

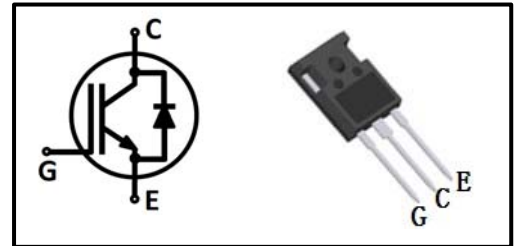
Features

- 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

- Solar Inverter
- Welding Machine
- UPS
- PFC
- PTC heater
- Climate compressor

Type	Marking	Package Code
MPBW40N120EH	MP40N120EH	TO-247-3



Maximum Rated Values

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
DC collector current, limited by T_{vjmax} $T_C=25^\circ\text{C}$ $T_C=130^\circ\text{C}$	I_C	80 40	A
Pulsed collector current, t_p limited by $T_{vjmax}^{1)}$	I_{Cpuls}	160	
Diode forward current, limited by T_{vjmax} $T_C=25^\circ\text{C}$ $T_C=100^\circ\text{C}$	I_F	80 40	
Diode pulsed current, t_p limited by $T_{vjmax}^{1)}$	I_{Fpuls}	160	
Gate-emitter voltage	V_{GE}	± 20	V
Transient Gate-emitter voltage ($t_p \leq 10\mu\text{s}, D < 0.01$)		± 30	
Power dissipation $T_C=25^\circ\text{C}$	P_{tot}	428	W
Power dissipation $T_C=100^\circ\text{C}$		214	
Operating junction temperature	T_{vj}	-40~175	°C
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}	-	0.28	0.35	K/W
Diode thermal resistance, junction-case	R_{thJCD}	-	-	0.80	
Thermal Resistance, junction-ambient	R_{thJA}	-	-	40	

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

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE}=0\text{V}, I_C=0.25\text{mA}$	1200	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_{GE}=15\text{V}, I_C=40\text{A}$ $T_{vj}=25^{\circ}\text{C}$	-	1.9	2.2	
		$T_{vj}=150^{\circ}\text{C}$	-	2.3	-	
		$T_{vj}=175^{\circ}\text{C}$	-	2.45	-	
G-E threshold voltage	$V_{GE(th)}$	$I_C=1.5\text{mA}, V_{CE}=V_{GE}$	5.0	5.8	6.5	
C-E leakage current	I_{CES}	$V_{CE}=1200\text{V},$ $V_{GE}=0\text{V}$ $T_{vj}=25^{\circ}\text{C}$	-	-	0.01	mA
		$T_{vj}=175^{\circ}\text{C}$	-	-	4.0	
G-E leakage current	I_{GES}	$V_{CE}=0\text{V}, V_{GE}=20\text{V}$	-	-	250	nA

Dynamic Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input capacitance	C_{iss}	$V_{CE}=25\text{V},$ $V_{GE}=0\text{V},$ $f=1\text{MHz}$	-	5348	-	pF
Output capacitance	C_{oss}		-	130	-	
Reverse transfer capacitance	C_{rss}		-	46	-	
Gate charge	Q_G	$V_{CC}=400\text{V}, I_C=40\text{A},$ $V_{GE}=15\text{V}$	-	251	-	nC

IGBT Switching Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit	
Turn-on delay time	$t_{d(on)}$	$T_{vj}=25^{\circ}C$, $V_{CC}=600V$, $I_C=40A$, $V_{GE}=0/15V$, $R_G=10\Omega$, Inductive load	-	125	-	ns	
Rise time	t_r		-	64	-		
Turn-off delay time	$t_{d(off)}$		-	323	-		
Fall time	t_f		-	70	-		
Turn-on energy	E_{on}		-	1.98	-		mJ
Turn-off energy	E_{off}		-	1.46	-		
Total switching energy	E_{ts}	-	3.44	-			
Turn-on delay time	$t_{d(on)}$	$T_{vj}=175^{\circ}C$, $V_{CC}=600V$, $I_C=40A$, $V_{GE}=0/15V$, $R_G=10\Omega$, Inductive load	-	102	-	ns	
Rise time	t_r		-	63	-		
Turn-off delay time	$t_{d(off)}$		-	392	-		
Fall time	t_f		-	110	-		
Turn-on energy	E_{on}		-	3.35	-	mJ	
Turn-off energy	E_{off}		-	2.21	-		
Total switching energy	E_{ts}	-	5.56	-			

Diode Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Diode forward voltage	V_F	$V_{GE}=0V$, $I_F=40A$ $T_{vj}=25^{\circ}C$	-	2.4	2.8	V
		$T_{vj}=150^{\circ}C$	-	2.1	-	
		$T_{vj}=175^{\circ}C$	-	2.0	-	
Diode reverse recovery time	t_{rr}	$T_{vj}=25^{\circ}C$, $V_R=600V$, $I_F=40A$, $di_F/dt=550A/\mu s$	-	164	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.49	-	μC
Diode peak reverse recovery current	I_{rrm}		-	20.0	-	A
Diode reverse recovery time	t_{rr}	$T_{vj}=175^{\circ}C$, $V_R=600V$, $I_F=40A$, $di_F/dt=550A/\mu s$	-	286	-	ns
Diode reverse recovery charge	Q_{rr}		-	3.52	-	μC
Diode peak reverse recovery current	I_{rrm}		-	28.8	-	A

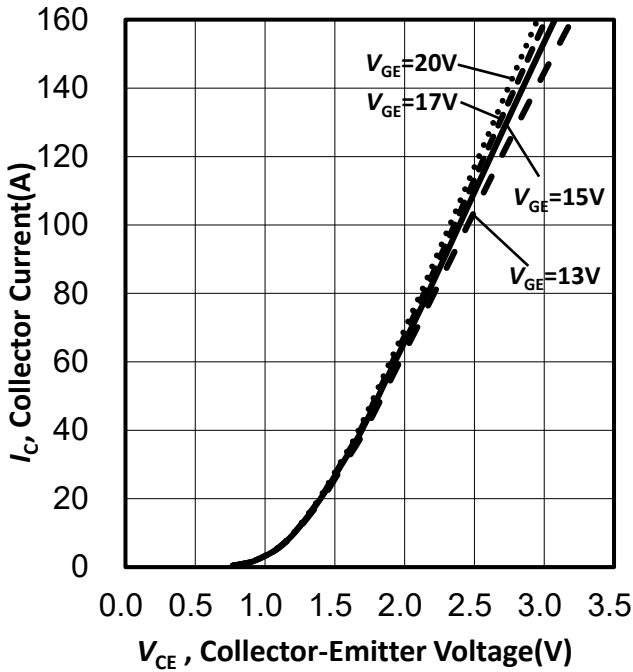


Figure 1. Typical output characteristic ($T_{vj}=25^{\circ}\text{C}$)

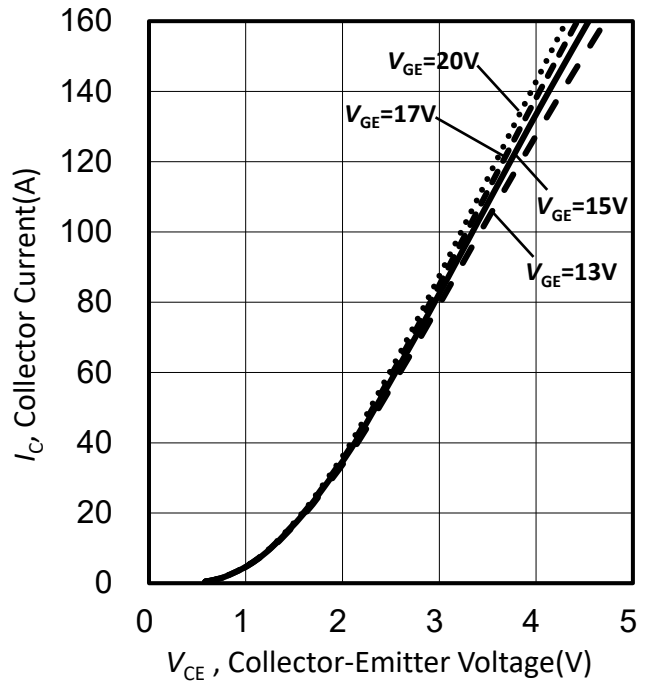


Figure 2. Typical output characteristic ($T_{vj}=125^{\circ}\text{C}$)

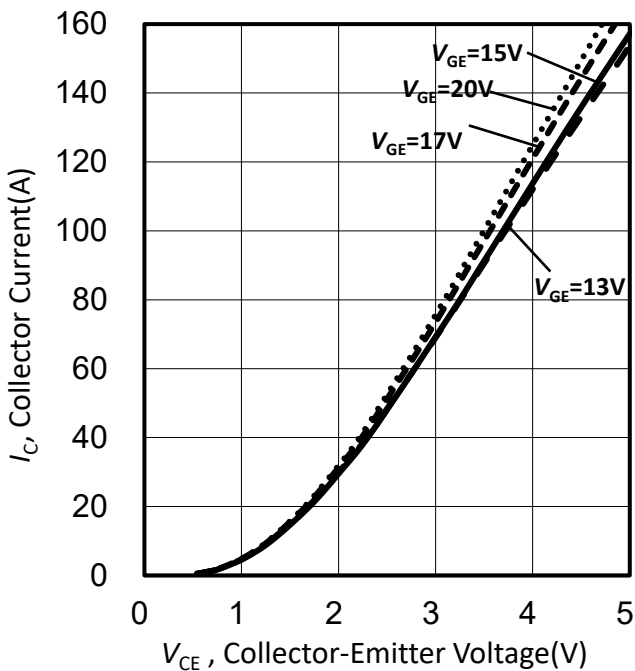


Figure 3. Typical output characteristic ($T_{vj}=150^{\circ}\text{C}$)

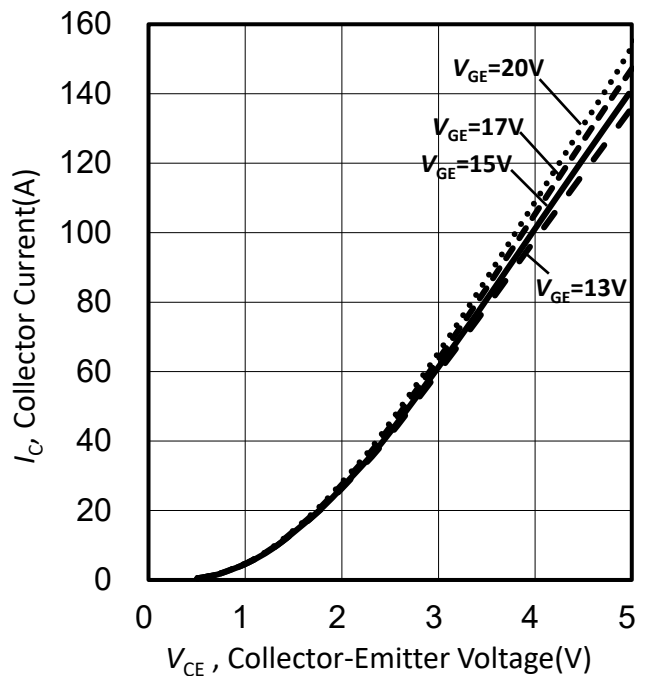


Figure 4. Typical output characteristic ($T_{vj}=175^{\circ}\text{C}$)

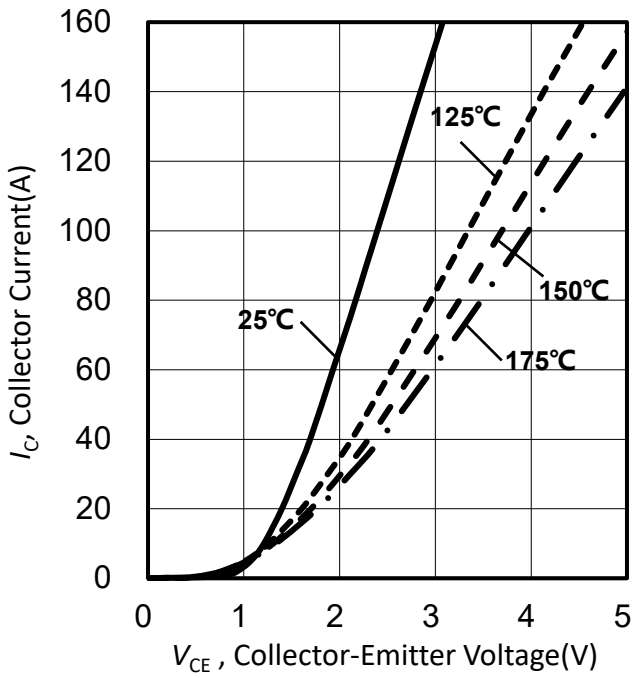


Figure 5. Typical $V_{CE(sat)}$ - I_c characteristic ($V_{GE}=15V$)

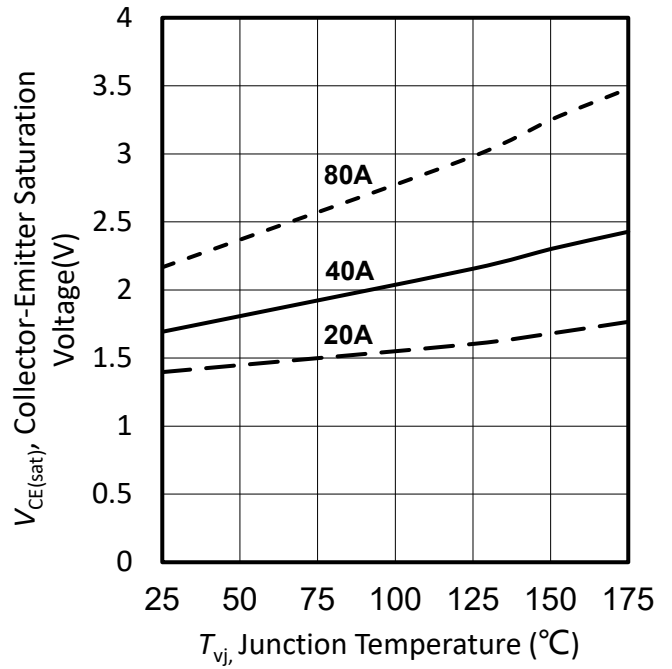


Figure 6. Typical $V_{CE(sat)}$ - T_j characteristic ($V_{GE}=15V$)

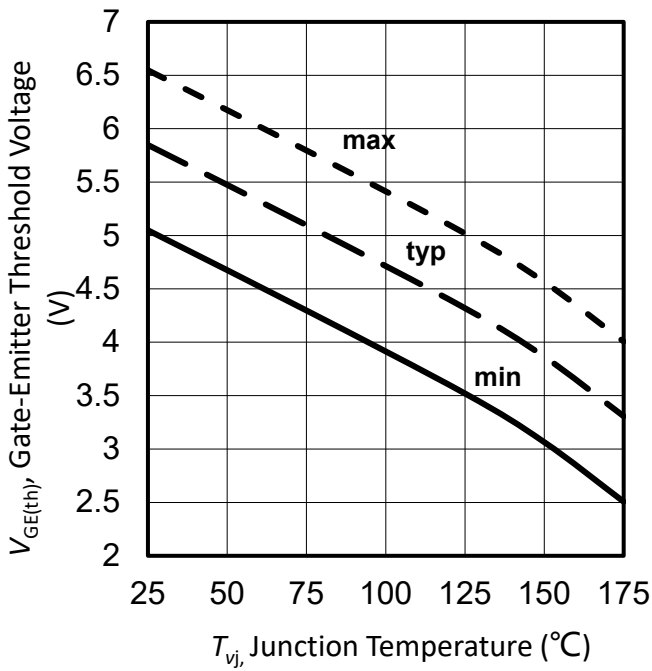


Figure 7. $V_{GE(th)}$ - T_j characteristic ($I_c=1.5mA$)

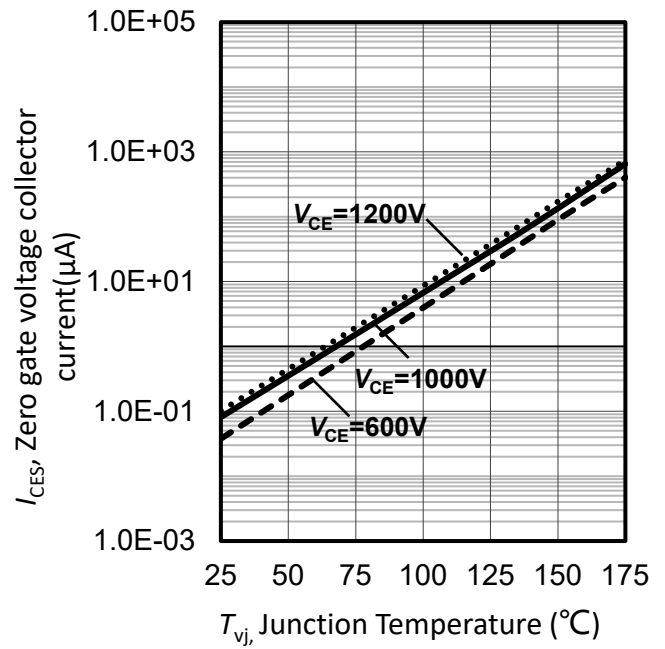


Figure 8. Typical I_{CES} - T_j characteristic ($V_{GE}=0V$)

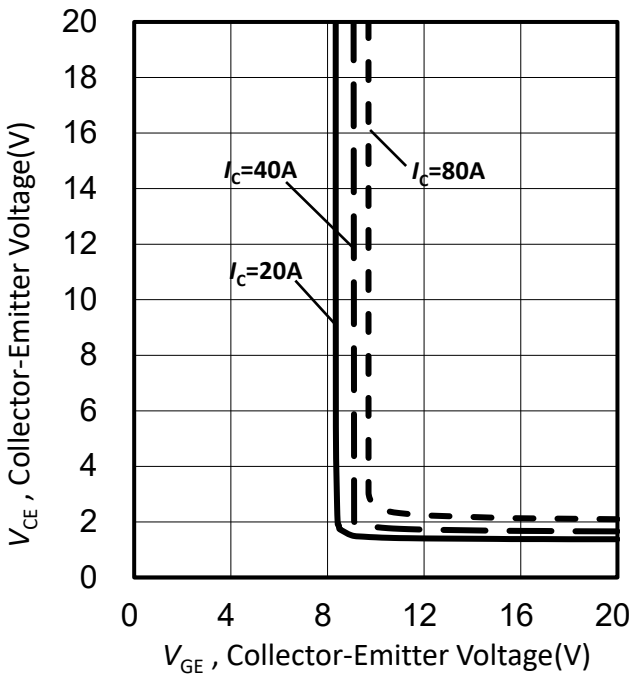


Figure 9. Typical $V_{CE(sat)}-V_{GE(th)}$ characteristic ($T_{vj}=25^{\circ}C$)

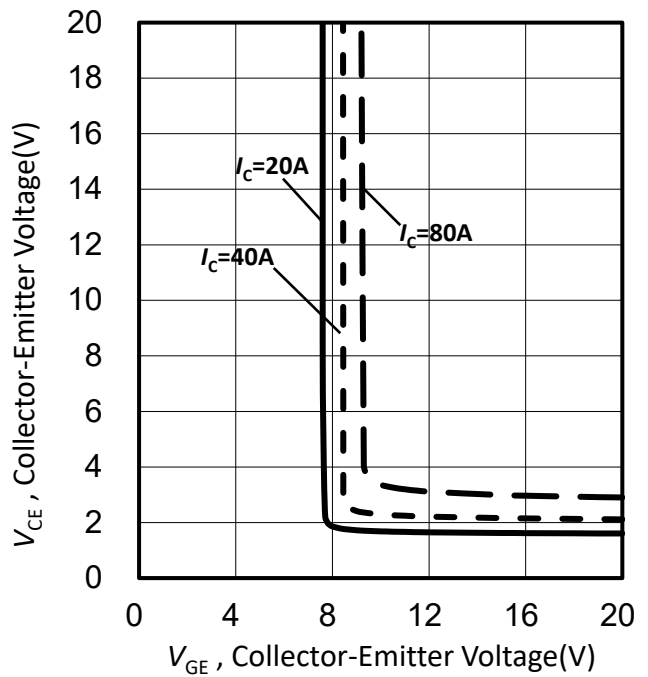


Figure 10. Typical $V_{CE(sat)}-V_{GE(th)}$ characteristic ($T_{vj}=125^{\circ}C$)

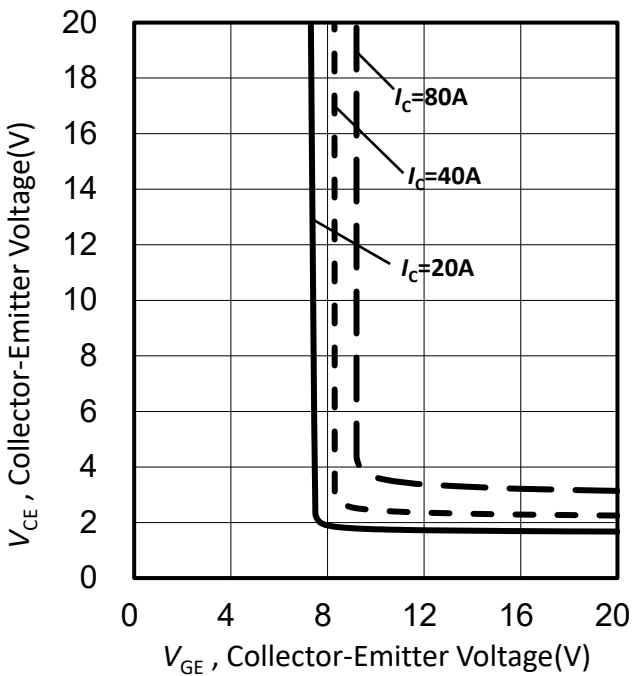


Figure 11. Typical $V_{CE(sat)}-V_{GE(th)}$ characteristic ($T_{vj}=150^{\circ}C$)

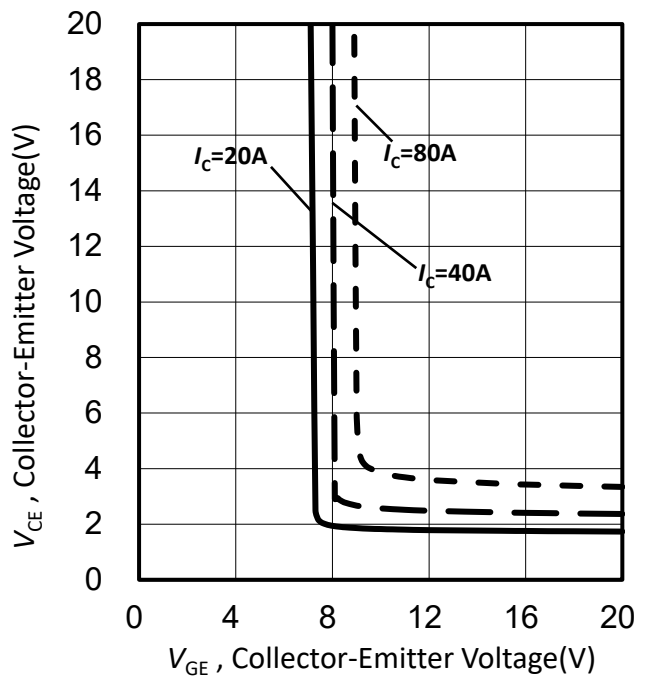


Figure 12. Typical $V_{CE(sat)}-V_{GE(th)}$ characteristic ($T_{vj}=175^{\circ}C$)

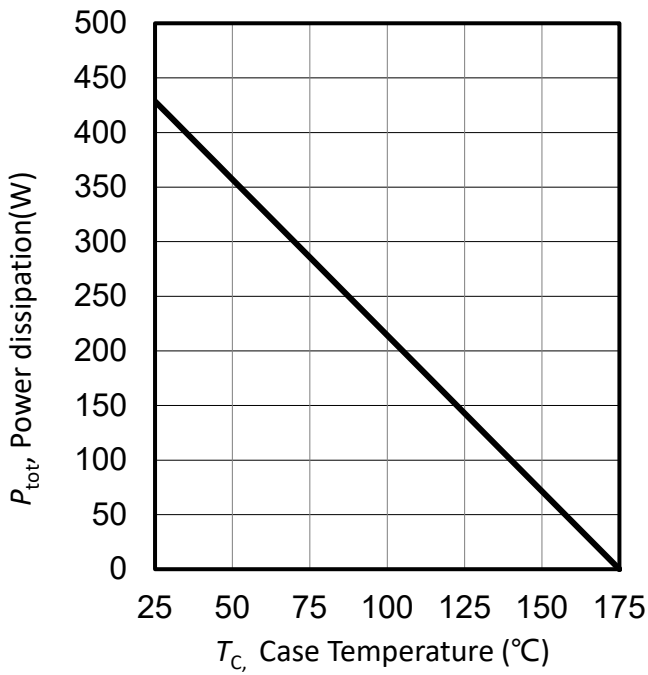


Figure 13. Power dissipation as a function of case temperature ($T_{vj} \leq 175^\circ\text{C}$)

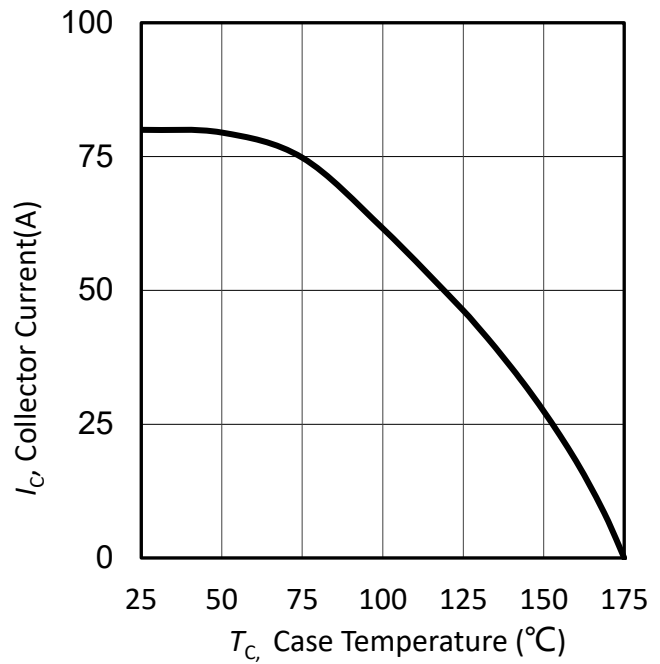


Figure 14. Collector current as a function of case temperature ($T_{vj} \leq 175^\circ\text{C}, V_{GE} \geq 15\text{V}$)

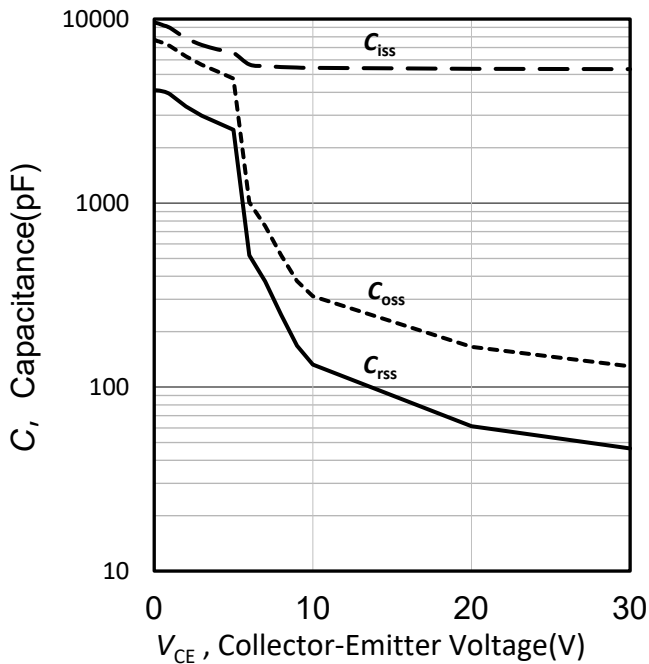


Figure 15. Typical capacitance as a function of collector-emitter voltage ($V_{GE}=0\text{V}, f=1\text{MHz}$)

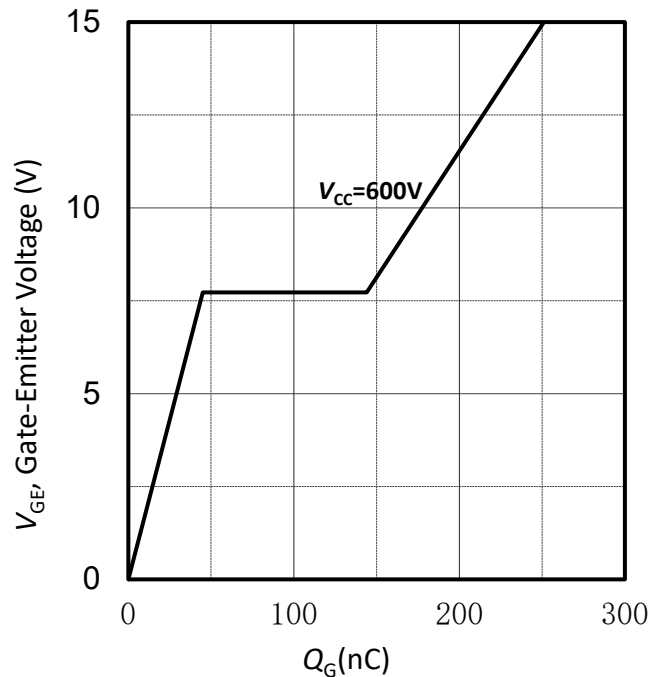


Figure 16. Typical gate charge

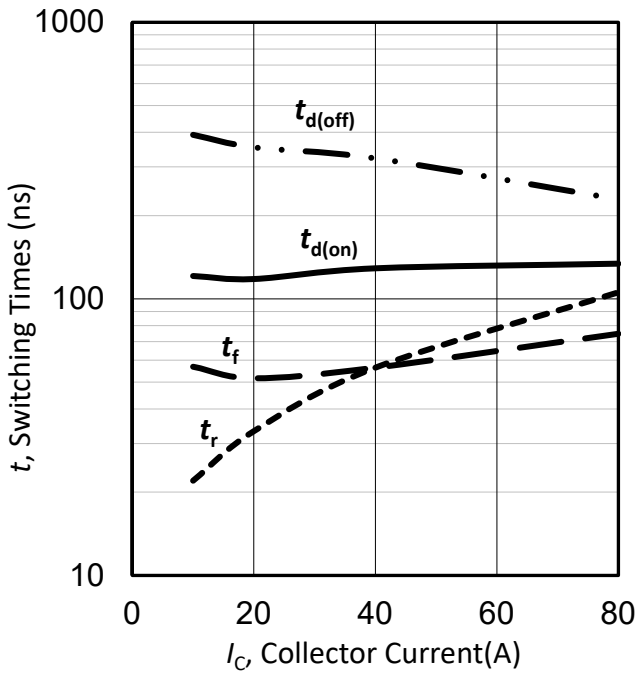


Figure 17. Typical switching times as a function of collector current
(inductive load, $T_{vj}=25^{\circ}\text{C}$,
 $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=10\Omega$)

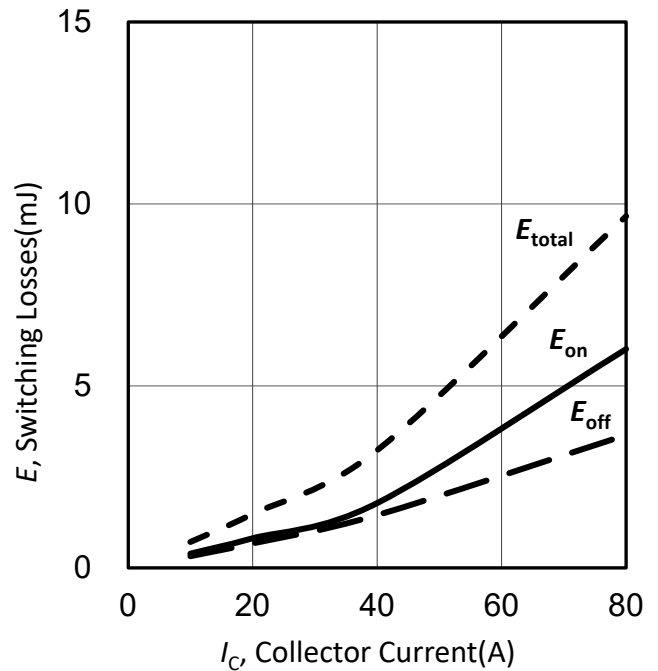


Figure 18. Typical switching losses as a function of collector current
(inductive load, $T_{vj}=25^{\circ}\text{C}$,
 $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=10\Omega$)

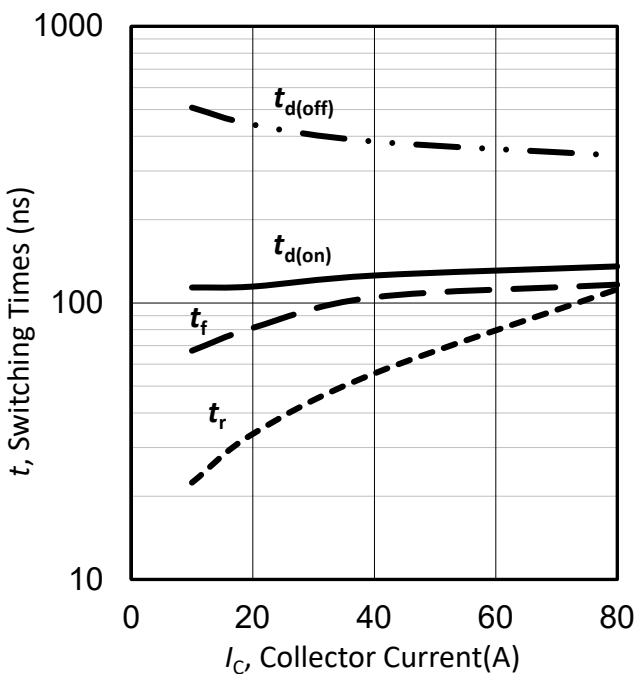


Figure 19. Typical switching times as a function of collector current
(inductive load, $T_{vj}=175^{\circ}\text{C}$,
 $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=10\Omega$)

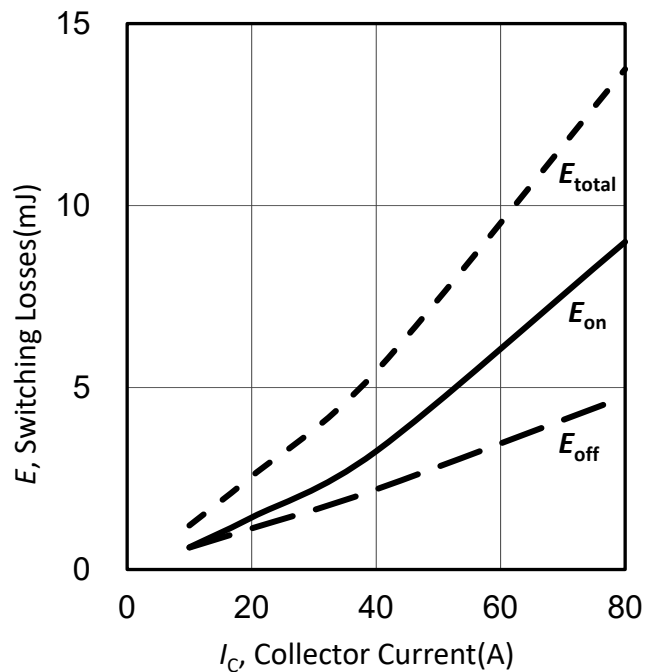


Figure 20. Typical switching losses as a function of collector current
(inductive load, $T_{vj}=175^{\circ}\text{C}$,
 $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=10\Omega$)

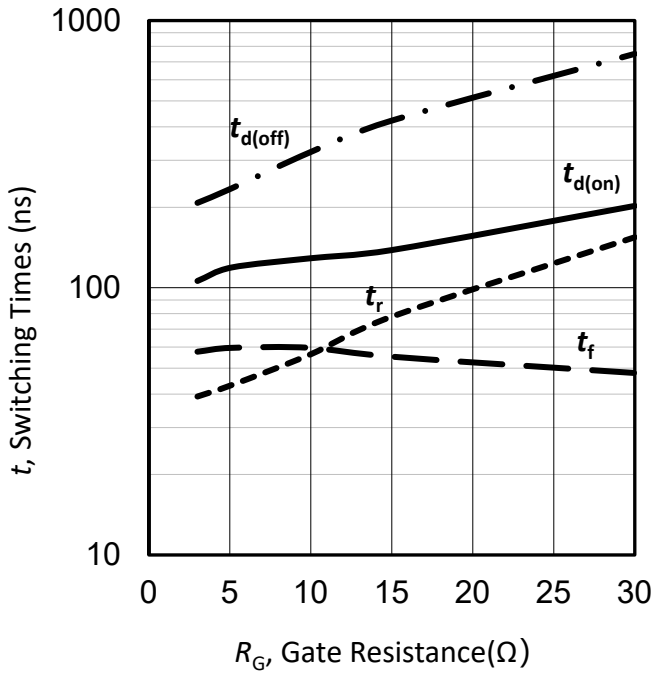


Figure 21. Typical switching times as a function of gate resistor
(inductive load, $T_{vj}=25^{\circ}\text{C}$,
 $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$)

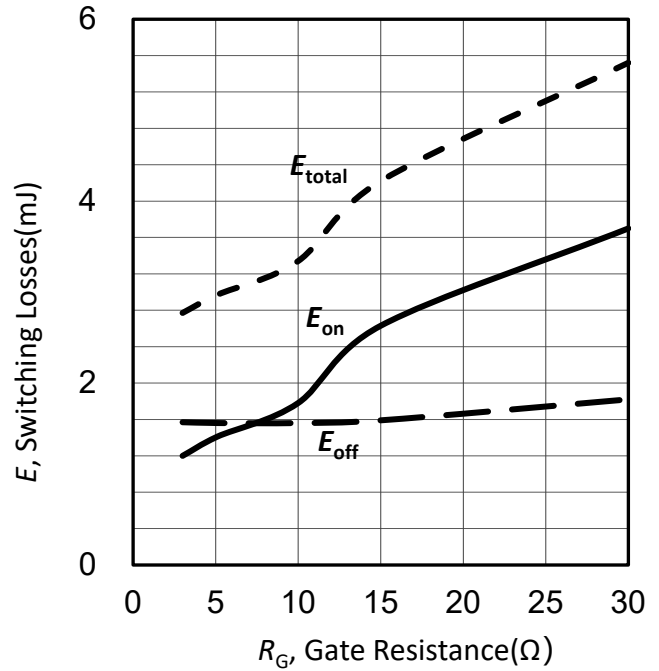


Figure 22. Typical switching energy losses as a function of gate resistor
(inductive load, $T_{vj}=25^{\circ}\text{C}$,
 $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$)

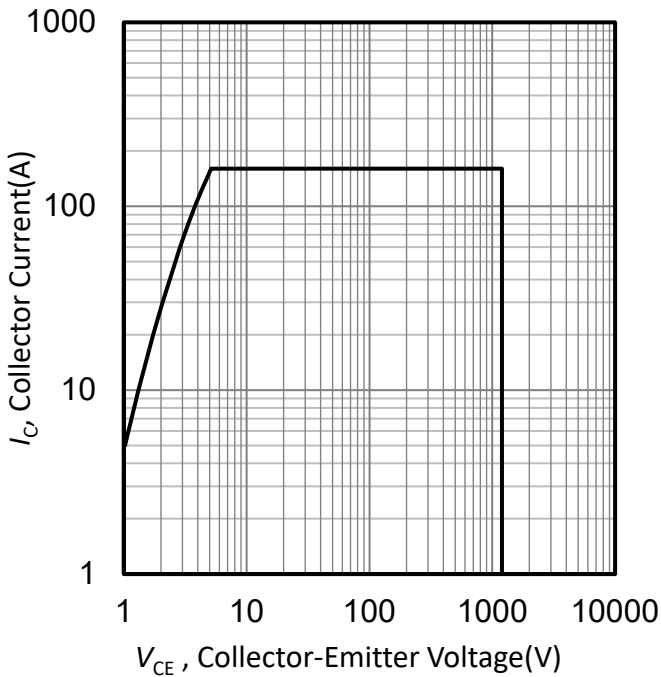


Figure 23. IGBT reverse bias safe operating area
($T_{vj}\leq 175^{\circ}\text{C}$, $V_{GE}=15\text{V}$)

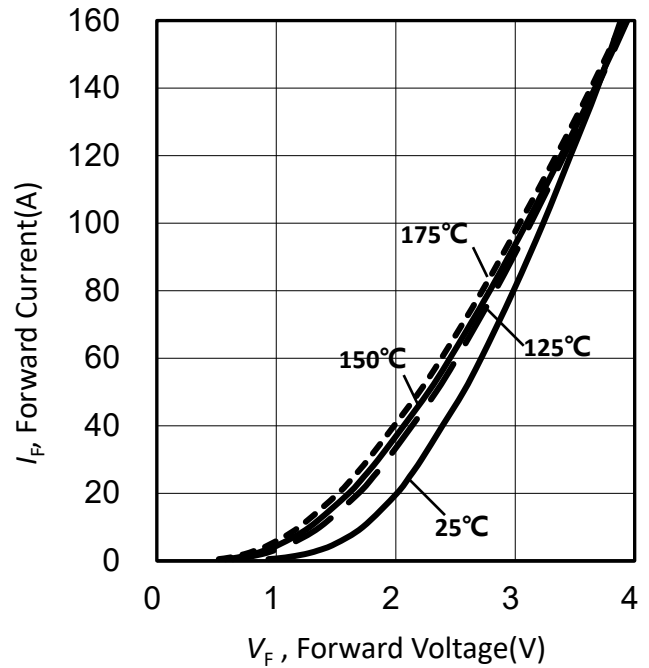


Figure 24. Typical diode forward current as a function of forward voltage

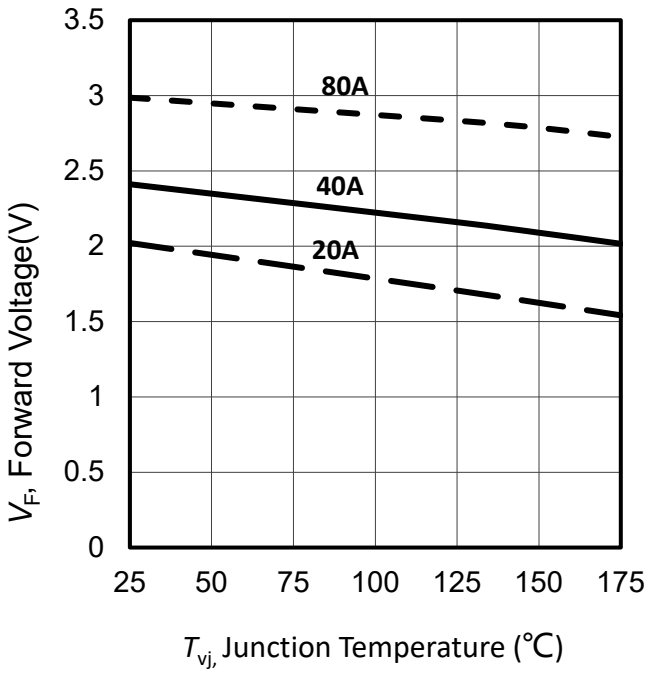


Figure 25. Typical diode forward voltage as a function of junction temperature

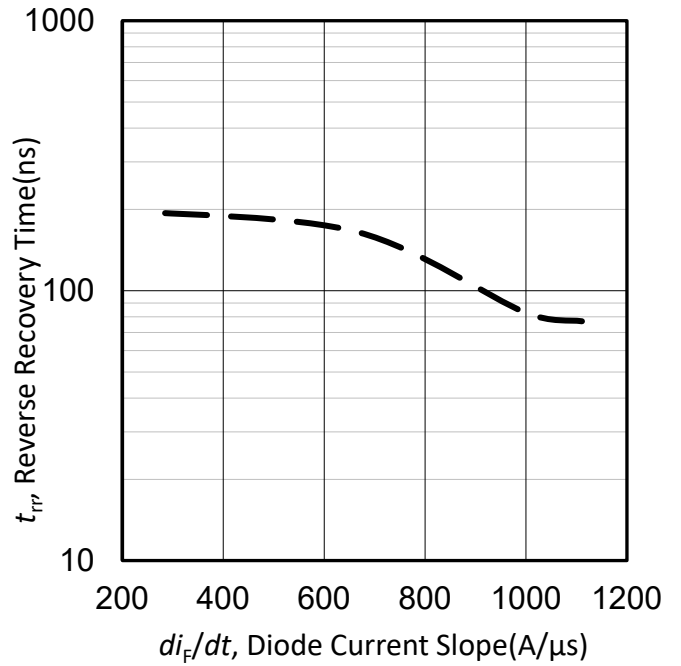


Figure 26. Typical reverse recovery time as a function of diode current slope ($V_R=600V$, $I_F=40A$, $T_{vj}=25^\circ C$)

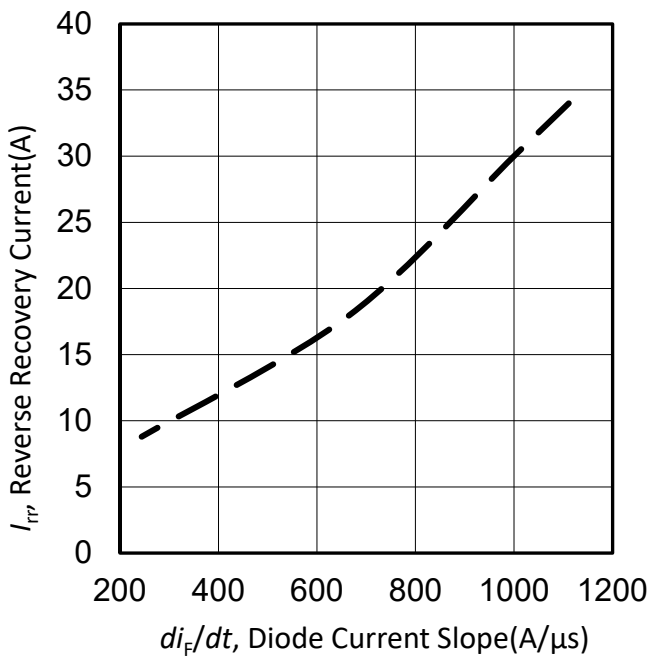


Figure 27. Typical reverse recovery current as a function of diode current slope ($V_R=600V$, $I_F=40A$, $T_{vj}=25^\circ C$)

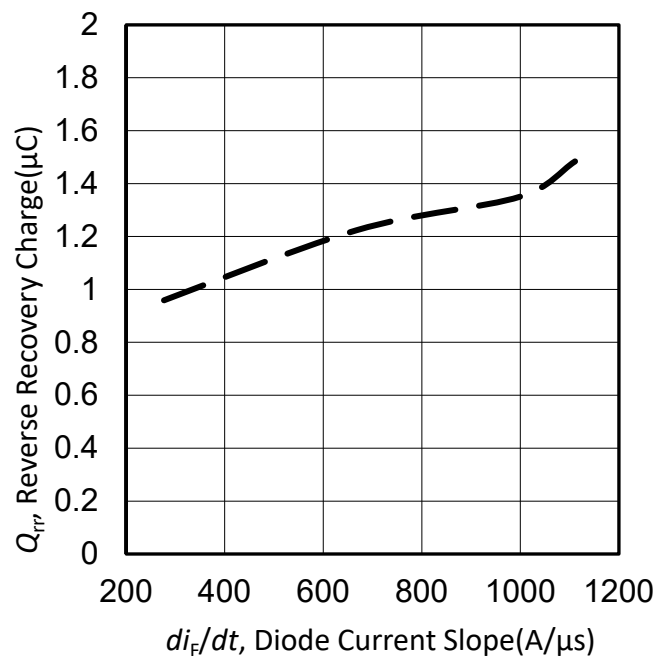


Figure 28. Typical reverse recovery charge as a function of diode current slope ($V_R=600V$, $I_F=40A$, $T_{vj}=25^\circ C$)

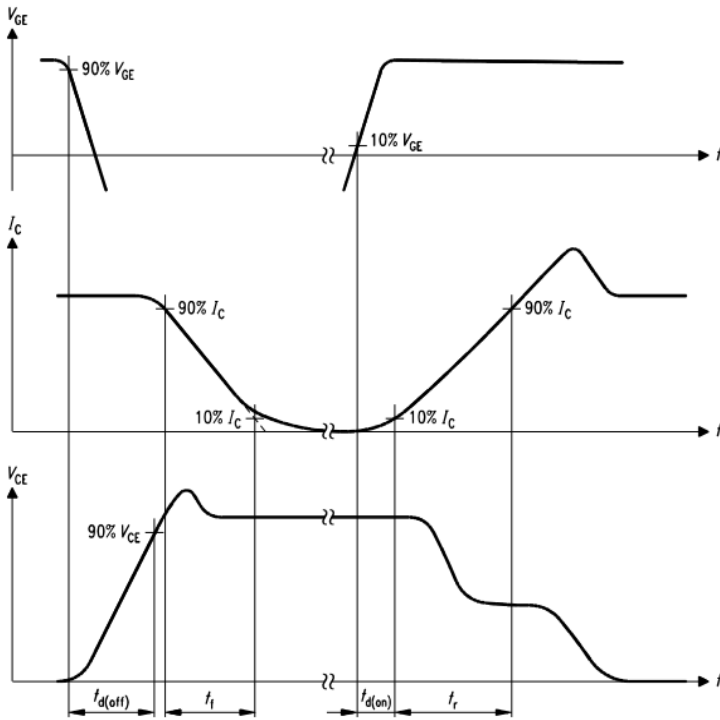


Figure A. Definition of switching times

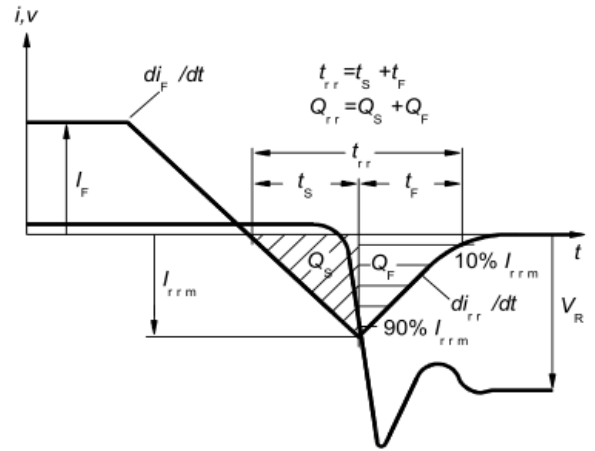


Figure C. Definition of diodes switching characteristics

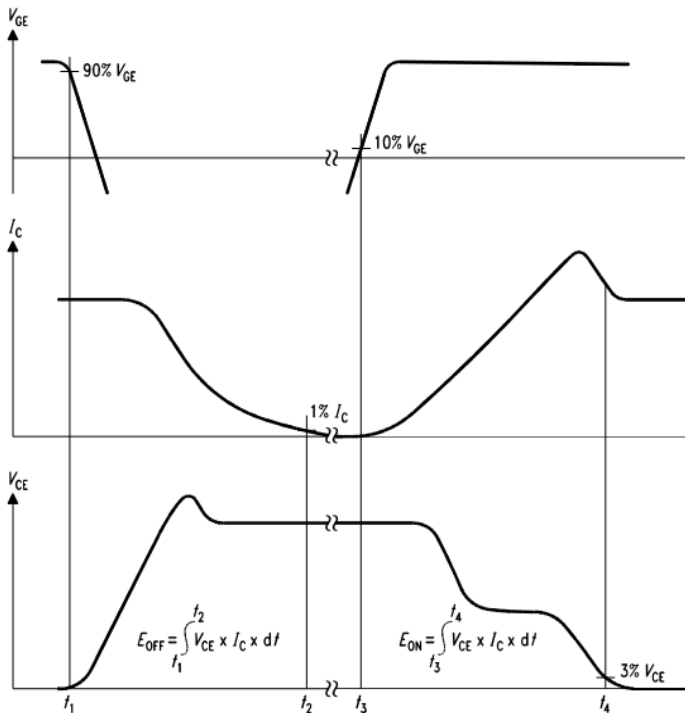


Figure B. Definition of switching losses

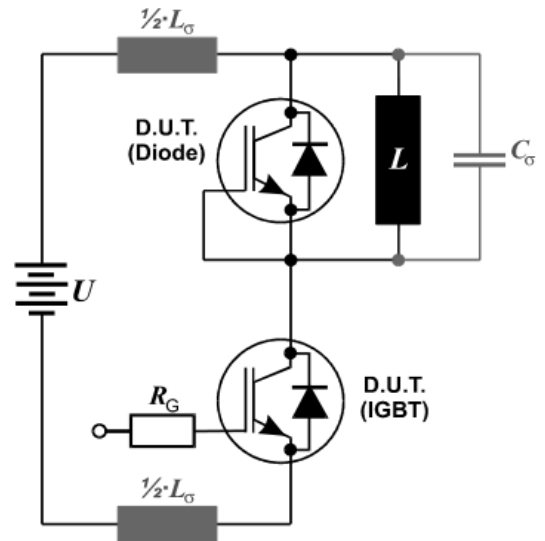
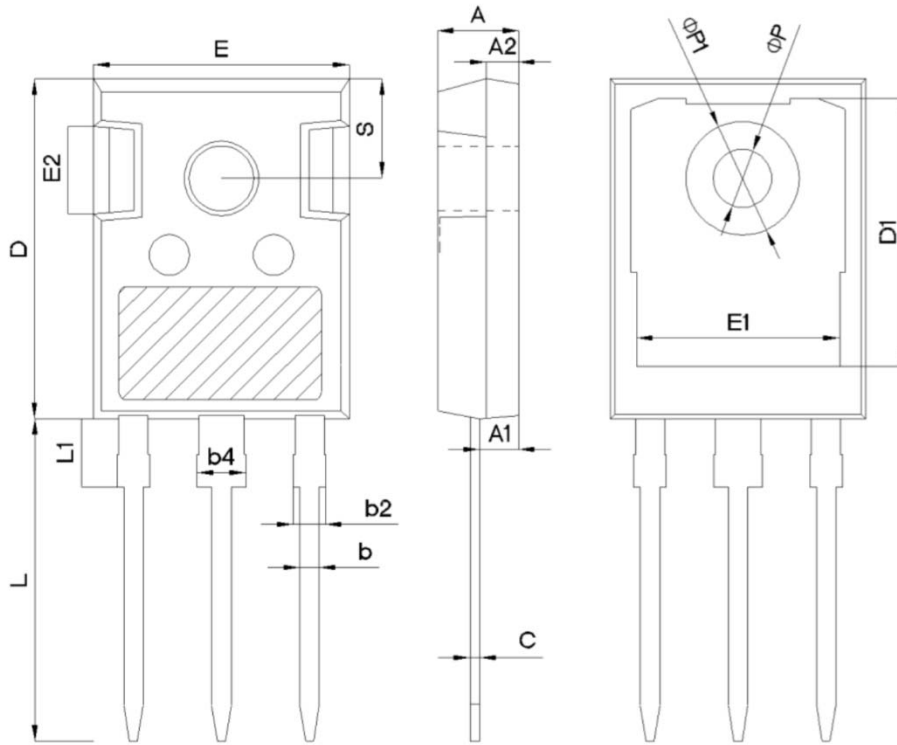


Figure D. Switching test circuit

TO-247-3



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	2021.11
1.1	Update electrical characteristics and charts	2021.12
1.2	Add charts	2022.3

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