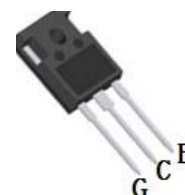
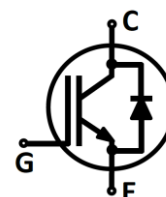


Features

- 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
- Solar inverter



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	80 40	A
Pulsed collector current, t_p limited by $T_{jmax}^{1)}$	I_{Cpuls}	160	
Diode forward current, limited by T_{jmax} $T_C=25^{\circ}C$ $T_C=100^{\circ}C$	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 ($t_p \leq 10\mu s, D < 0.01$)		± 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}	3	μs
Power dissipation $T_C=25^{\circ}C$	P_{tot}	428	W
Power dissipation $T_C=100^{\circ}C$		214	
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	
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 $T_j=25^{\circ}\text{C}$, 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	$V_{CE(sat)}$	$V_{GE}=15V, I_C=40A$ $T_j=25^{\circ}\text{C}$	-	1.65	1.9	
		$T_j=150^{\circ}\text{C}$	-	2.05	-	
		$T_j=175^{\circ}\text{C}$	-	2.15	-	
G-E threshold voltage	$V_{GE(th)}$	$I_C=1.5mA, V_{CE}=V_{GE}$	5.0	5.4	6.5	mA
C-E leakage current	I_{CES}	$V_{CE}=1200V,$ $V_{GE}=0V$ $T_j=25^{\circ}\text{C}$	-	-	0.1	
		$T_j=175^{\circ}\text{C}$	-	-	4.0	
G-E leakage current	I_{GES}	$V_{CE}=0V, V_{GE}=20V$	-	-	250	nA
Transconductance	g_{fs}	$V_{CE}=20V, I_C=40A$	-	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	$I_{C(SC)}$	$V_{GE}=15V,$ $V_{CC}\leq 600V,$ $t_{SC}\leq 10\mu s, T_j=175^{\circ}\text{C}$	-	160	-	A

IGBT Switching Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Turn-on delay time	$t_{d(on)}$	$T_j=25^{\circ}\text{C}$, $V_{CC}=600\text{V}$, $I_C=40\text{A}$, $V_{GE}=-15/15\text{V}$, $R_G=10\Omega$, 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	$t_{d(on)}$	$T_j=175^{\circ}\text{C}$, $V_{CC}=600\text{V}$, $I_C=40\text{A}$, $V_{GE}=-15/15\text{V}$, $R_G=10\Omega$, 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	$V_{GE}=0\text{V}$, $I_F=40\text{A}$ $T_j=25^{\circ}\text{C}$	-	2.2	-	V
		$T_j=150^{\circ}\text{C}$	-	1.8	-	
		$T_j=175^{\circ}\text{C}$	-	1.6	-	
Diode reverse recovery time	t_{rr}	$T_j=25^{\circ}\text{C}$, $V_R=600\text{V}$, $I_F=40\text{A}$, $di_F/dt=500\text{A}/\mu\text{s}$	-	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}	$T_j=175^{\circ}\text{C}$, $V_R=600\text{V}$, $I_F=40\text{A}$, $di_F/dt=500\text{A}/\mu\text{s}$	-	526	-	ns
Diode reverse recovery charge	Q_{rr}		-	9.0	-	μC
Diode peak reverse recovery current	I_{rrm}		-	37	-	A

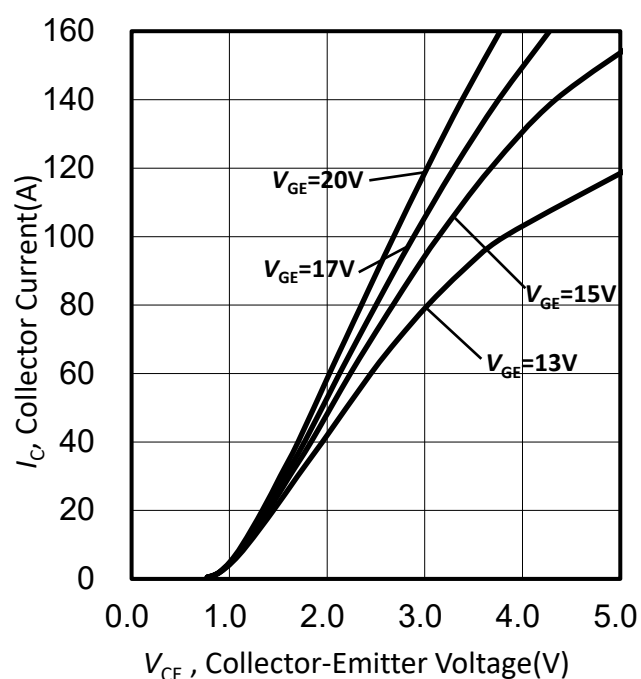


Figure 1. Typical output characteristic
($T_j = 25^\circ\text{C}$)

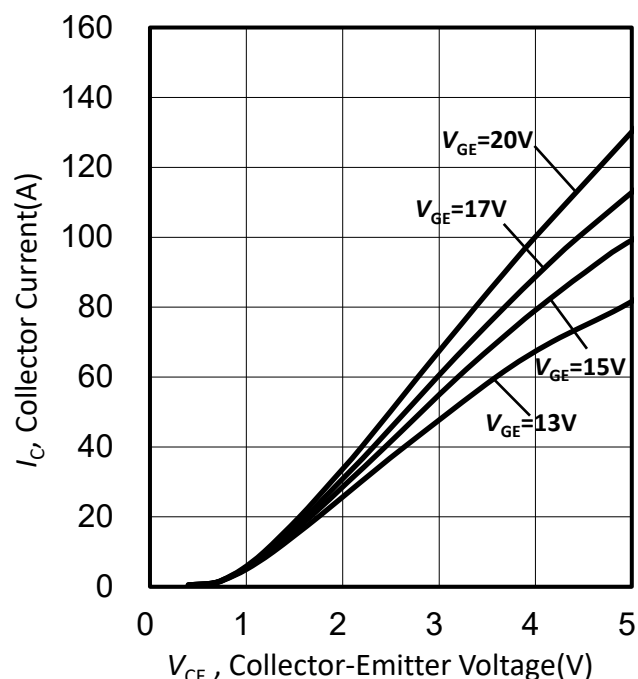


Figure 2. Typical output characteristic
($T_j = 175^\circ\text{C}$)

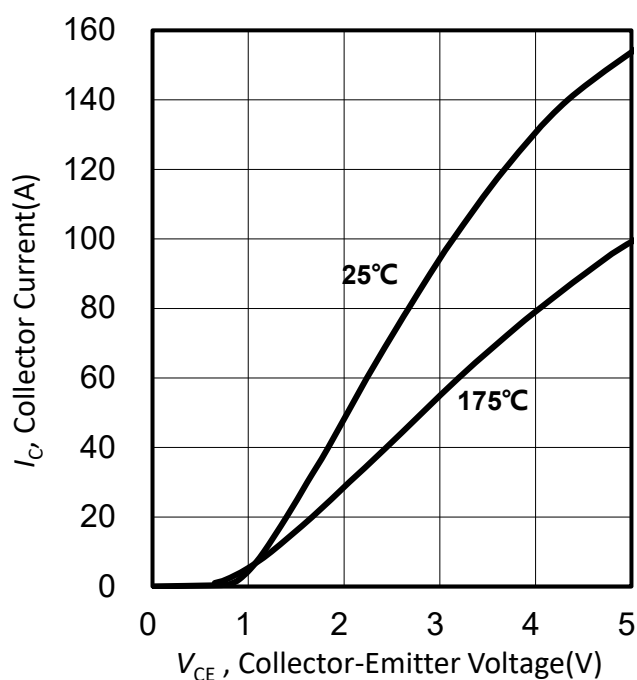


Figure 3. Typical $V_{ce(sat)} - I_c$ characteristic
($V_{ge} = 15\text{V}$)

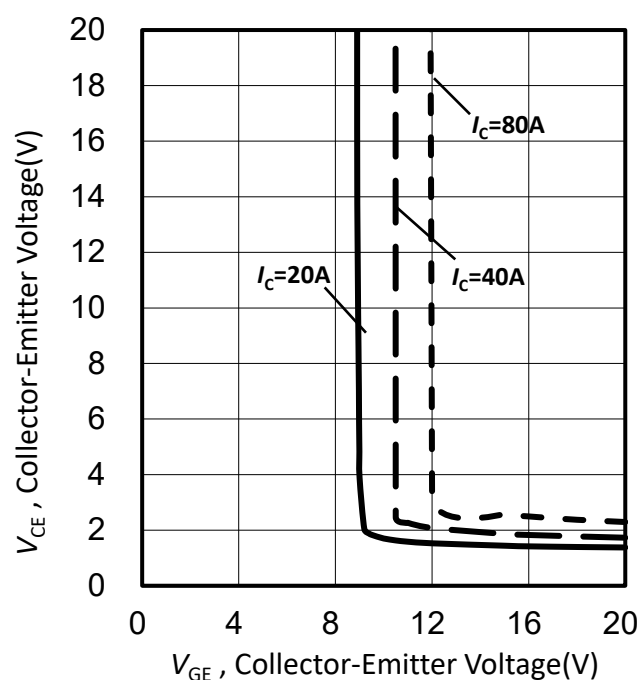


Figure 4. Typical $V_{ce(sat)} - V_{ge(th)}$ characteristic
($T_{vj} = 25^\circ\text{C}$)

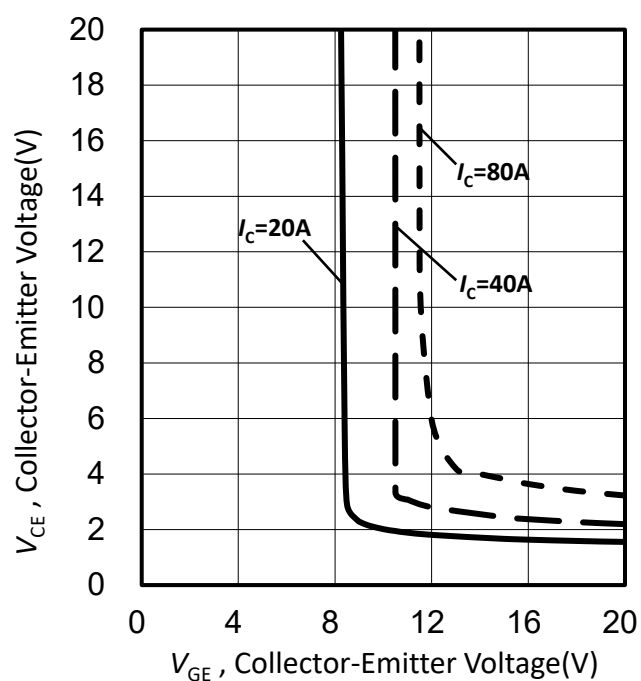


Figure 5. Typical $V_{CE(sat)}-V_{GE(th)}$ characteristic
($T_{vj}=175^{\circ}\text{C}$)

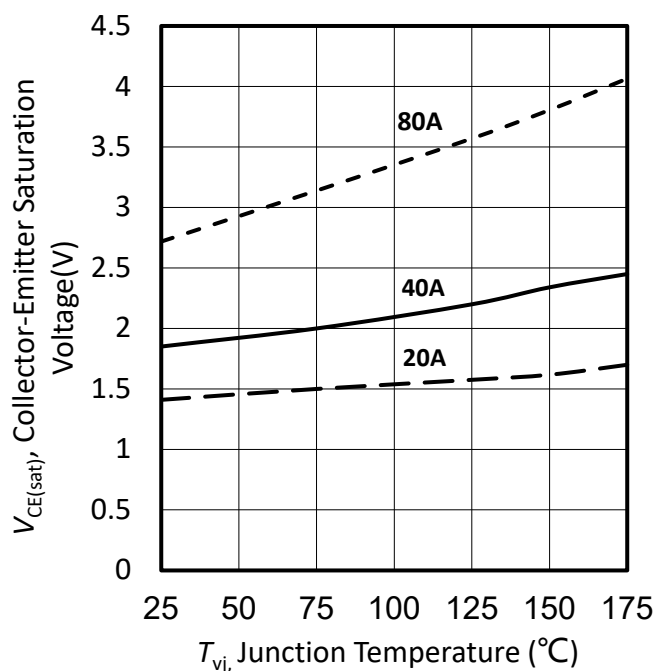


Figure 6. Typical $V_{CE(sat)}-T_j$ characteristic
($V_{GE}=15\text{V}$)

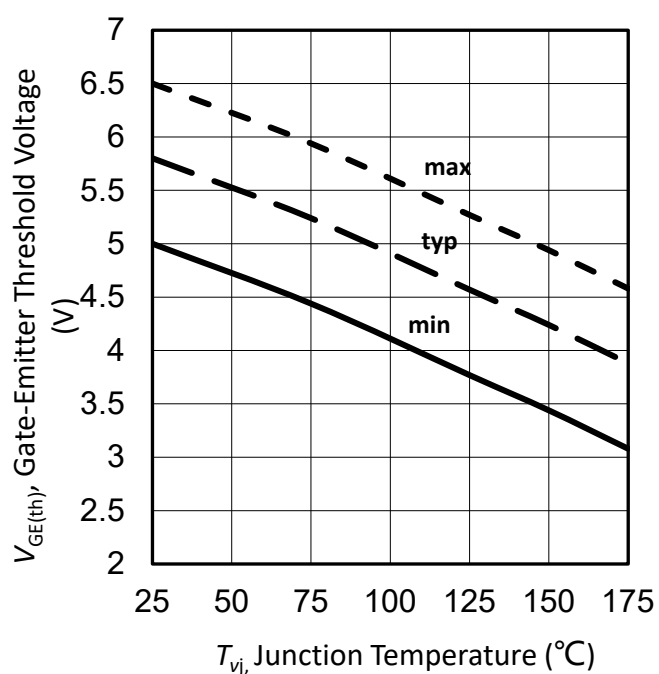


Figure 7. $V_{GE(th)}-T_j$ characteristic
($I_C=1.5\text{mA}$)

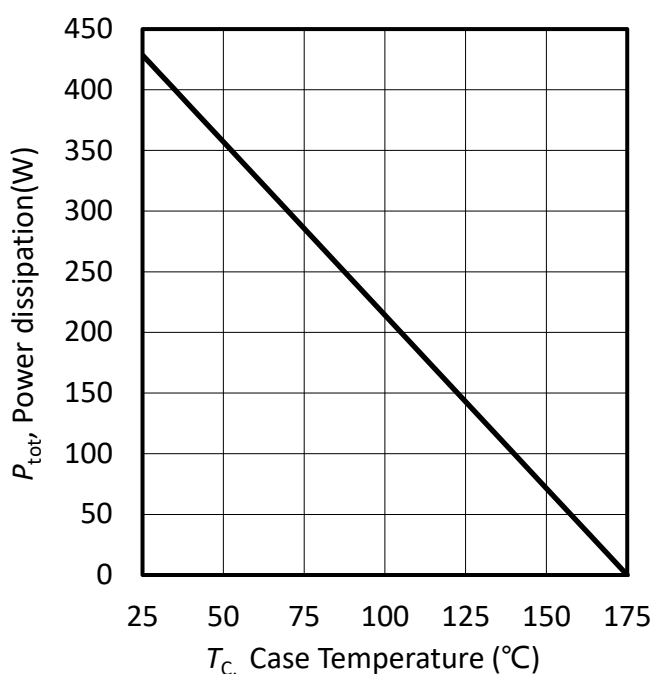


Figure 8. Power dissipation as a function
of case temperature
($T_j \leq 175^{\circ}\text{C}$)

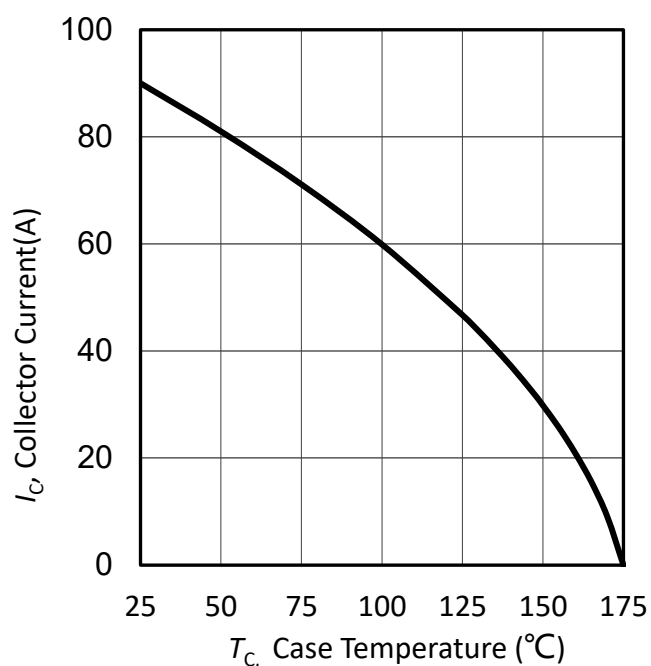


Figure 9. Collector current as a function of case temperature
($T_{vj} \leq 175^\circ\text{C}$, $V_{GE} \geq 15\text{V}$)

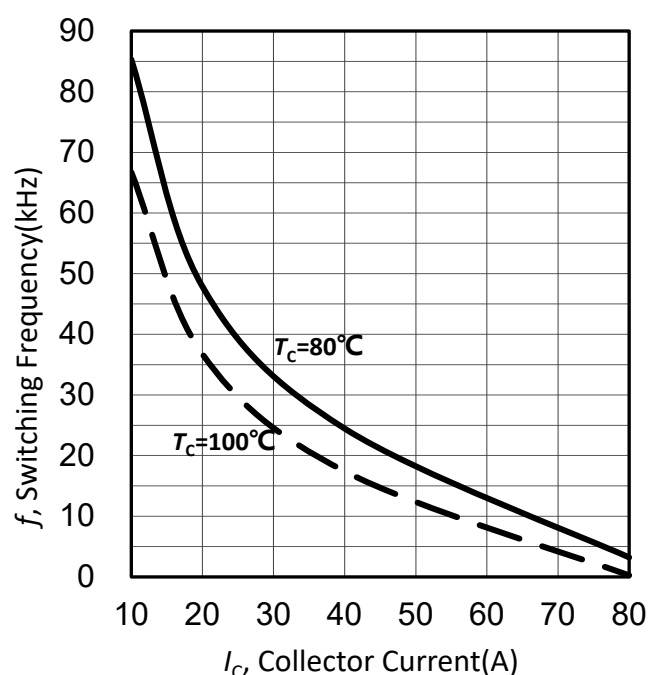


Figure 10. Maximum possible switching frequency as a function of collector current
($T_{vj} \leq 175^\circ\text{C}$, $V_{GE} = -15\text{V}/15\text{V}$, $R_G = 10\Omega$, $D = 0.5$)

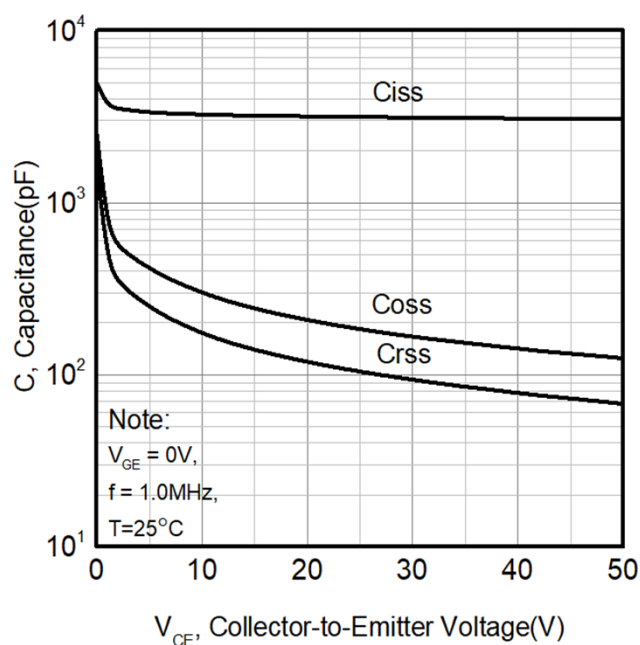


Figure 11. Typical capacitance as a function of collector-emitter voltage

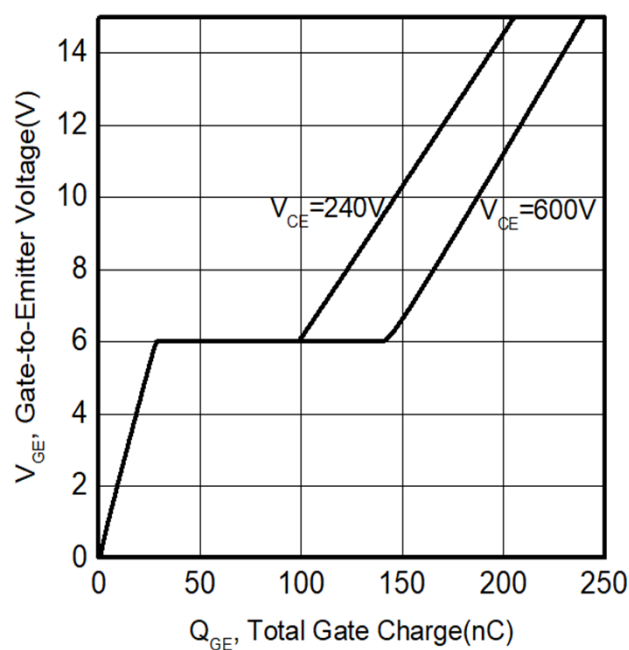


Figure 12. Typical gate charge

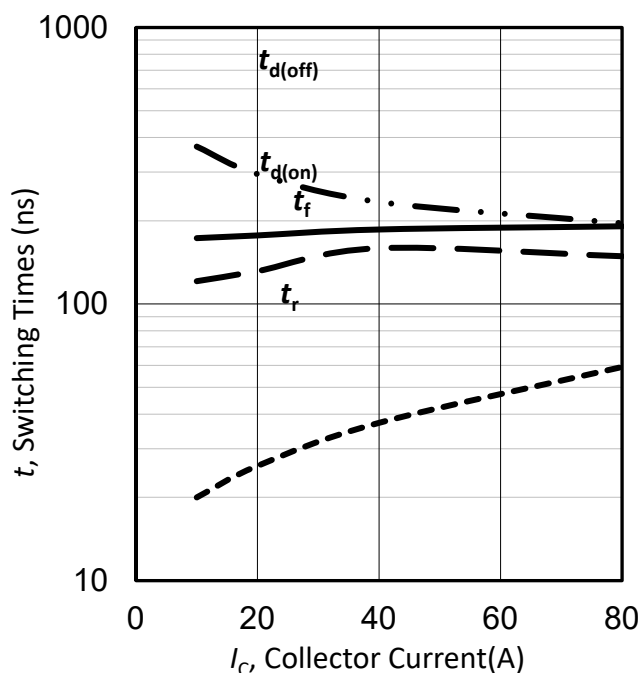


Figure 13. Typical switching times as a function of collector current
(inductive load, $T_{vj}=25^\circ\text{C}$,
 $V_{CE}=600\text{V}$, $V_{GE}=-15/15\text{V}$, $R_G=10\Omega$)

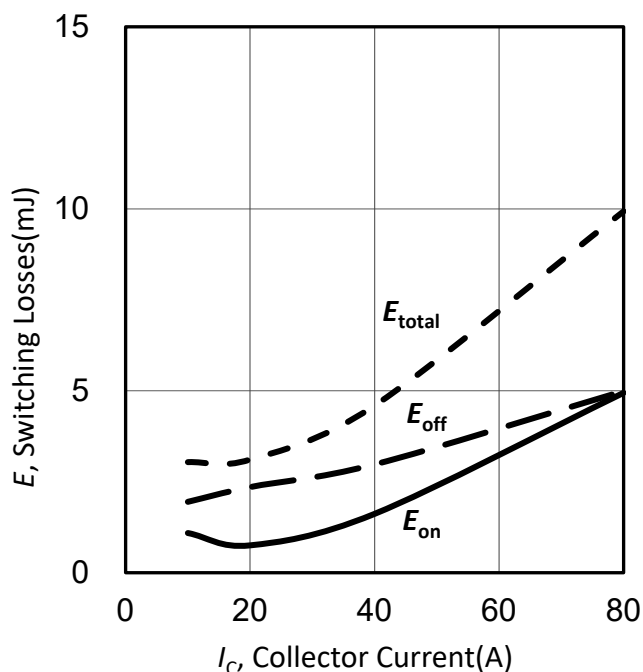


Figure 14. Typical switching losses as a function of collector current
(inductive load, $T_{vj}=25^\circ\text{C}$,
 $V_{CE}=600\text{V}$, $V_{GE}=-15/15\text{V}$, $R_G=10\Omega$)

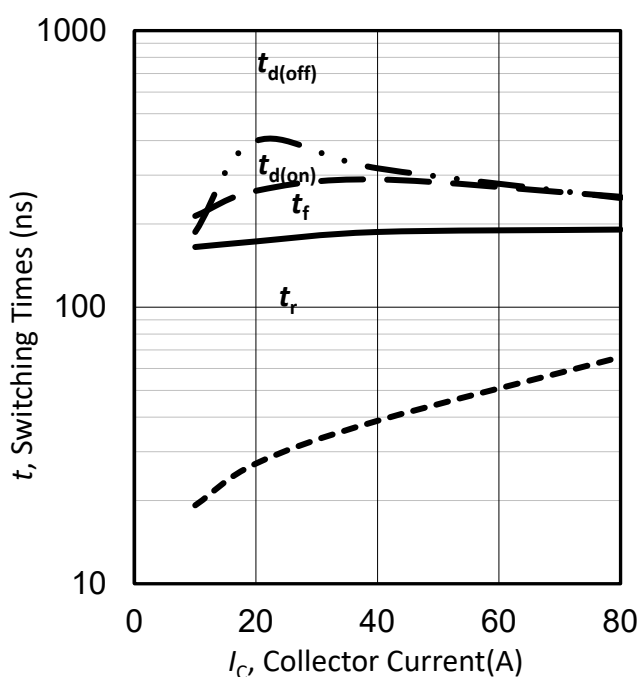


Figure 15. Typical switching times as a function of collector current
(inductive load, $T_{vj}=175^\circ\text{C}$,
 $V_{CE}=600\text{V}$, $V_{GE}=-15/15\text{V}$, $R_G=10\Omega$)

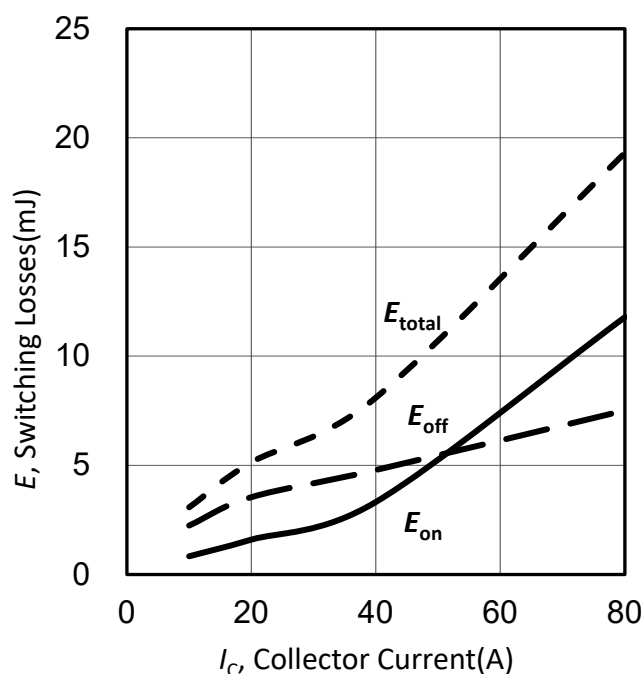


Figure 16. Typical switching losses as a function of collector current
(inductive load, $T_{vj}=175^\circ\text{C}$,
 $V_{CE}=600\text{V}$, $V_{GE}=-15/15\text{V}$, $R_G=10\Omega$)

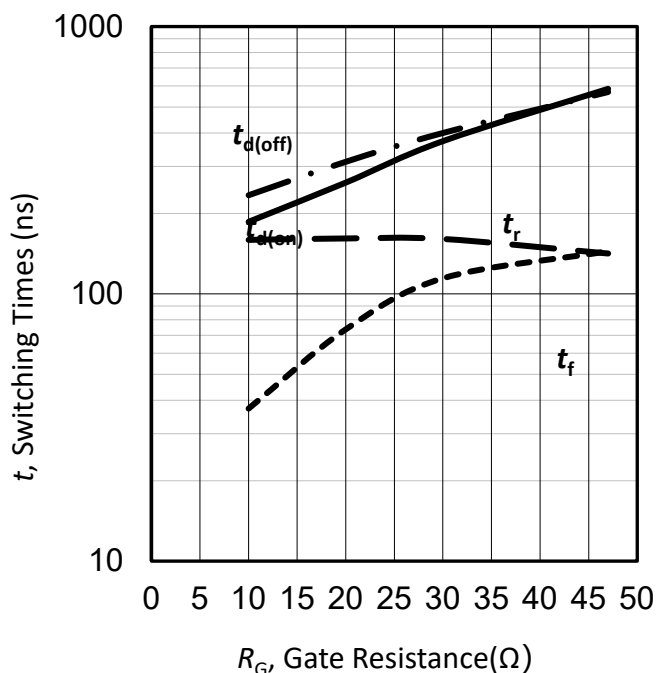


Figure 17. Typical switching times as a function of gate resistor
(inductive load, $T_{vj}=25^{\circ}\text{C}$,
 $V_{CE}=600\text{V}$, $V_{GE}=-15/15\text{V}$, $I_C=40\text{A}$)

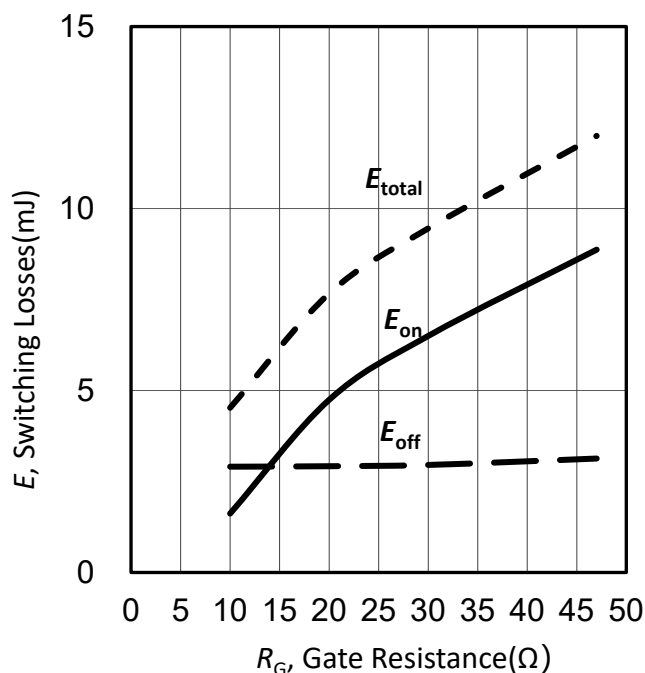


Figure 18. Typical switching energy losses as a function of gate resistor
(inductive load, $T_{vj}=25^{\circ}\text{C}$,
 $V_{CE}=600\text{V}$, $V_{GE}=-15/15\text{V}$, $I_C=40\text{A}$)

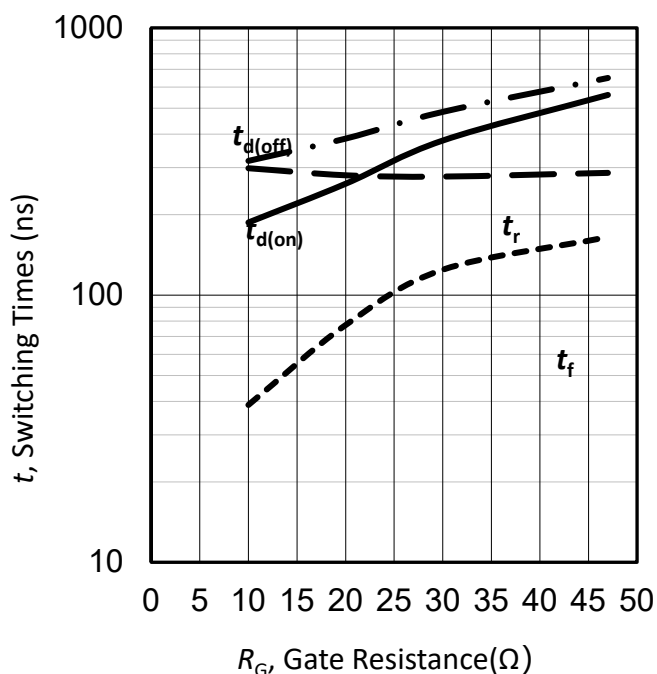


Figure 19. Typical switching times as a function of gate resistor
(inductive load, $T_{vj}=175^{\circ}\text{C}$,
 $V_{CE}=600\text{V}$, $V_{GE}=-15/15\text{V}$, $I_C=40\text{A}$)

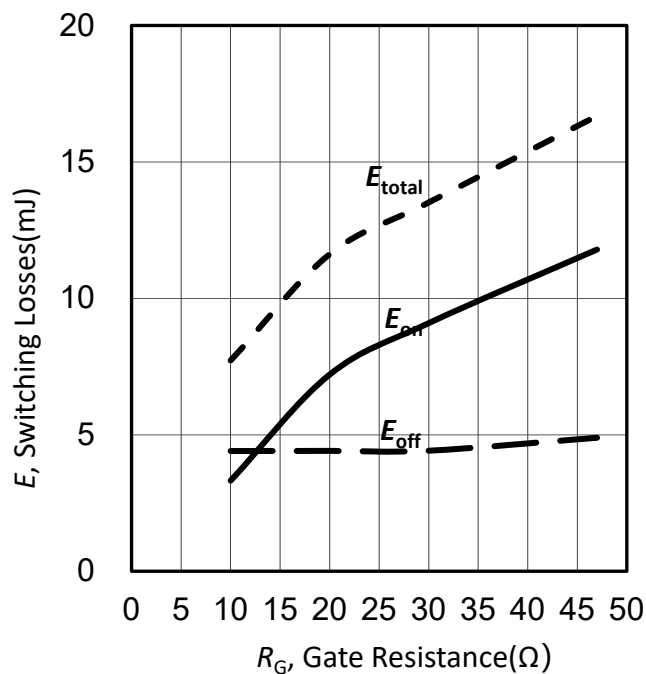


Figure 20. Typical switching energy losses as a function of gate resistor
(inductive load, $T_{vj}=175^{\circ}\text{C}$,
 $V_{CE}=600\text{V}$, $V_{GE}=-15/15\text{V}$, $I_C=40\text{A}$)

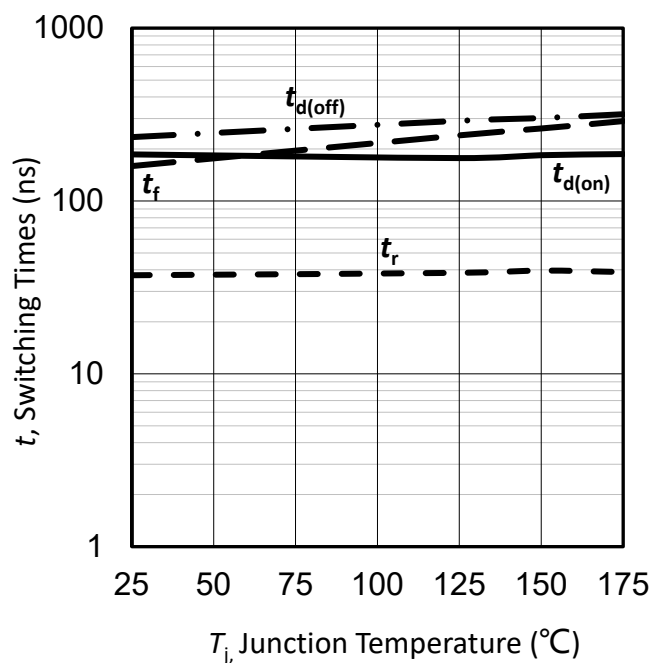


Figure 21. Typical switching times as a function of junction temperature
(inductive load, $V_{CE}=600V$, $V_{GE}=-15/15V$, $I_C=40A$, $R_G=10\Omega$)

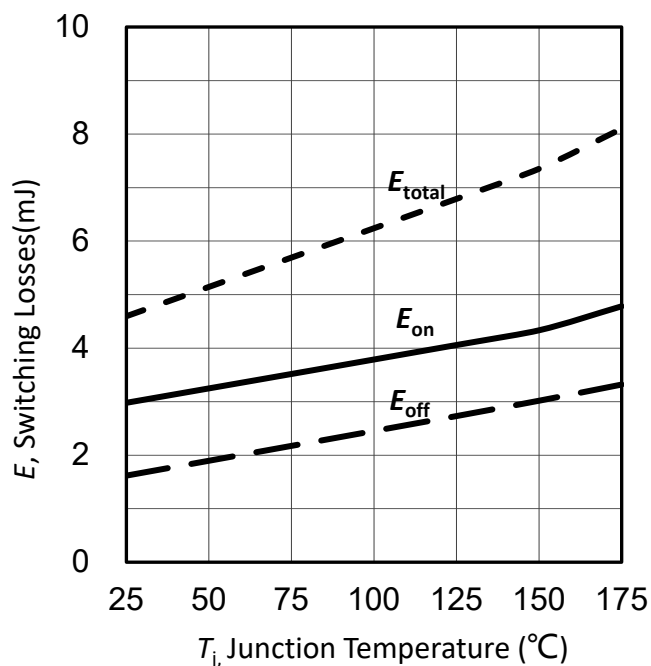


Figure 22. Typical switching energy losses as a function of junction temperature
(inductive load, $V_{CE}=600V$, $V_{GE}=-15/15V$, $I_C=40A$, $R_G=10\Omega$)

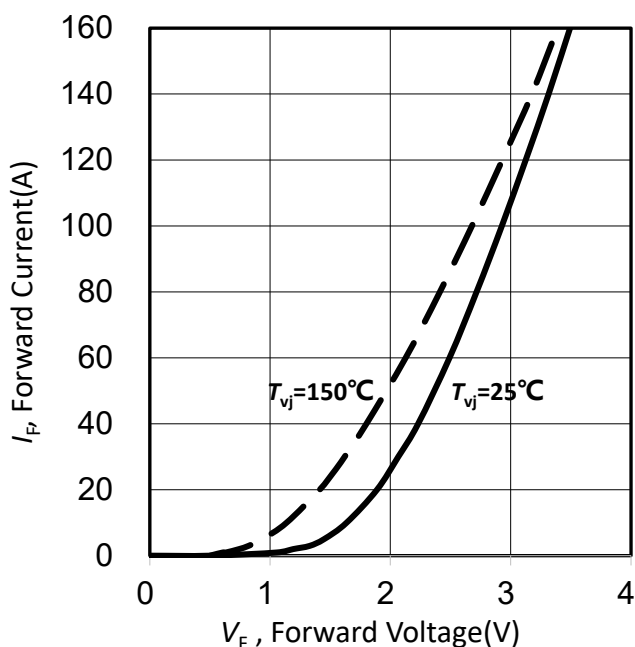


Figure 23. Typical diode forward current as a function of forward voltage

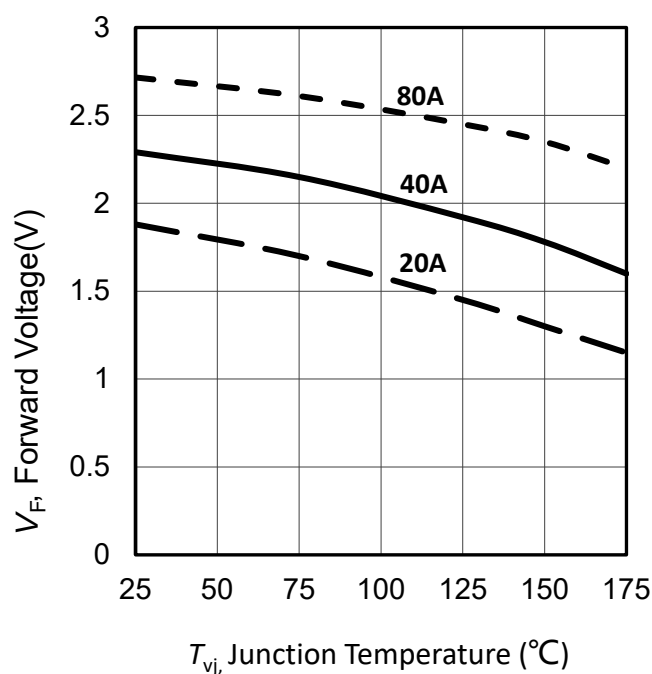


Figure 24. Typical V_F - T_j characteristic

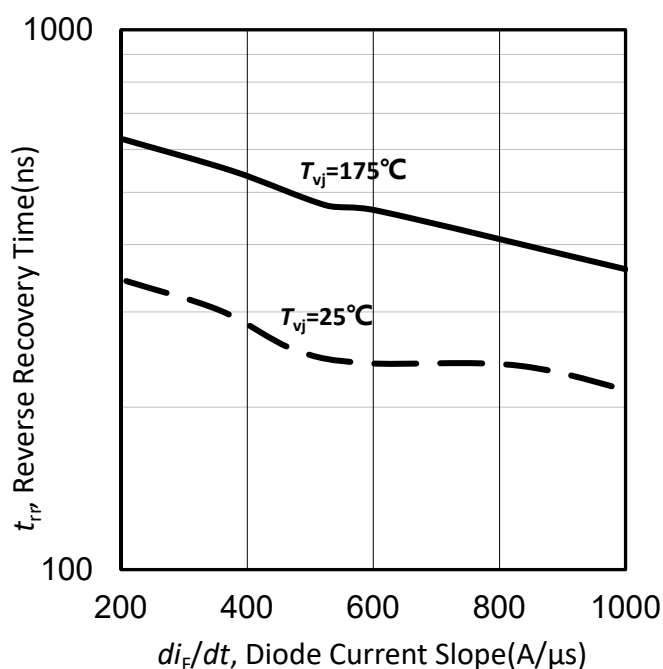


Figure 25. Typical reverse recovery time as a function of diode current slope ($V_R=600\text{V}$, $I_F=40\text{A}$)

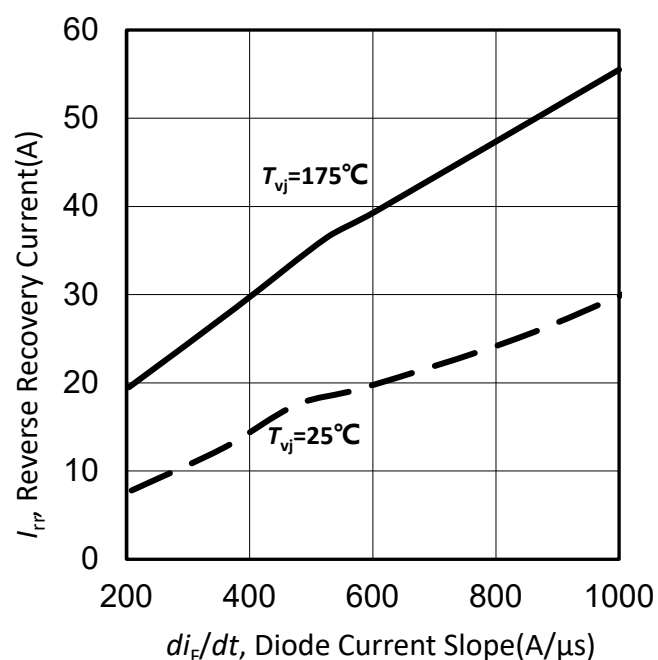


Figure 26. Typical reverse recovery current as a function of diode current slope ($V_R=600\text{V}$, $I_F=40\text{A}$)

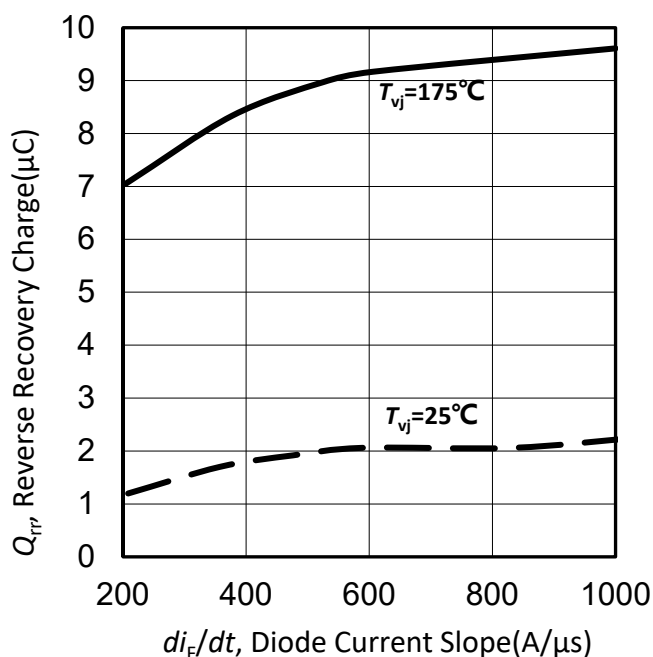


Figure 27. Typical reverse recovery charge as a function of diode current slope ($V_R=600\text{V}$, $I_F=40\text{A}$)

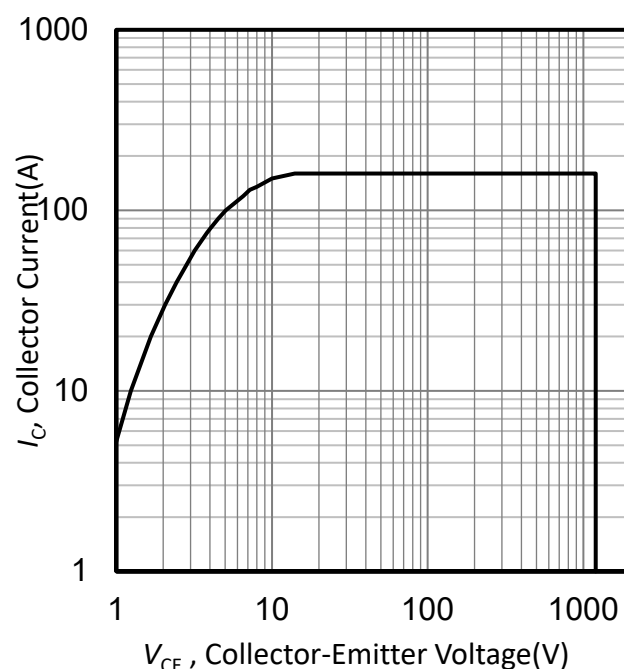


Figure 28. IGBT reverse bias safe operating area ($T_{vj} \leq 175^{\circ}\text{C}$, $V_{GE}=15\text{V}$)

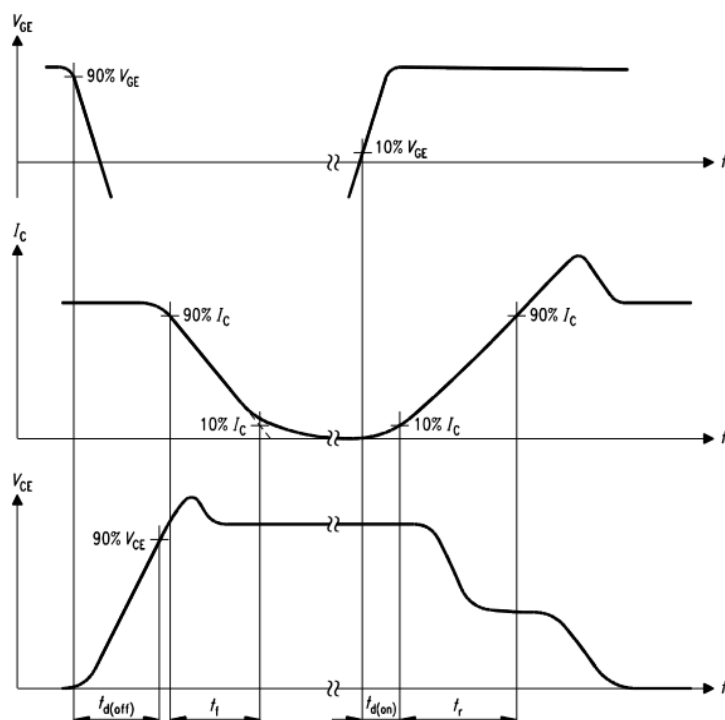


Figure A. Definition of switching times

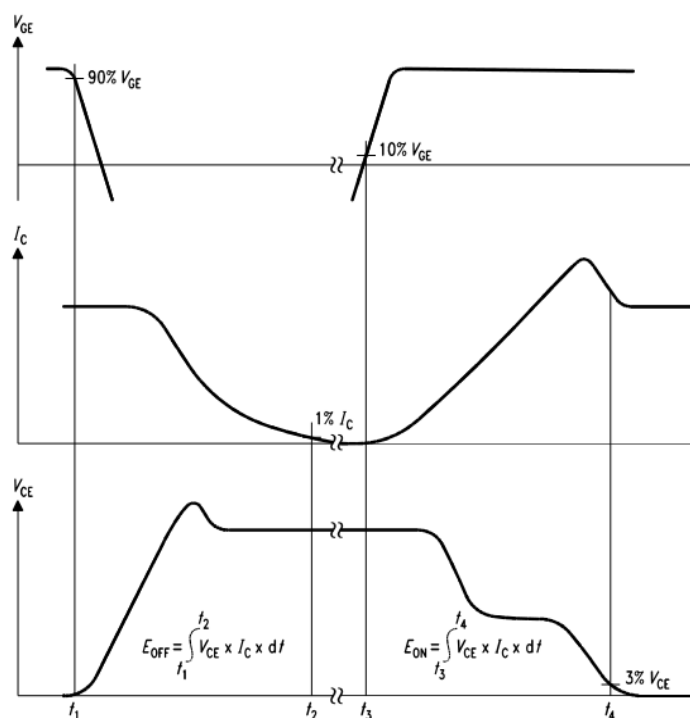


Figure B. Definition of switching losses

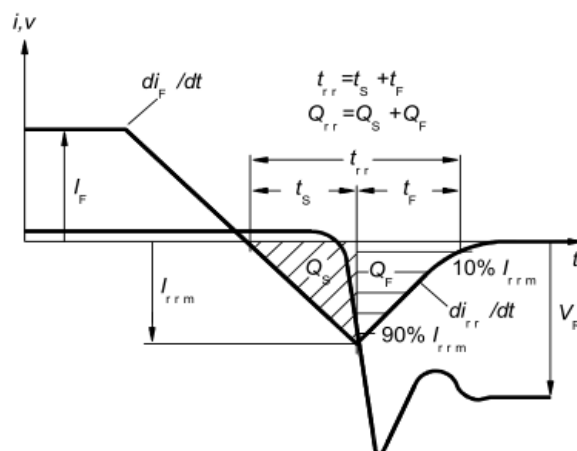


Figure C. Definition of diodes switching characteristics

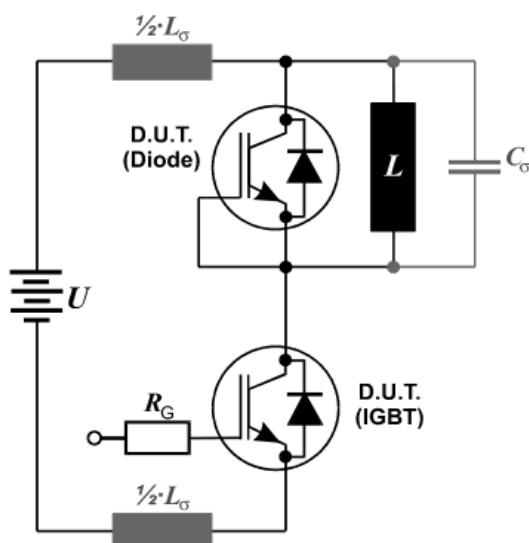
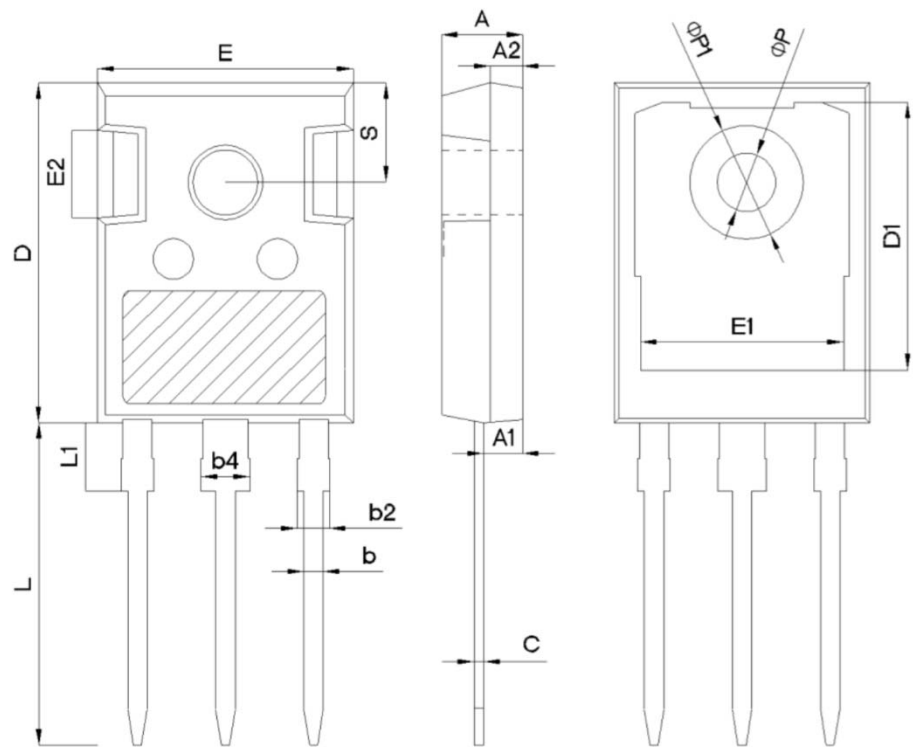


Figure D. Switching test circuit

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		