MPBQ75N120BF

1200V-75A Trench and Field Stop IGBT

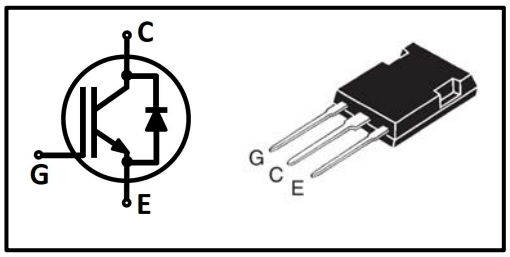
Features

- 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

Applications

- Frequency converter
- UPS
- Solar Inverter
- Welding

Type	Marking	Package Code
MPBQ75N120BF	MP75N120BF	TO-247-3L Plus



Maximum Rated Values

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
DC collector current, limited by T_{vjmax} T_C=25℃ T_C=134.5℃	I_C	150 75	A
Pulsed collector current, t_p limited by T_{vjmax}[1)]	I_{Cpuls}	300	
Diode forward current, limited by T_{vjmax} T_C=25℃ T_C=100℃	I_F	150 75	
Diode pulsed current, t_p limited by T_{vjmax}[1)]	I_{Fpuls}	300	
Gate-emitter voltage	V_{GE}	±20	V
Transient Gate-emitter voltage（t_p≤10us,D<0.01)		±30	
Short circuit withstand time V_{GE}=15V, V_{CC}=600V, T_{vj}≤175℃ Allowed number of short circuits < 1000 Time between short circuits: ≥ 1.0s	t_{SC}	10	μs
Power dissipation T_C=25℃	P_{tot}	833	W
Power dissipation T_C=100℃		416	
Operating junction temperature	T_{vj}	-40~175	℃
Storage temperature	T_{stg}	-55~150	
Soldering temperature, wave soldering 1.6mm (0.063in.) from case for 10s		260	

[1)] 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_{vj}=25℃, 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_{vj}=25℃	-	1.90	2.30	
		T_{vj}=125℃	-	2.35	-	
		T_{vj}=150℃	-	2.45	-	
		T_{vj}=175℃	-	2.60	-	
G-E threshold voltage	$V_{GE(th)}$	I_C=2.4mA, V_{CE}=V_{GE}	5.0	5.8	6.5	
C-E leakage current	I_{CES}	V_{CE}=1200V,V_{GE}=0V T_{vj}=25℃	-	-	0.1	mA
		T_{vj}=175℃	-	-	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	-	5235	-	pF
Output capacitance	C_{oes}		-	400	-	
Reverse transfer capacitance	C_{res}		-	192	-	
Gate charge	Q_G	V_{CC}=600V, I_C=75A, V_{GE}=15V	-	290	-	nC
Short circuit collector current	$I_{C(SC)}$	V_{GE}=15V, V_{CC}≤600V, t_{SC}≤10μs, T_{vj}=175℃	-	300	-	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_{vj}=25℃, V_{CC}=600V, I_C=75A, V_{GE}=-15/15V, R_G=10Ω, Inductive load	-	212	-	ns
Rise time	t_r		-	52	-	
Turn-off delay time	$t_{d(off)}$		-	247	-	
Fall time	t_f		-	104	-	
Turn-on energy	E_{on}		-	4.6	-	mJ
Turn-off energy	E_{off}		-	4.4	-	
Total switching energy	E_{ts}		-	9.0	-	
Turn-on delay time	$t_{d(on)}$	T_{vj}=175℃, V_{CC}=600V, I_C=75A, V_{GE}=-15/15V, R_G=10Ω, Inductive load	-	209	-	ns
Rise time	t_r		-	55	-	
Turn-off delay time	$t_{d(off)}$		-	327	-	
Fall time	t_f		-	171	-	
Turn-on energy	E_{on}		-	10.7	-	mJ
Turn-off energy	E_{off}		-	6.6	-	
Total switching energy	E_{ts}		-	17.3	-	

Diode Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Diode forward voltage	V_F	V_{GE}=0V, I_F=75A T_{vj}=25℃	1.7	2.2	2.55	V
		T_{vj}=150℃	-	1.9	-	
		T_{vj}=175℃	-	1.8	-	
Diode reverse recovery time	t_{rr}	T_{vj}=25℃, V_R=600V, I_F=75A, di_F/dt=500A/μs	-	292	-	ns
Diode reverse recovery charge	Q_{rr}		-	3.7	-	μC
Diode peak reverse recovery current	I_{rrm}		-	24	-	A
Diode reverse recovery time	t_{rr}	T_{vj}=175℃, V_R=600V, I_F=75A, di_F/dt=500A/μs	-	638	-	ns
Diode reverse recovery charge	Q_{rr}		-	14.7	-	μC
Diode peak reverse recovery current	I_{rrm}		-	58	-	A

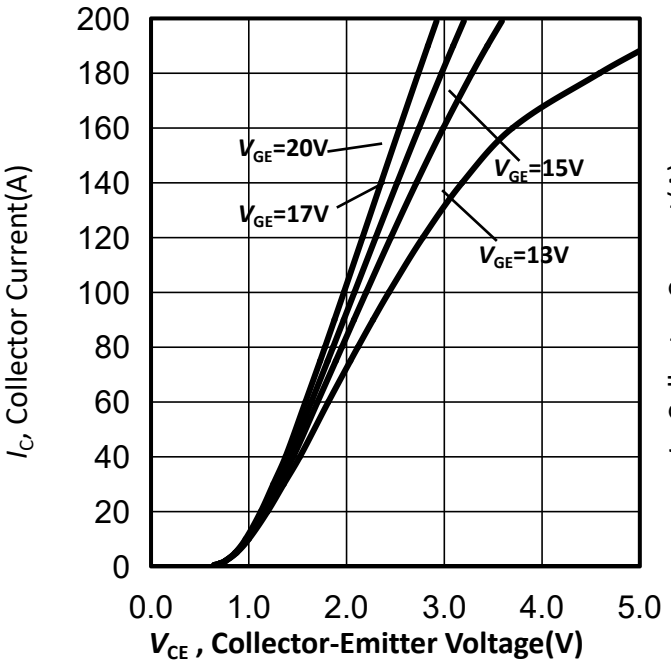


Figure 1. Typical output characteristic
（T_{vj}=25℃）

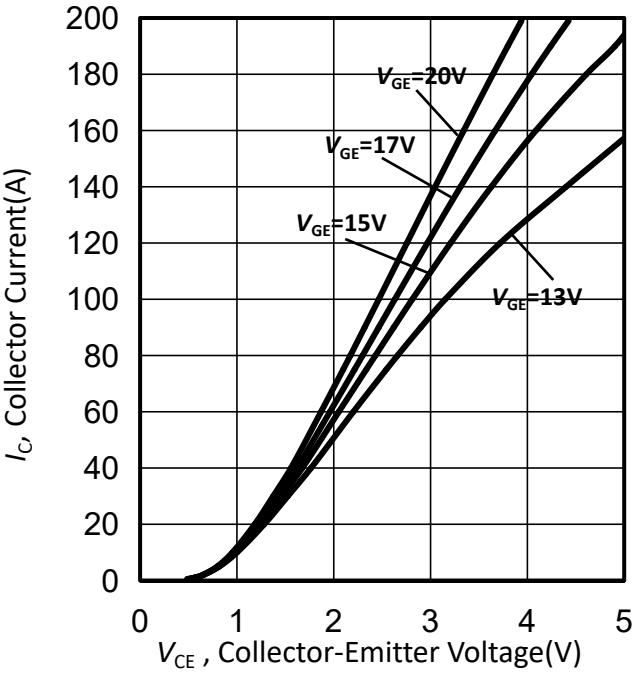


Figure 2. Typical output characteristic
（T_{vj}=125℃）

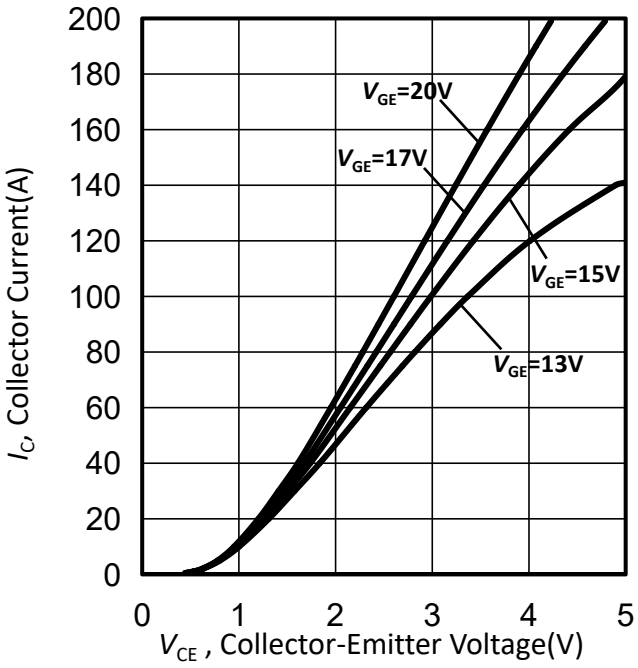


Figure 3. Typical output characteristic
（T_{vj}=150℃）

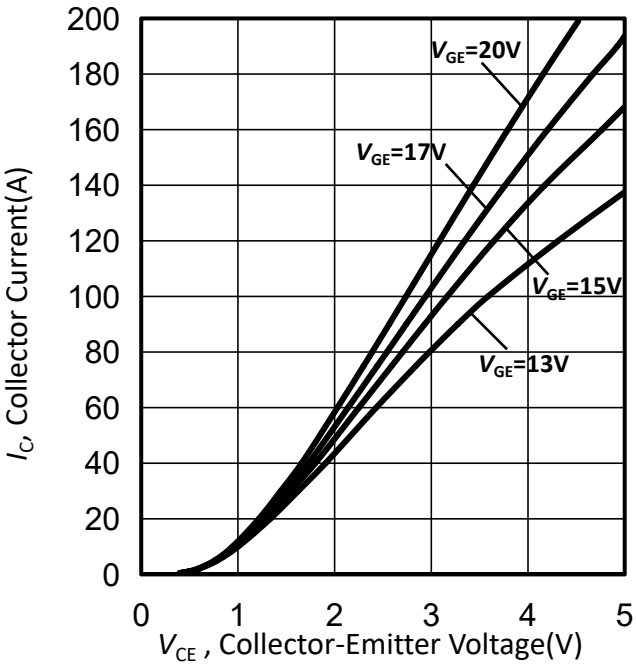


Figure 4. Typical output characteristic
（T_{vj}=175℃）

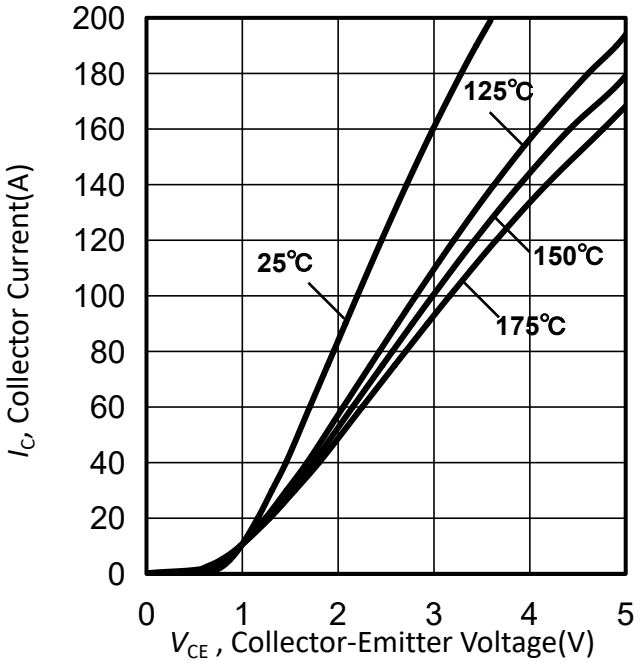


Figure 5. Typical $V_{CE(sat)}$-I_c characteristic
（V_{GE}=15V）

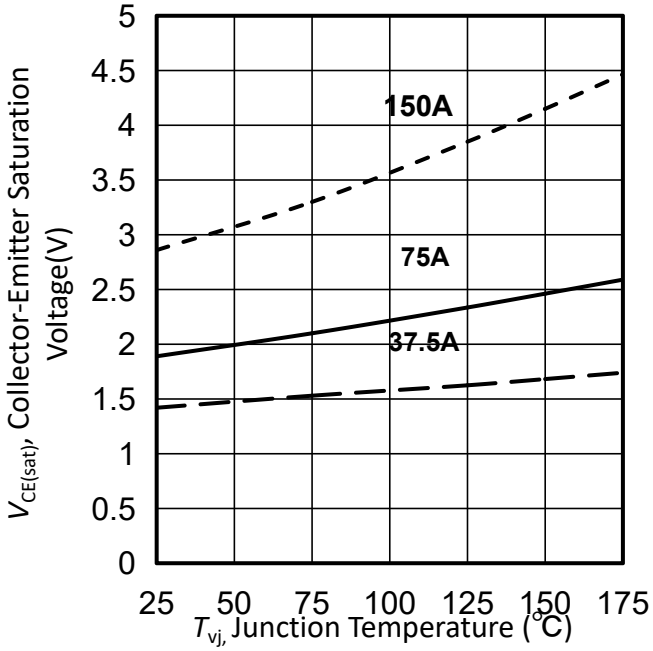


Figure 6. Typical $V_{CE(sat)}$-T_{vj} characteristic
（V_{GE}=15V）

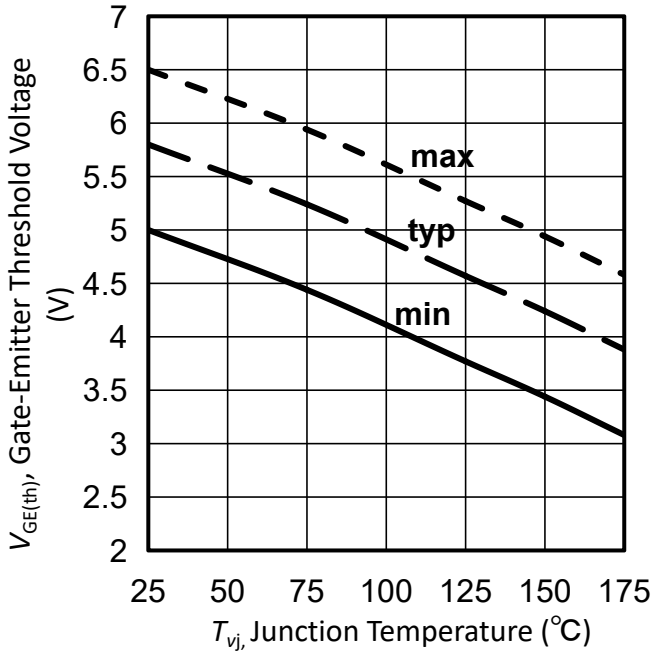


Figure 7.$V_{GE(th)}$-T_{vj} characteristic
（I_c=2.4mA）

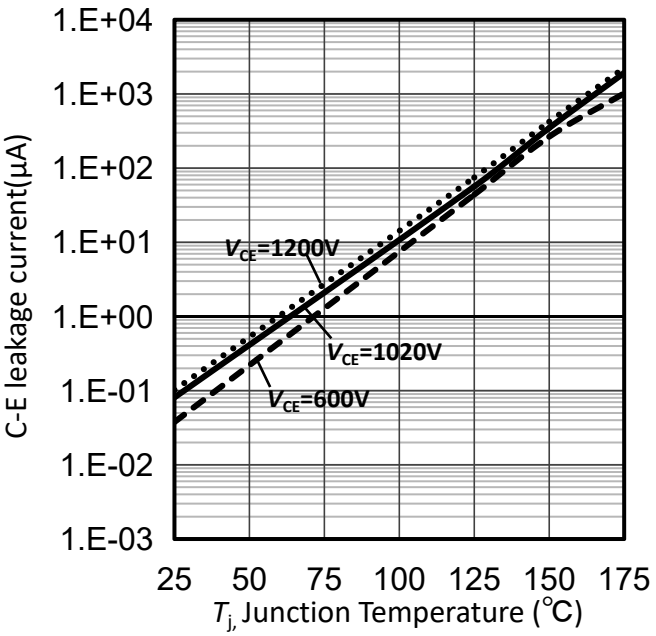


Figure 8. Typical I_{CES}-T_{vj} characteristic
（V_{GE}=0V）

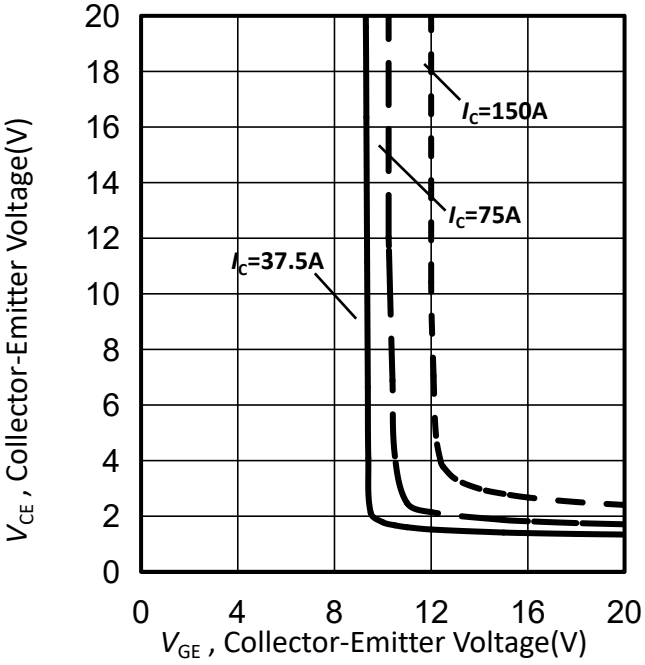


Figure 9. Typical $V_{CE(sat)}$-$V_{GE(th)}$ characteristic
(T_{vj}=25℃)

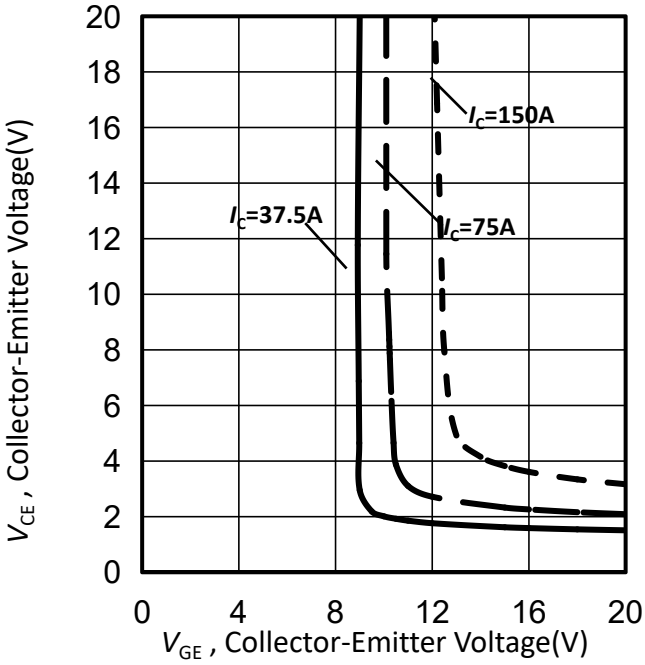


Figure 10. Typical $V_{CE(sat)}$-$V_{GE(th)}$ characteristic
(T_{vj}=125℃)

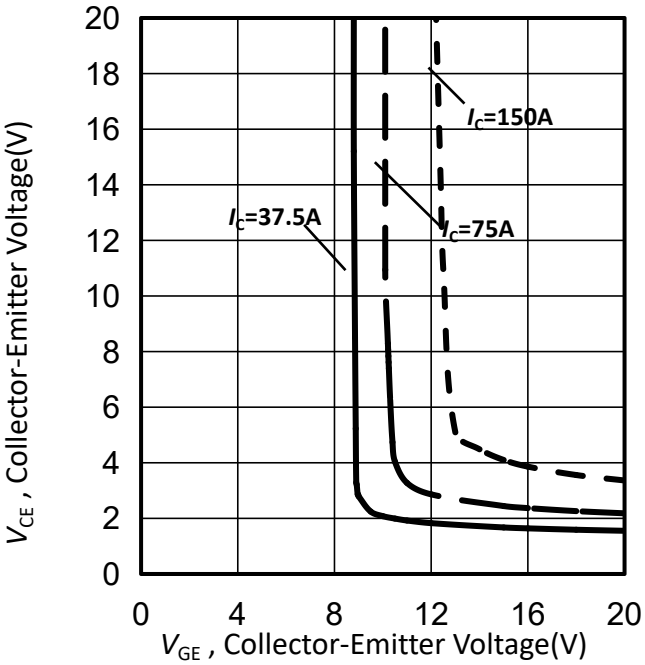


Figure 11. Typical $V_{CE(sat)}$-$V_{GE(th)}$ characteristic
(T_{vj}=150℃)

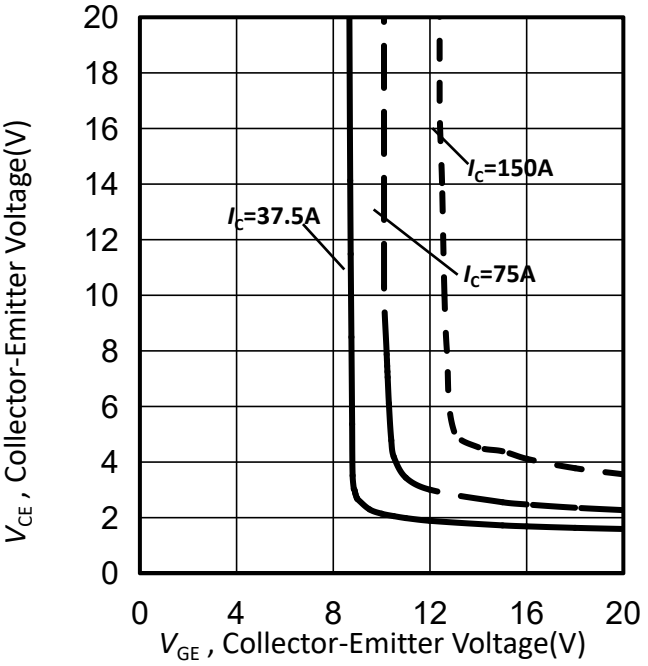


Figure 12. Typical $V_{CE(sat)}$-$V_{GE(th)}$ characteristic
(T_{vj}=175℃)

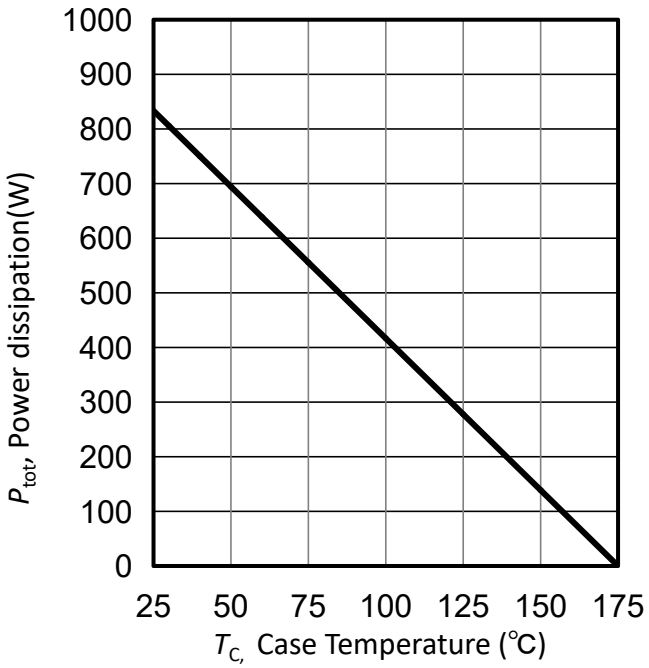


Figure 13. Power dissipation as a function of case temperature（T_j≤175℃ ）

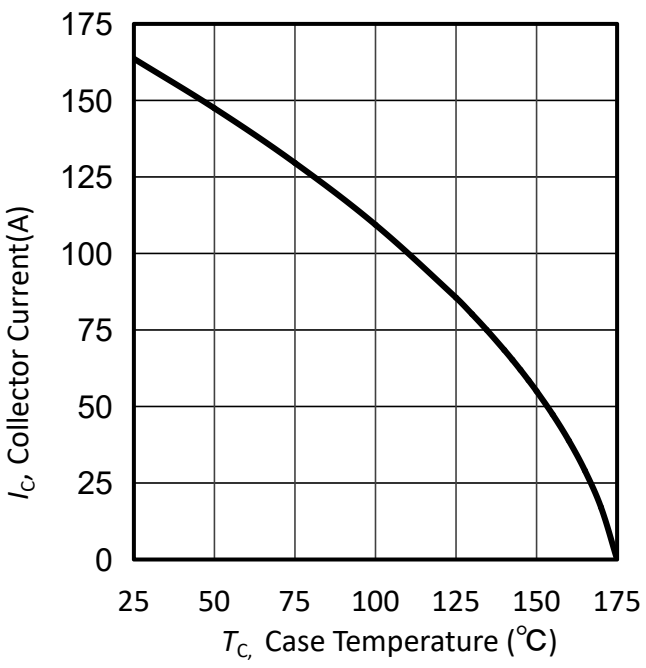


Figure 14. Collector current as a function of case temperature
(T_{vj}≤175℃ ,V_{GE}≥15V)

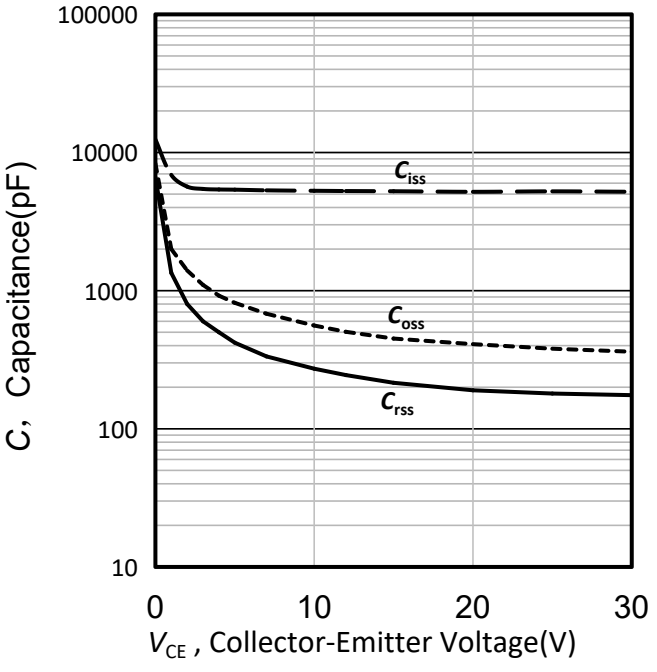


Figure 15. Typical capacitance as a function of collector-emitter voltage
(V_{GE}=0V, f=1MHz)

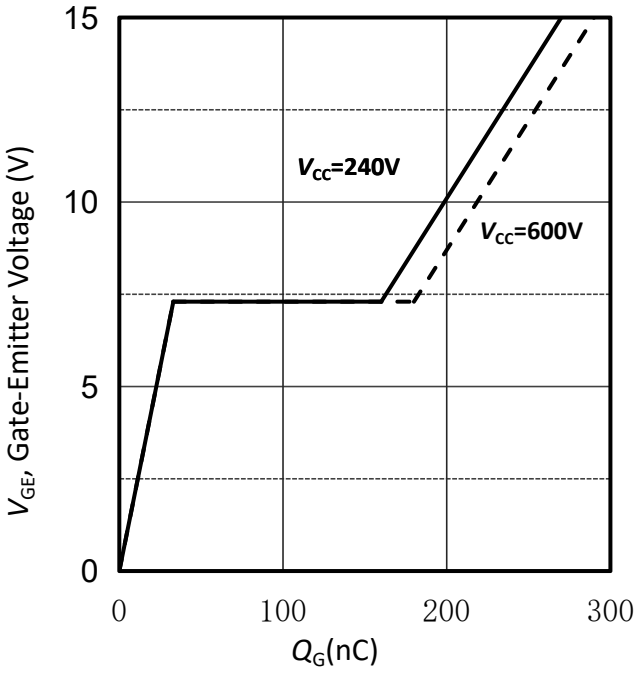


Figure 16. Typical gate charge

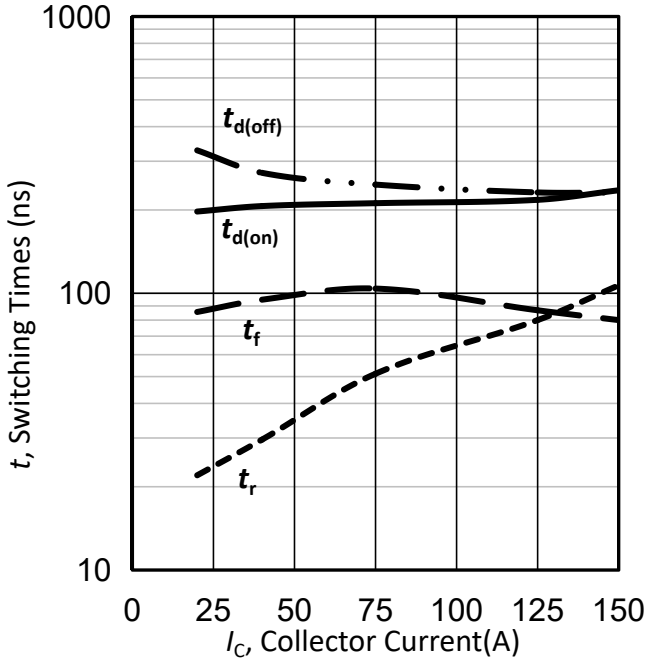


Figure 17. Typical switching times as a function of collector current
(inductive load, T_{vj}=25℃, V_{CE}=600V, V_{GE}=-15/15V, R_G=10Ω)

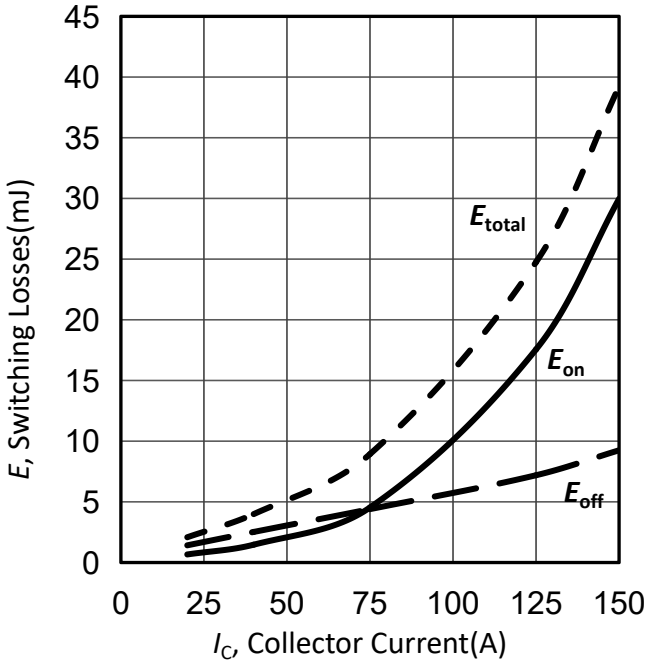


Figure 18. Typical switching times as a function of collector current
(inductive load, T_{vj}=25℃, V_{CE}=600V, V_{GE}=-15/15V, R_G=10Ω)

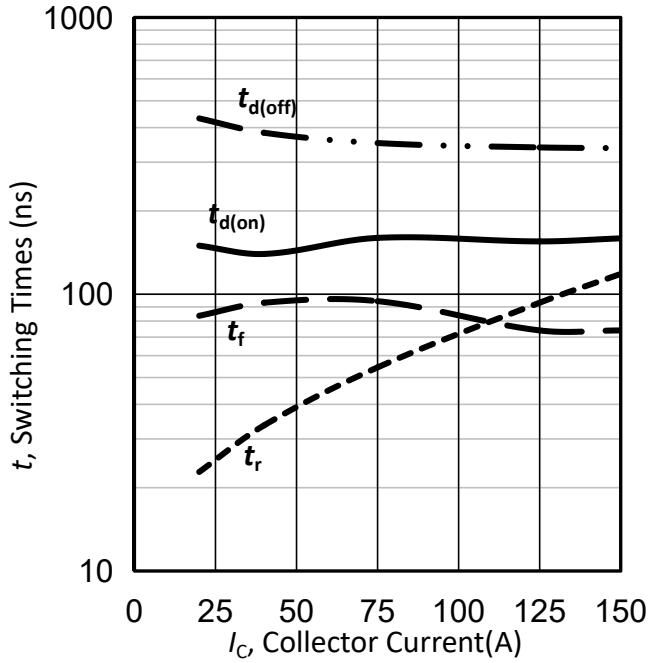


Figure 19. Typical switching times as a function of collector current
(inductive load, T_{vj}=25℃, V_{CE}=600V, V_{GE}=-5/17V, R_G=10Ω)

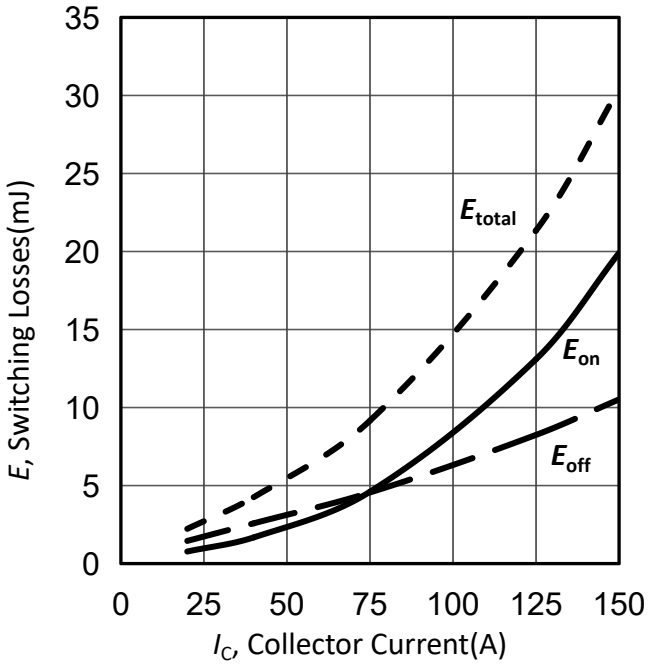


Figure 20. Typical switching times as a function of collector current
(inductive load, T_{vj}=25℃, V_{CE}=600V, V_{GE}=-5/17V, R_G=10Ω)

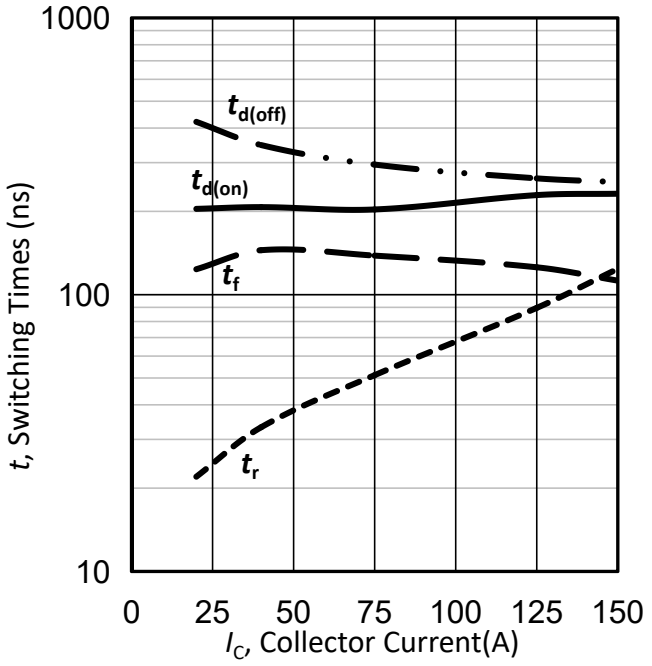


Figure 21. Typical switching times as a function of collector current
(inductive load, T_{vj}=125℃, V_{CE}=600V, V_{GE}=-15/15V, R_G=10Ω)

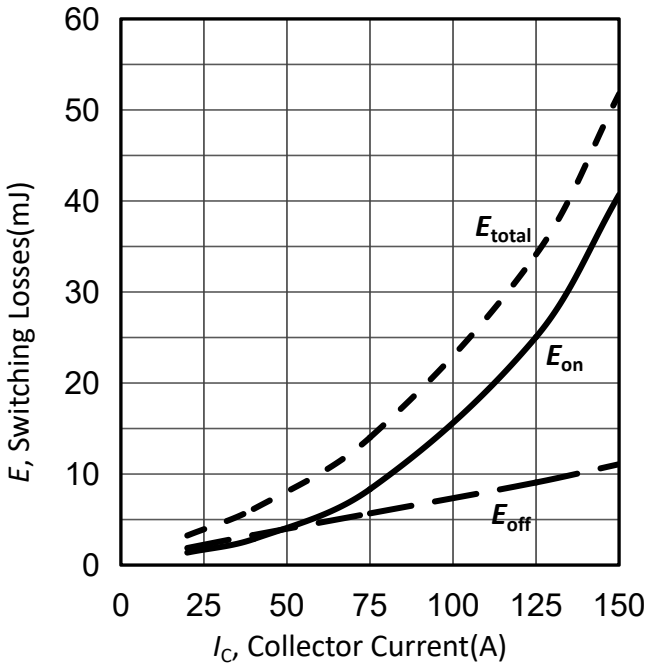


Figure 22. Typical switching times as a function of collector current
(inductive load, T_{vj}=125℃, V_{CE}=600V, V_{GE}=-15/15V, R_G=10Ω)

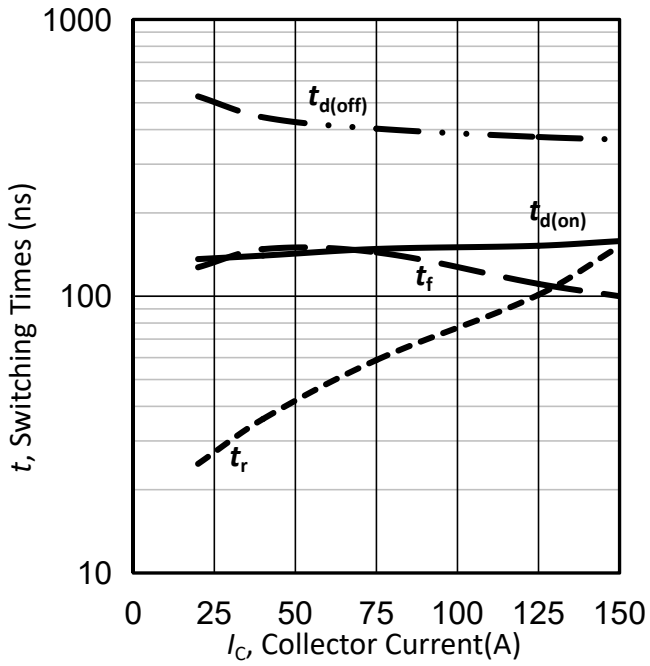


Figure 23. Typical switching times as a function of collector current
(inductive load, T_{vj}=125℃, V_{CE}=600V, V_{GE}=-5/17V, R_G=10Ω)

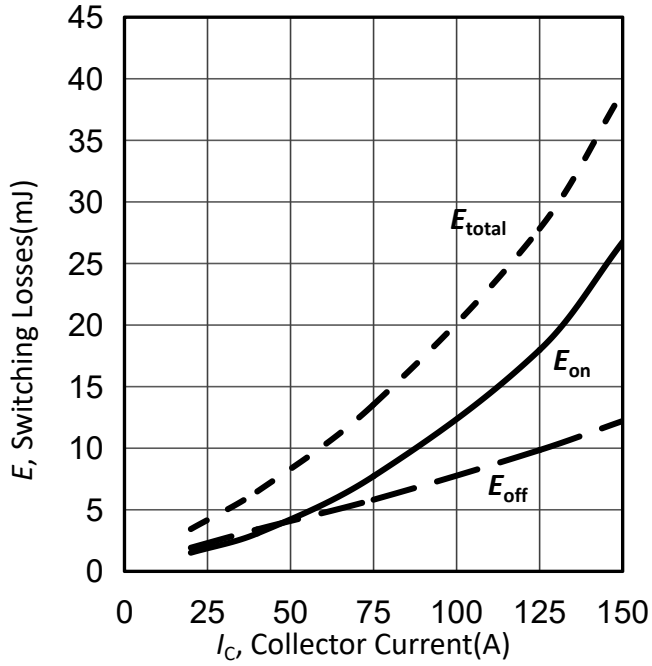


Figure 24. Typical switching times as a function of collector current
(inductive load, T_{vj}=125℃, V_{CE}=600V, V_{GE}=-5/17V, R_G=10Ω)

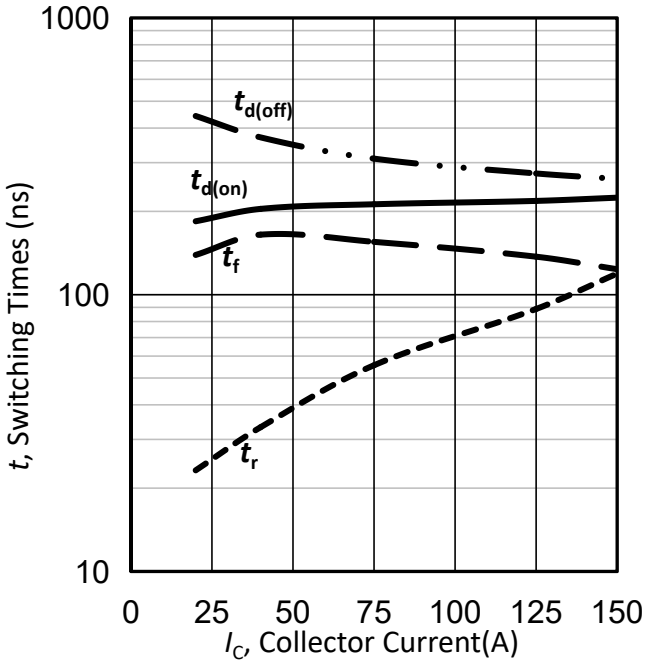


Figure 25. Typical switching times as a function of collector current
(inductive load, T_{vj}=150℃, V_{CE}=600V, V_{GE}=-15/15V, R_G=10Ω)

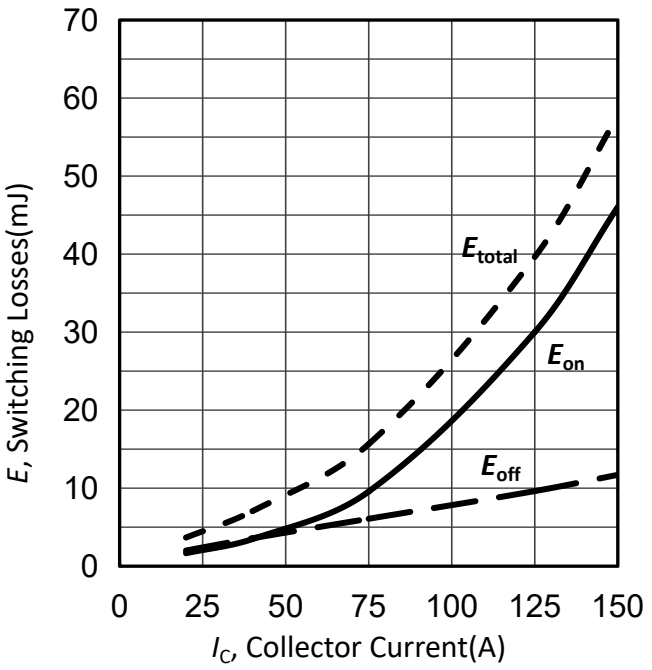


Figure 26. Typical switching times as a function of collector current
(inductive load, T_{vj}=150℃, V_{CE}=600V, V_{GE}=-15/15V, R_G=10Ω)

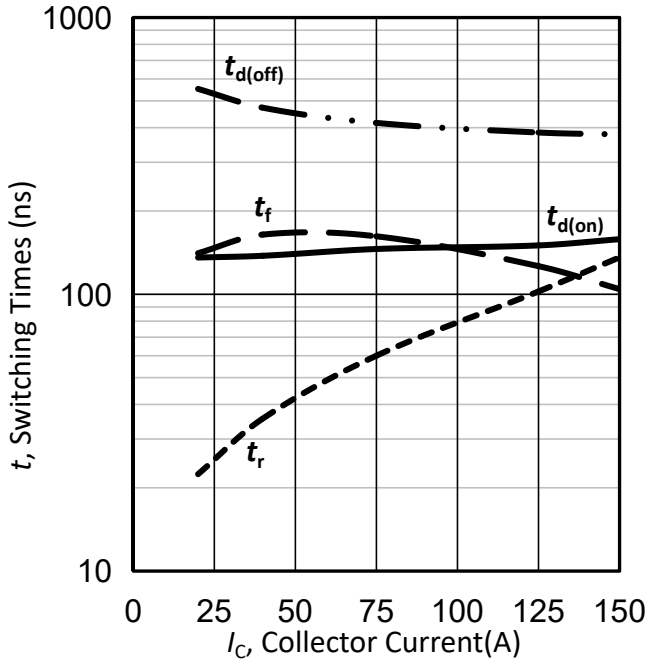


Figure 27. Typical switching times as a function of collector current
(inductive load, T_{vj}=150℃, V_{CE}=600V, V_{GE}=-5/17V, R_G=10Ω)

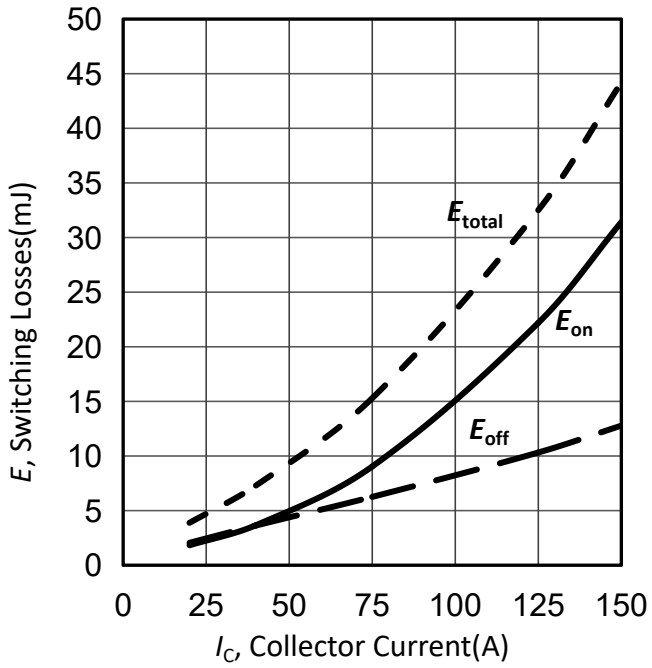


Figure 28. Typical switching times as a function of collector current
(inductive load, T_{vj}=150℃, V_{CE}=600V, V_{GE}=-5/17V, R_G=10Ω)

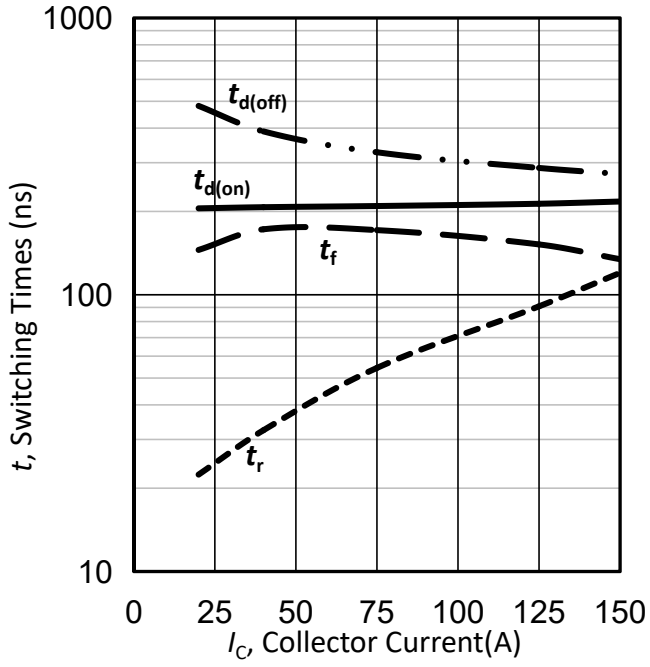


Figure 29. Typical switching times as a function of collector current
(inductive load, T_{vj}=175℃, V_{CE}=600V, V_{GE}=-15/15V, R_G=10Ω)

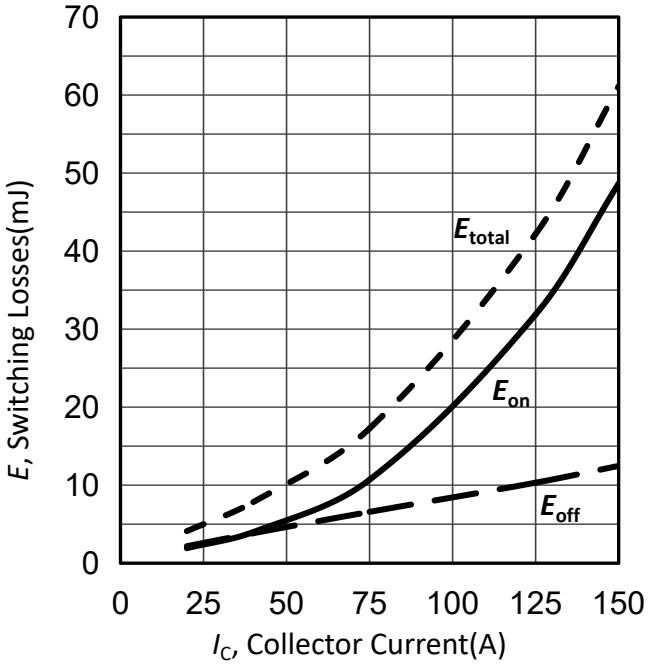


Figure 30. Typical switching times as a function of collector current
(inductive load, T_{vj}=175℃, V_{CE}=600V, V_{GE}=-15/15V, R_G=10Ω)

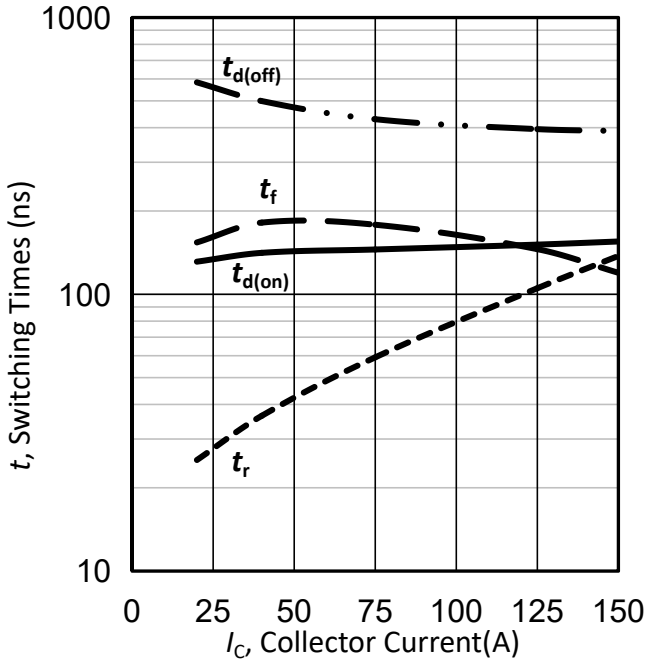


Figure 31. Typical switching times as a function of collector current
(inductive load, T_{vj}=175℃, V_{CE}=600V, V_{GE}=-5/17V, R_G=10Ω)

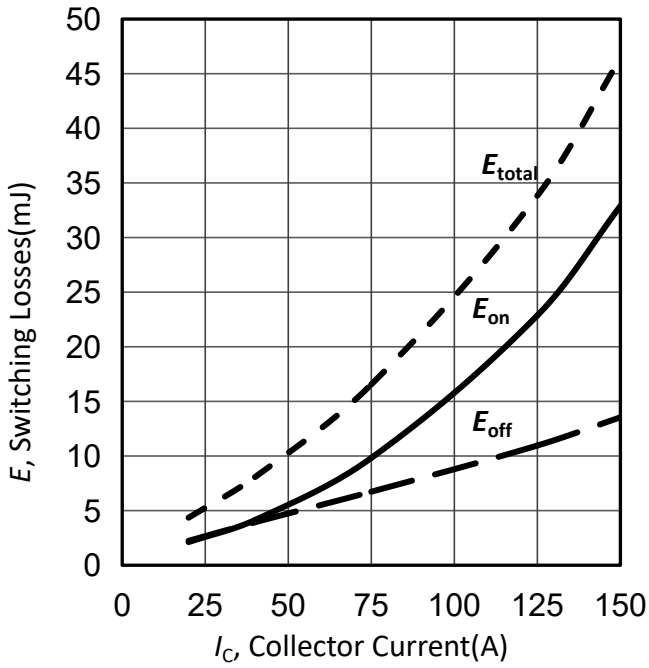


Figure 32. Typical switching times as a function of collector current
(inductive load, T_{vj}=175℃, V_{CE}=600V, V_{GE}=-5/17V, R_G=10Ω)

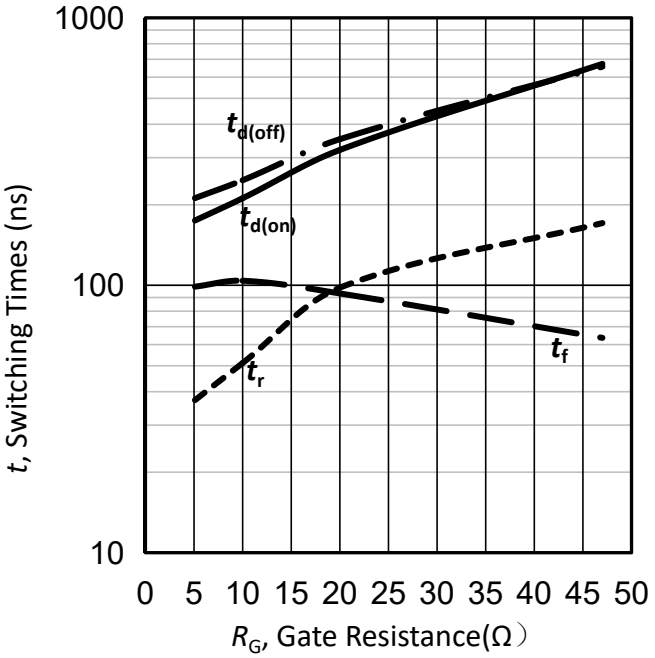


Figure 33. Typical switching times as a function of gate resistor
(inductive load, T_{vj}=25℃,
V_{CE}=600V, V_{GE}=-15/15V, I_C=75A)

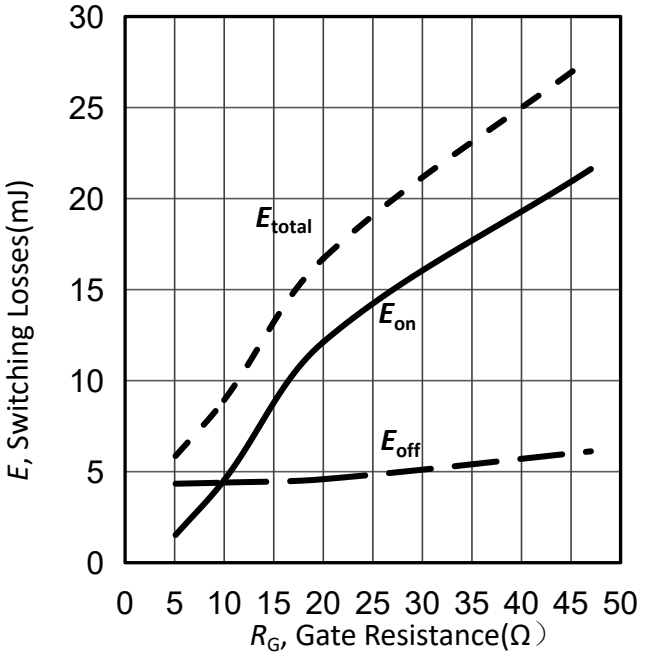


Figure 34. Typical switching energy losses as a function of gate resistor
(inductive load, T_{vj}=25℃,
V_{CE}=600V, V_{GE}=-15/15V, I_C=75A)

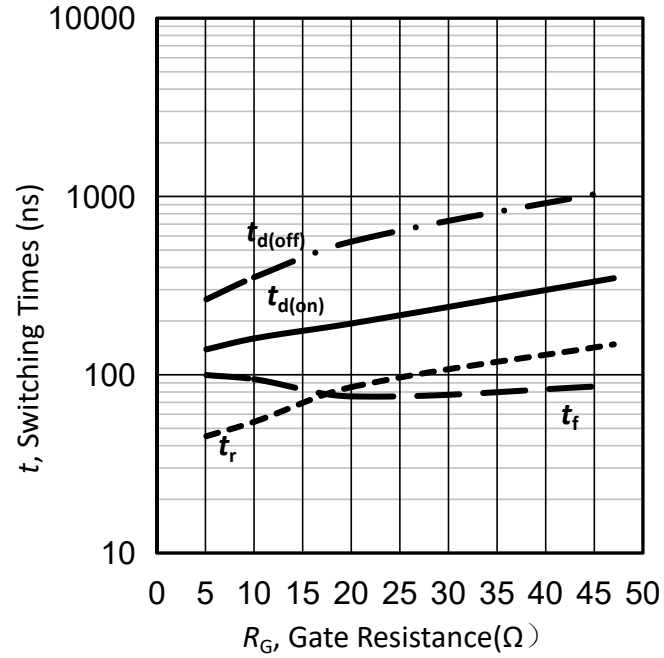


Figure 35. Typical switching times as a function of gate resistor
(inductive load, T_{vj}=25℃,
V_{CE}=600V, V_{GE}=-5/17V, I_C=75A)

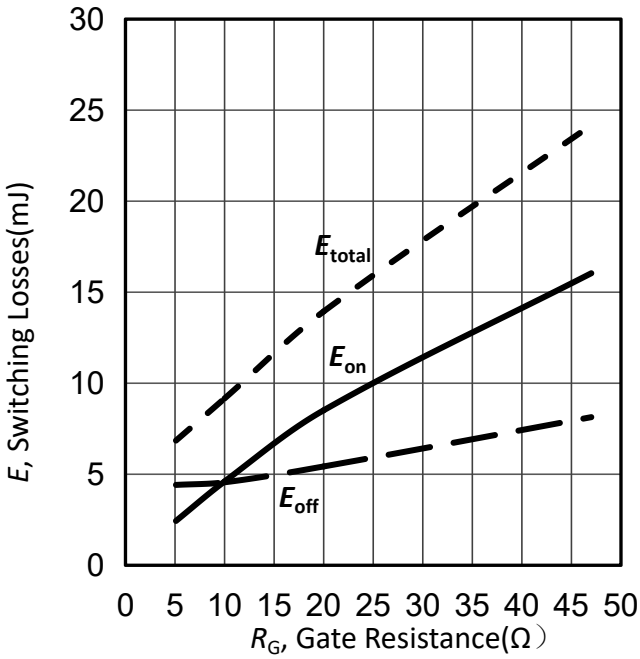


Figure 36. Typical switching energy losses as a function of gate resistor
(inductive load, T_{vj}=25℃,
V_{CE}=600V, V_{GE}=-5/17V, I_C=75A)

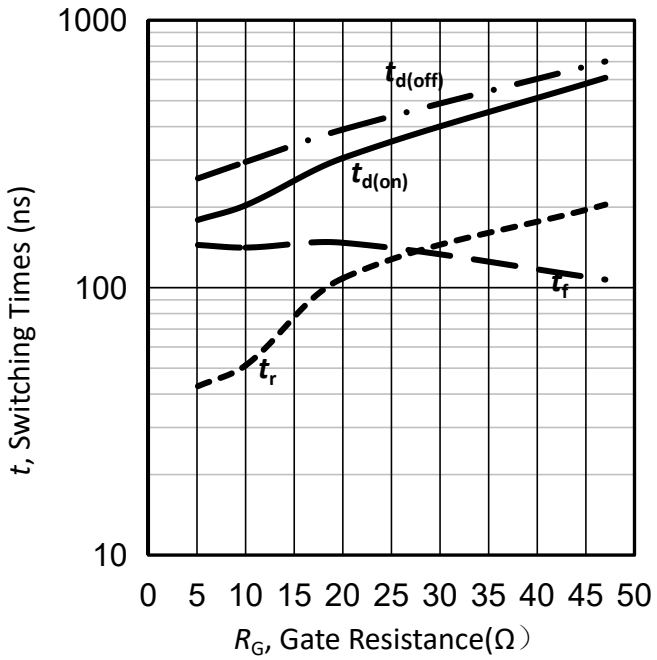


Figure 37. Typical switching times as a function of gate resistor
(inductive load, T_{vj}=125℃, V_{CE}=600V, V_{GE}=-15/15V, I_C=75A)

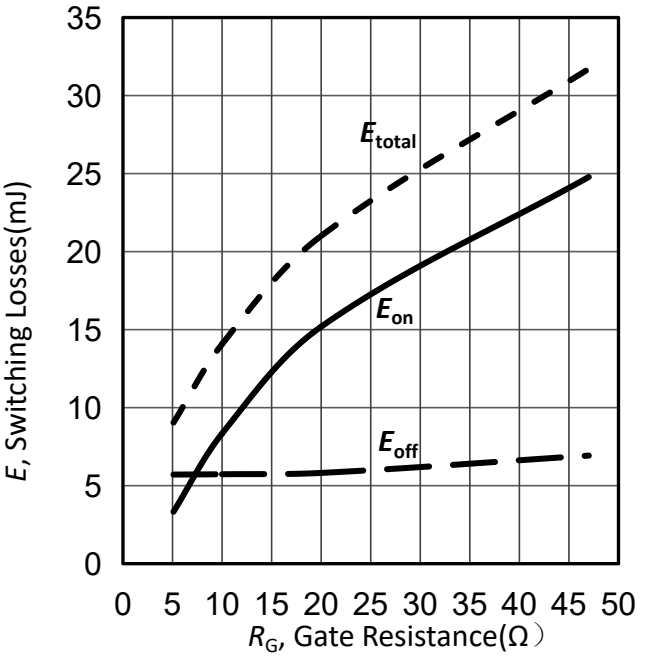


Figure 38. Typical switching energy losses as a function of gate resistor
(inductive load, T_{vj}=125℃, V_{CE}=600V, V_{GE}=-15/15V, I_C=75A)

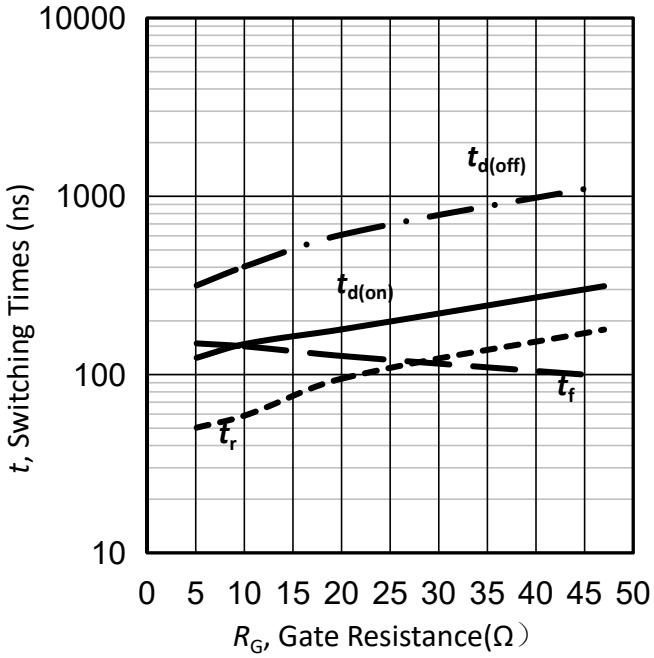


Figure 39. Typical switching times as a function of gate resistor
(inductive load, T_{vj}=125℃, V_{CE}=600V, V_{GE}=-5/17V, I_C=75A)

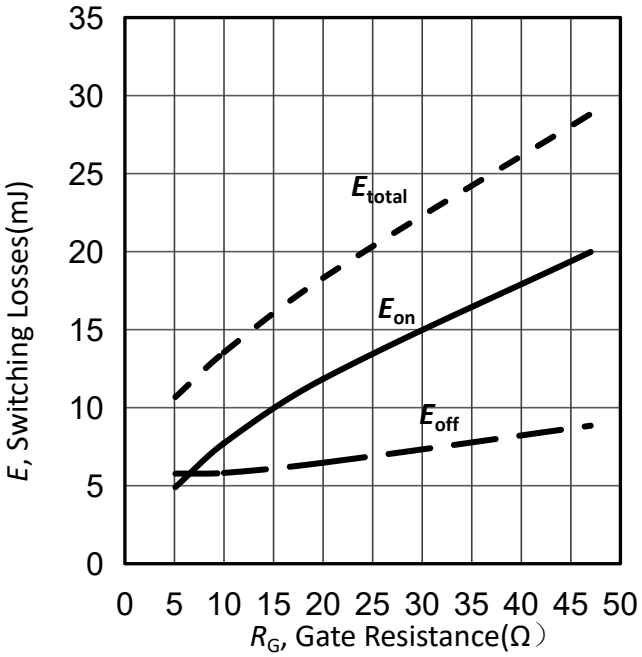


Figure 40. Typical switching energy losses as a function of gate resistor
(inductive load, T_{vj}=125℃, V_{CE}=600V, V_{GE}=-5/17V, I_C=75A)

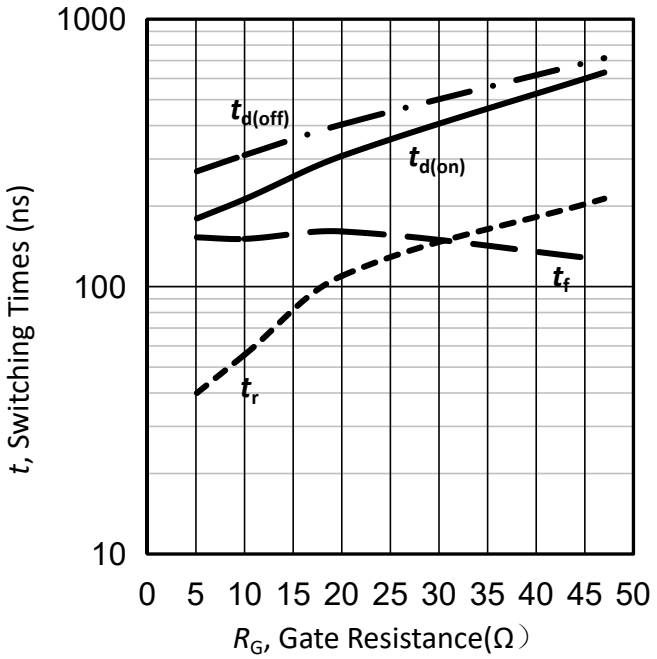


Figure 41. Typical switching times as a function of gate resistor
(inductive load, T_{vj}=150℃, V_{CE}=600V, V_{GE}=-15/15V, I_C=75A)

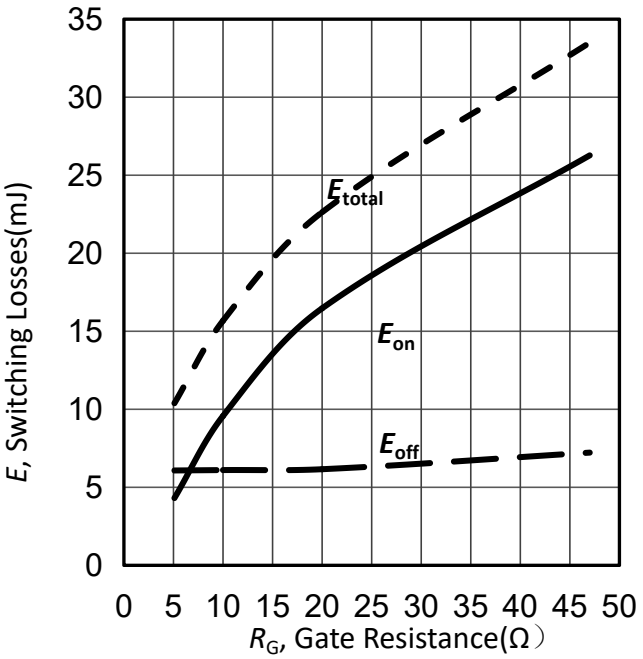


Figure 42. Typical switching energy losses as a function of gate resistor
(inductive load, T_{vj}=150℃, V_{CE}=600V, V_{GE}=-15/15V, I_C=75A)

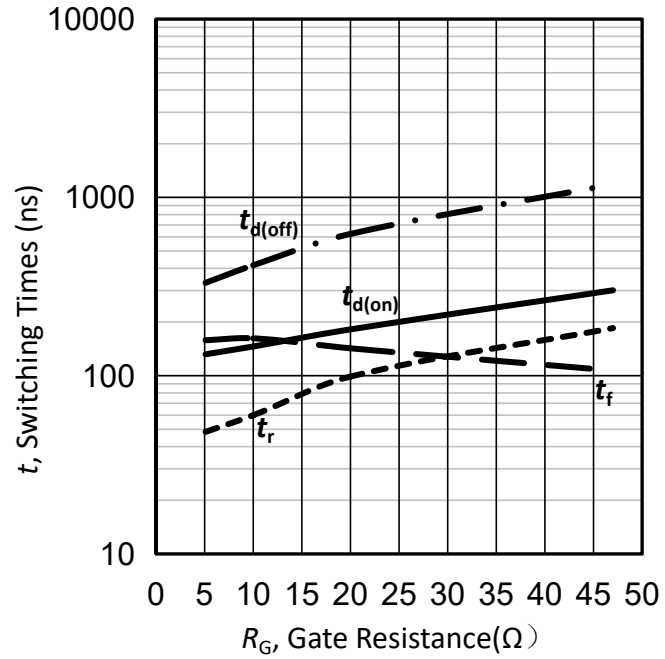


Figure 43. Typical switching times as a function of gate resistor
(inductive load, T_{vj}=150℃, V_{CE}=600V, V_{GE}=-5/17V, I_C=75A)

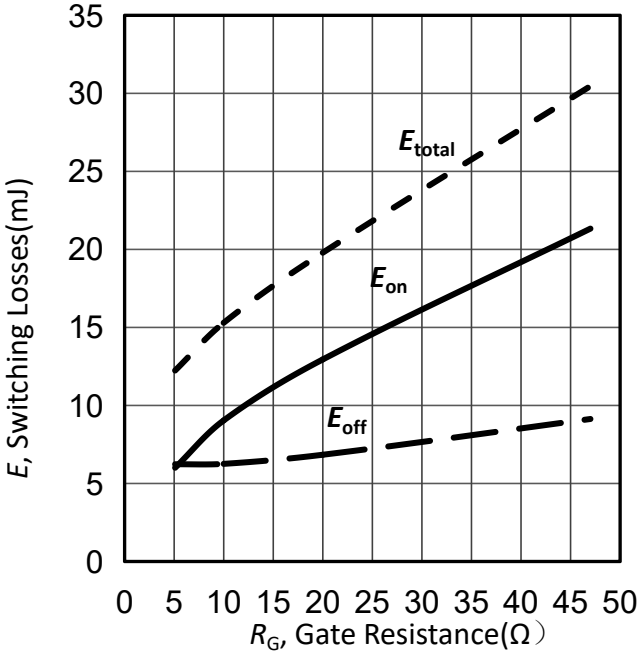


Figure 44. Typical switching energy losses as a function of gate resistor
(inductive load, T_{vj}=150℃, V_{CE}=600V, V_{GE}=-5/17V, I_C=75A)

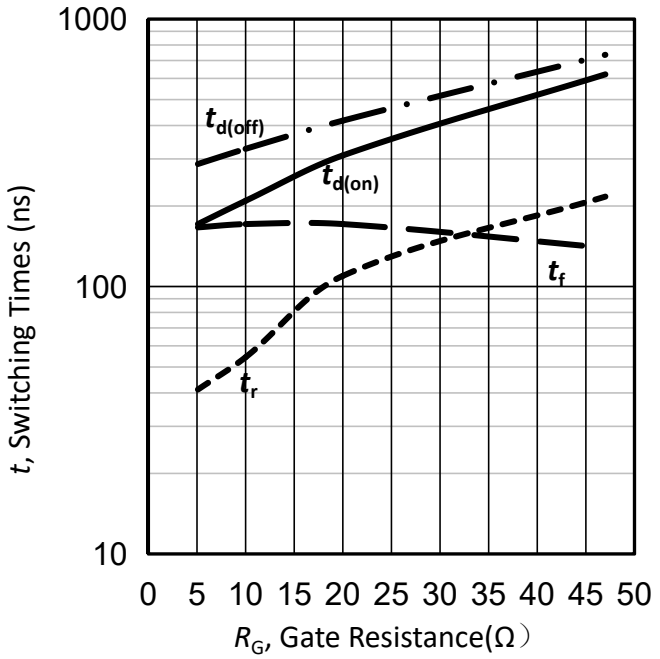


Figure 45. Typical switching times as a function of gate resistor
(inductive load, T_{vj}=175℃, V_{CE}=600V, V_{GE}=-15/15V, I_C=75A)

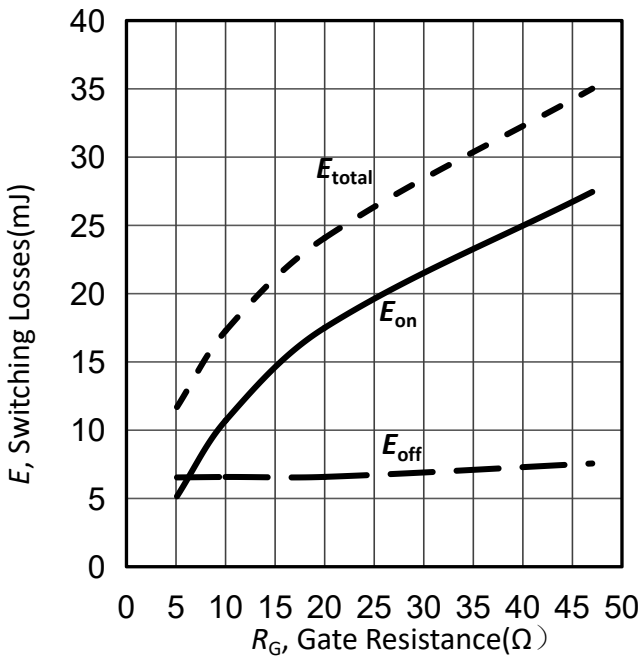


Figure 46. Typical switching energy losses as a function of gate resistor
(inductive load, T_{vj}=175℃, V_{CE}=600V, V_{GE}=-15/15V, I_C=75A)

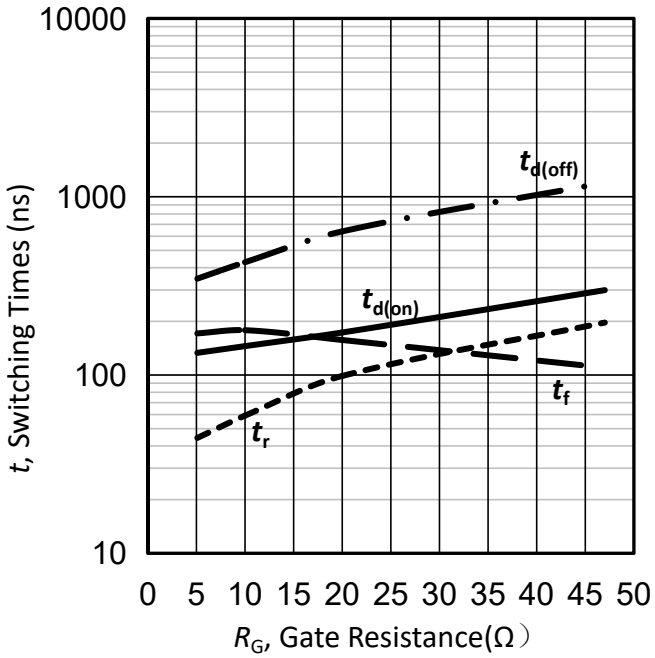


Figure 47. Typical switching times as a function of gate resistor
(inductive load, T_{vj}=175℃, V_{CE}=600V, V_{GE}=-5/17V, I_C=75A)

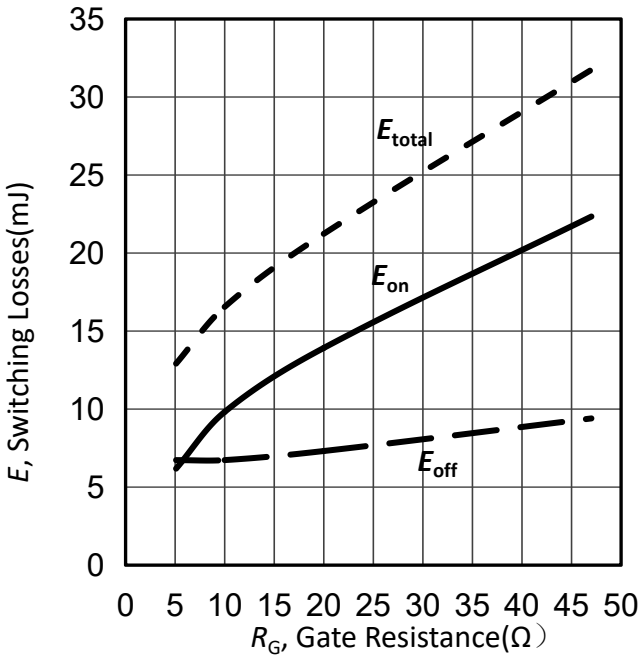


Figure 48. Typical switching energy losses as a function of gate resistor
(inductive load, T_{vj}=175℃, V_{CE}=600V, V_{GE}=-5/17V, I_C=75A)

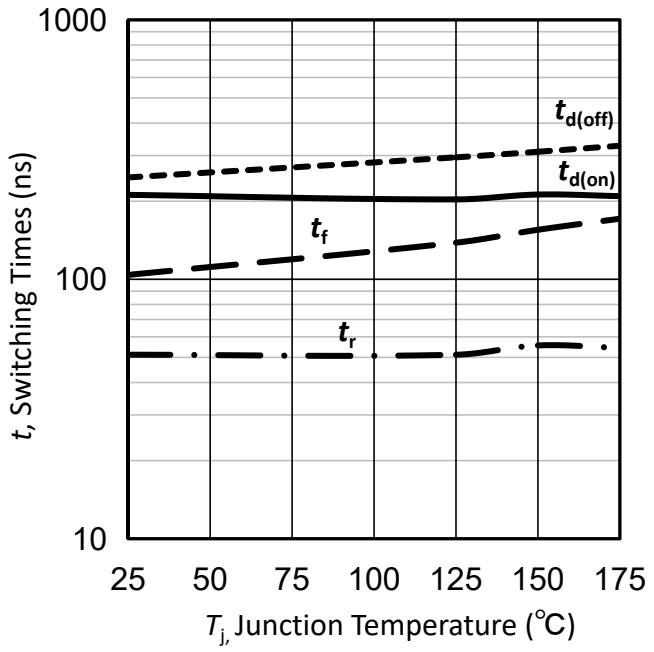


Figure 49. Typical switching times as a function of junction temperature
(inductive load, V_{CE}=600V, V_{GE}=-15/15V, I_C=75A, , R_G=10Ω)

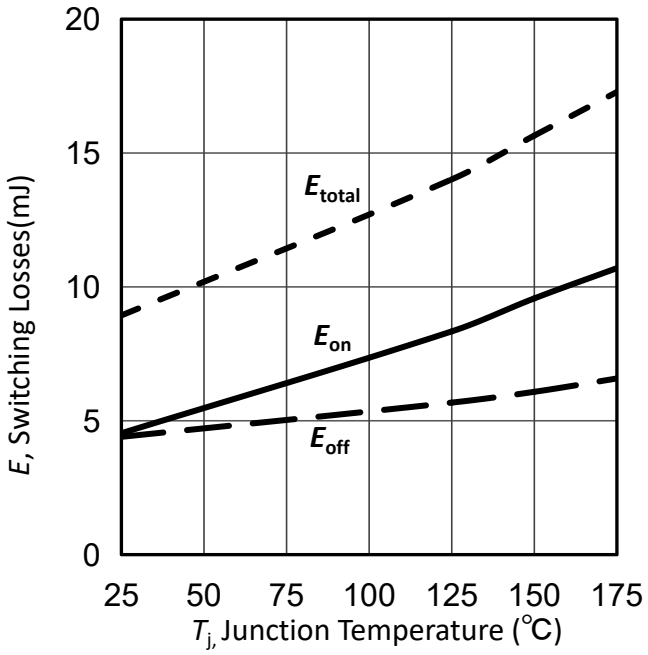


Figure 50. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE}=600V, V_{GE}=-15/15V, I_C=75A, , R_G=10Ω)

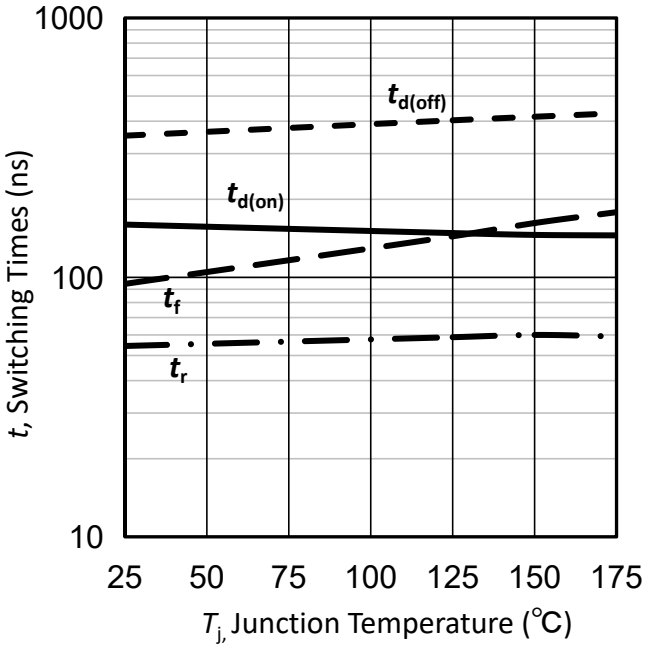


Figure 51. Typical switching times as a function of junction temperature
(inductive load, V_{CE}=600V, V_{GE}=-5/17V, I_C=75A, , R_G=10Ω)

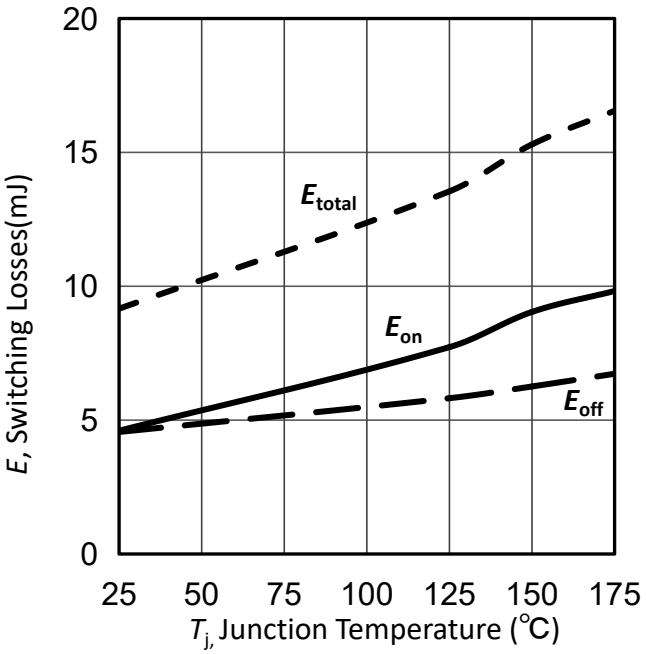


Figure 52. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE}=600V, V_{GE}=-5/17V, I_C=75A, , R_G=10Ω)

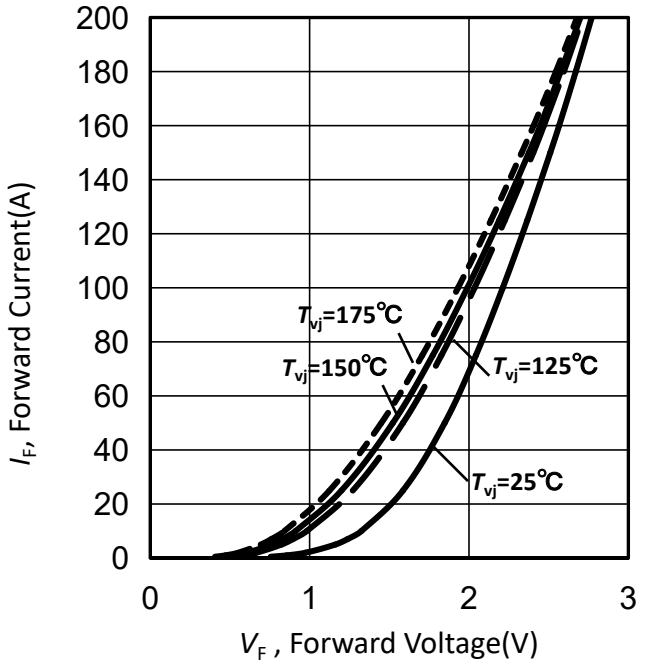


Figure 53. Typical diode forward current as a function of forward voltage

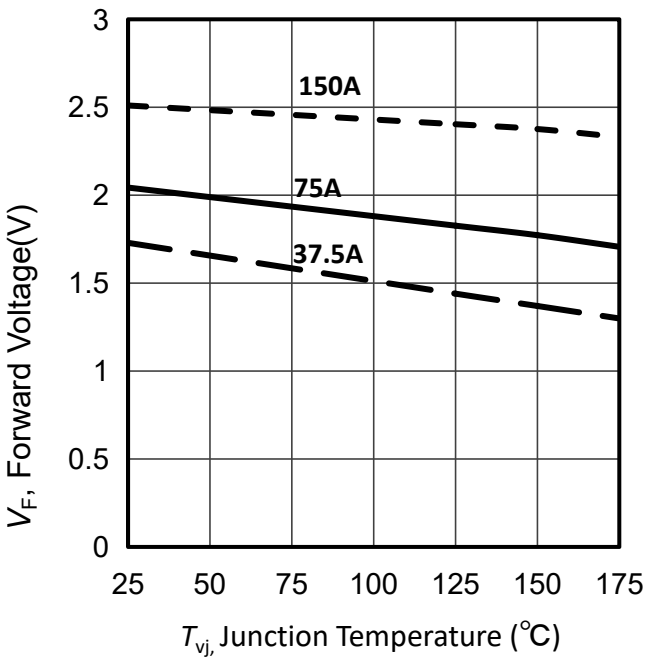


Figure 54. Typical diode forward voltage as a function of junction temperature

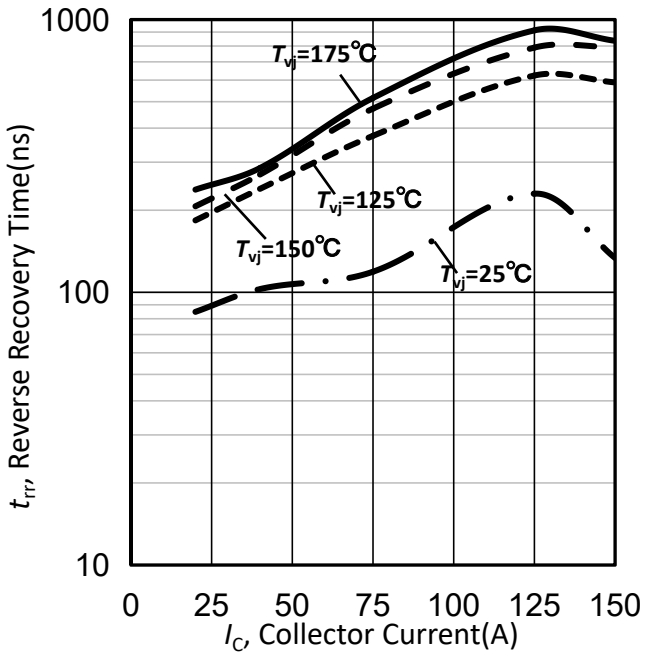


Figure 55. Typical reverse recovery time as a function of collector current
(inductive load,
V_{CE}=600V, V_{GE}=-15/15V, R_G=10Ω)

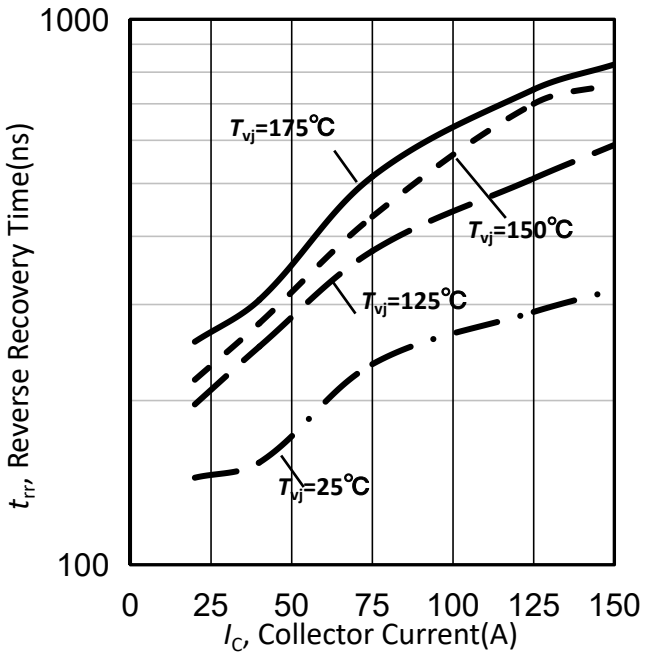


Figure 56. Typical reverse recovery time as a function of collector current
(inductive load,
V_{CE}=600V, V_{GE}=-5/17V, R_G=10Ω)

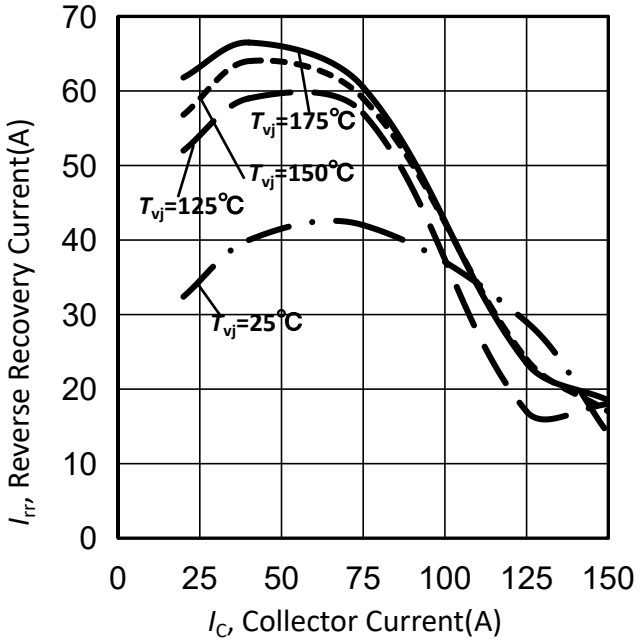


Figure 57. Typical reverse recovery current as a function of collector current
(inductive load,
V_{CE}=600V, V_{GE}=-15/15V, R_G=10Ω)

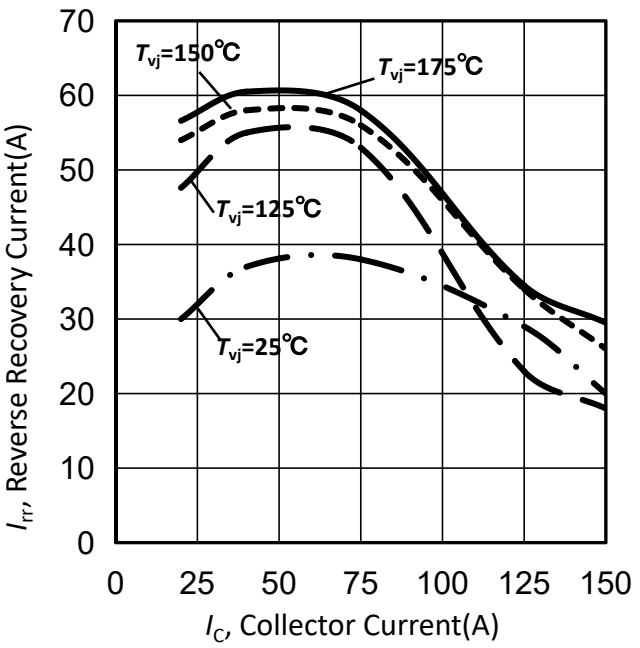


Figure 58. Typical reverse recovery current as a function of collector current
(inductive load,
V_{CE}=600V, V_{GE}=-5/17V, R_G=10Ω)

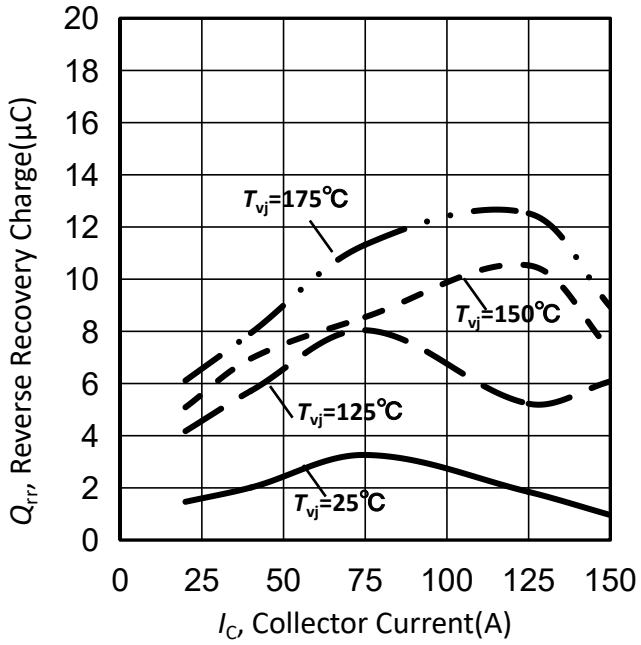


Figure 59. Typical reverse recovery charge as a function of collector current
(inductive load,
V_{CE}=600V, V_{GE}=-15/15V, R_G=10Ω)

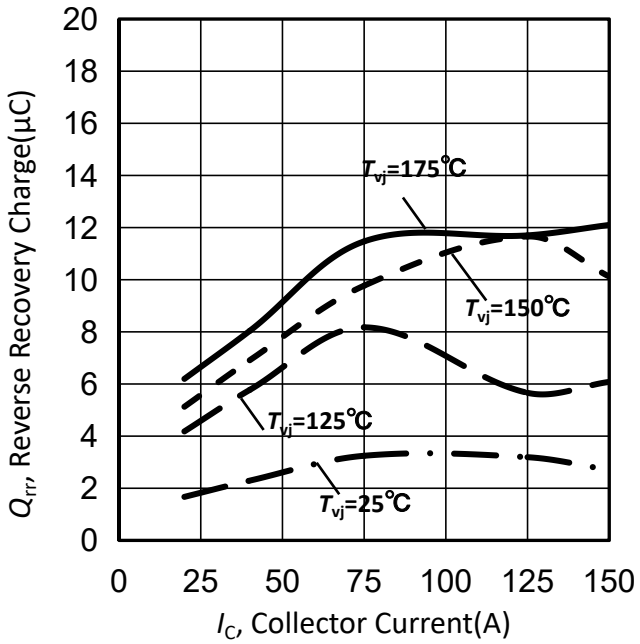


Figure 60. Typical reverse recovery charge as a function of collector current
(inductive load,
V_{CE}=600V, V_{GE}=-5/17V, R_G=10Ω)

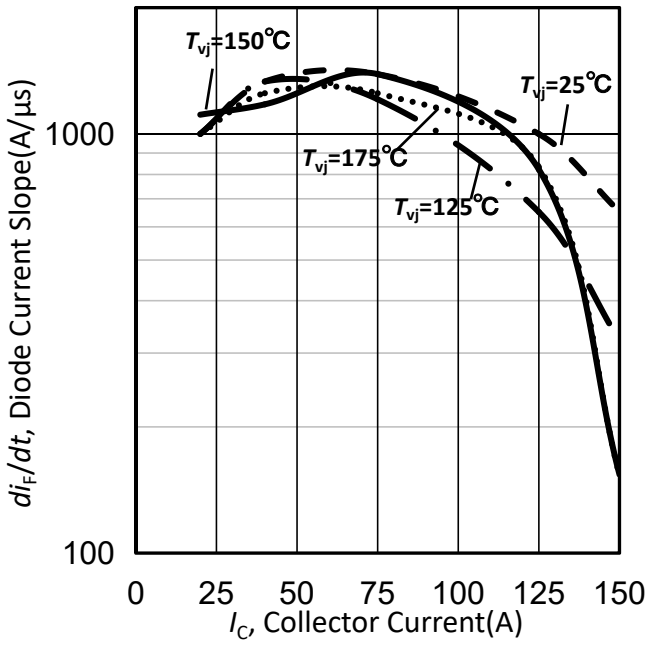


Figure 61. Typical diode current slope as a function of collector current
(inductive load,
V_{CE}=600V, V_{GE}=-15/15V, R_G=10Ω)

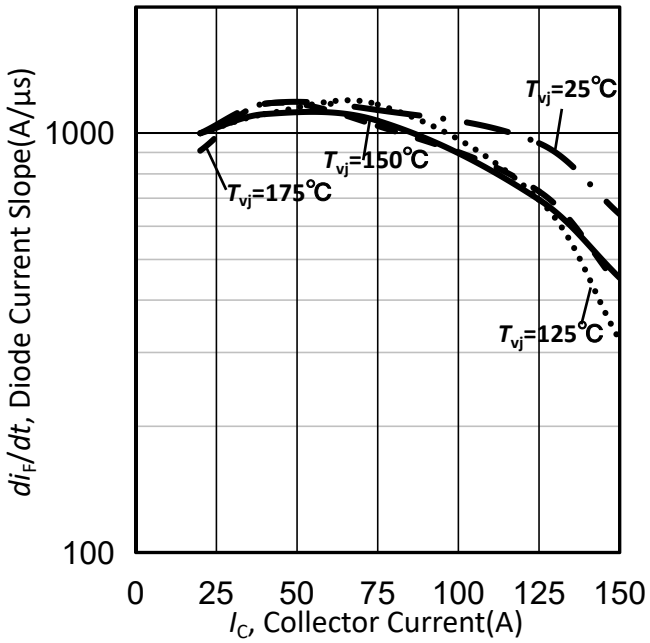


Figure 62. Typical diode current slope as a function of collector current
(inductive load,
V_{CE}=600V, V_{GE}=-5/17V, R_G=10Ω)

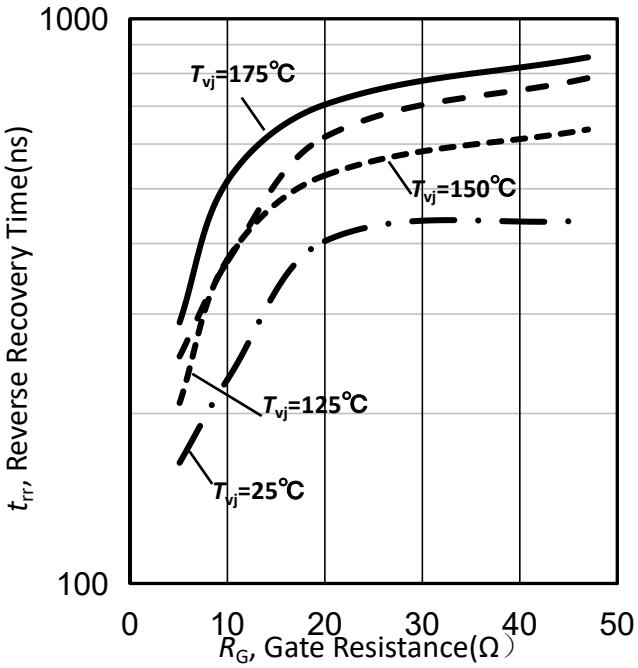


Figure 63. Typical reverse recovery time as a function of gate resistor
(inductive load,
V_{CE}=600V, V_{GE}=-15/15V, I_C=75A)

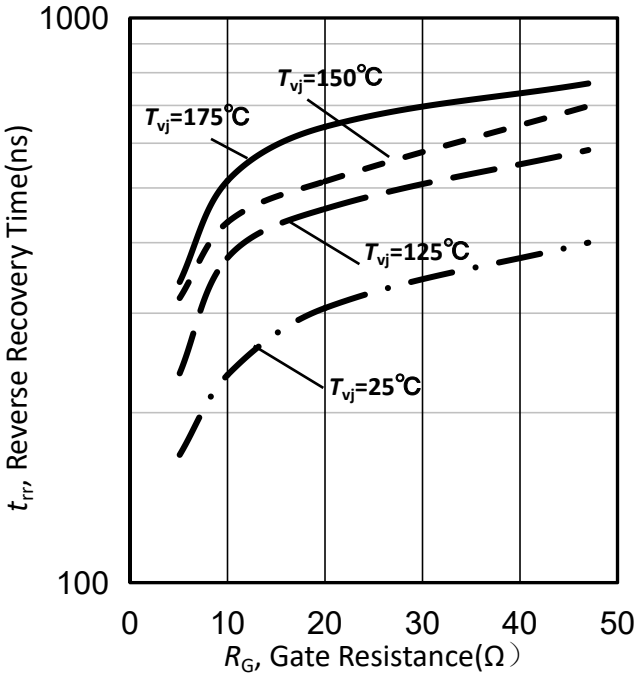


Figure 64. Typical reverse recovery time as a function of gate resistor
(inductive load,
V_{CE}=600V, V_{GE}=-5/17V, I_C=75A)

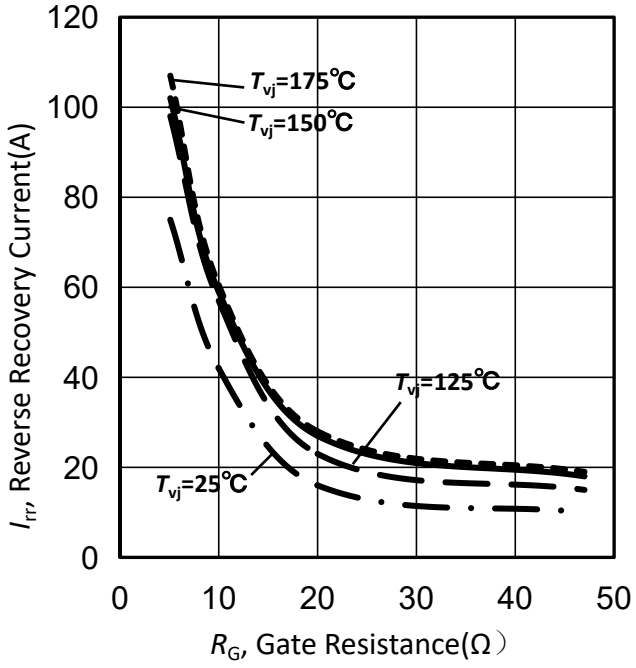


Figure 65. Typical reverse recovery current as a function of gate resistor
(inductive load,
V_{CE}=600V, V_{GE}=-15/15V, I_C=75A)

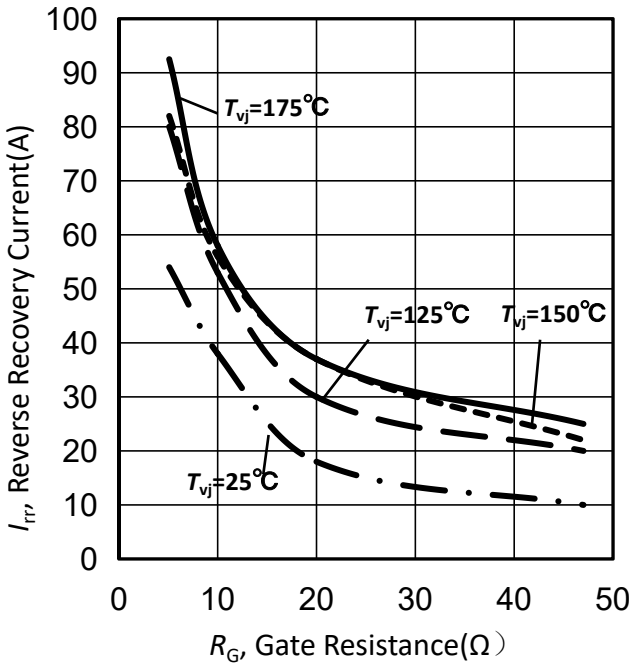


Figure 66. Typical reverse recovery current as a function of gate resistor
(inductive load,
V_{CE}=600V, V_{GE}=-5/17V, I_C=75A)

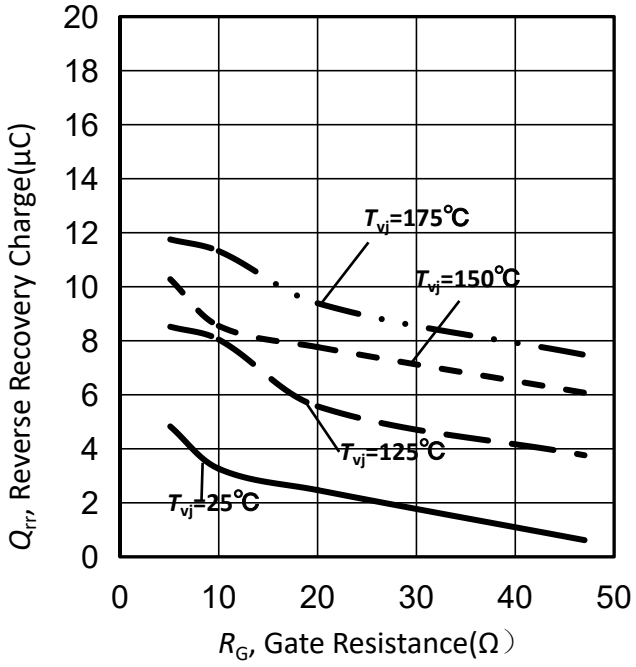


Figure 67. Typical reverse recovery charge as a function of gate resistor
(inductive load,
V_{CE}=600V, V_{GE}=-15/15V, I_C=75A)

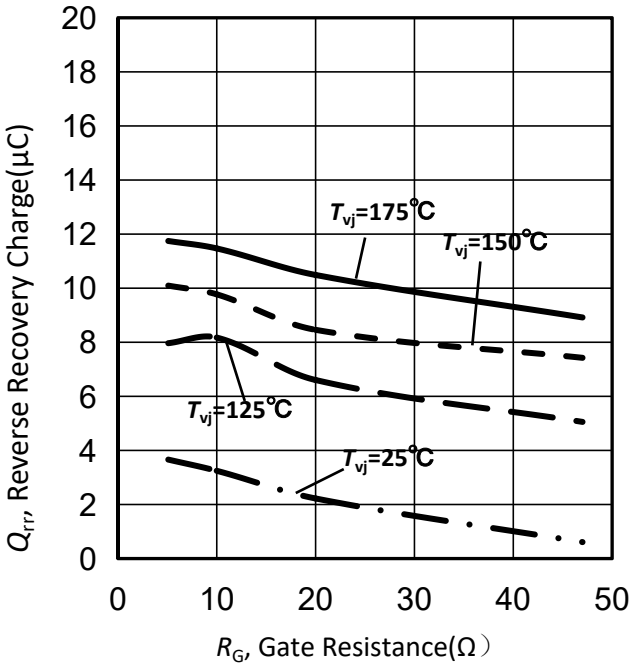


Figure 68. Typical reverse recovery charge as a function of gate resistor
(inductive load,
V_{CE}=600V, V_{GE}=-5/17V, I_C=75A)

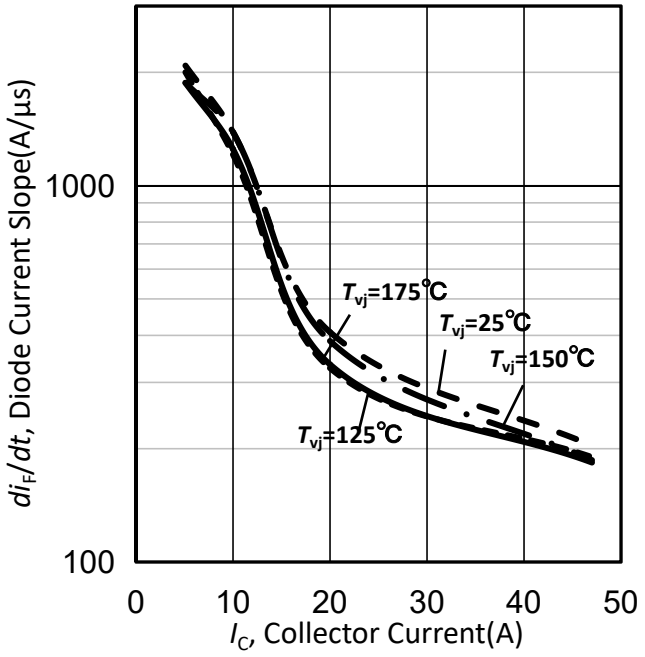


Figure 69. Typical diode current slope as a function of gate resistor
(inductive load,
V_{CE}=600V, V_{GE}=-15/15V, I_C=75A)

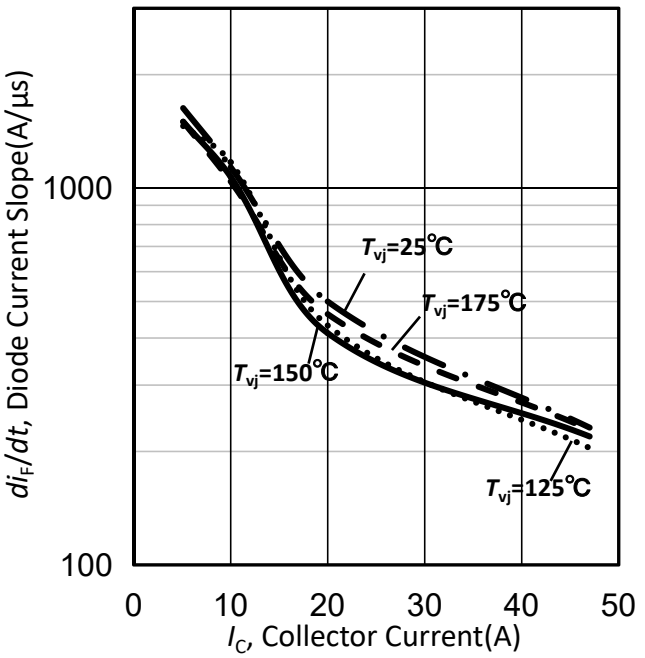


Figure 70. Typical diode current slope as a function of gate resistor
(inductive load,
V_{CE}=600V, V_{GE}=-5/17V, I_C=75A)

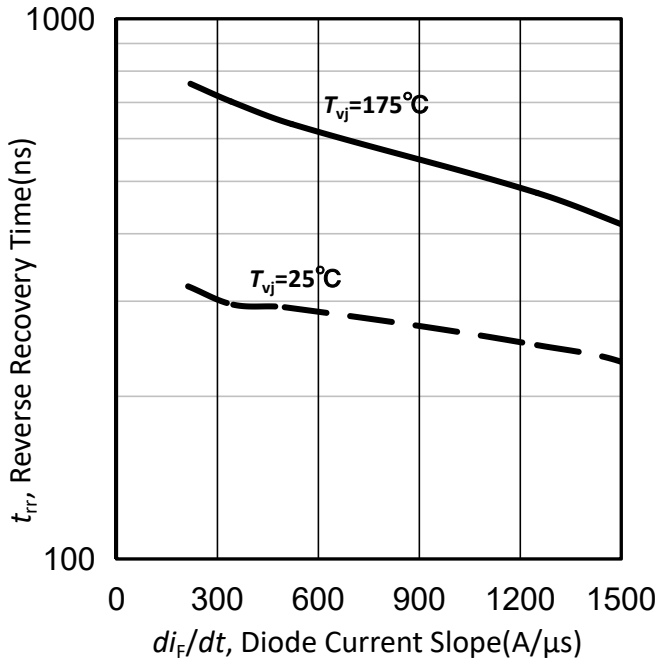


Figure 71. Typical reverse recovery time as a function of diode current slope
(V_R=600V， I_F=75A)

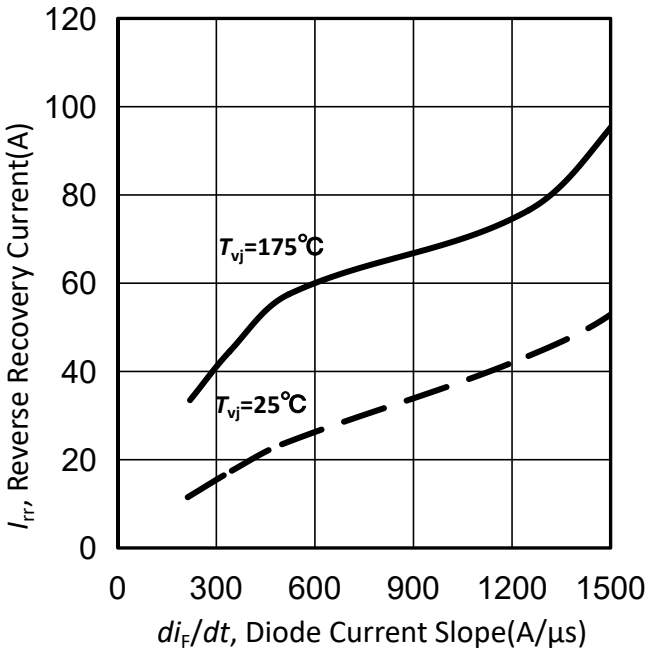


Figure 72. Typical reverse recovery current as a function of diode current slope
(V_R=600V， I_F=75A)

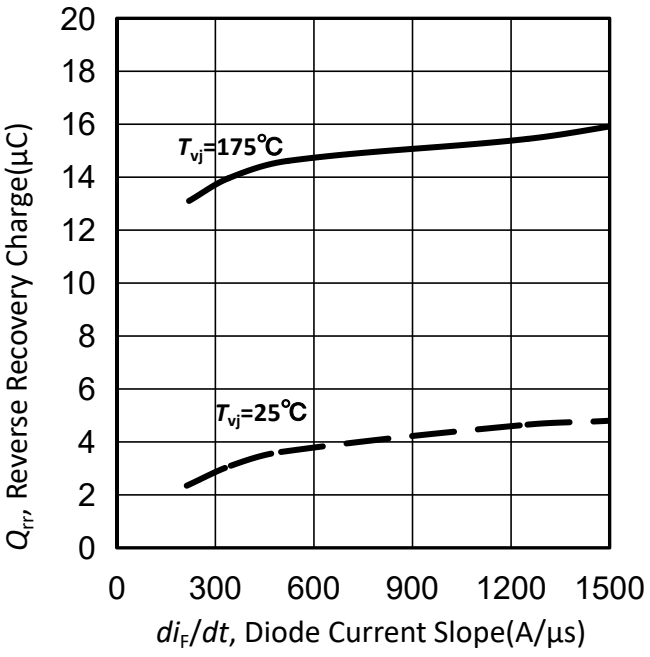


Figure 73. Typical reverse recovery charge as a function of diode current slope
(V_R=600V， I_F=75A)

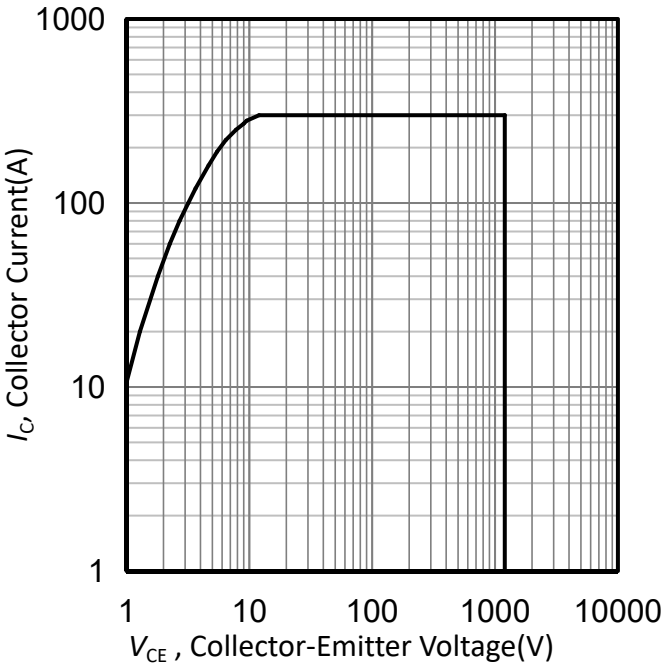


Figure 74. IGBT reverse bias safe operating area
(T_{vj}≤175℃,V_{GE}=15V)

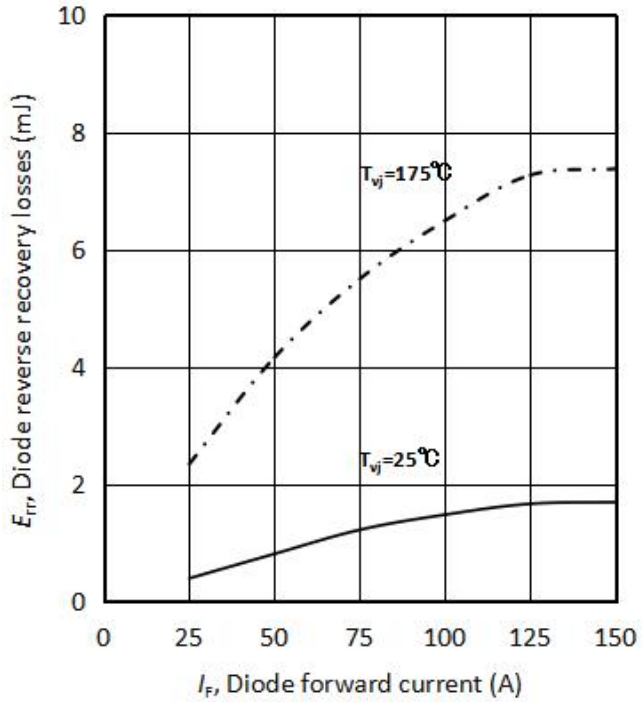


Figure 75. Switching Energy vs Forward Current Diode

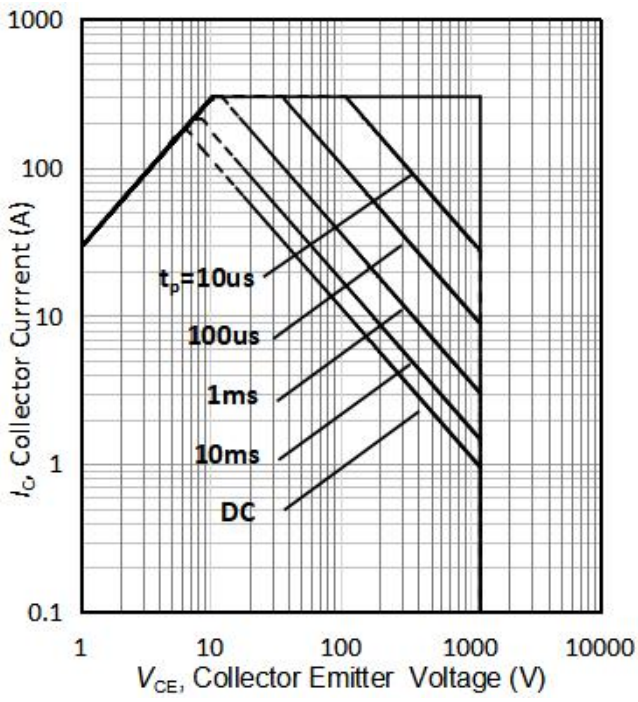


Figure 76. IGBT Forward bias safe operating area
(D=0， T_C=25℃， T_{vj}≤175℃,V_{GE}=15V)

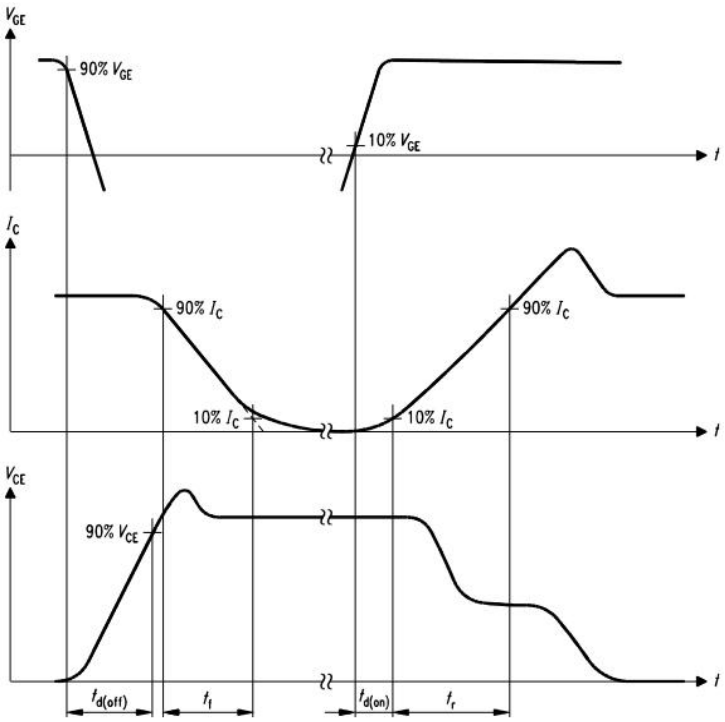


Figure A. Definition of switching times

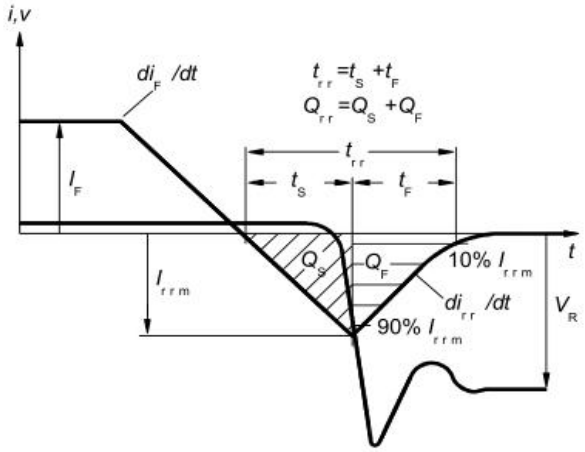


Figure C. Definition of diodes switching characteristics

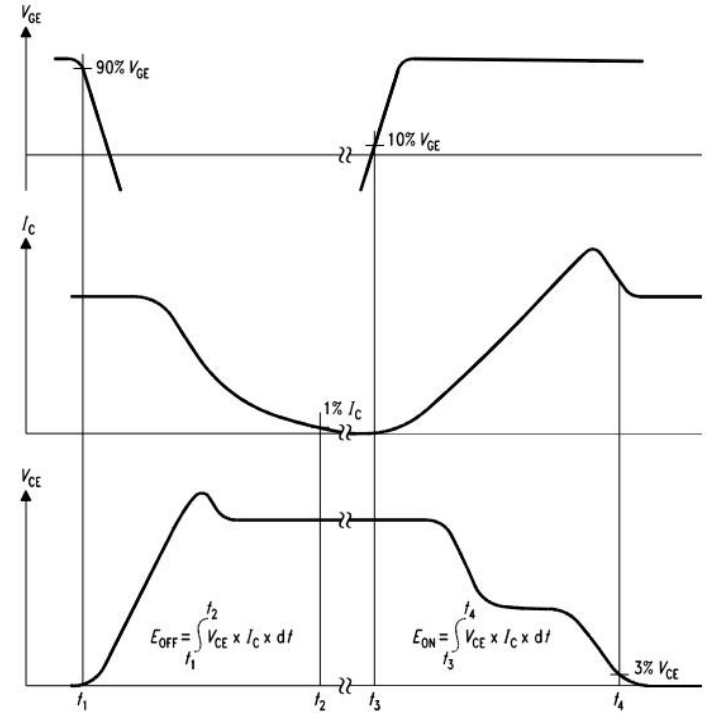


Figure B. Definition of switching losses

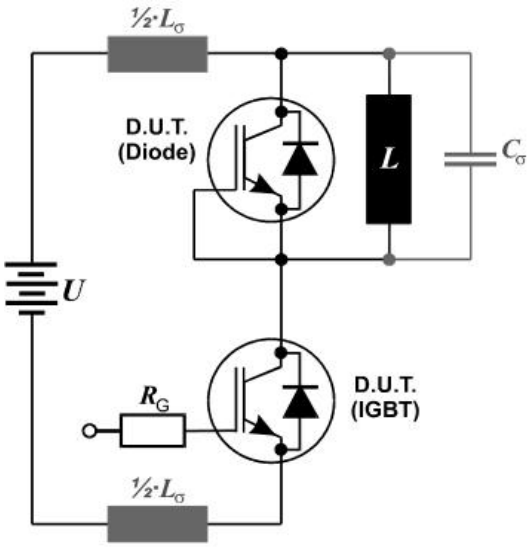
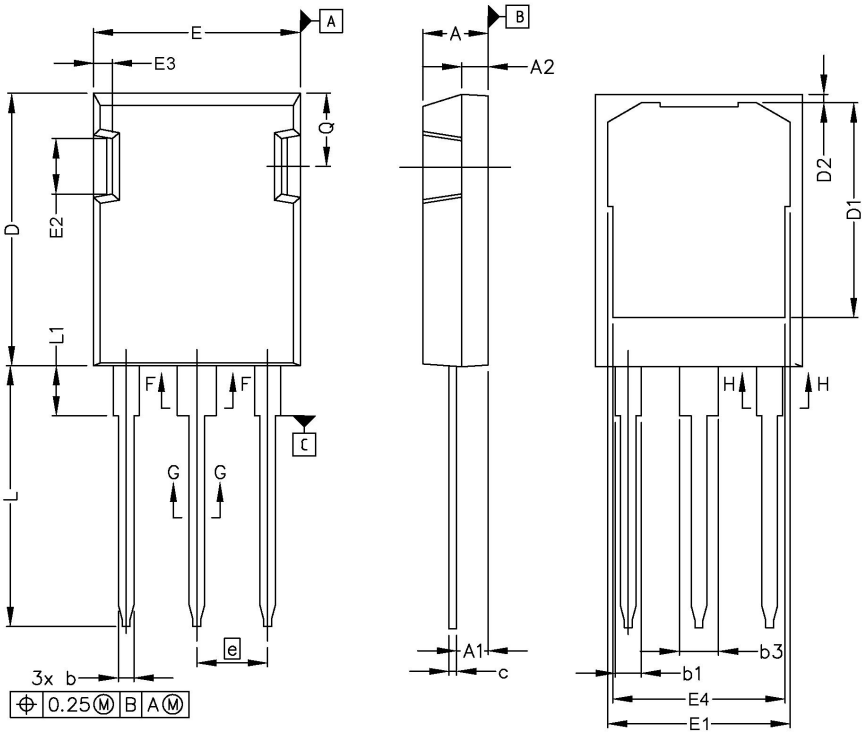


Figure D. Switching test circuit

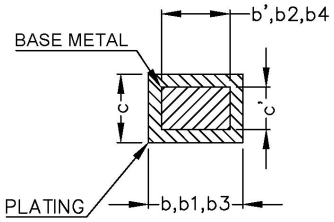
TO-247-3L Plus



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 & TOLERANCEING 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)



SECTION "F-F", "G-G" AND "H-H"
SCALE: NONE

Revision History

Revision	Subjects (major changes since last revision)	Date
1.0	Initial version	2020.8
1.1	Update Thermal Characteristics	2021.3
2.0	Update Electrical Characteristics at T_j=175℃	2021.8
2.1	Update Electrical Characteristics and charts	2021.11
3.0	Update Electrical Characteristics and add charts	2021.11
4.0	Update Electrical Characteristics	2022.10
4.1	Update Electrical Characteristics and charts	2022.12
5.0	Add chart	2023.8
5.1	Add FBSOA chart	2023.9

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