

HX40N120-TO247

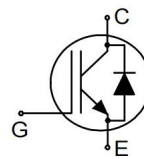
1200V high speed switching series third generation

Features

- low EMI
- Very soft, fast recovery anti-parallel diode
- maximum junction temperature 175°C
- qualified according to JEDEC for target applications
- Pb-free lead plating; RoHS compliant

Applications

- uninterruptible power supplies
- welding converters
- converters with high switching frequency



Maximum Ratings

For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

Parameter	Symbol	Value	Unit
Collector-emitter voltage	VCE	1200	V
DC collector current, limited by T_{vjmax} $T_C = 25^\circ\text{C}$ $T_C = 100^\circ\text{C}$	I_C	80.0 40.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	160.0	A
Turn off safe operating area $V_{CE} \leq 1200\text{V}$, $T_{vj} \leq 175^\circ\text{C}$	-	160.0	A
Diode forward current, limited by T_{vjmax} $T_C = 25^\circ\text{C}$ $T_C = 100^\circ\text{C}$	I_F	40.0 20.0	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	160.0	A
Gate-emitter voltage	VGE	± 20	V
Short circuit withstand time $V_{GE} = 15.0\text{V}$, $V_{CC} \leq 600\text{V}$ Allowed number of short circuits < 1000 Time between short circuits: $\geq 1.0\text{s}$ $T_{vj} = 175^\circ\text{C}$	t_{SC}	10	μs
Power dissipation $T_C = 25^\circ\text{C}$ Power dissipation $T_C = 100^\circ\text{C}$	P_{tot}	483.0 220.0	W
Operating junction temperature	T_{vj}	$-40 \dots +175$	$^\circ\text{C}$
Storage temperature	T_{stg}	$-55 \dots +150$	$^\circ\text{C}$
Soldering temperature, wave soldering 1.6 mm (0.063 in.) from case for 10s		260	$^\circ\text{C}$
Mounting torque, M3 screw Maximum of mounting processes: 3	M	0.6	Nm

Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction - case	$R_{th(j-c)}$		0.31	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		1.11	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		40	K/W

Electrical Characteristic, at $T_{vj} = 25^{\circ}\text{C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Static Characteristic						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0V, I_C = 0.50mA$	1200	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	$V_{GE} = 15.0V, I_C = 40.0A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 125^{\circ}C$ $T_{vj} = 175^{\circ}C$	- - -	2.05 2.50 2.70	2.40 - -	V
Diode forward voltage	V_F	$V_{GE} = 0V, I_F = 20.0A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$	- -	1.80 1.85	2.35 -	V
Diode forward voltage	V_F	$V_{GE} = 0V, I_F = 40.0A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 125^{\circ}C$ $T_{vj} = 175^{\circ}C$	- - -	2.40 2.60 2.60	3.05 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 1.00mA, V_{CE} = V_{GE}$	5.0	5.8	6.5	V
Zero gate voltage collector current	I_{CES}	$V_{CE} = 1200V, V_{GE} = 0V$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$	- -	- -	250.0 2500.0	μA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0V, V_{GE} = 20V$	-	-	600	nA
Transconductance	g_{fs}	$V_{CE} = 20V, I_C = 15.0A$	-	20.0	-	S

Electrical Characteristic, at $T_{vj} = 25^{\circ}\text{C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Dynamic Characteristic						
Input capacitance	Cies	VCE = 25V, VGE = 0V, f = 1MHz	-	2330	-	pF
Output capacitance	Coes		-	185	-	
Reverse transfer capacitance	Cres		-	130	-	
Gate charge	QG	VCC = 960V, IC = 40.0A, VGE = 15V	-	185.0	-	nC

Internal emitter inductance measured 5mm (0.197 in.) from case	LE		-	13.0	-	nH
Short circuit collector current Max. 1000 short circuits Time between short circuits: $\geq 1.0s$	IC(SC)	VGE = 15.0V, VCC $\leq$ 600V, tSC $\leq 10\mu s$ TVj = 175°C	-	139	-	A

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at $T_{vj} = 25^{\circ}\text{C}$						
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 25^{\circ}\text{C}$, $V_{CC} = 600\text{V}$, $I_C = 40.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(on)} = 12.0\Omega$, $R_{G(off)} = 12.0\Omega$, $L_{\sigma} = 70\text{nH}$, $C_{\sigma} = 67\text{pF}$ Energy losses include “tail” and diode reverse recovery.	-	30	-	ns
Rise time	t_r		-	57	-	ns
Turn-off delay time	$t_{d(off)}$		-	290	-	ns
Fall time	t_f		-	16	-	ns
Turn-on energy	E_{on}		-	3.20	-	mJ
Turn-off energy	E_{off}		-	1.20	-	mJ
Total switching energy	E_{ts}		-	4.40	-	mJ
Diode Characteristic, at $T_{vj} = 25^{\circ}\text{C}$						
Diode reverse recovery time	t_{rr}	$T_{vj} = 25^{\circ}\text{C}$, $V_R = 600\text{V}$, $I_F = 40.0\text{A}$, $dI_F/dt = 500\text{A}/\mu\text{s}$	-	355	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.90	-	μC
Diode peak reverse recovery current	I_{rrm}		-	12.8	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-150	-	A/ μs

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at $T_{vj} = 175^{\circ}\text{C}$						
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 175^{\circ}\text{C}$, $V_{CC} = 600\text{V}$, $I_C = 40.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(on)} = 12.0\Omega$, $R_{G(off)} = 12.0\Omega$, $L_{\sigma} = 70\text{nH}$, $C_{\sigma} = 67\text{pF}$ L_{σ} , C_{σ} from Fig. E Energy losses include “tail” and diode reverse recovery.	-	29	-	ns
Rise time	t_r		-	49	-	ns
Turn-off delay time	$t_{d(off)}$		-	366	-	ns
Fall time	t_f		-	48	-	ns
Turn-on energy	E_{on}		-	4.40	-	mJ
Turn-off energy	E_{off}		-	2.60	-	mJ
Total switching energy	E_{ts}		-	7.00	-	mJ
Diode Characteristic, at $T_{vj} = 175^{\circ}\text{C}$						
Diode reverse recovery time	t_{rr}	$T_{vj} = 175^{\circ}\text{C}$, $V_R = 600\text{V}$, $I_F = 40.0\text{A}$, $di_F/dt = 500\text{A}/\mu\text{s}$	-	639	-	ns
Diode reverse recovery charge	Q_{rr}		-	4.30	-	μC
Diode peak reverse recovery current	I_{rrm}		-	16.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	dI_{rr}/dt		-	-105	-	A/ μs

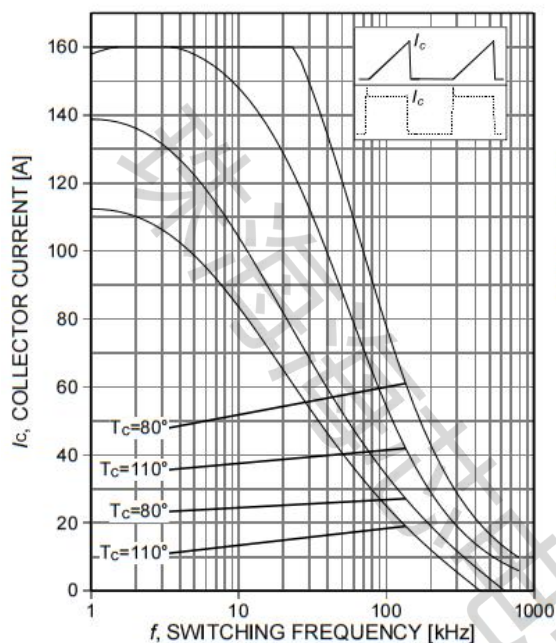


Figure 1. Collector current as a function of switching frequency
($T_j \leq 175^\circ\text{C}$, $D=0.5$, $V_{CE}=600\text{V}$, $V_{GE}=15/0\text{V}$, $r_G=12\Omega$)

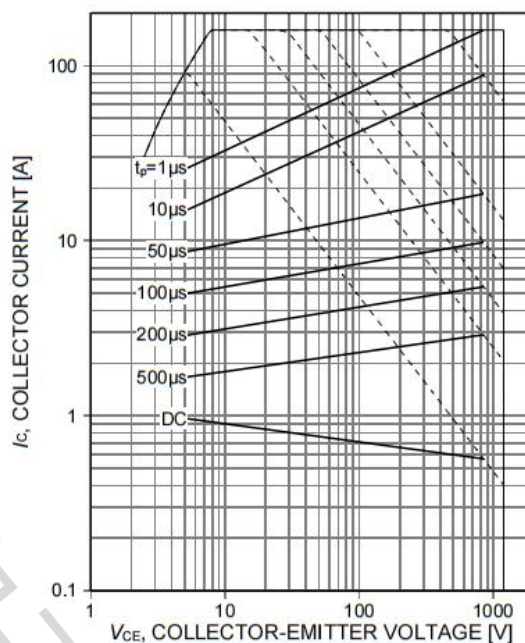


Figure 2. Forward bias safe operating area
($D=0$, $T_c=25^\circ\text{C}$, $T_j \leq 175^\circ\text{C}$; $V_{GE}=15\text{V}$)

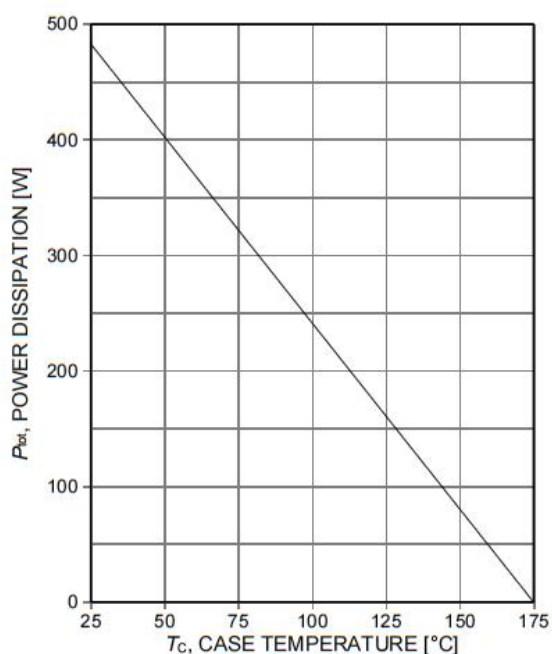


Figure 3. Power dissipation as a function of case temperature
($T_j \leq 175^\circ\text{C}$)

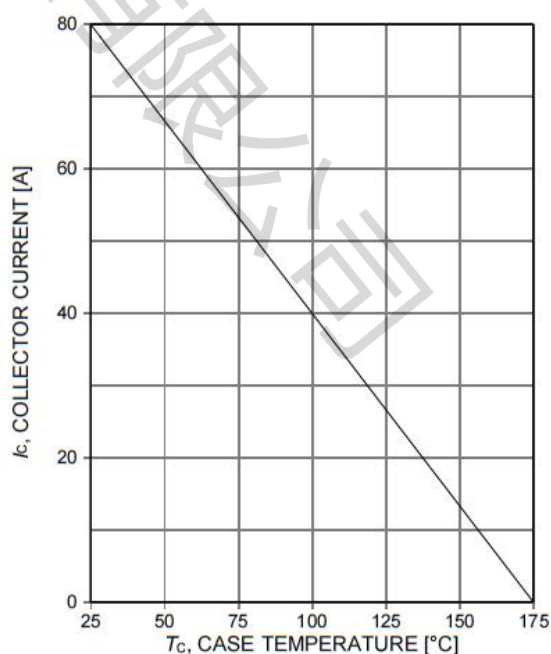


Figure 4. Collector current as a function of case temperature
($V_{GE} \geq 15\text{V}$, $T_j \leq 175^\circ\text{C}$)

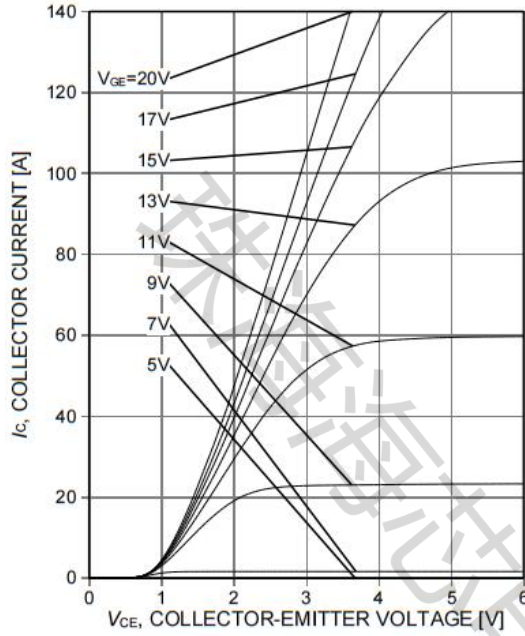


Figure 5. Typical output characteristic
($T_j=25^\circ\text{C}$)

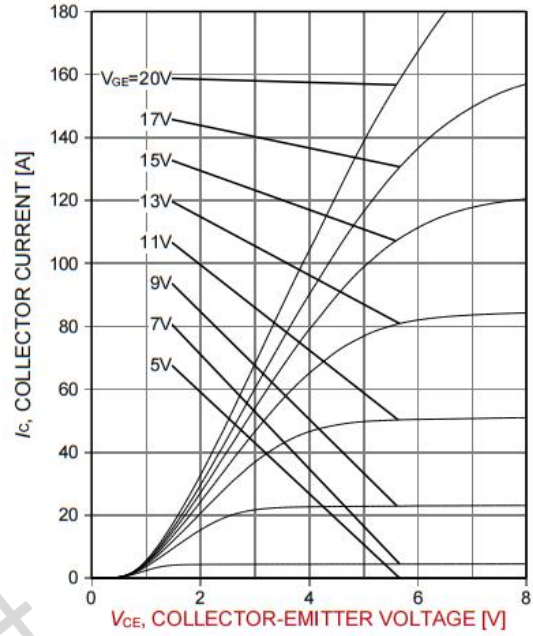


Figure 6. Typical output characteristic
($T_j=175^\circ\text{C}$)

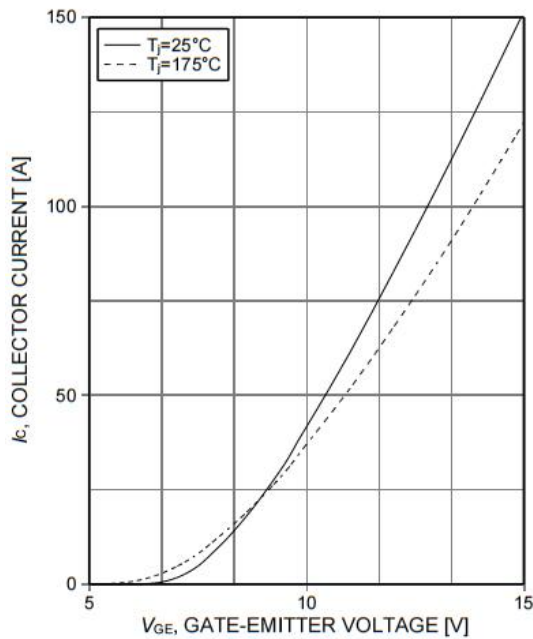


Figure 7. Typical transfer characteristic
($V_{CE}=20\text{V}$)

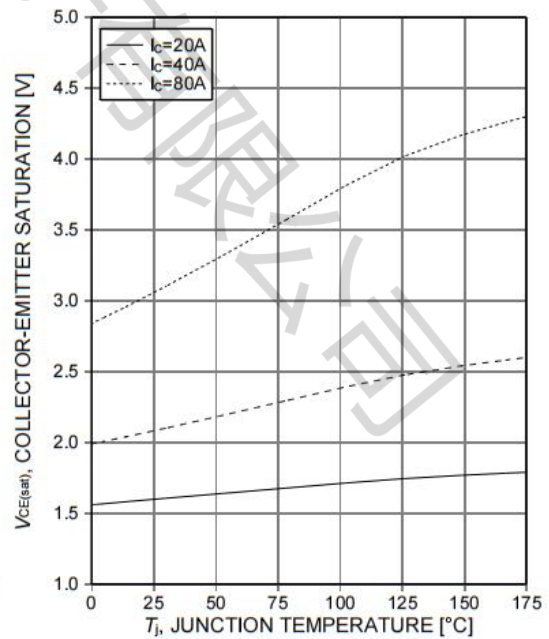


Figure 8. Typical collector-emitter saturation voltage as
a function of junction temperature

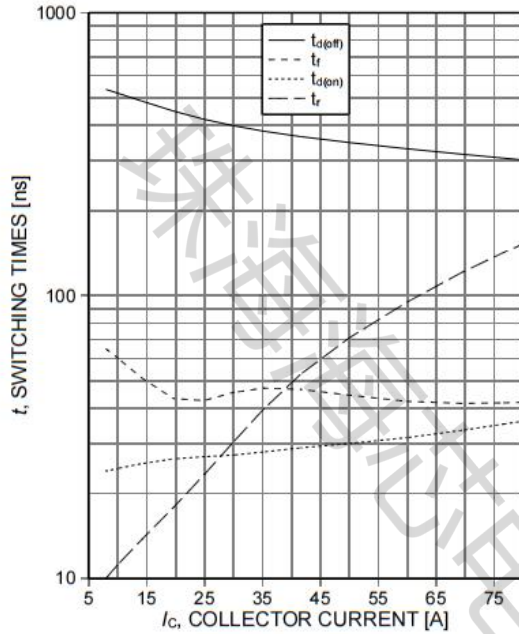


Figure 9. Typical switching times as a function of collector current
(ind. load, $T_j=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=15/0\text{V}$, $r_G=12\Omega$, test circuit in Fig. E)

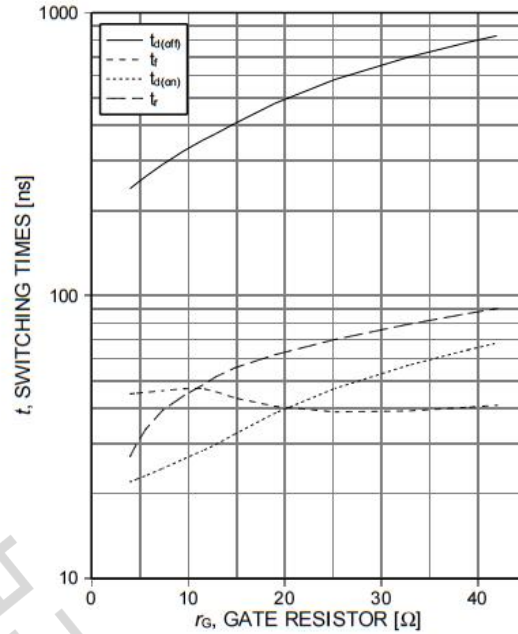


Figure 10. Typical switching times as a function of gate resistor
(ind. load, $T_j=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=15/0\text{V}$, $I_c=40\text{A}$, test circuit in Fig. E)

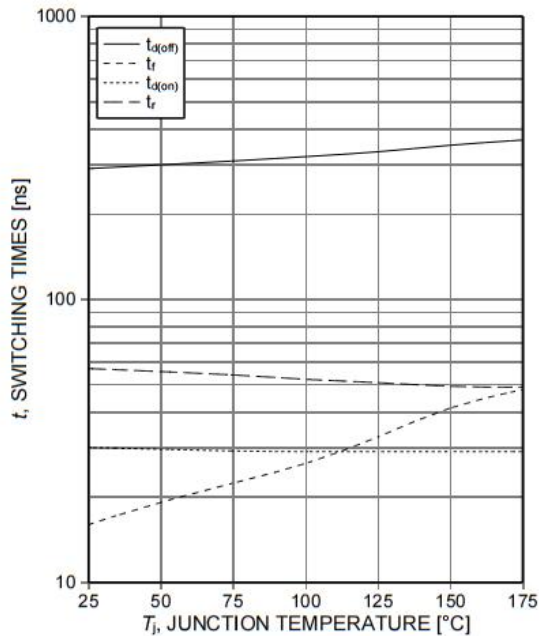


Figure 11. Typical switching times as a function of junction temperature
(ind. load, $V_{CE}=600\text{V}$, $V_{GE}=15/0\text{V}$, $I_c=40\text{A}$, $r_G=12\Omega$, test circuit in Fig. E)

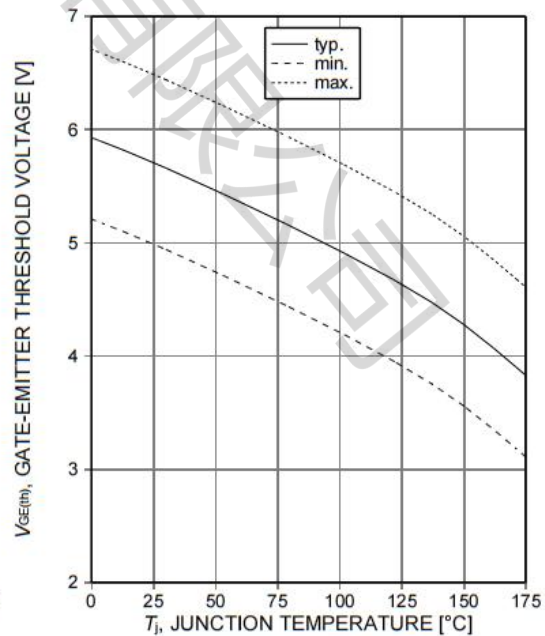


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
($I_c=1\text{mA}$)

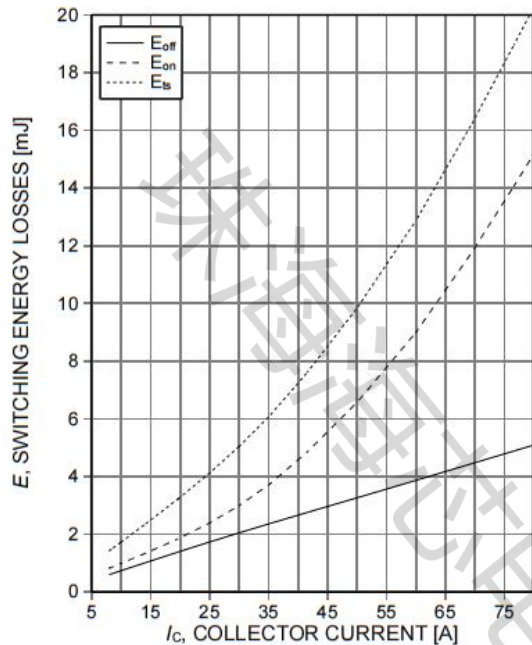


Figure 13. Typical switching energy losses as a function of collector current (ind. load, $T_j=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=15/0\text{V}$, $r_G=12\Omega$, test circuit in Fig. E)

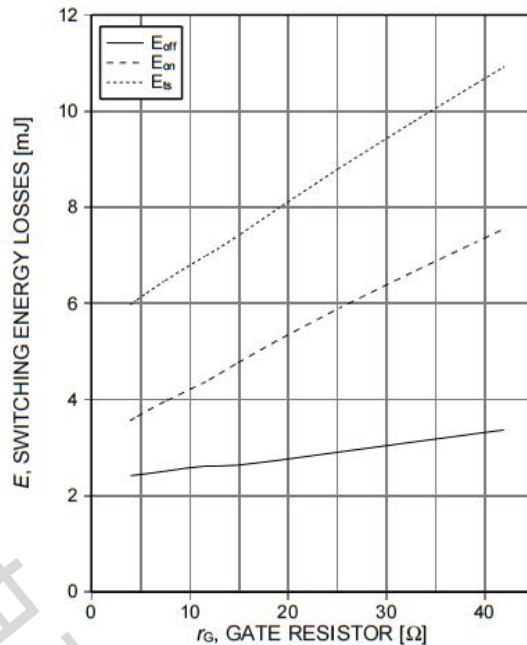


Figure 14. Typical switching energy losses as a function of gate resistor (ind. load, $T_j=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=40\text{A}$, test circuit in Fig. E)

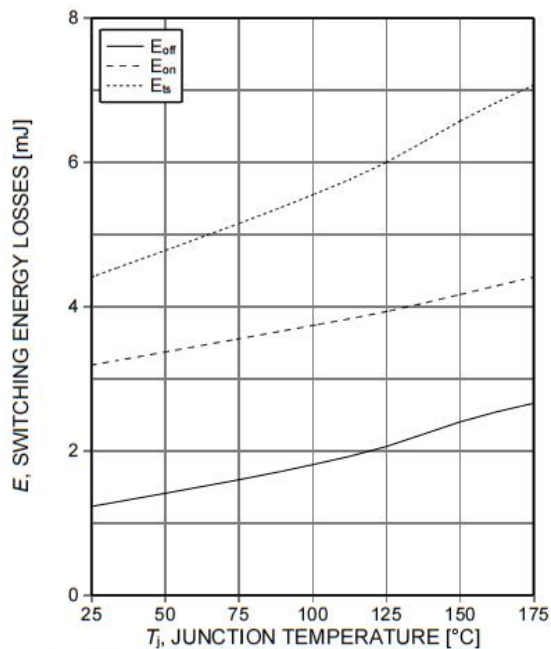


Figure 15. Typical switching energy losses as a function of junction temperature (ind. load, $V_{CE}=600\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=40\text{A}$, $r_G=12\Omega$, test circuit in Fig. E)

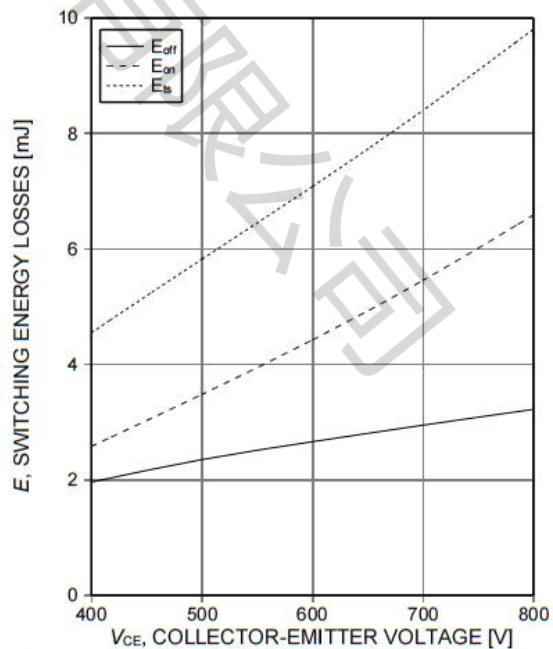


Figure 16. Typical switching energy losses as a function of collector emitter voltage (ind. load, $T_j=175^\circ\text{C}$, $V_{GE}=15/0\text{V}$, $I_C=40\text{A}$, $r_G=12\Omega$, test circuit in Fig. E)

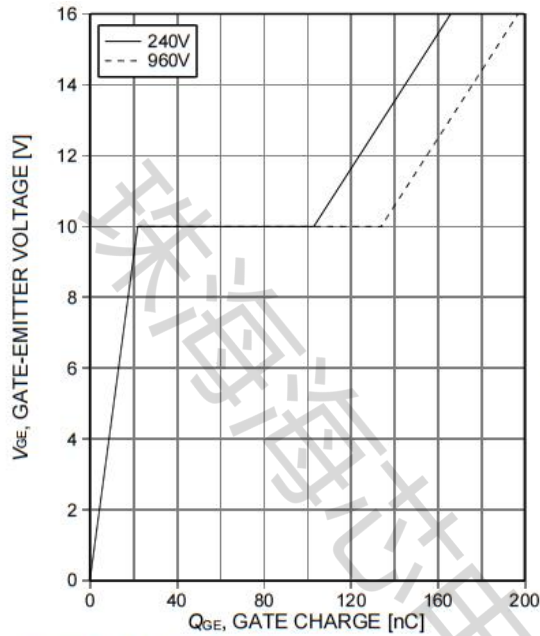


Figure 17. Typical gate charge
($I_C=40A$)

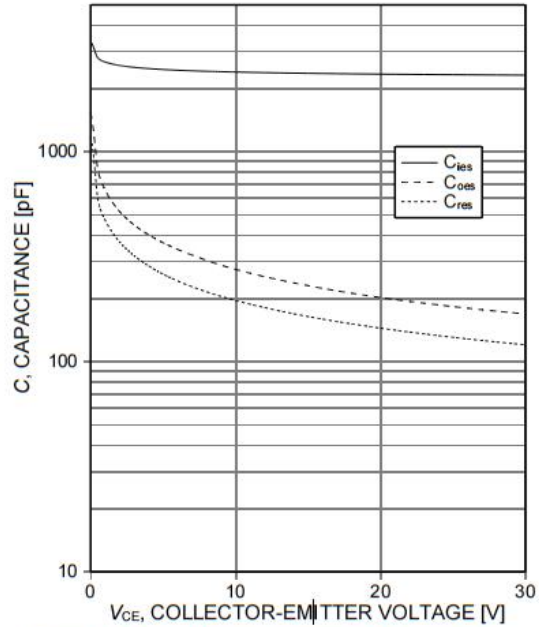


Figure 18. Typical capacitance as a function of collector-emitter voltage
($V_{GE}=0V$, $f=1MHz$)

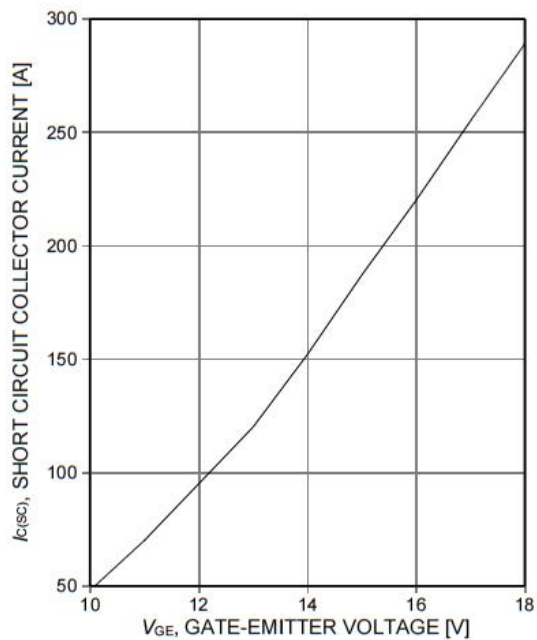


Figure 19. Typical short circuit collector current as a function of gate-emitter voltage
($V_{CE} \leq 600V$, start at $T_J=25^\circ C$)

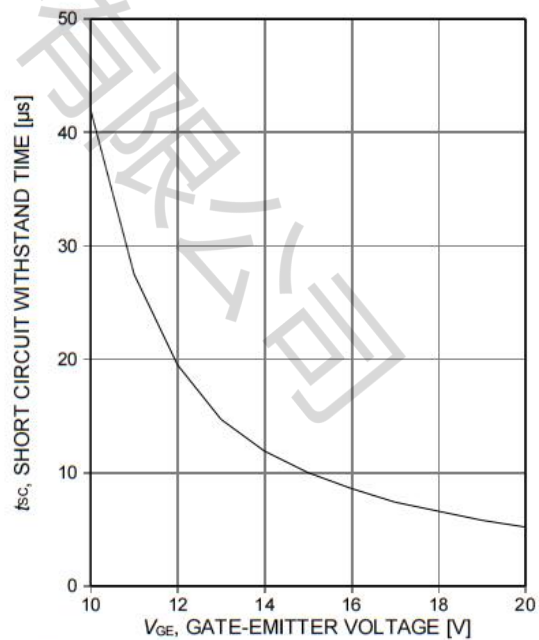


Figure 20. Short circuit withstand time as a function of gate-emitter voltage
($V_{CE} \leq 600V$, start at $T_J \leq 150^\circ C$)

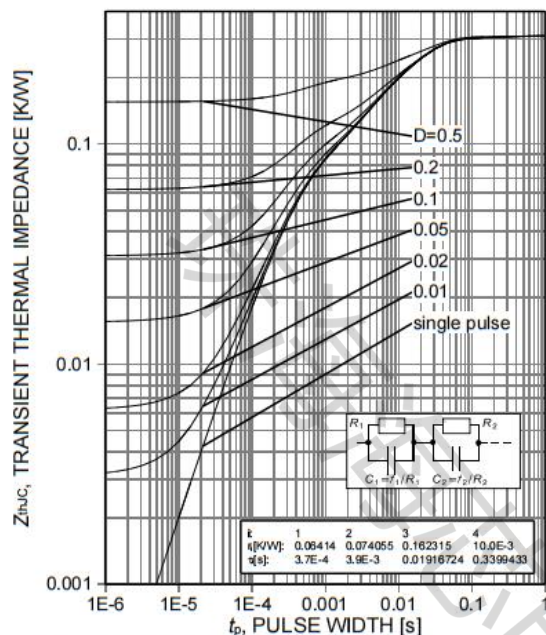


Figure 21. IGBT transient thermal impedance ($D=t_p/T$)

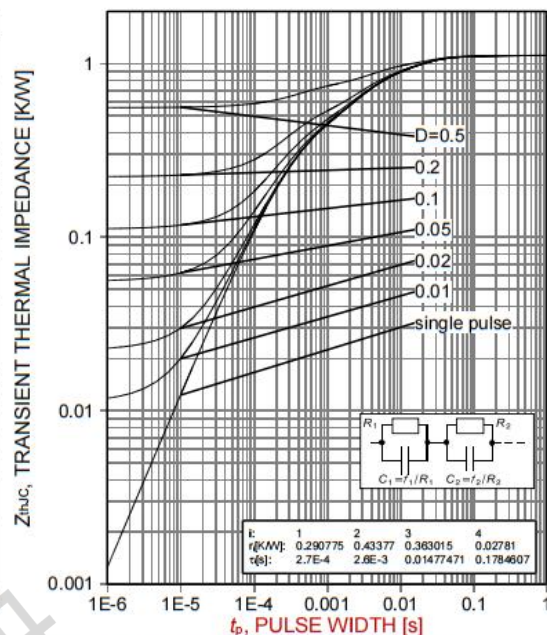


Figure 22. Diode transient thermal impedance as a function of pulse width ($D=t_p/T$)

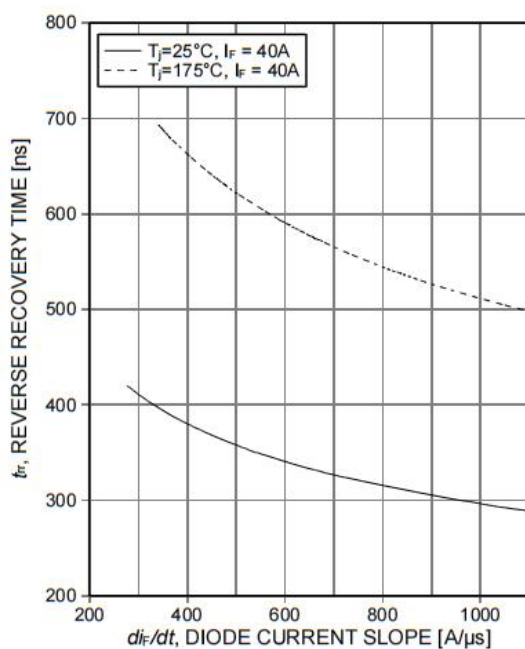


Figure 23. Typical reverse recovery time as a function of diode current slope ($V_R=600V$)

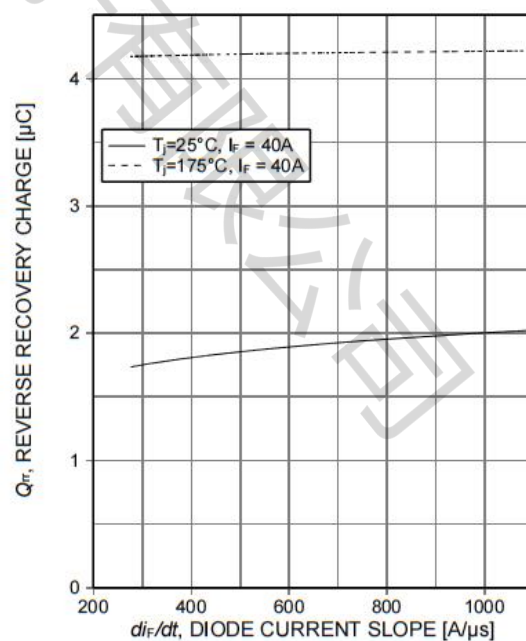


Figure 24. Typical reverse recovery charge as a function of diode current slope ($V_R=600V$)

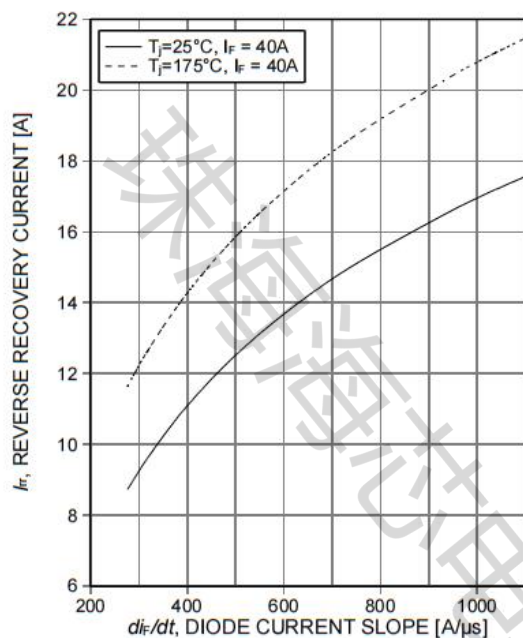


Figure 25. Typical reverse recovery current as a function of diode current slope ($V_R=600V$)

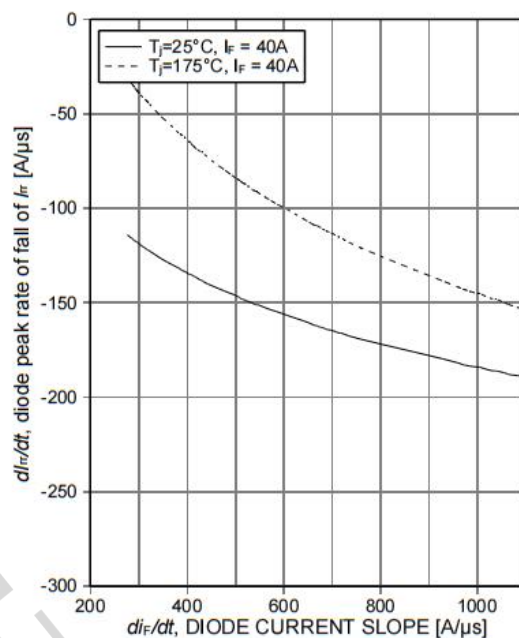


Figure 26. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope ($V_R=600V$)

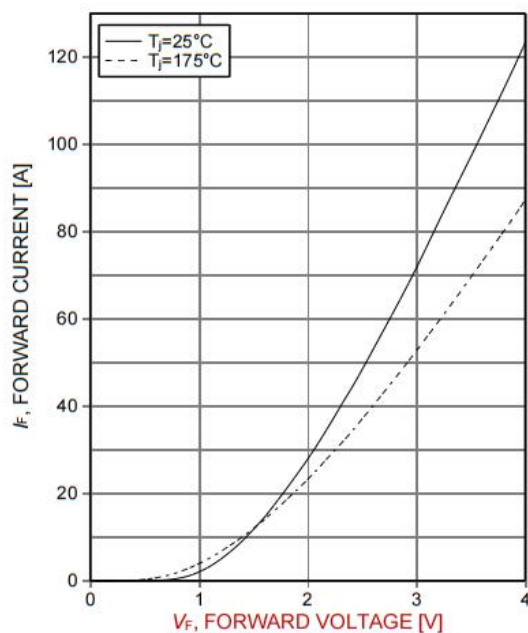


Figure 27. Typical diode forward current as a function of forward voltage

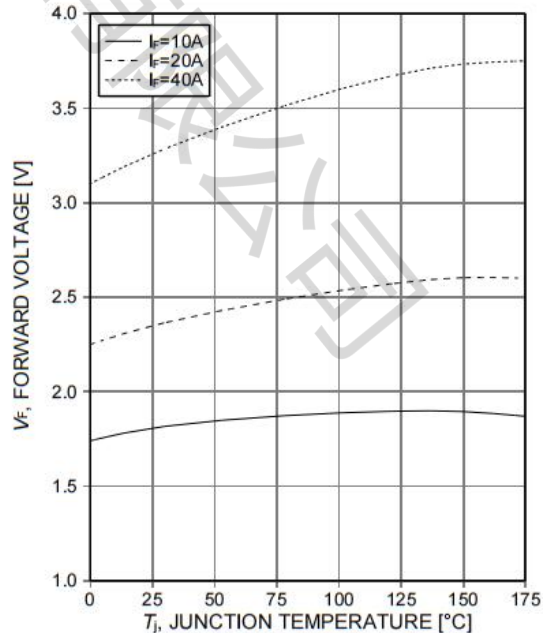
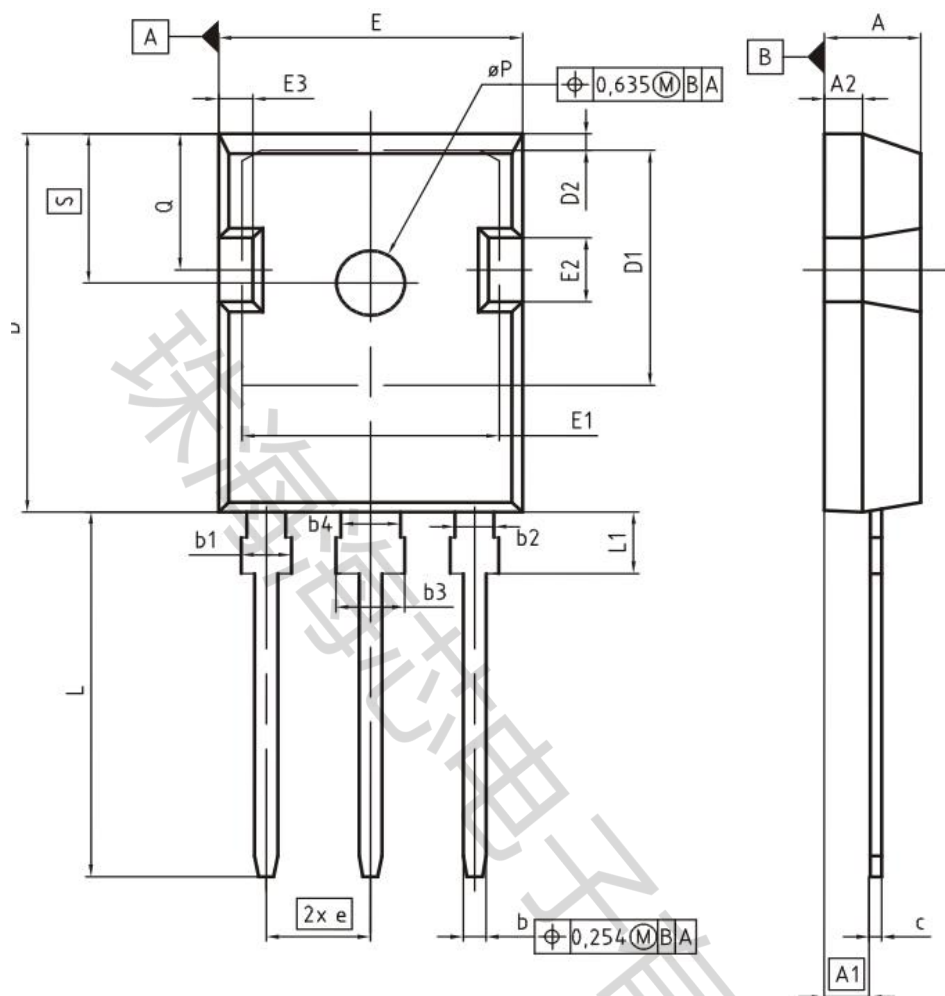


Figure 28. Typical diode forward voltage as a function of junction temperature

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DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.190	0.205
A1	2.27	2.54	0.089	0.100
A2	1.85	2.16	0.073	0.085
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	0.640	0.695
D2	0.95	1.35	0.037	0.053
E	15.70	16.13	0.618	0.635
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.00	2.60	0.039	0.102
e	5.44 (BSC)		0.214 (BSC)	
N	3		3	
L	19.80	20.32	0.780	0.800
L1	4.10	4.47	0.161	0.176
øP	3.50	3.70	0.138	0.146
Q	5.49	6.00	0.216	0.236
S	6.04	6.30	0.238	0.248

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