MPBW40N120BF

1200V-40A Trench and Field Stop IGBT

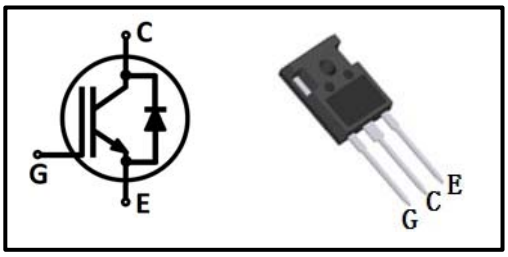
Features

- 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
- PTC heater
- Climate compressor
- Solar inverter

Type	Marking	Package Code
MPBW40N120BF	MP40N120BF	TO-247-3



Maximum Rated Values

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
DC collector current, limited by T_{jmax} T_C=25℃ T_C=100℃	I_C	 80 40	A
Pulsed collector current, t_p limited by T_{jmax} [1)]	I_{Cpuls}	160	
Diode forward current, limited by T_{jmax} T_C=25℃ T_C=100℃	I_F	 80 40	
Diode pulsed current, t_p limited by T_{jmax} [1)]	I_{Fpuls}	160	
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_j≤175℃ Allowed number of short circuits < 1000 Time between short circuits: ≥ 1.0s	t_{SC}	10	μs
Power dissipation T_C=25℃	P_{tot}	428	W
Power dissipation T_C=100℃		214	
Operating junction temperature	T_j	-40~175	℃
Storage temperature	T_{stg}	-55~150	
Soldering temperature, wave soldering 1.6mm (0.063in.) from case for 10s		260	
Mounting torque, M3 screw Maximum of mounting processes: 3	M	0.6	Nm

[1)] Defined by design. Not subject to production test.

Thermal Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
IGBT thermal resistance, junction-case	R_{thJC}	-	-	0.35	K/W
Diode thermal resistance, junction-case	R_{thJCD}	-	-	0.60	
Thermal Resistance, junction-ambient	R_{thJA}	-	-	40	

Electrical Characteristics（at T_j=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=40A T_j=25℃	-	1.85	2.2	
		T_j=150℃	-	2.35	-	
		T_j=175℃	-	2.45	-	
G-E threshold voltage	$V_{GE(th)}$	I_C=1.5mA, V_{CE}=V_{GE}	5.0	5.8	6.5	
C-E leakage current	I_{CES}	V_{CE}=1200V, V_{GE}=0V T_j=25℃	-	-	0.1	mA
		T_j=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=40A	-	20	-	S

Dynamic Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input capacitance	C_{ies}	V_{CE}=25V, V_{GE}=0V, f=1MHz	-	3149	-	pF
Output capacitance	C_{oes}		-	183	-	
Reverse transfer capacitance	C_{res}		-	103	-	
Gate charge	Q_G	V_{CC}=600V, I_C=40A, V_{GE}=15V	-	240	-	nC
Short circuit collector current	$I_{C(SC)}$	V_{GE}=15V, V_{CC}≤600V, t_{SC}≤10μs, T_j=175℃	-	160	-	A

IGBT Switching Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Turn-on delay time	$t_{d(on)}$	T_j=25℃, V_{CC}=600V, I_C=40A, V_{GE}=-15/15V, R_G=10Ω, Inductive load	-	186	-	ns
Rise time	t_r		-	38	-	
Turn-off delay time	$t_{d(off)}$		-	234	-	
Fall time	t_f		-	159	-	
Turn-on energy	E_{on}		-	1.6	-	mJ
Turn-off energy	E_{off}		-	3.0	-	
Total switching energy	E_{ts}		-	4.6	-	
Turn-on delay time	$t_{d(on)}$	T_j=175℃, V_{CC}=600V, I_C=40A, V_{GE}=-15/15V, R_G=10Ω, Inductive load	-	187	-	ns
Rise time	t_r		-	39	-	
Turn-off delay time	$t_{d(off)}$		-	318	-	
Fall time	t_f		-	290	-	
Turn-on energy	E_{on}		-	3.4	-	mJ
Turn-off energy	E_{off}		-	4.8	-	
Total switching energy	E_{ts}		-	8.2	-	

Diode Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Diode forward voltage	V_F	V_{GE}=0V, I_F=40A T_j=25℃	-	2.2	-	V
		T_j=150℃	-	1.8	-	
		T_j=175℃	-	1.6	-	
Diode reverse recovery time	t_{rr}	T_j=25℃, V_R=600V, I_F=40A, di_F/dt=500A/μs	-	255	-	ns
Diode reverse recovery charge	Q_{rr}		-	2.0	-	μC
Diode peak reverse recovery current	I_{rrm}		-	18	-	A
Diode reverse recovery time	t_{rr}	T_j=175℃, V_R=600V, I_F=40A, di_F/dt=500A/μs	-	526	-	ns
Diode reverse recovery charge	Q_{rr}		-	9.0	-	μC
Diode peak reverse recovery current	I_{rrm}		-	37	-	A

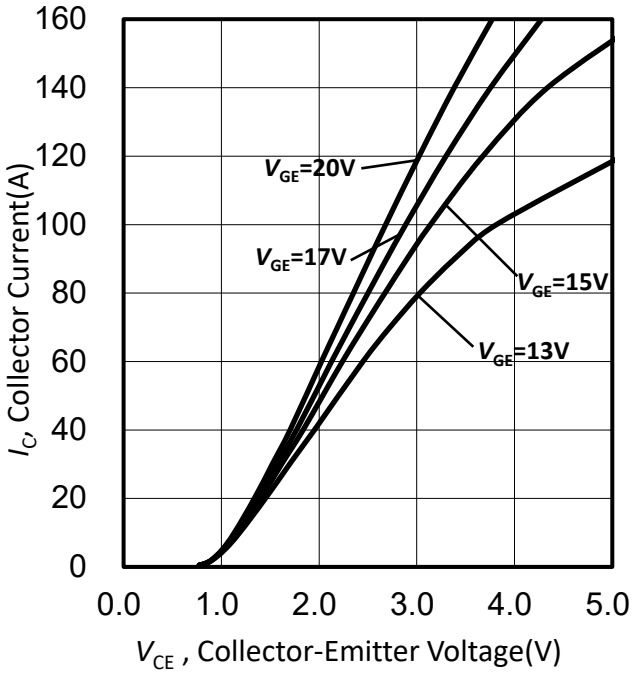


Figure 1. Typical output characteristic
(T_j=25℃)

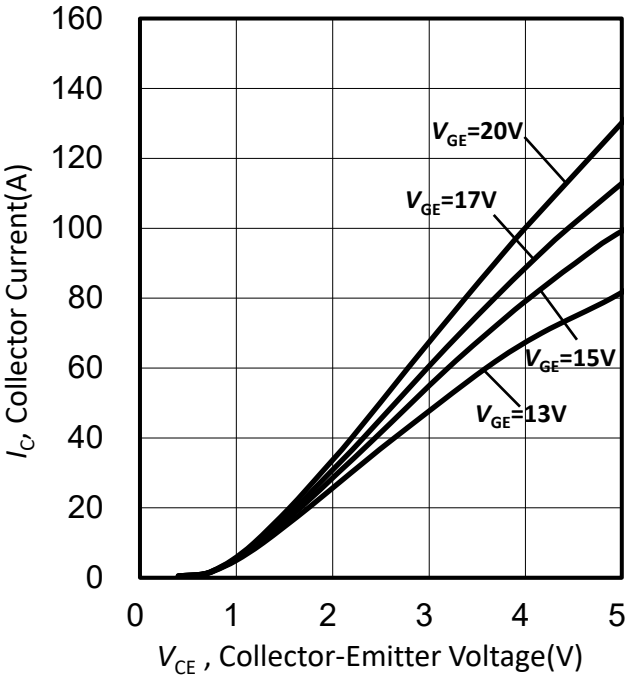


Figure 2. Typical output characteristic
(T_j=175℃)

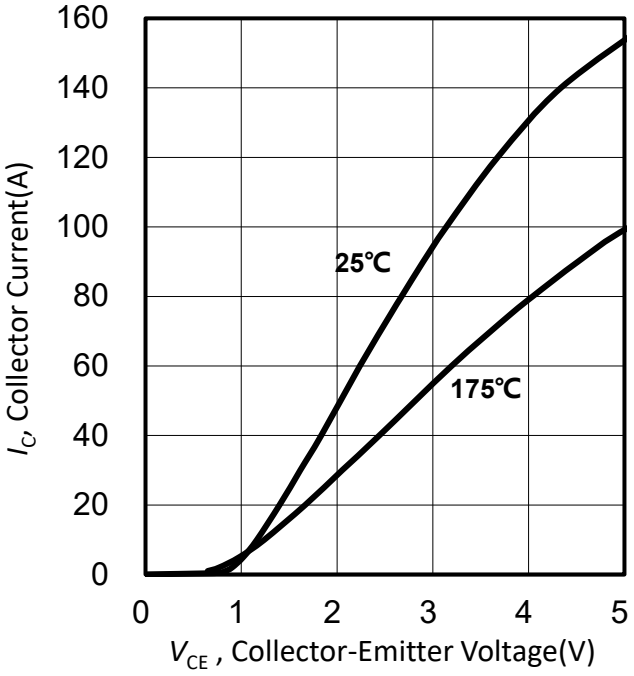


Figure 3. Typical $V_{CE(sat)}$-I_c characteristic
(V_{GE}=15V)

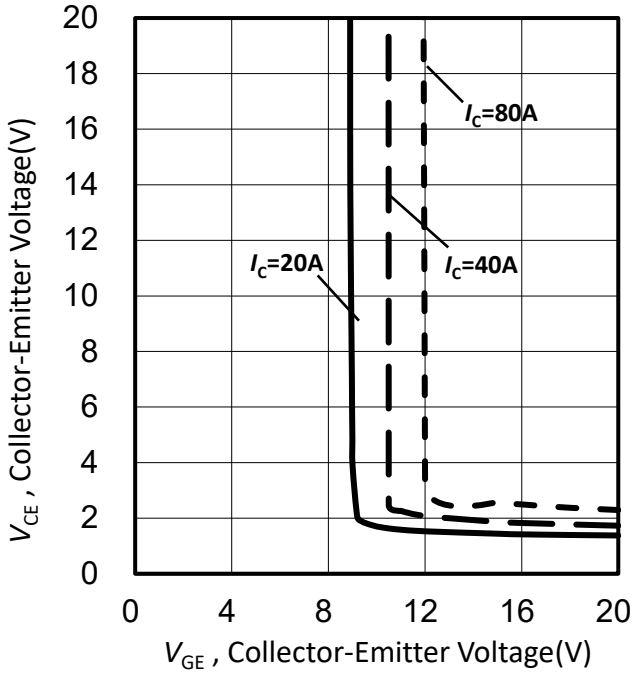


Figure 4. Typical $V_{CE(sat)}$-$V_{GE(th)}$ characteristic
(T_{vj}=25℃)

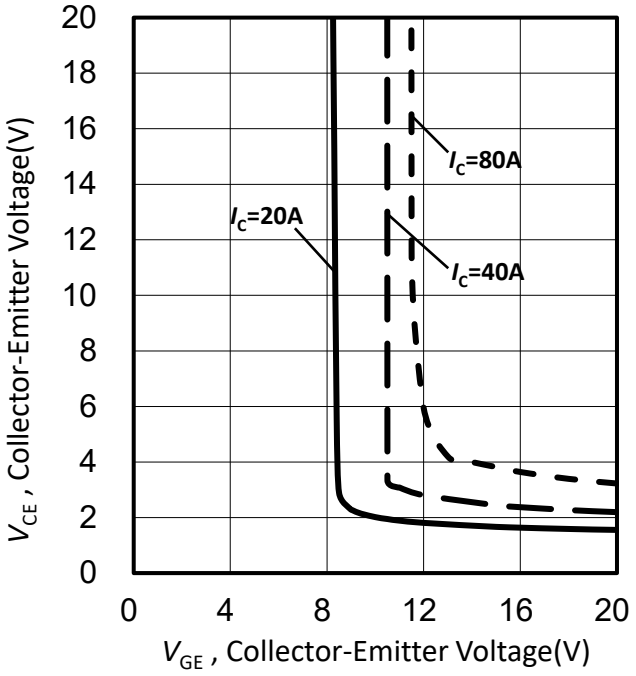


Figure 5. Typical $V_{CE(sat)}$-$V_{GE(th)}$ characteristic
(T_{vj}=175℃)

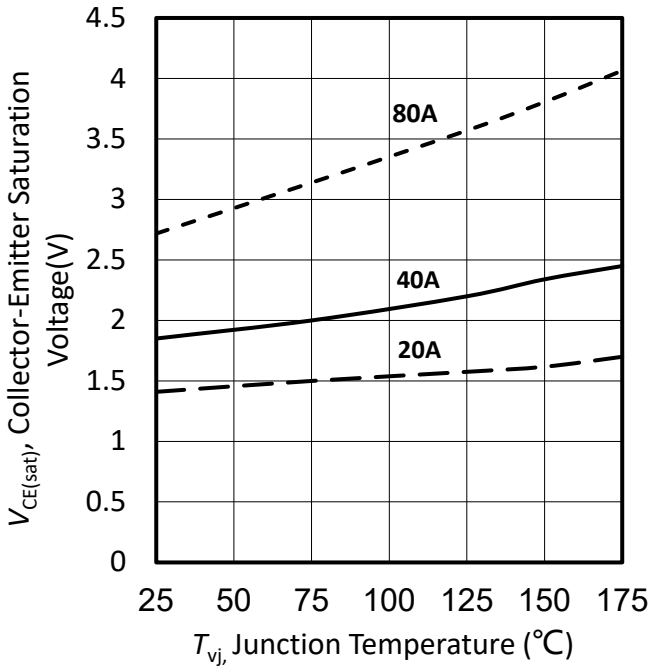


Figure 6. Typical $V_{CE(sat)}$-T_j characteristic
(V_{GE}=15V)

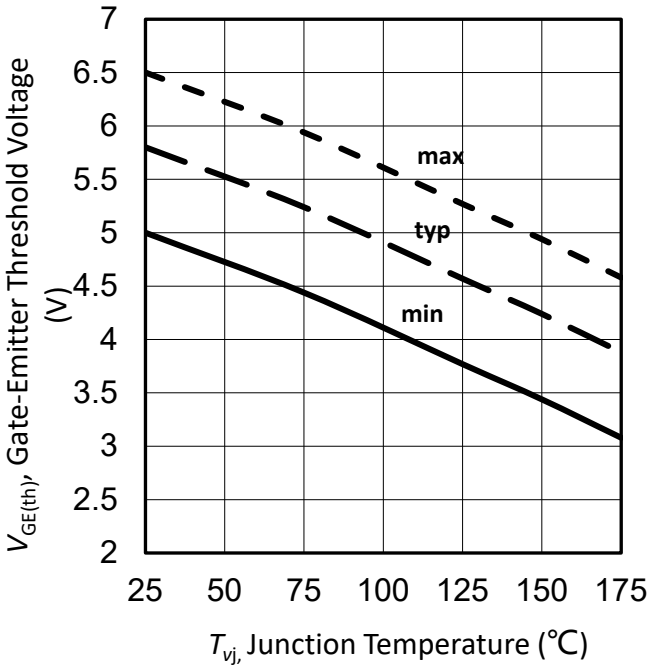


Figure 7. $V_{GE(th)}$-T_j characteristic
(I_c=1.5mA)

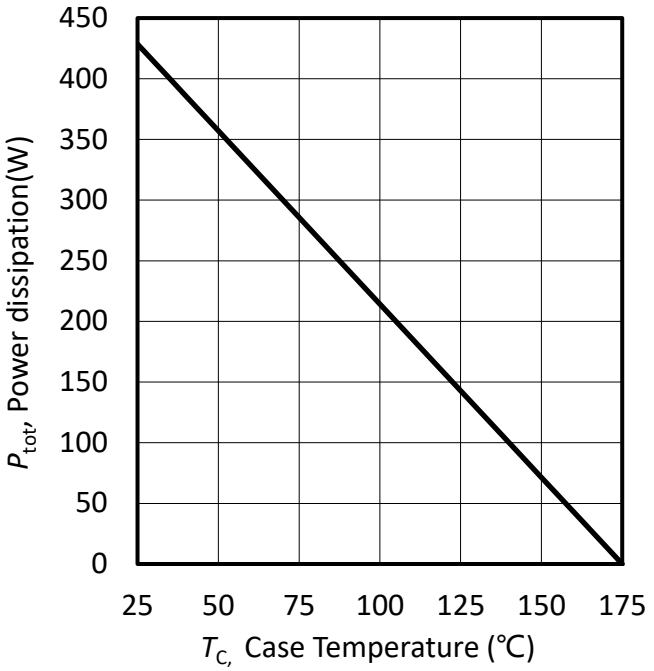


Figure 8. Power dissipation as a function of case temperature
(T_j≤175℃)

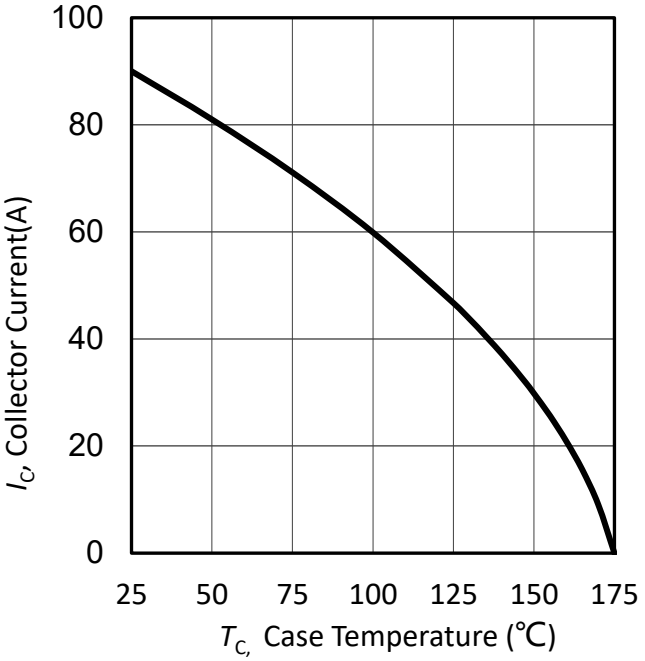


Figure 9. Collector current as a function of case temperature
(T_{vj}≤175℃ ,V_{GE}≥15V)

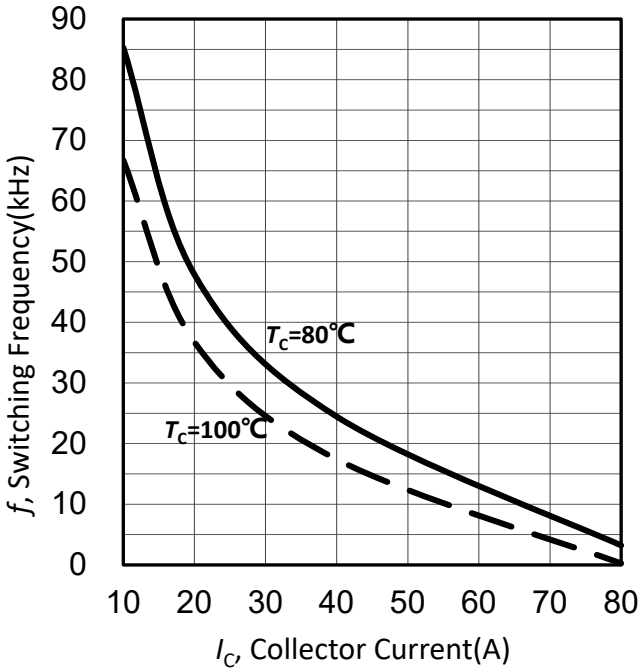


Figure 10. Maximum possible switching frequency as a function of collector current
(T_{vj}≤175℃ ,V_{GE}=-15V/15V, R_G=10Ω, D=0.5)

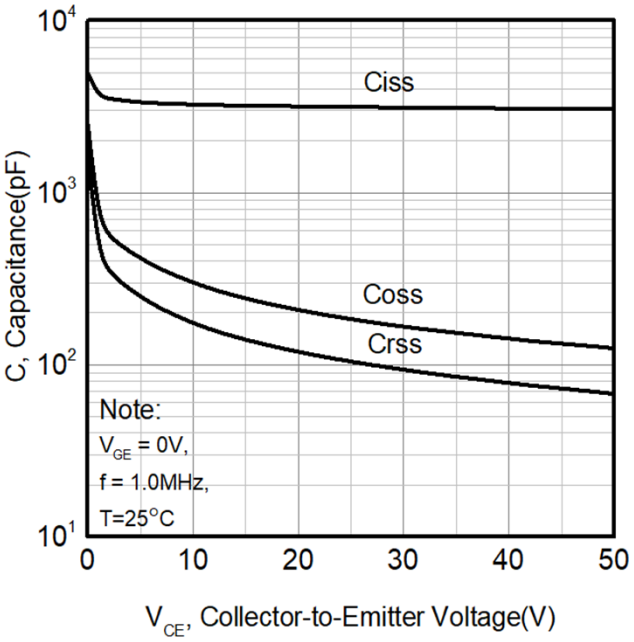


Figure 11. Typical capacitance as a function of collector-emitter voltage

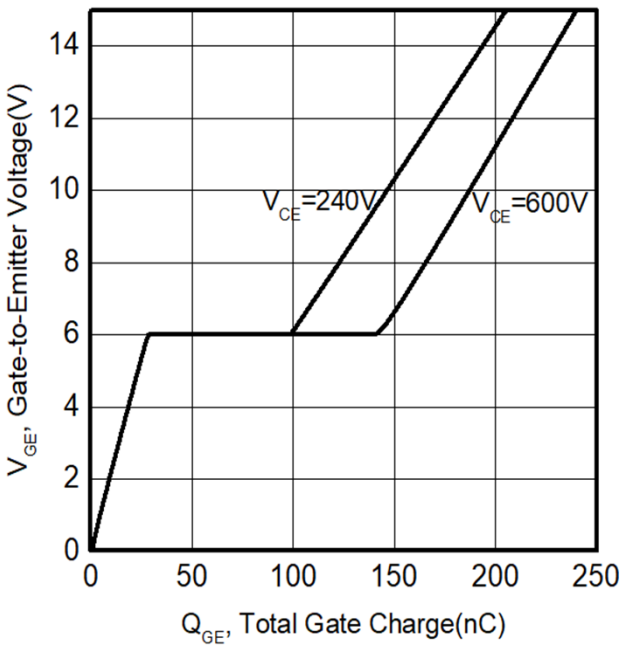


Figure 12. Typical gate charge

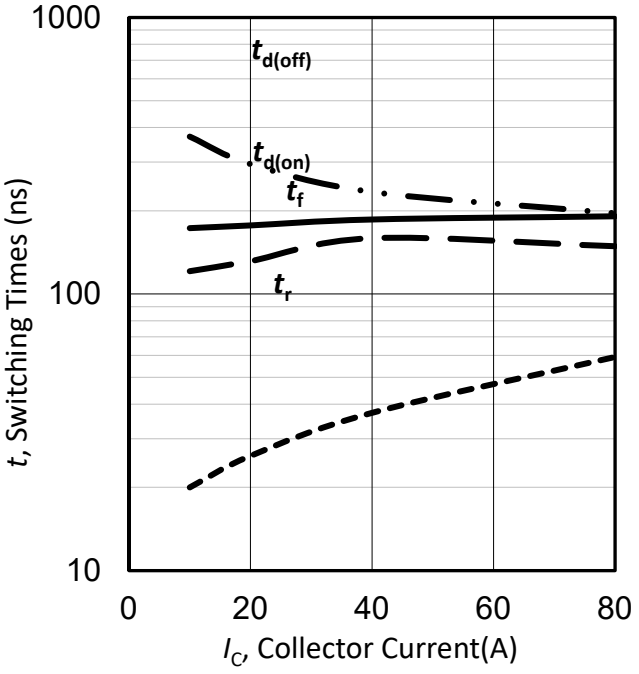


Figure 13. Typical switching times as a function of collector current
(inductive load, T_{vj}=25℃, V_{CE}=600V, V_{GE}=-15/15V, R_G=10Ω)

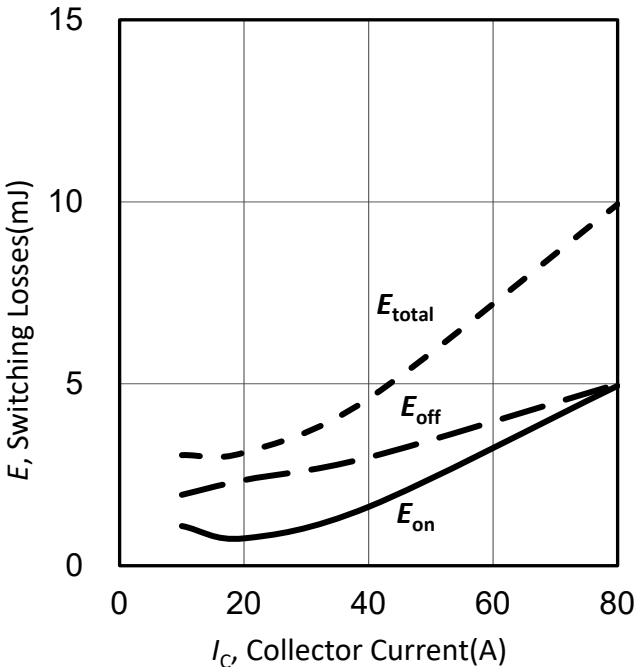


Figure 14. Typical switching times as a function of collector current
(inductive load, T_{vj}=25℃, V_{CE}=600V, V_{GE}=-15/15V, R_G=10Ω)

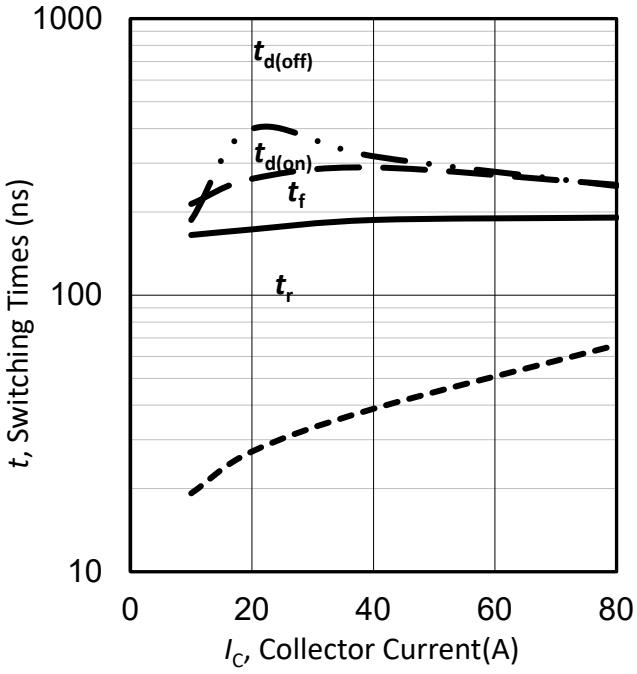


Figure 15. Typical switching times as a function of collector current
(inductive load, T_{vj}=175℃, V_{CE}=600V, V_{GE}=-15/15V, R_G=10Ω)

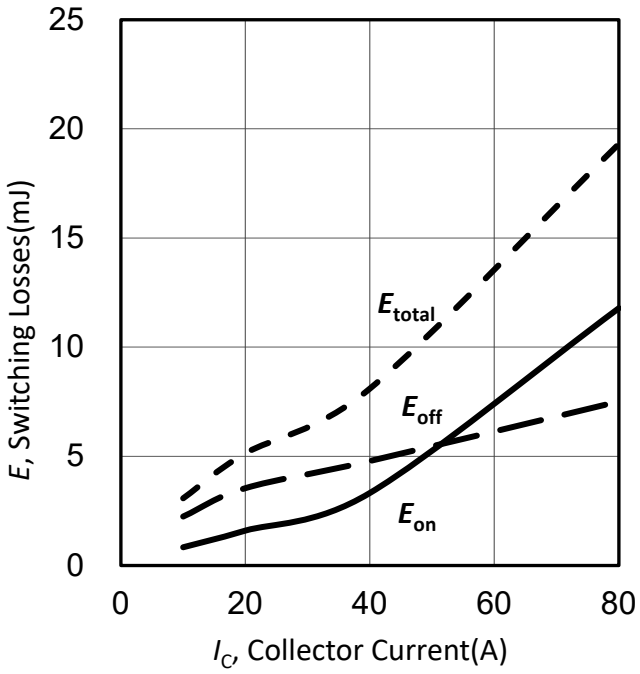


Figure 16. Typical switching times as a function of collector current
(inductive load, T_{vj}=175℃, V_{CE}=600V, V_{GE}=-15/15V, R_G=10Ω)

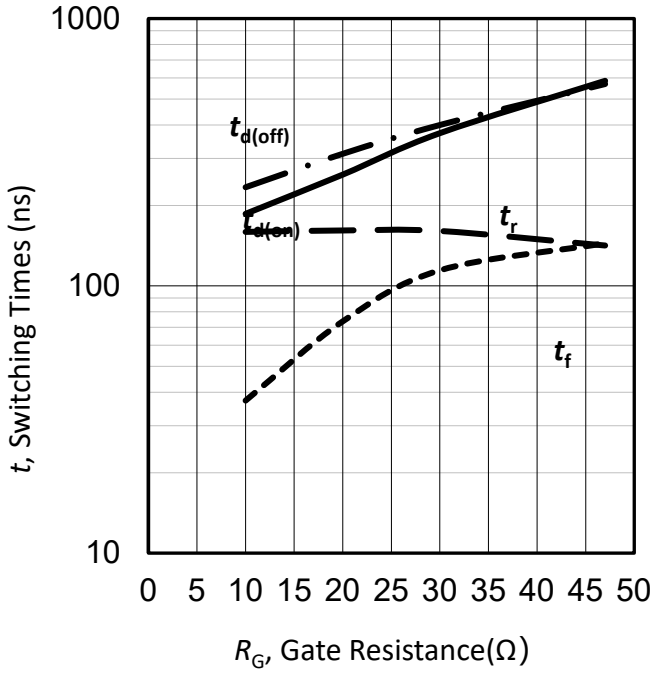


Figure 17. Typical switching times as a function of gate resistor
(inductive load, T_{vj}=25℃, V_{CE}=600V, V_{GE}=-15/15V, I_C=40A)

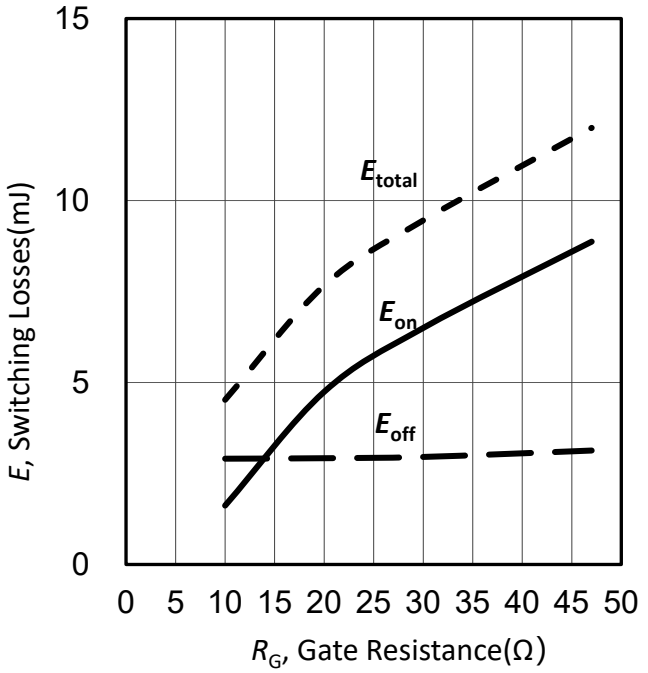


Figure 18. Typical switching energy losses as a function of gate resistor
(inductive load, T_{vj}=25℃, V_{CE}=600V, V_{GE}=-15/15V, I_C=40A)

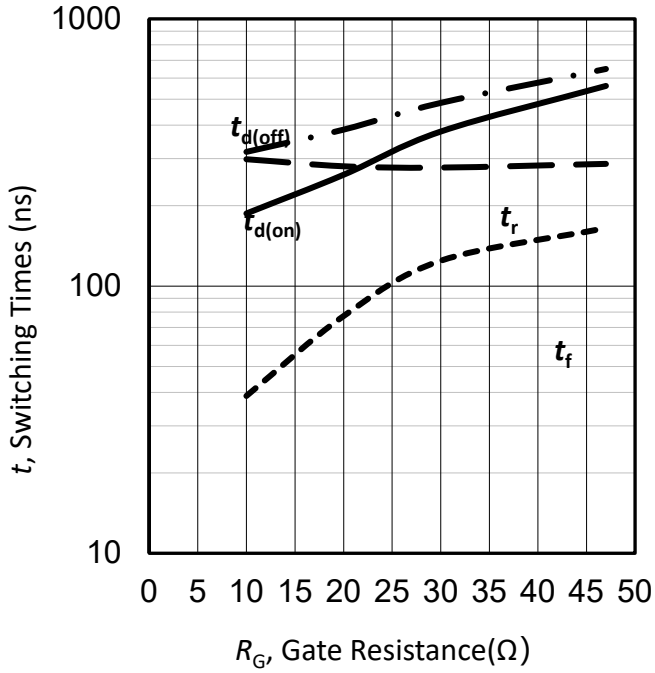


Figure 19. Typical switching times as a function of gate resistor
(inductive load, T_{vj}=175℃, V_{CE}=600V, V_{GE}=-15/15V, I_C=40A)

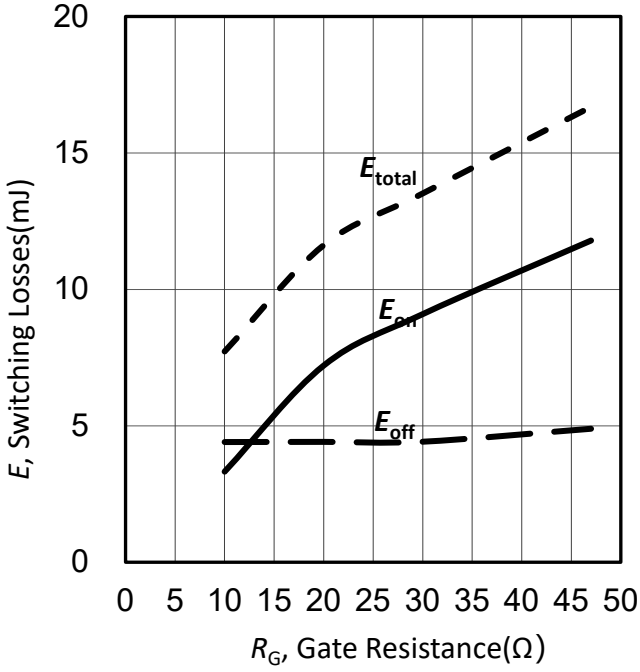


Figure 20. Typical switching energy losses as a function of gate resistor
(inductive load, T_{vj}=175℃, V_{CE}=600V, V_{GE}=-15/15V, I_C=40A)

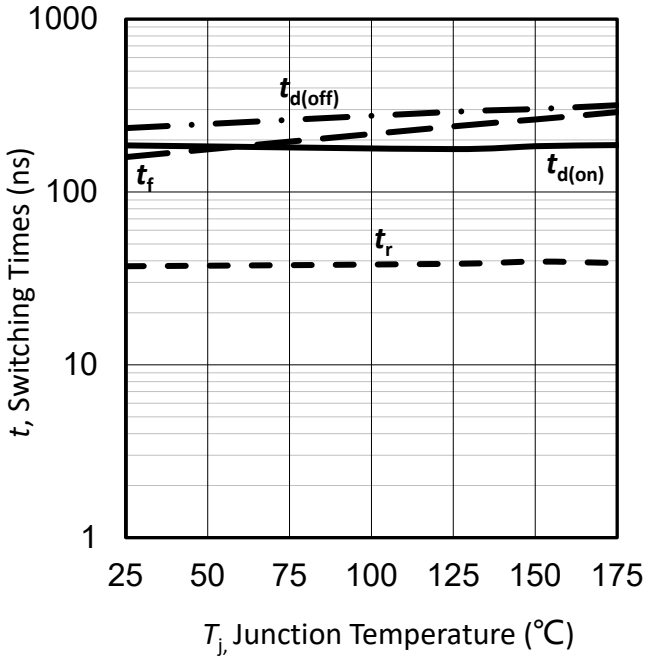


Figure 21. Typical switching times as a function of junction temperature
(inductive load, V_{CE}=600V, V_{GE}=-15/15V, I_C=40A, , R_G=10Ω)

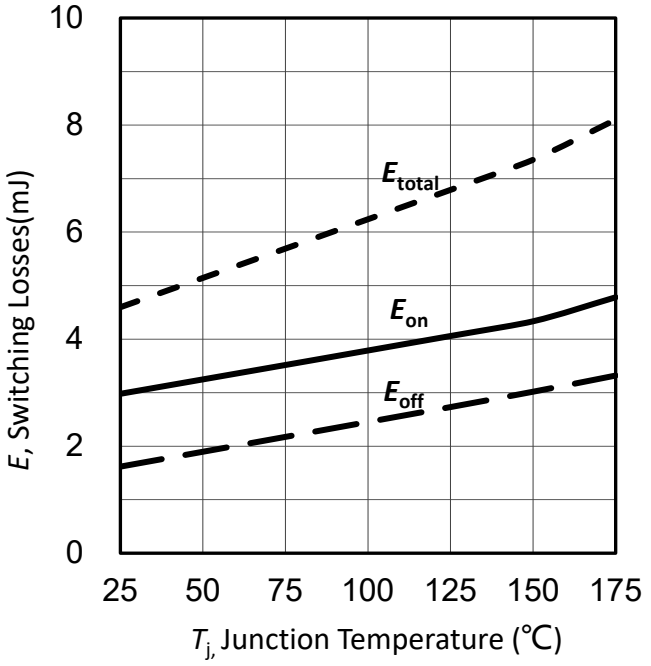


Figure 22. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE}=600V, V_{GE}=-15/15V, I_C=40A, , R_G=10Ω)

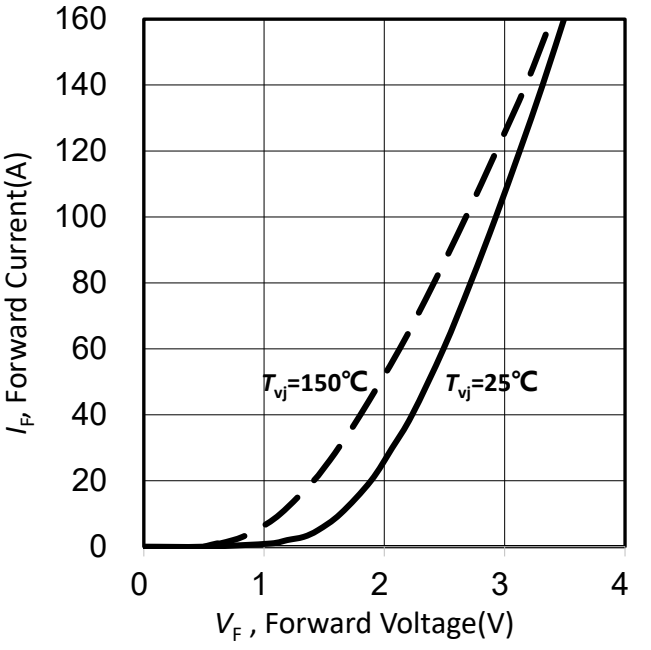


Figure 23. Typical diode forward current as a function of forward voltage

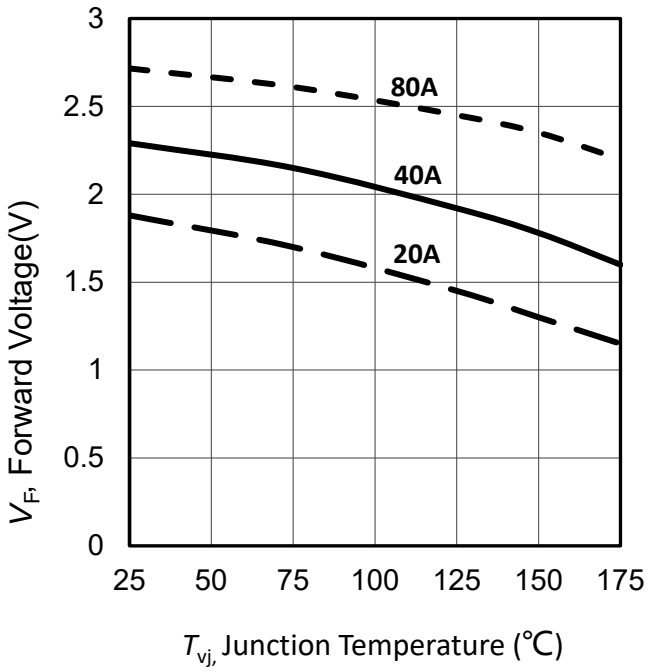


Figure 24. Typical V_F-T_j characteristic

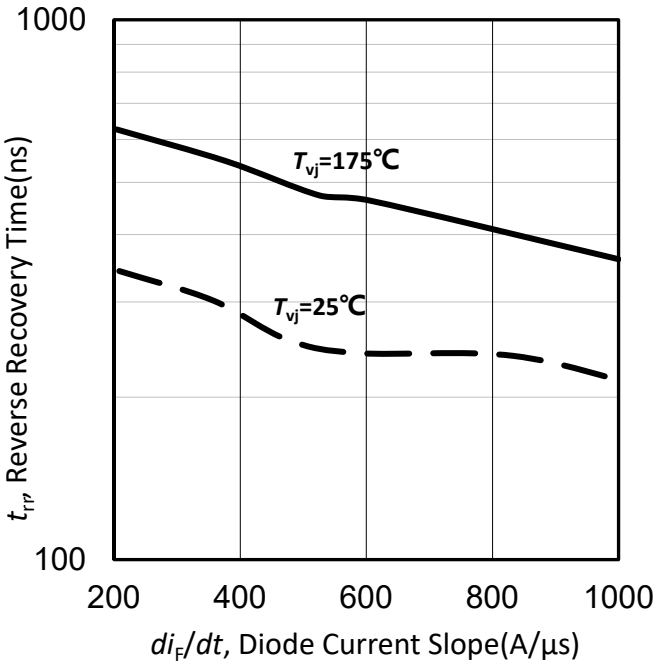


Figure 25. Typical reverse recovery time as a function of diode current slope
(V_R=600V， I_F=40A)

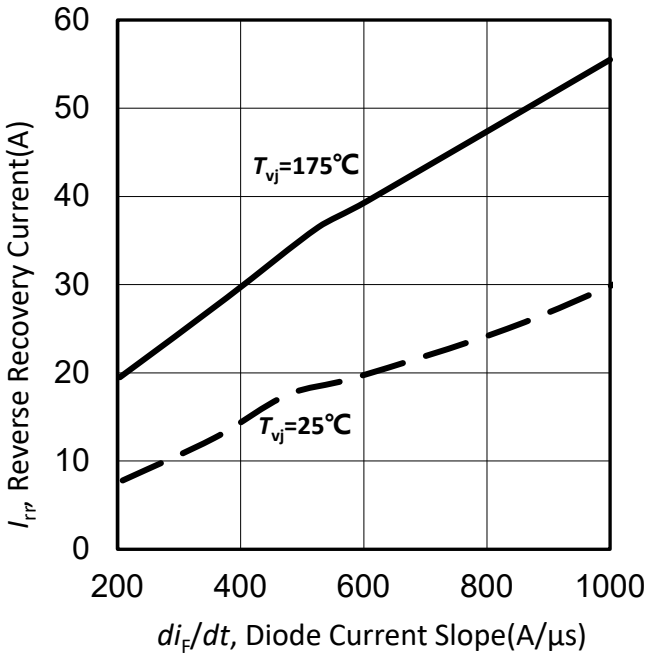


Figure 26. Typical reverse recovery current as a function of diode current slope
(V_R=600V， I_F=40A)

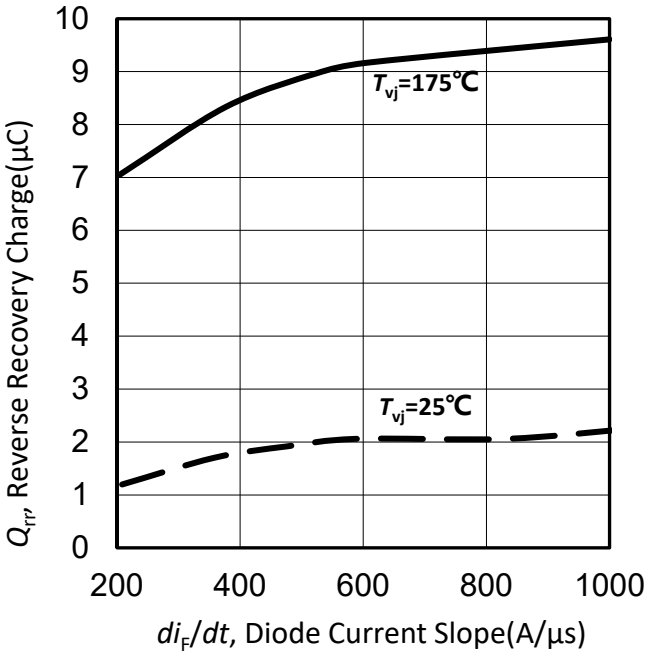


Figure 27. Typical reverse recovery charge as a function of diode current slope
(V_R=600V， I_F=40A)

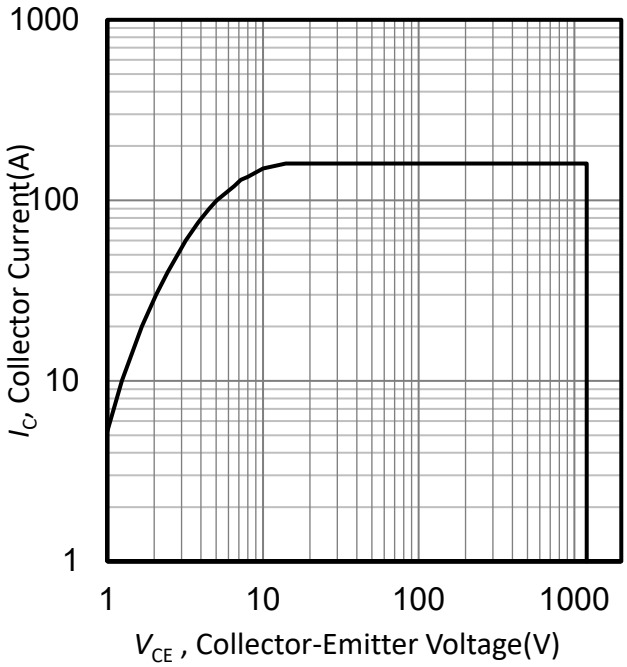


Figure 28. IGBT reverse bias safe operating area
(T_{vj}≤175℃,V_{GE}=15V)

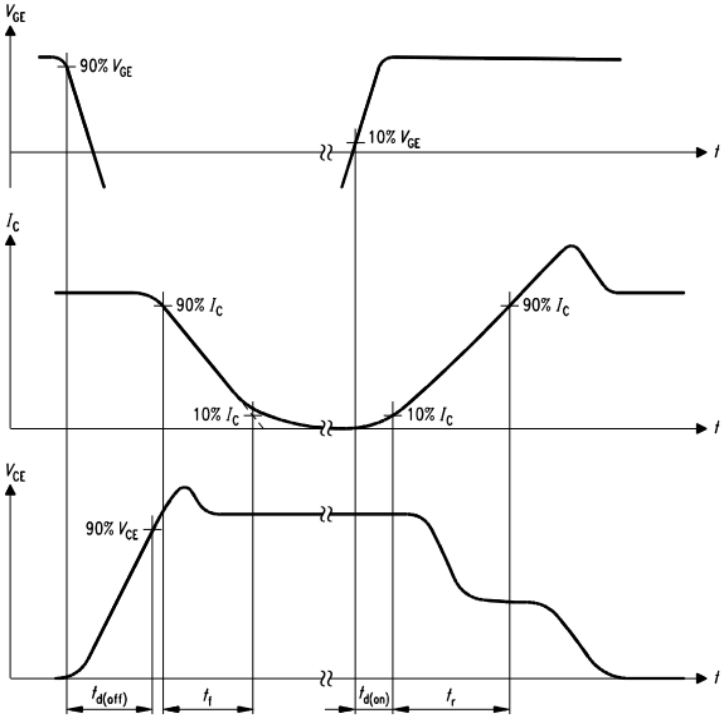


Figure A. Definition of switching times

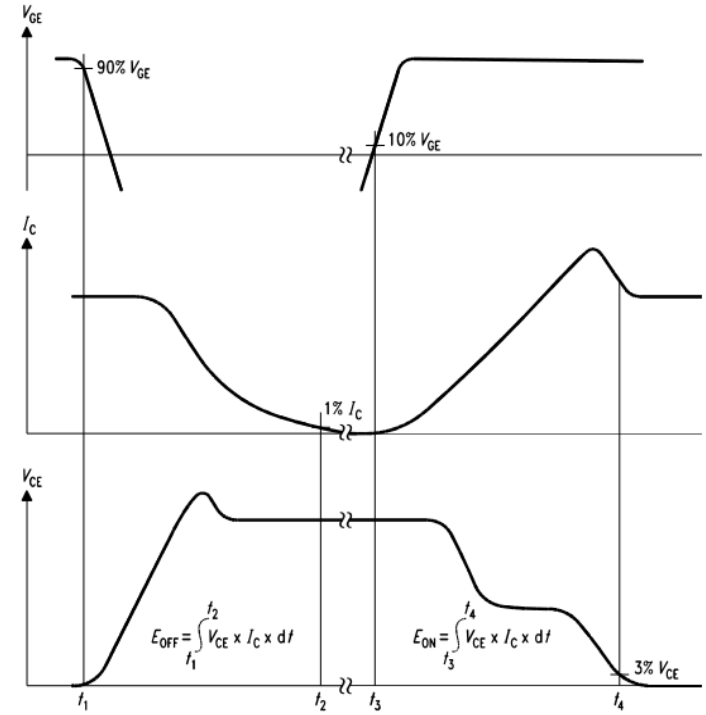


Figure B. Definition of switching losses

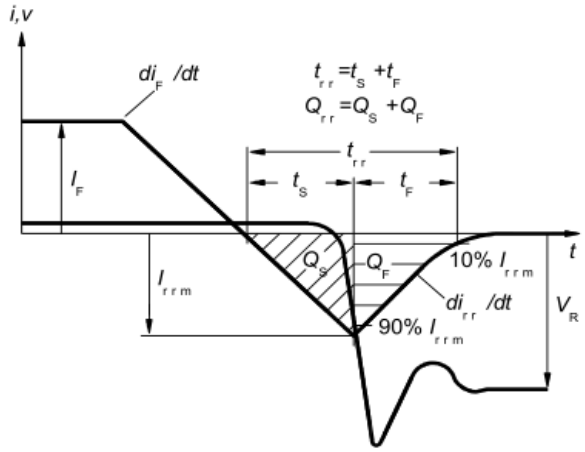


Figure C. Definition of diodes switching characteristics

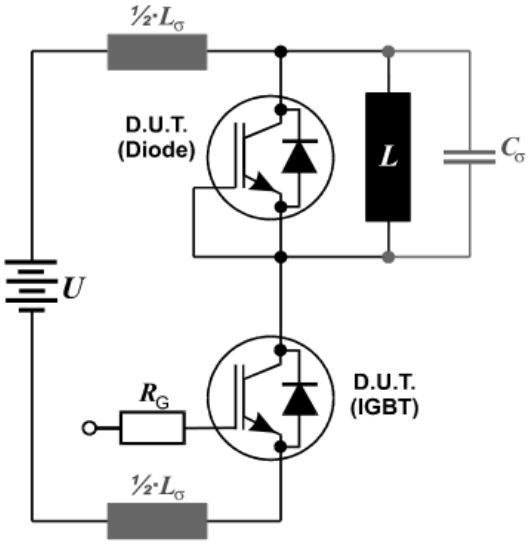
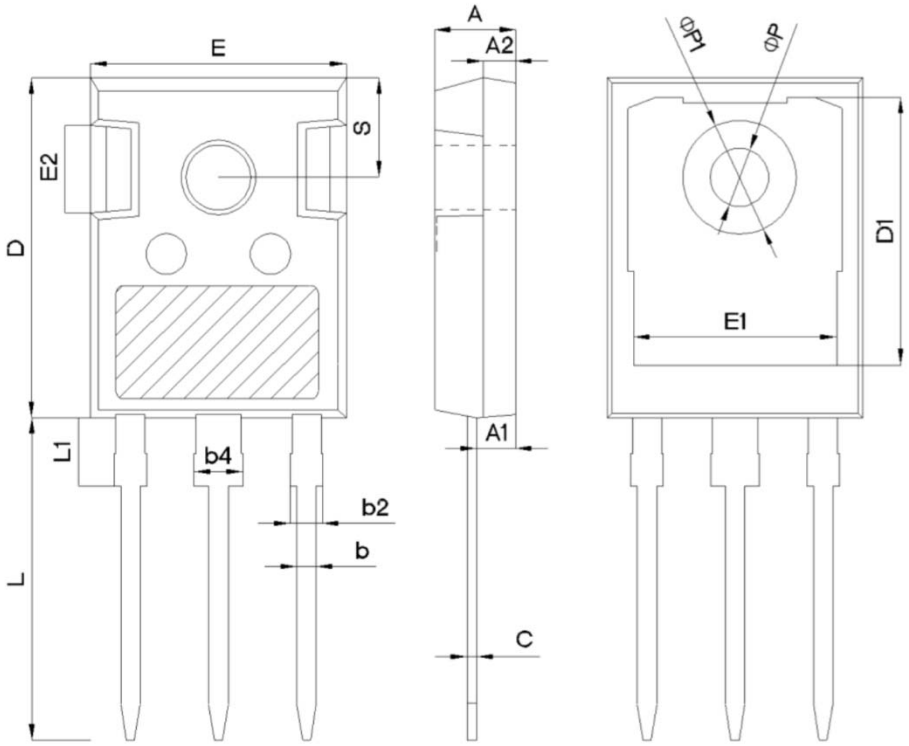


Figure D. Switching test circuit

TO-247-3



SYMBOL	mm		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.61
A2	1.85	2.00	2.15
b	1.11	1.21	1.36
b2	1.91	2.01	2.21
b4	2.91	3.01	3.21
c	0.51	0.61	0.75
D	20.70	21.00	21.30
D1	16.25	16.55	16.85
E	15.50	15.80	16.10
E1	13.00	13.30	13.60
E2	4.80	5.00	5.20
E3	2.30	2.50	2.70
e	5.44BSC		
L	19.62	19.92	20.22
L1	-	-	4.30
ΦP	3.40	3.60	3.80
ΦP1	-	-	7.30
S	6.15BSC		

Revision History

Revision	Subjects (major changes since last revision)	Date
1.0	Initial version	2019.8
2.0	Add chart	2020.6
2.1	Add Electrical Characteristics at T_j=175℃	2021.8
2.2	Update chart	2021.8
3.0	Update Electrical Characteristics and chart	2021.11
3.1	Update Recommended application	2021.12

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