

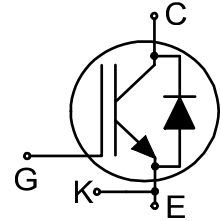
High speed switching series third generation IGBT

Low switching losses IGBT in Highspeed3 technology copacked with soft, fast recovery full current rated anti-parallel Emitter Controlled diode

Features:

High speed H3 technology offers:

- Ultra-low loss switching losses thanks to Kelvin emitter pin package in combination with High speed H3 technology
- High efficiency in hard switching and resonant topologies
- 10µsec short circuit withstand time at $T_{vj}=175^{\circ}\text{C}$
- Easy paralleling capability due to positive temperature coefficient in $V_{CE(sat)}$
- Low EMI
- Low Gate Charge Q_G
- Very soft, fast recovery full current anti-parallel diode
- Maximum junction temperature 175°C
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models:
<http://www.infineon.com/igbt/>

**Applications:**

- Industrial UPS
- Charger
- Energy Storage
- Three-level Solar String Inverter

Product Validation:

Qualified for industrial applications according to the relevant tests of JEDEC47/20/22

**Key Performance and Package Parameters**

Type	V_{CE}	I_C	$V_{CEsat}, T_{vj}=25^{\circ}\text{C}$	T_{vjmax}	Marking	Package
IKY40N120CH3	1200V	40A	2V	175°C	K40MCH3	PG-TO247-4-2

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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, $T_{vj} \geq 25^{\circ}\text{C}$	V_{CE}	1200	V
DC collector current, limited by T_{vjmax} $T_c = 25^{\circ}\text{C}$ value limited by bondwire $T_c = 134^{\circ}\text{C}$	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 $V_{CE} \leq 1200\text{V}$, $T_{vj} \leq 175^{\circ}\text{C}$, $t_p = 1\mu\text{s}$	-	160.0	A
Diode forward current, limited by T_{vjmax} $T_c = 25^{\circ}\text{C}$ value limited by bondwire $T_c = 100^{\circ}\text{C}$	I_F	80.0 40.0	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	160.0	A
Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 10\mu\text{s}$, $D < 0.010$)	V_{GE}	± 20 ± 30	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 $T_c = 134^{\circ}\text{C}$	P_{tot}	500.0 136.0	W
Operating junction temperature	T_{vj}	$-40...+175$	$^{\circ}\text{C}$
Storage temperature	T_{stg}	$-55...+150$	$^{\circ}\text{C}$
Soldering temperature, wave soldering 1.6mm (0.063in.) from case for 10s		260	$^{\circ}\text{C}$

Thermal Resistance

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	

R_{th} Characteristics

IGBT thermal resistance, junction - case	$R_{th(j-c)}$		-	-	0.30	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		-	-	0.50	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		-	-	40	K/W

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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}	$V_{GE} = 15.0V, I_C = 40.0A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$	- -	2.00 2.50	2.35 -	V
Diode forward voltage	V_F	$V_{GE} = 0V, I_F = 40.0A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$	- -	1.90 1.85	2.30 -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 1.50mA, V_{CE} = V_{GE}$	5.1	5.8	6.5	V
Zero gate voltage collector current	I_{CES}	$V_{CE} = 1200V, V_{GE} = 0V$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$	- -	- 3000	250 -	μA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0V, V_{GE} = 20V$	-	-	100	nA
Transconductance	g_{fs}	$V_{CE} = 20V, I_C = 40.0A$	-	14.0	-	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	C _{ies}	V _{CE} = 25V, V _{GE} = 0V, f = 1MHz	-	2385	-	pF
Output capacitance	C _{oes}		-	235	-	
Reverse transfer capacitance	C _{res}		-	132	-	
Gate charge	Q _G	V _{CC} = 960V, I _C = 40.0A, V _{GE} = 15V	-	190.0	-	nC

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	$t_{d(\text{on})}$	$T_{vj} = 25^{\circ}\text{C},$ $V_{CC} = 600\text{V}, I_C = 40.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(\text{on})} = 12.0\Omega, R_{G(\text{off})} = 12.0\Omega,$ $L\sigma = 70\text{nH}, C\sigma = 67\text{pF}$ $L\sigma, C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	30	-	ns
Rise time	t_r		-	29	-	ns
Turn-off delay time	$t_{d(\text{off})}$		-	280	-	ns
Fall time	t_f		-	26	-	ns
Turn-on energy	E_{on}		-	2.18	-	mJ
Turn-off energy	E_{off}		-	1.30	-	mJ
Total switching energy	E_{ts}		-	3.48	-	mJ

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Diode Characteristic, at $T_{vj} = 25^{\circ}\text{C}$

Diode reverse recovery time	t_{rr}	$T_{vj} = 25^{\circ}\text{C},$ $V_R = 600\text{V},$ $I_F = 40.0\text{A},$ $di_F/dt = 600\text{A}/\mu\text{s}$	-	350	-	ns
Diode reverse recovery charge	Q_{rr}		-	3.00	-	μC
Diode peak reverse recovery current	I_{rrm}		-	22.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-188	-	$\text{A}/\mu\text{s}$

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	$t_{d(on)}$	$T_{vj} = 175^{\circ}\text{C},$ $V_{CC} = 600\text{V}, I_C = 40.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(on)} = 12.0\Omega, R_{G(off)} = 12.0\Omega,$ $L\sigma = 70\text{nH}, C\sigma = 67\text{pF}$ $L\sigma, C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	29	-	ns
Rise time	t_r		-	32	-	ns
Turn-off delay time	$t_{d(off)}$		-	375	-	ns
Fall time	t_f		-	64	-	ns
Turn-on energy	E_{on}		-	3.10	-	mJ
Turn-off energy	E_{off}		-	2.50	-	mJ
Total switching energy	E_{ts}		-	5.60	-	mJ

Diode Characteristic, at $T_{vj} = 175^{\circ}\text{C}$

Diode reverse recovery time	t_{rr}	$T_{vj} = 175^{\circ}\text{C},$ $V_R = 600\text{V},$ $I_F = 40.0\text{A},$ $di_F/dt = 600\text{A}/\mu\text{s}$	-	550	-	ns
Diode reverse recovery charge	Q_{rr}		-	7.50	-	μC
Diode peak reverse recovery current	I_{rrm}		-	30.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-142	-	$\text{A}/\mu\text{s}$

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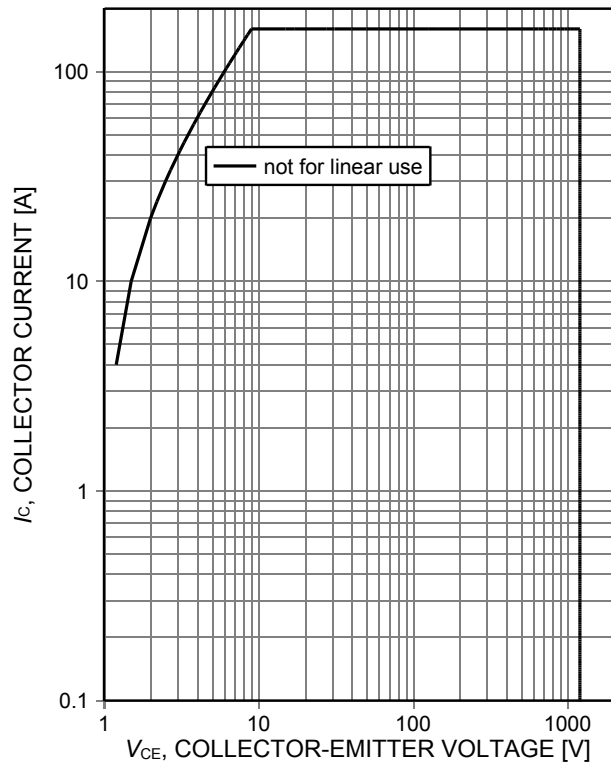


Figure 1. **Forward bias safe operating area**
($D=0$, $T_C=25^\circ\text{C}$, $T_{vj}\leq 175^\circ\text{C}$; $V_{GE}=15\text{V}$)

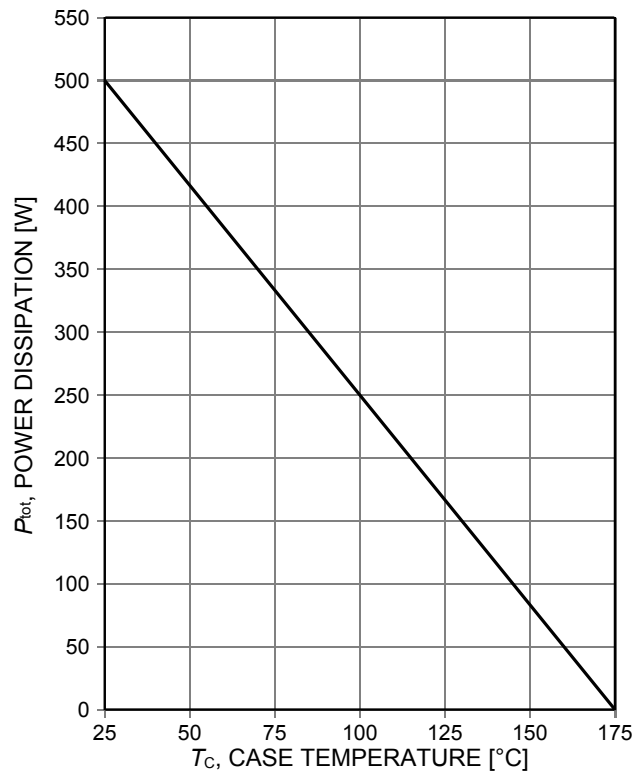


Figure 2. **Power dissipation as a function of case temperature**
($T_{vj}\leq 175^\circ\text{C}$)

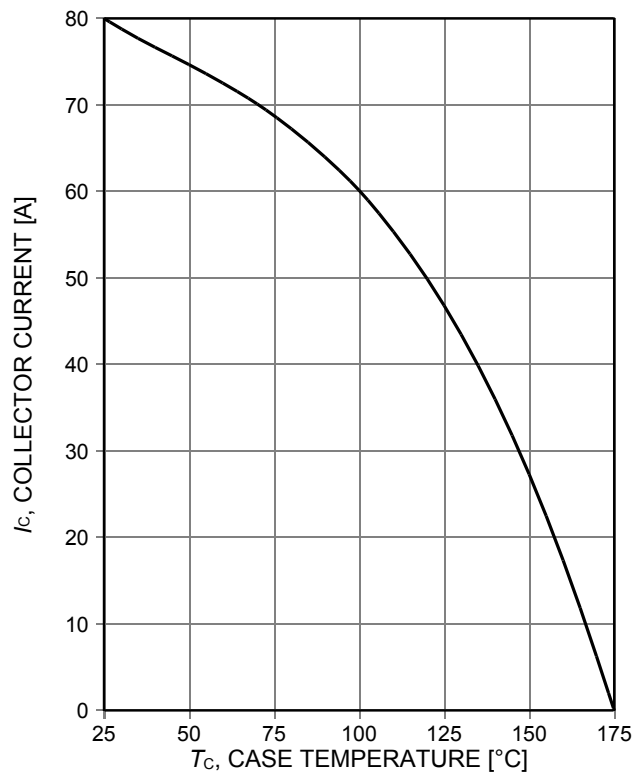


Figure 3. **Collector current as a function of case temperature**
($V_{GE}\geq 15\text{V}$, $T_{vj}\leq 175^\circ\text{C}$)

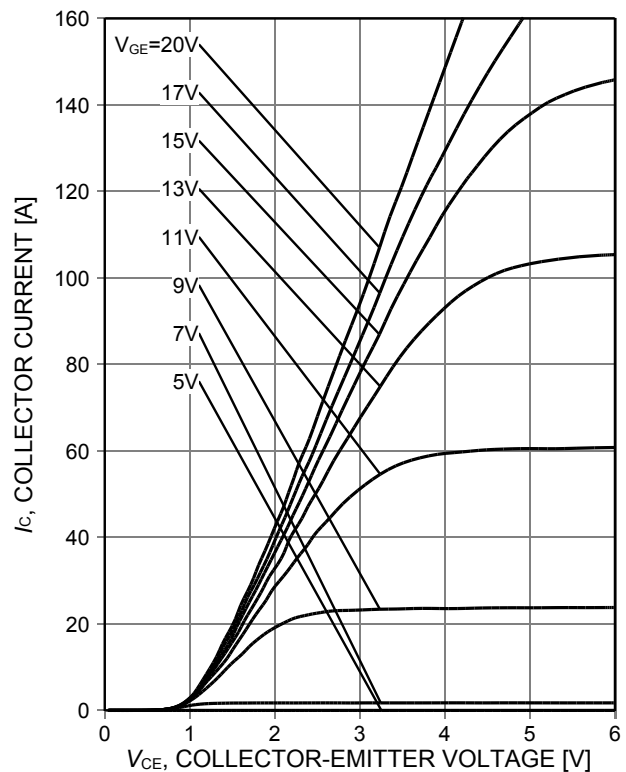


Figure 4. **Typical output characteristic**
($T_{vj}=25^\circ\text{C}$)

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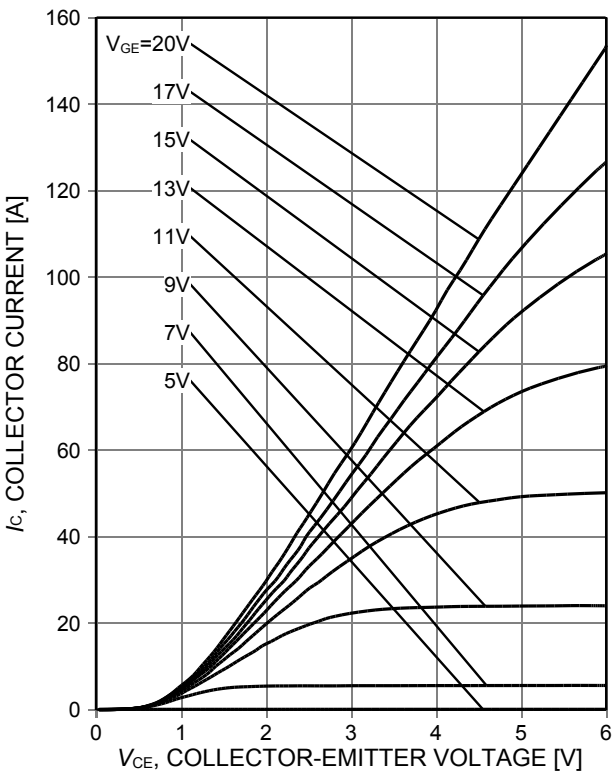


Figure 5. **Typical output characteristic**
($T_{vj}=175^{\circ}\text{C}$)

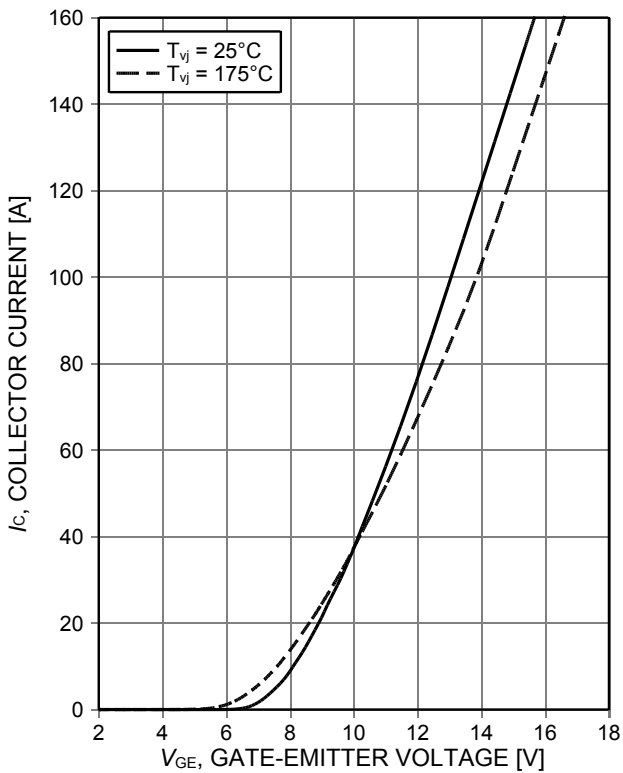


Figure 6. **Typical transfer characteristic**
($V_{ce}=20\text{V}$)

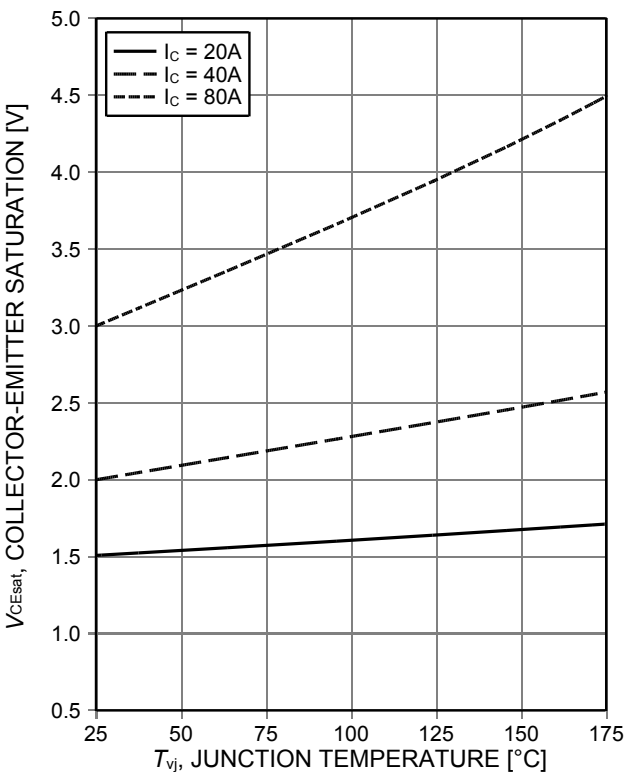


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{ge}=15\text{V}$)

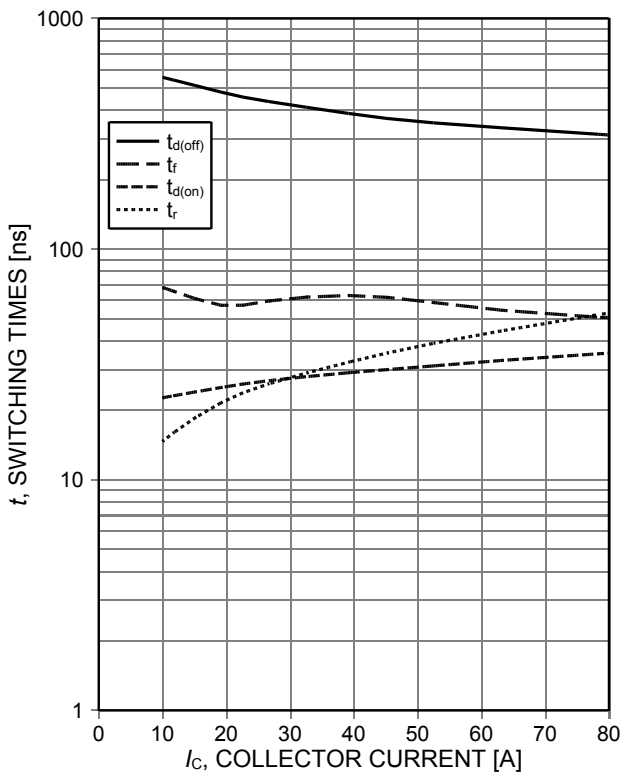


Figure 8. **Typical switching times as a function of collector current**
(inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{ce}=600\text{V}$, $V_{ge}=0/15\text{V}$, $R_G=12\Omega$, Dynamic test circuit in Figure E)

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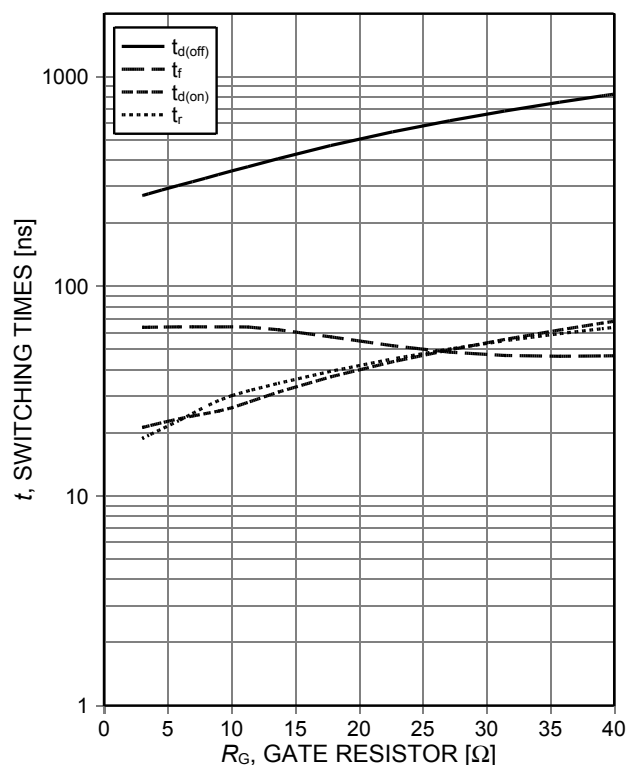


Figure 9. **Typical switching times as a function of gate resistor**
(inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, Dynamic test circuit in Figure E)

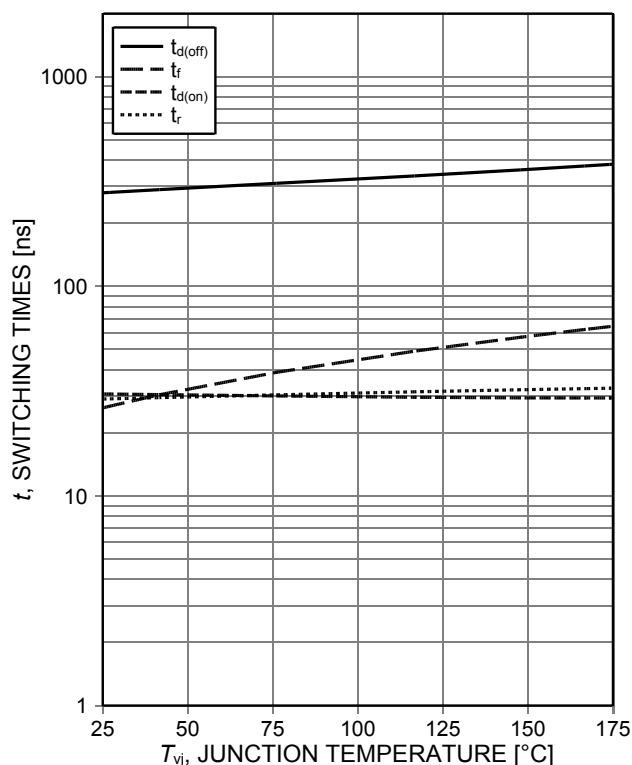


Figure 10. **Typical switching times as a function of junction temperature**
(inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, $R_G=12\Omega$, Dynamic test circuit in Figure E)

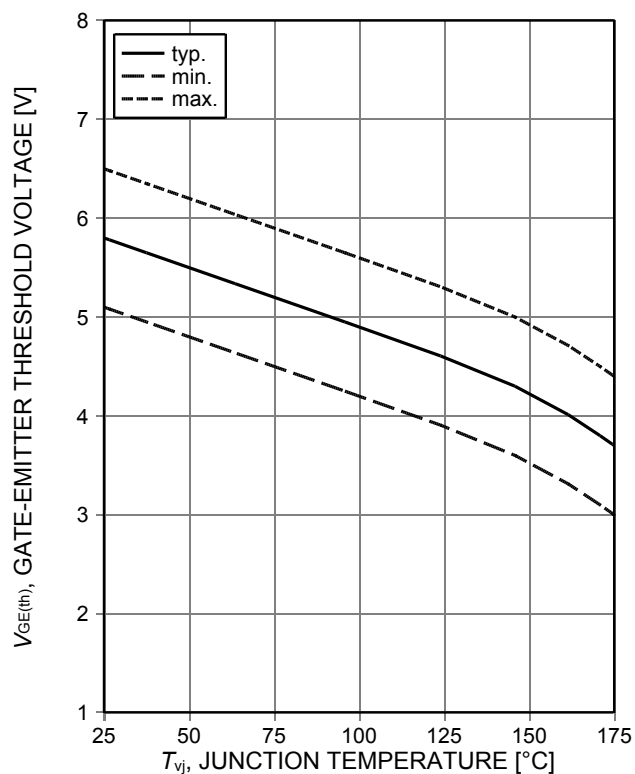


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
($I_C=1.5\text{mA}$)

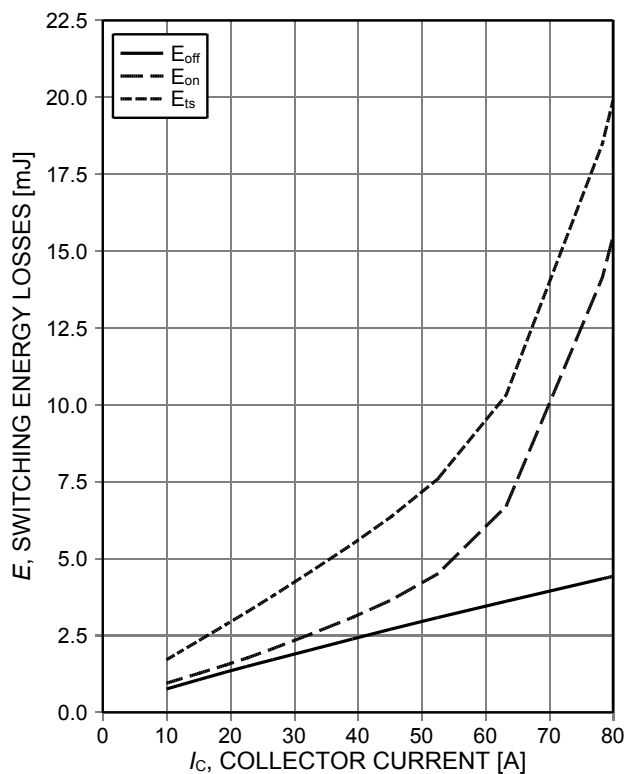


Figure 12. **Typical switching energy losses as a function of collector current**
(inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=12\Omega$, Dynamic test circuit in Figure E)

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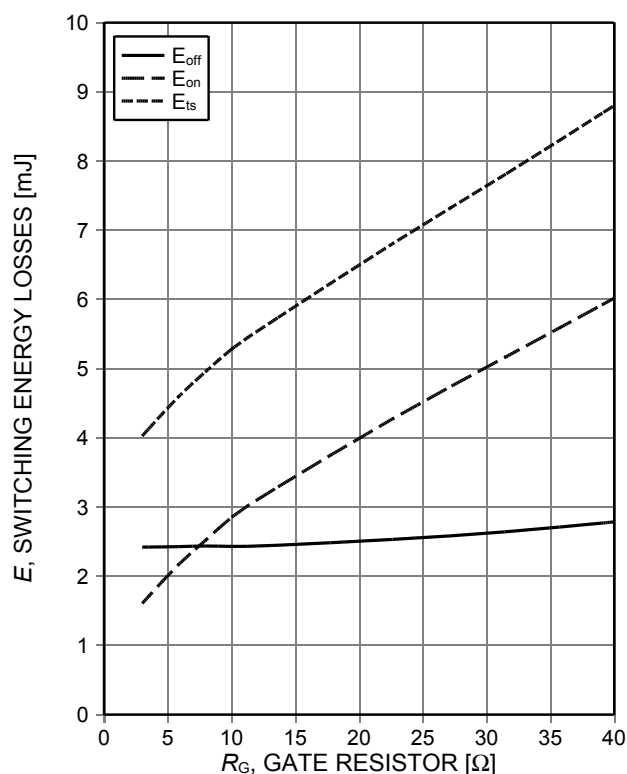


Figure 13. **Typical switching energy losses as a function of gate resistor**
(inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, Dynamic test circuit in Figure E)

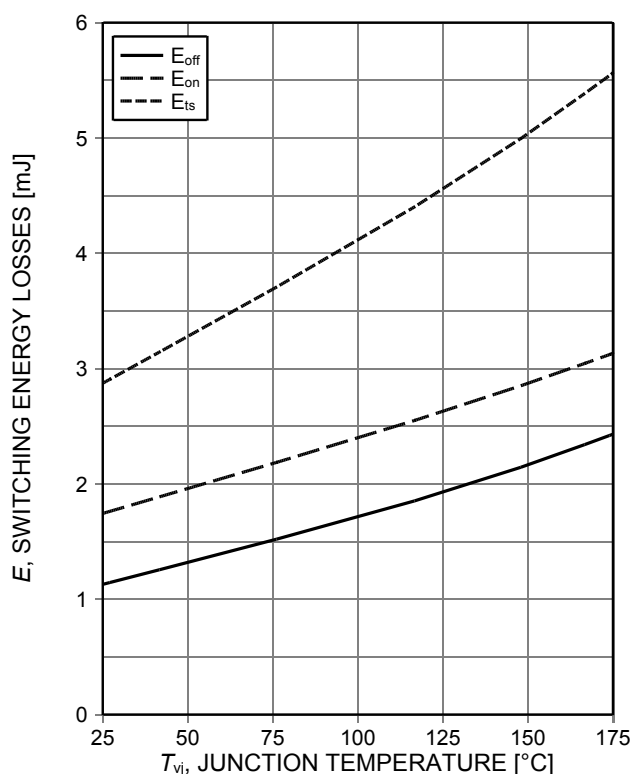


Figure 14. **Typical switching energy losses as a function of junction temperature**
(inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, $R_G=12\Omega$, Dynamic test circuit in Figure E)

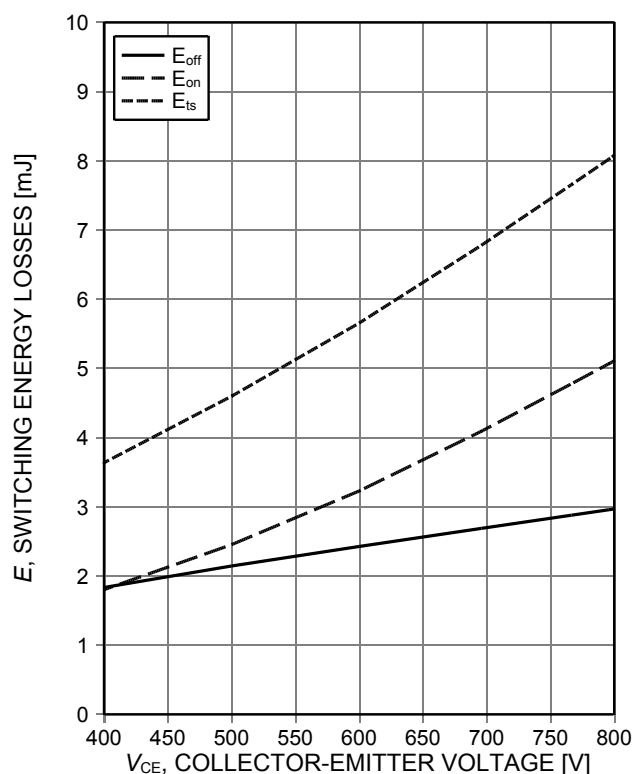


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, $R_G=12\Omega$, Dynamic test circuit in Figure E)

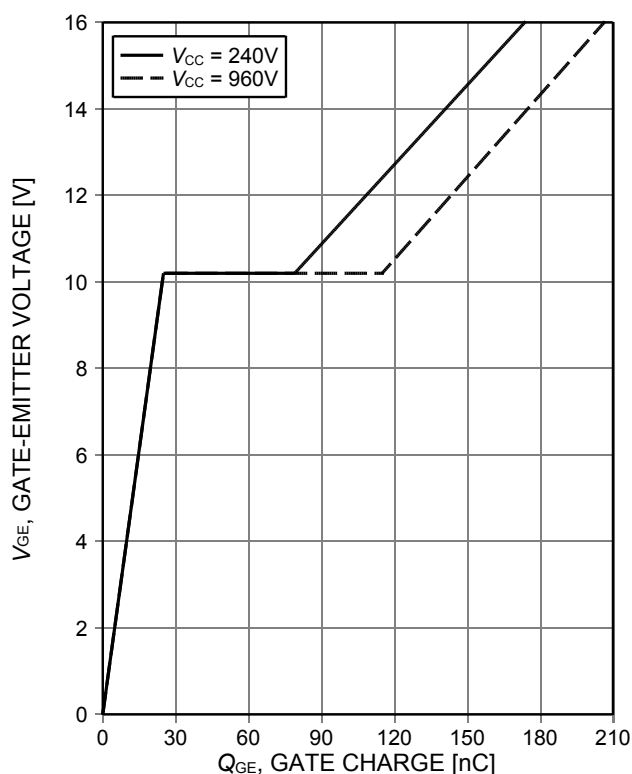


Figure 16. **Typical gate charge**
($I_C=40\text{A}$)

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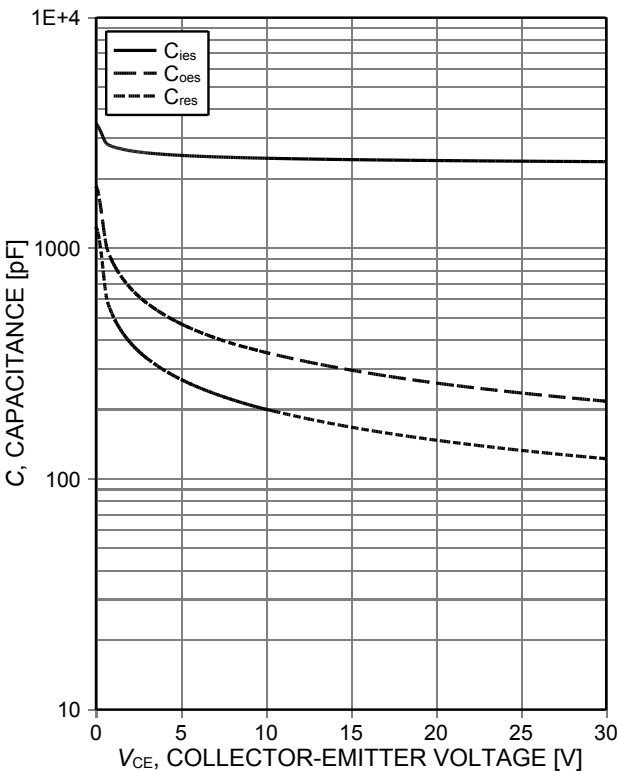


Figure 17. Typical capacitance as a function of collector-emitter voltage ($V_{GE}=0V$, $f=1MHz$)

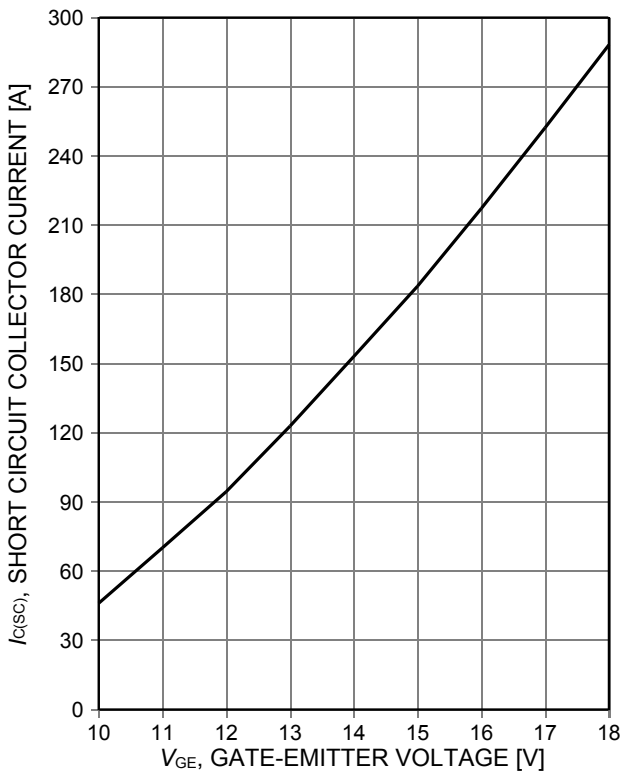


Figure 18. Typical short circuit collector current as a function of gate-emitter voltage ($V_{CE}\leq 600V$, $T_{vj}\leq 175^{\circ}C$)

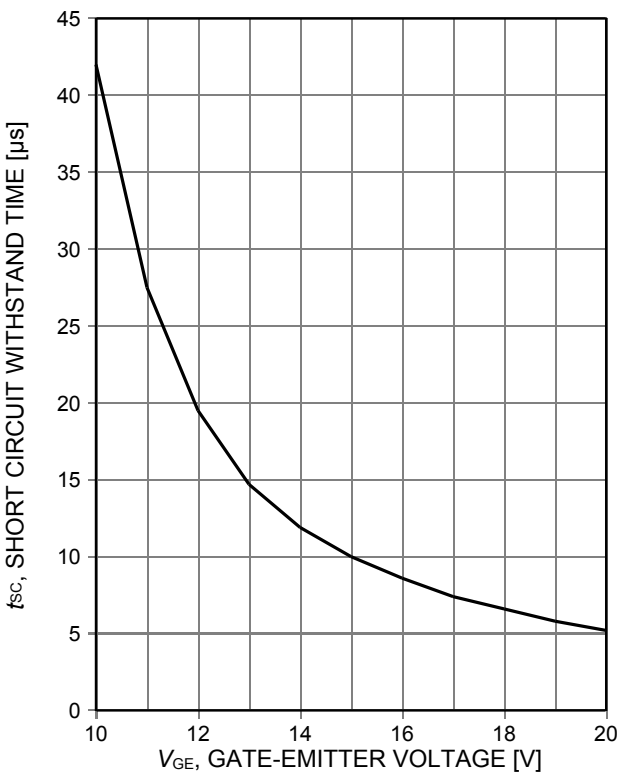


Figure 19. Short circuit withstand time as a function of gate-emitter voltage ($V_{CE}\leq 600V$, start at $T_{vj}\leq 175^{\circ}C$)

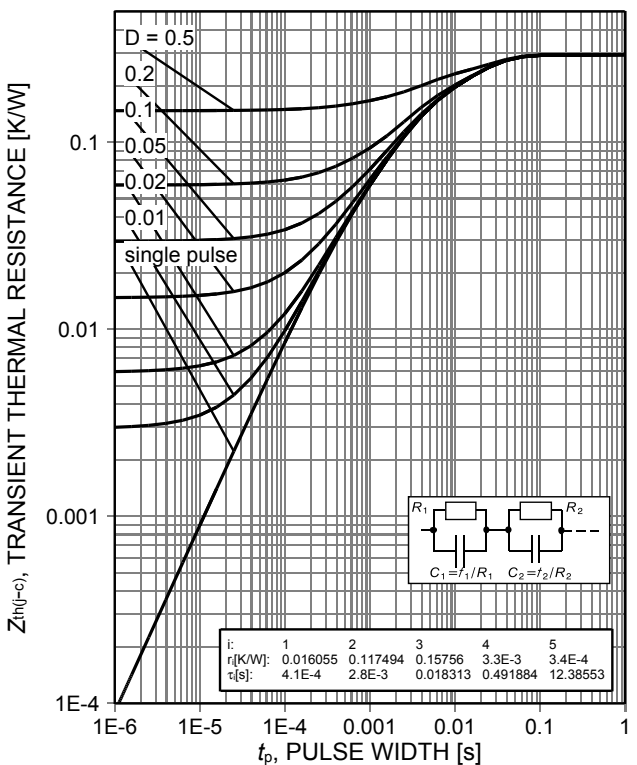


Figure 20. IGBT transient thermal resistance ($D=t_p/T$)

High speed switching series third generation IGBT

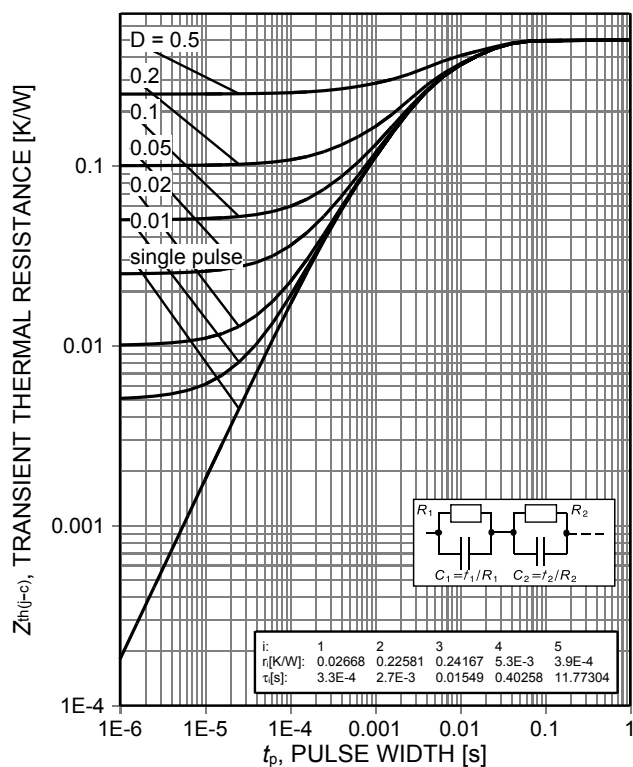


Figure 21. Diode transient thermal impedance as a function of pulse width ($D=t_p/T$)

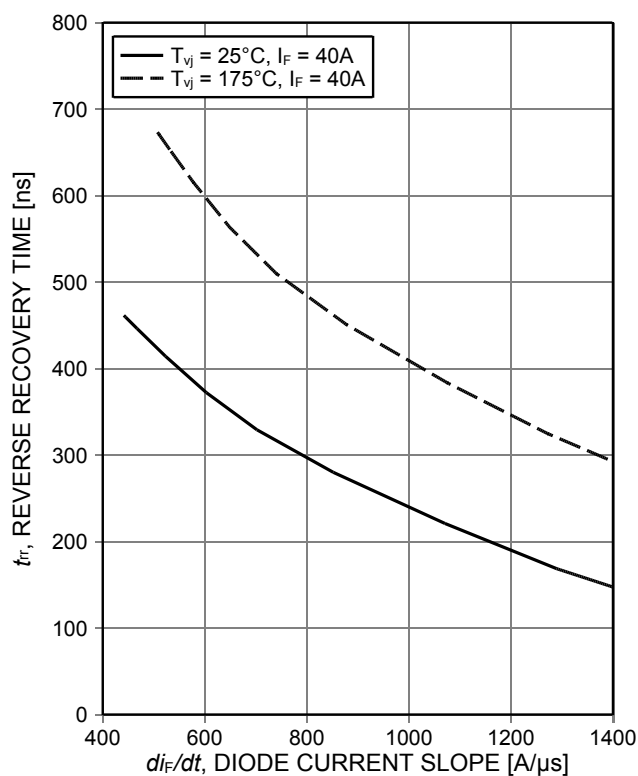


Figure 22. Typical reverse recovery time as a function of diode current slope ($V_R=600V$)

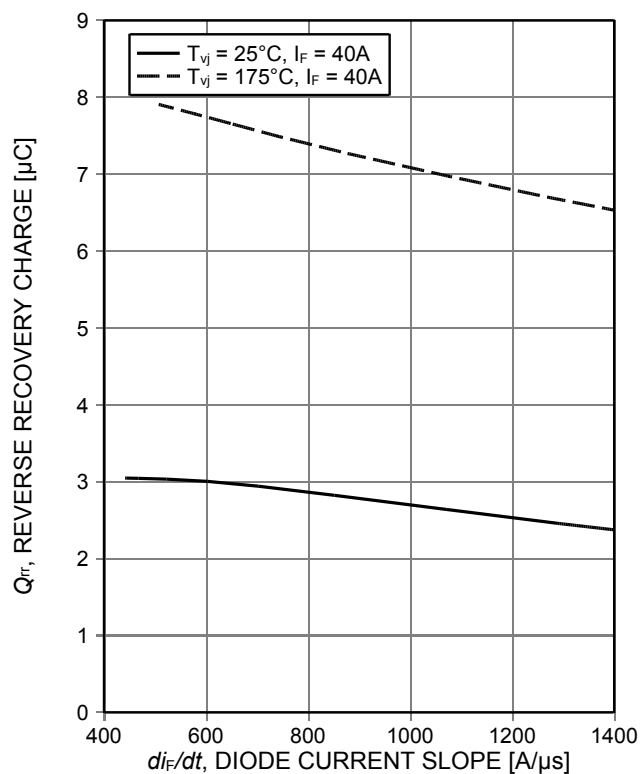


Figure 23. Typical reverse recovery charge as a function of diode current slope ($V_R=600V$)

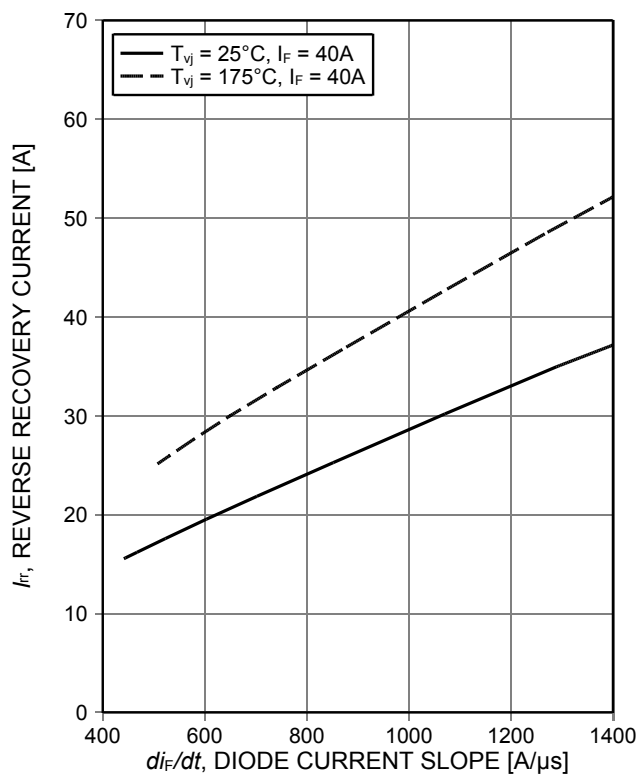


Figure 24. Typical reverse recovery current as a function of diode current slope ($V_R=600V$)

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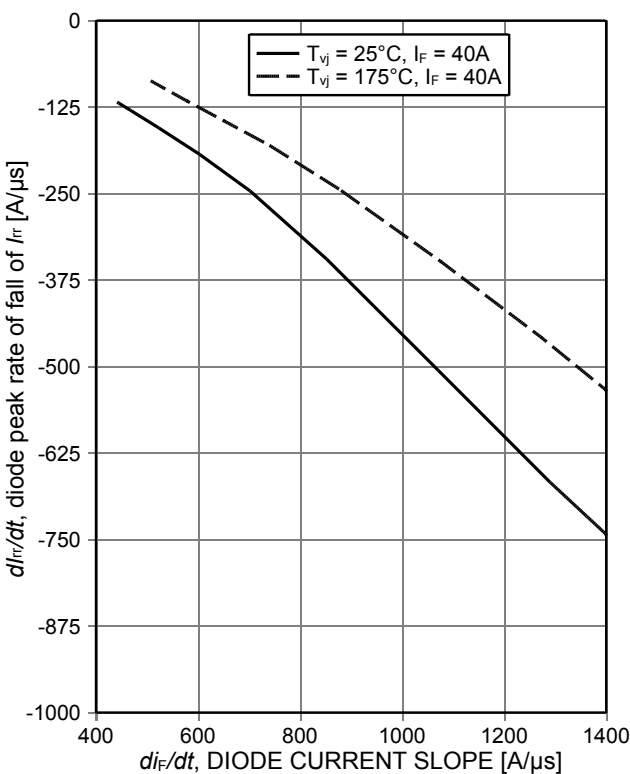


Figure 25. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope ($V_R=600\text{V}$)

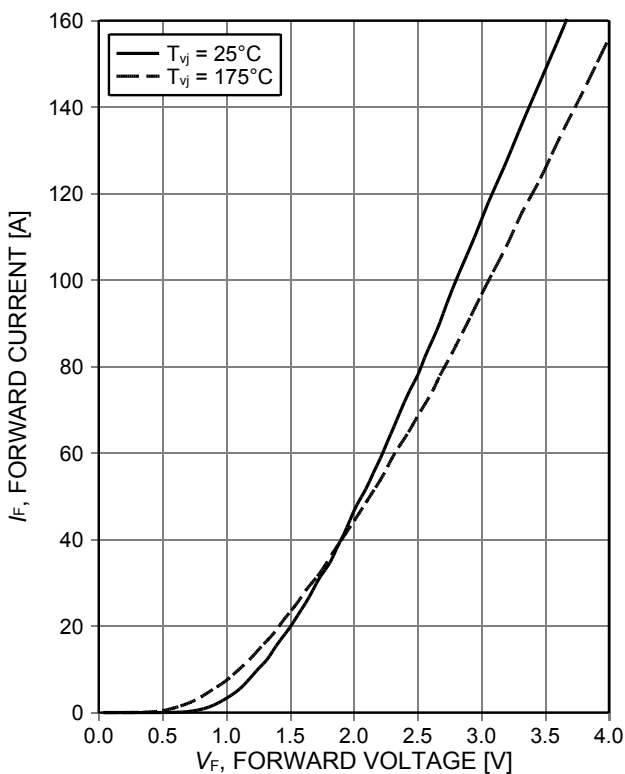


Figure 26. Typical diode forward current as a function of forward voltage

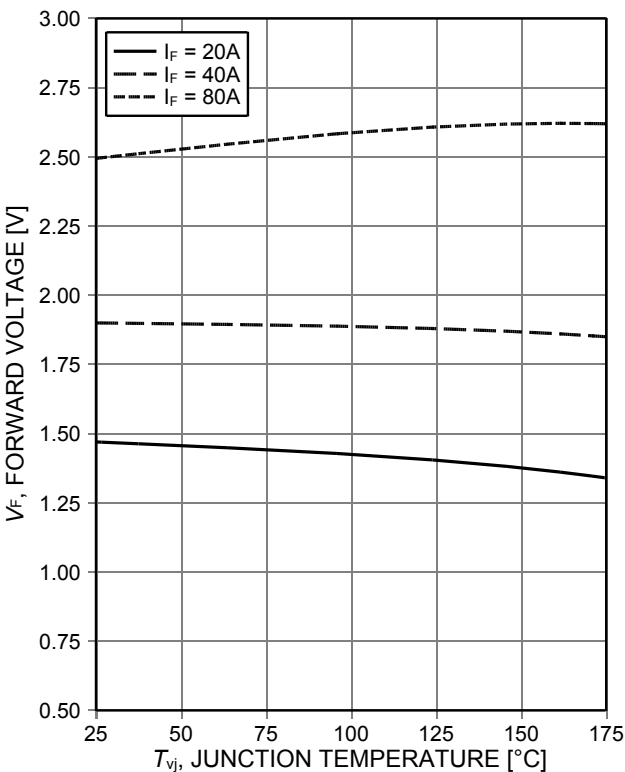
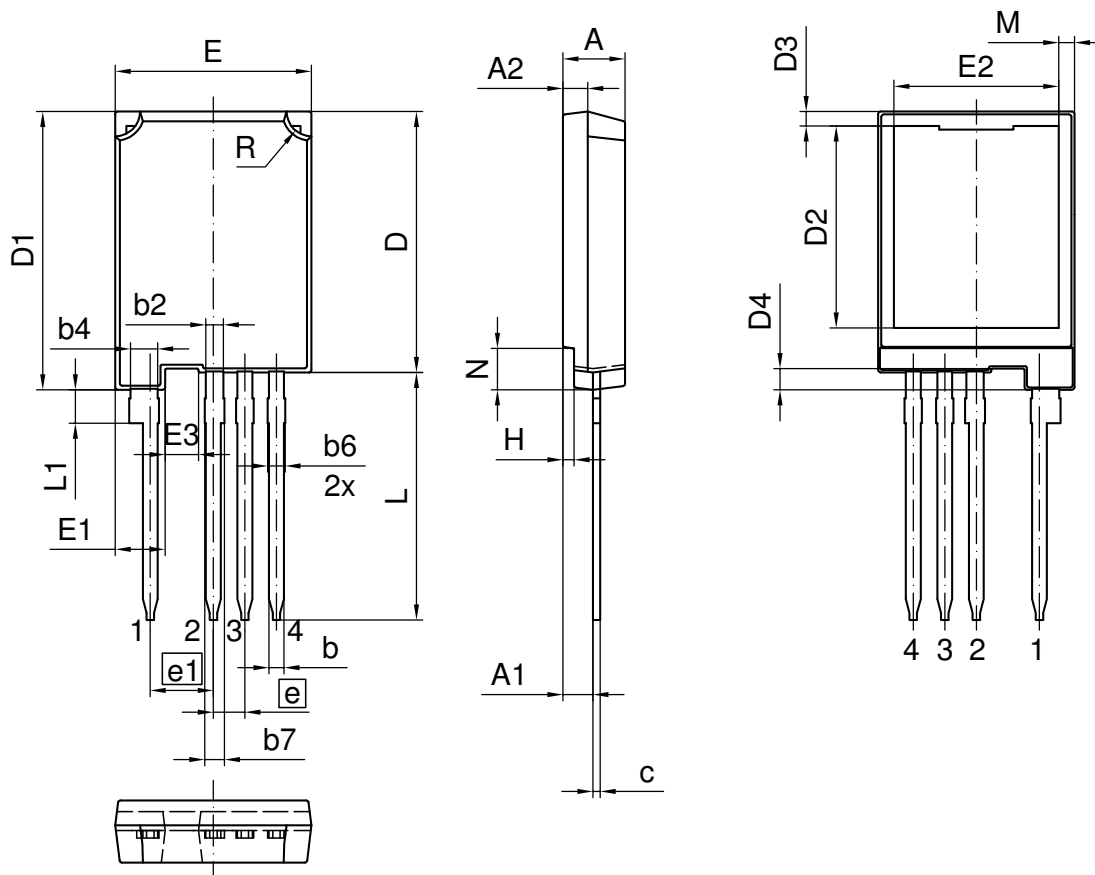


Figure 27. Typical diode forward voltage as a function of junction temperature

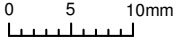
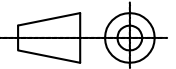
PG-TO247-4-2

**NOTES:**

PACKAGE SURFACE ROUTE BETWEEN
PIN 1 & PIN 2 WILL BE 5.1mm MIN.

ALL b... AND c DIMENSIONS INCLUDING
PLATING EXCEPT AREA OF CUTTING

DIMENSION	MILLIMETERS	
	MIN.	MAX.
A	4.9	5.1
A1	2.31	2.51
A2	1.9	2.1
b	1.16	1.29
b2	1.36	1.49
b4	2.16	2.29
b6	1.16	1.45
b7	1.16	1.65
c	0.59	0.66
D	20.9	21.1
D1	22.3	22.5
D2	15.95	16.55
D3	1	1.35
D4	1.6	1.8
E	15.7	15.9
E1	3.9	4.1
E2	13.1	13.5
E3	2.58	2.78
e	2.54	
e1	5.08	
H	0.8	1
L	19.8	20.1
L1	2.55	2.85
M	0.97	1.57
N	3.24	3.44
R	1.9	2.1

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SCALE 2:1 
EUROPEAN PROJECTION 
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Testing Conditions

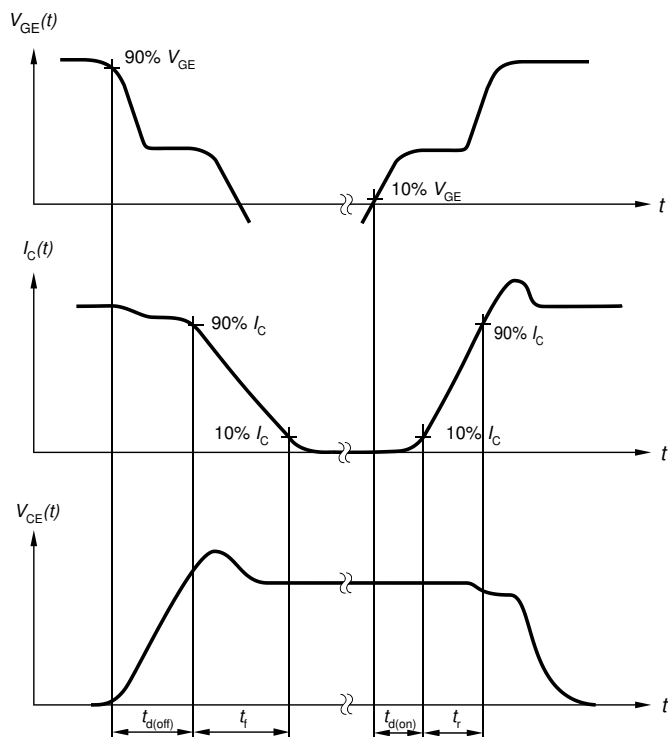


Figure A. Definition of switching times

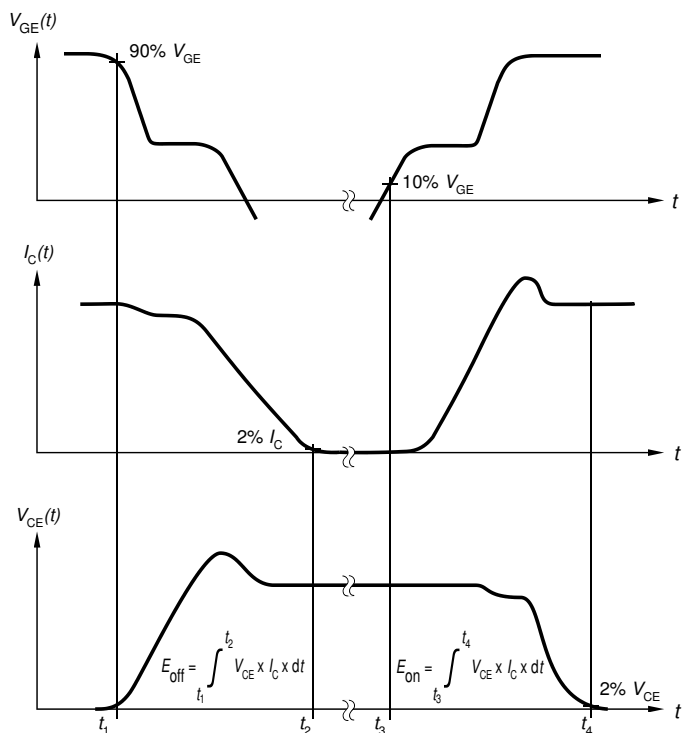


Figure B. Definition of switching losses

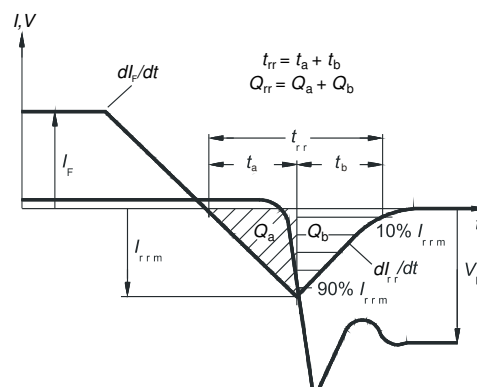


Figure C. Definition of diode switching characteristics

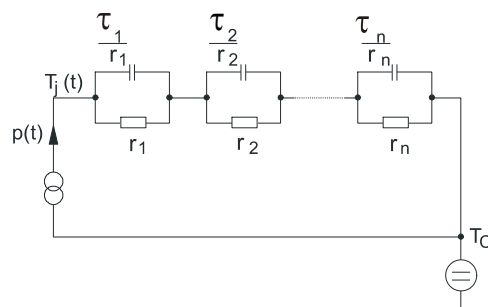


Figure D. Thermal equivalent circuit

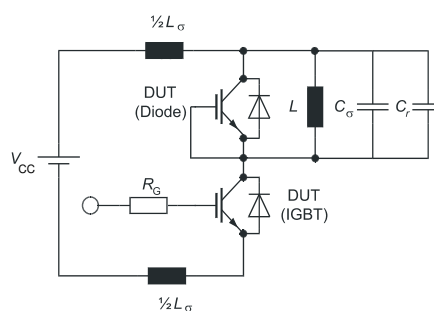


Figure E. **Dynamic test circuit**
 Parasitic inductance L_{σ} ,
 parasitic capacitor C_{σ} ,
 relief capacitor C_r ,
 (only for ZVT switching)

Revision History

IKY40N120CH3

Revision: 2019-04-15, Rev. 2.3

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2017-04-26	Final data sheet
2.2	2017-06-09	Update Figure 26
2.3	2019-04-15	Update condition for V _{ge} page 4 and Fig.11

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Please note that this product is not qualified according to the AEC Q100 or AEC Q101 documents of the Automotive Electronics Council.

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