Q	5.49	6.00

NOTE:  
 1. ALL METAL SURFACES, TIN PLATED, EXCEPT AREA OF CUT  
 2. DIMENSIONING & TOLERANCING CONFIRM TO ASME Y14.5M-1994  
 3. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.  
 4. THIS DRAWING WILL MEET ALL DIMENSIONS REQUIREMENT OF JEDEC outlines TO-247 AD.

- 1 - GATE
- 2 - DRAIN (COLLECTOR)
- 3 - SOURCE (EMITTER)
- 4 - DRAIN (COLLECTOR)





## Revision History

Revision	Subjects (major changes since last revision)	Date
1.0	Initial version	2022.5

## Terms & Conditions of usage

1. The product specifications, characteristics, data, materials and structures given in this datasheet are subject to change without notice.
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