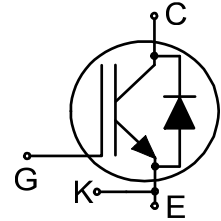


Sixth generation, high speed soft switching series

High speed soft switching TRENCHSTOP™ IGBT 6 in Trench and Fieldstop technology copacked with soft and fast recovery anti-parallel diode

Features:

- 1200V TRENCHSTOP™ IGBT6 technology offering:
- High efficiency in hard switching and resonant topologies
 - Easy paralleling capability due to positive temperature coefficient in V_{CEsat}
 - 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
- Welding

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
IKY40N120CS6	1200V	40A	1.85V	175°C	K40MCS6	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} $T_c = 25^{\circ}\text{C}$ $T_c = 100^{\circ}\text{C}$	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	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 ($t_p \leq 0.5\mu\text{s}$, $D < 0.001$)	V_{GE}	± 20 25	V
Power dissipation $T_c = 25^{\circ}\text{C}$ Power dissipation $T_c = 100^{\circ}\text{C}$	P_{tot}	500.0 250.0	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	$R_{th(j-c)}$		-	-	0.78	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 saturation voltage	V_{CEsat}	$V_{GE} = 15.0V, I_C = 40.0A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 125^{\circ}C$ $T_{vj} = 175^{\circ}C$	- - -	1.85 2.15 2.25	2.15 - -	V
Diode forward voltage	V_F	$V_{GE} = 0V, I_F = 40.0A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$	- -	2.20 2.25	2.55 -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 1.90mA, V_{CE} = V_{GE}$	5.1	5.7	6.3	V
Zero gate voltage collector current	I_{CES}	$V_{CE} = 1200V, V_{GE} = 0V$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$	- -	- 1600	850 -	μA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0V, V_{GE} = 20V$	-	-	600	nA
Transconductance	g_{fs}	$V_{CE} = 20V, I_C = 40.0A$	-	32.0	-	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	-	2700	-	pF
Output capacitance	C _{oes}		-	185	-	
Reverse transfer capacitance	C _{res}		-	120	-	
Gate charge	Q _G	V _{CC} = 960V, I _C = 40.0A, V _{GE} = 15V	-	285.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L _E		-	13.0	-	nH

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	$t_{d(\text{on})}$	$T_{vj} = 25^{\circ}\text{C}$, $V_{CC} = 600\text{V}$, $I_C = 40.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(\text{on})} = 9.0\Omega$, $R_{G(\text{off})} = 9.0\Omega$, $L_{\sigma} = 70\text{nH}$, $C_{\sigma} = 67\text{pF}$ L_{σ} , C_{σ} from Fig. E Energy losses include “tail” and diode reverse recovery.	-	27	-	ns
Rise time	t_r		-	27	-	ns
Turn-off delay time	$t_{d(\text{off})}$		-	315	-	ns
Fall time	t_f		-	27	-	ns
Turn-on energy	E_{on}		-	1.45	-	mJ
Turn-off energy	E_{off}		-	1.55	-	mJ
Total switching energy	E_{ts}		-	3.00	-	mJ

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

Diode reverse recovery time	t_{rr}	$T_{vj} = 25^{\circ}\text{C},$ $V_R = 600\text{V},$ $I_F = 40.0\text{A},$ $di_F/dt = 1650\text{A}/\mu\text{s},$ $L\sigma = 70\text{nH},$ $C\sigma = 67\text{pF}$	-	255	-	ns
Diode reverse recovery charge	Q_{rr}		-	2.60	-	μC
Diode peak reverse recovery current	I_{rrm}		-	39.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-450	-	$\text{A}/\mu\text{s}$

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	$t_{d(on)}$	$T_{vj} = 175^{\circ}\text{C},$ $V_{CC} = 600\text{V}, I_C = 40.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(on)} = 9.0\Omega, R_{G(off)} = 9.0\Omega,$ $L\sigma = 70\text{nH}, C\sigma = 67\text{pF}$ Energy losses include "tail" and diode reverse recovery.	-	27	-	ns
Rise time	t_r		-	29	-	ns
Turn-off delay time	$t_{d(off)}$		-	390	-	ns
Fall time	t_f		-	55	-	ns
Turn-on energy	E_{on}		-	2.05	-	mJ
Turn-off energy	E_{off}		-	2.95	-	mJ
Total switching energy	E_{ts}		-	5.00	-	mJ

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

Diode reverse recovery time	t_{rr}	$T_{vj} = 175^{\circ}\text{C},$ $V_R = 600\text{V},$ $I_F = 40.0\text{A},$ $di_F/dt = 1650\text{A}/\mu\text{s},$ $L\sigma = 70\text{nH},$ $C\sigma = 67\text{pF}$	-	360	-	ns
Diode reverse recovery charge	Q_{rr}		-	5.30	-	μC
Diode peak reverse recovery current	I_{rrm}		-	53.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-580	-	$\text{A}/\mu\text{s}$

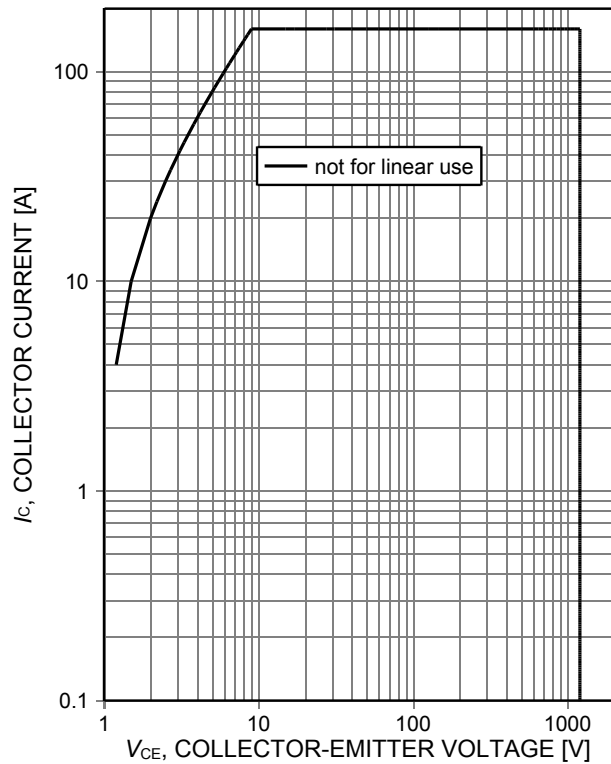


Figure 1. **Forward bias safe operating area**
($D=0$, $T_{vj} \leq 175^\circ\text{C}$; $V_{GE}=15\text{V}$, pulse width limited by T_{vjmax})

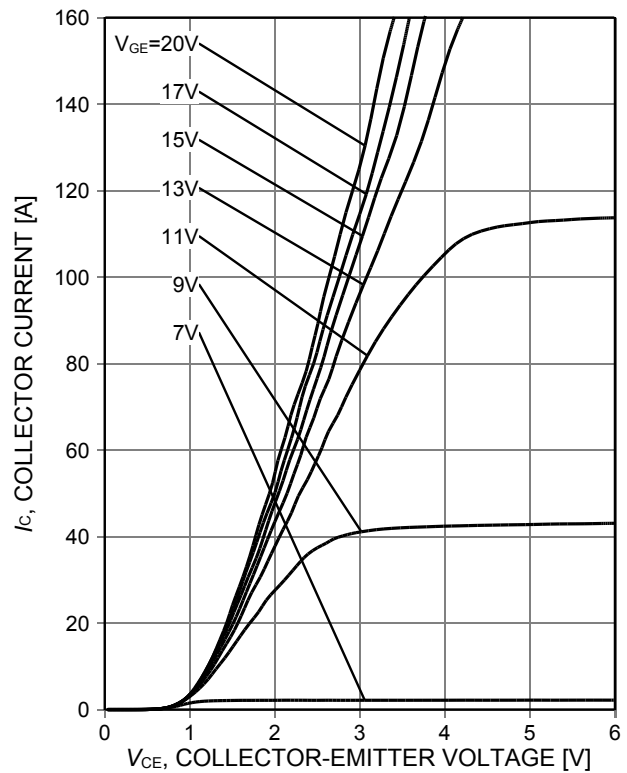


Figure 2. **Typical output characteristic**
($T_{vj}=25^\circ\text{C}$)

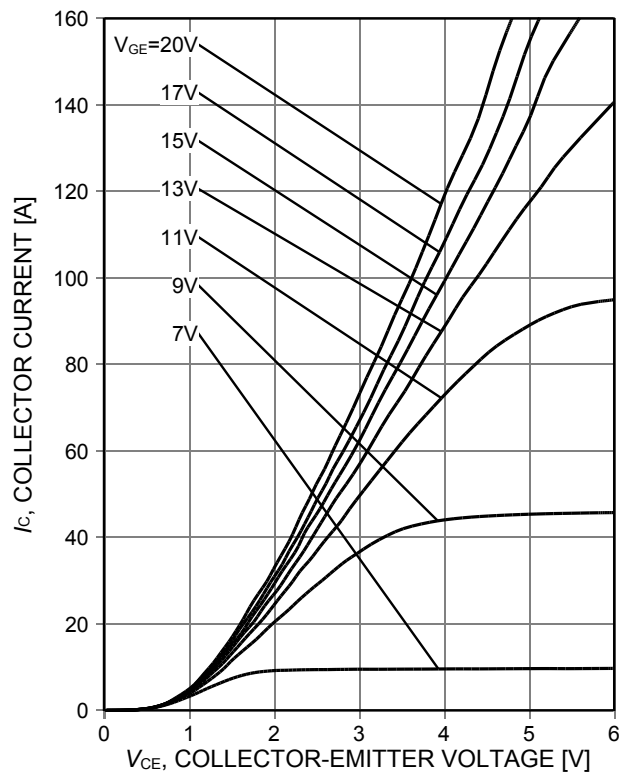


Figure 3. **Typical output characteristic**
($T_{vj}=175^\circ\text{C}$)

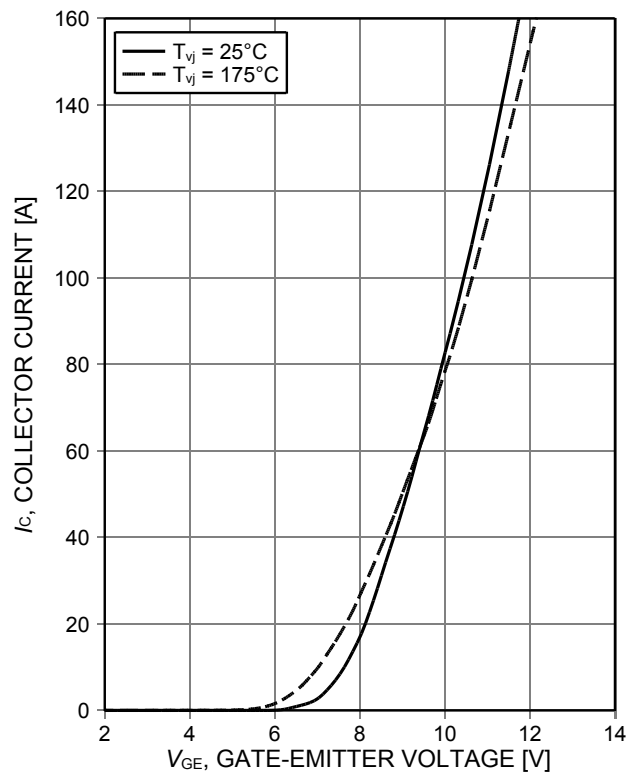


Figure 4. **Typical transfer characteristic**
($V_{CE}=20\text{V}$)

Sixth generation, high speed soft switching series

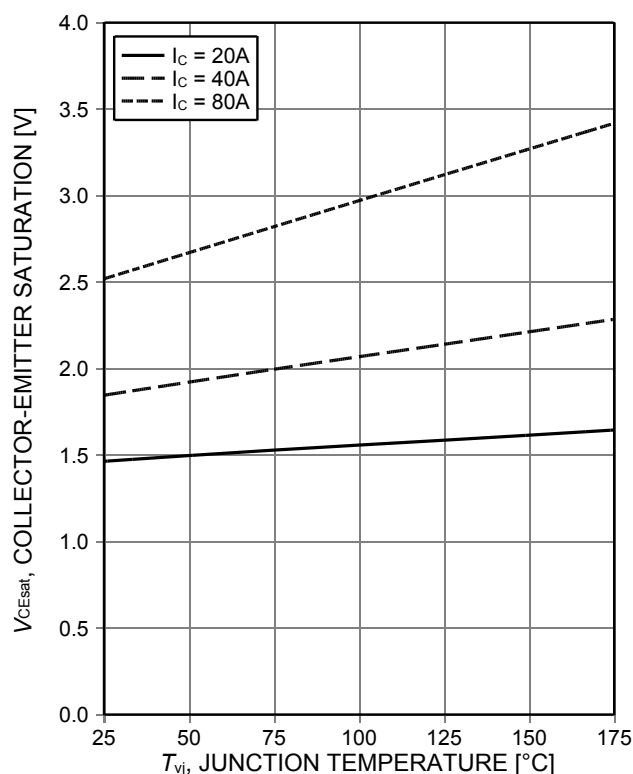


Figure 5. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}=15V$)

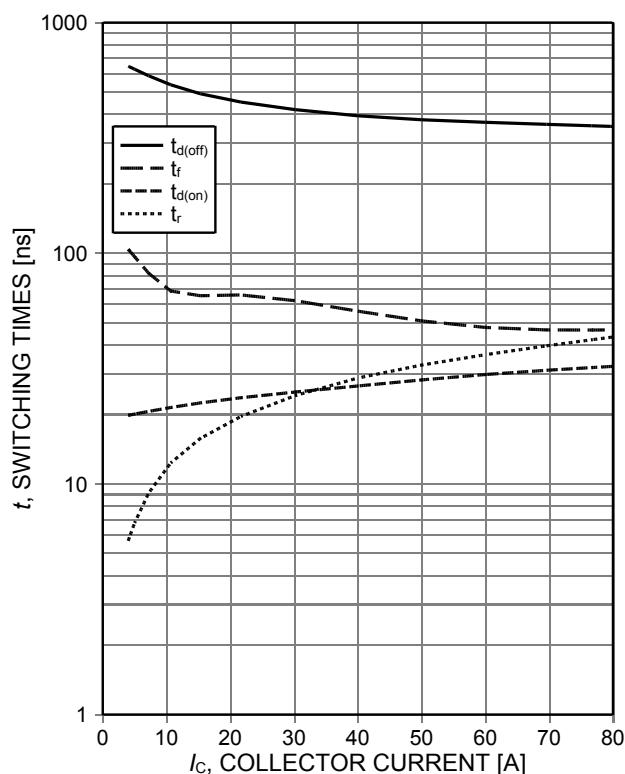


Figure 6. **Typical switching times as a function of collector current**
(inductive load, $T_{vj}=175^{\circ}C$, $V_{CE}=600V$, $V_{GE}=0/15V$, $R_G=9\Omega$, Dynamic test circuit in Figure E)

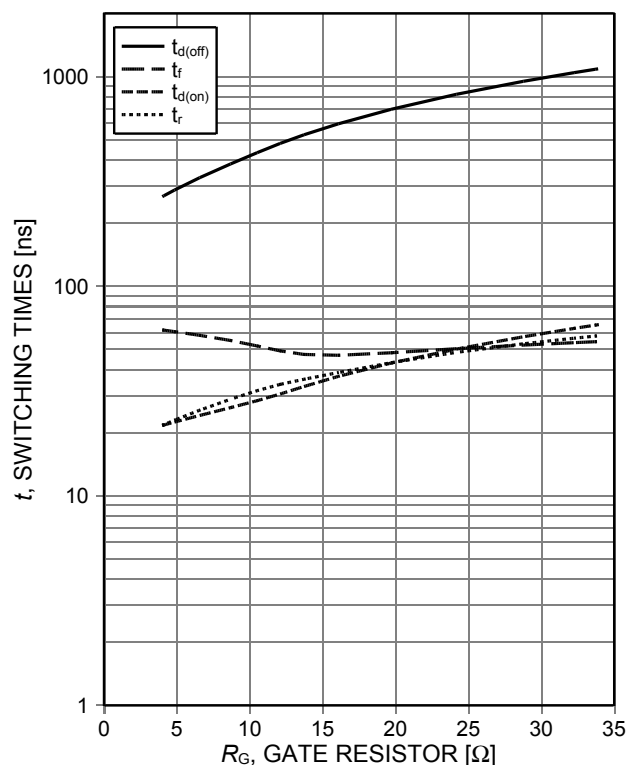


Figure 7. **Typical switching times as a function of gate resistor**
(inductive load, $T_{vj}=175^{\circ}C$, $V_{CE}=600V$, $V_{GE}=0/15V$, $I_C=40A$, Dynamic test circuit in Figure E)

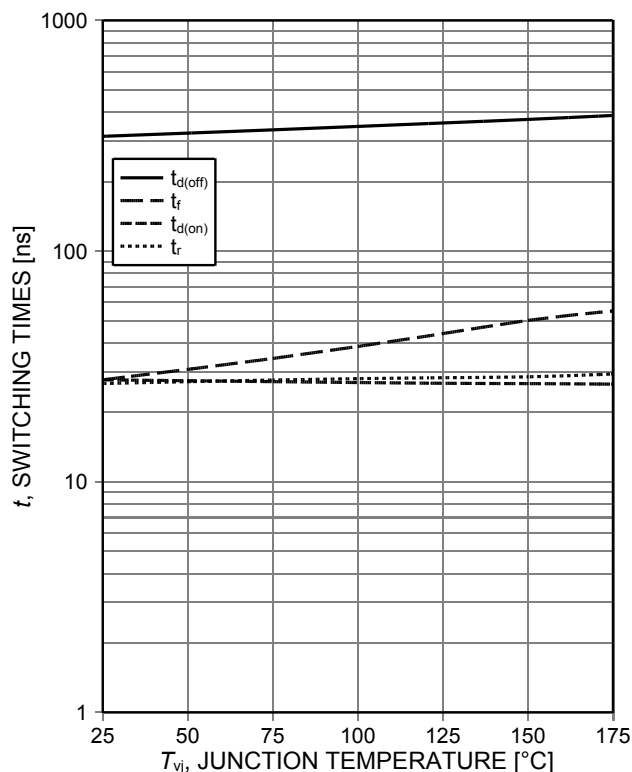


Figure 8. **Typical switching times as a function of junction temperature**
(inductive load, $V_{CE}=600V$, $V_{GE}=0/15V$, $I_C=40A$, $R_G=9\Omega$, Dynamic test circuit in Figure E)

Sixth generation, high speed soft switching series

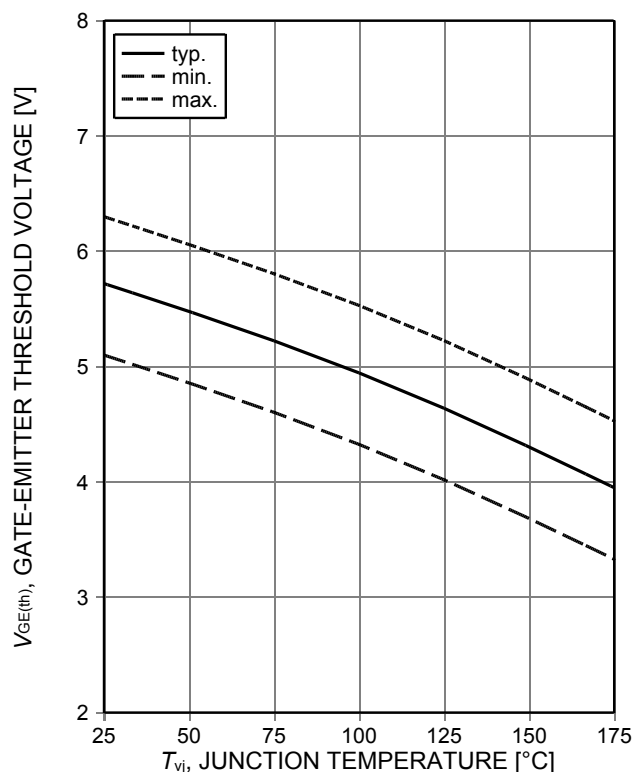


Figure 9. Gate-emitter threshold voltage as a function of junction temperature ($I_C=1.9\text{mA}$)

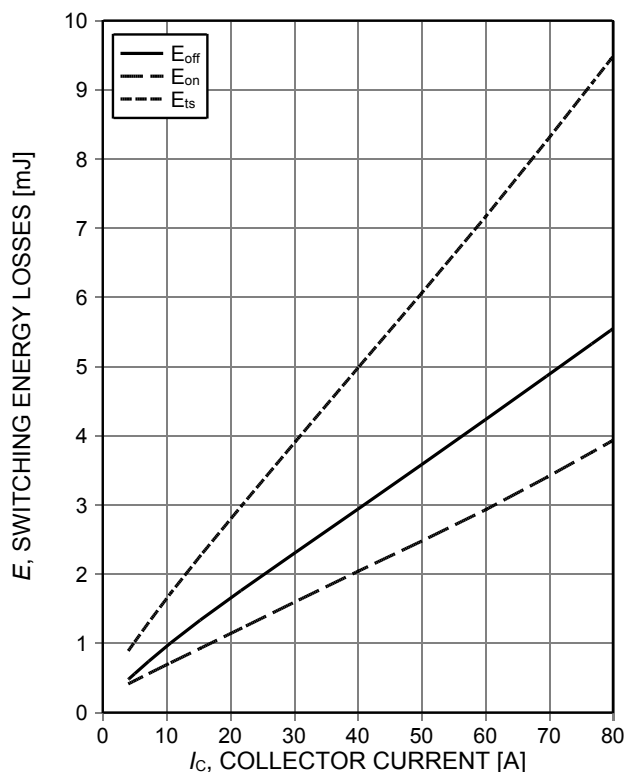


Figure 10. Typical switching energy losses as a function of collector current (inductive load, $T_{vj}=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=9\Omega$, Dynamic test circuit in Figure E)

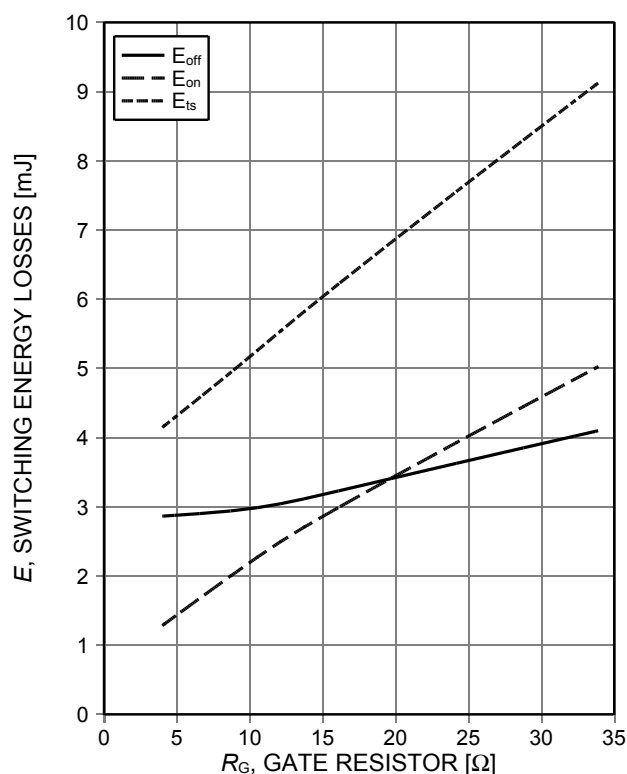


Figure 11. Typical switching energy losses as a function of gate resistor (inductive load, $T_{vj}=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, Dynamic test circuit in Figure E)

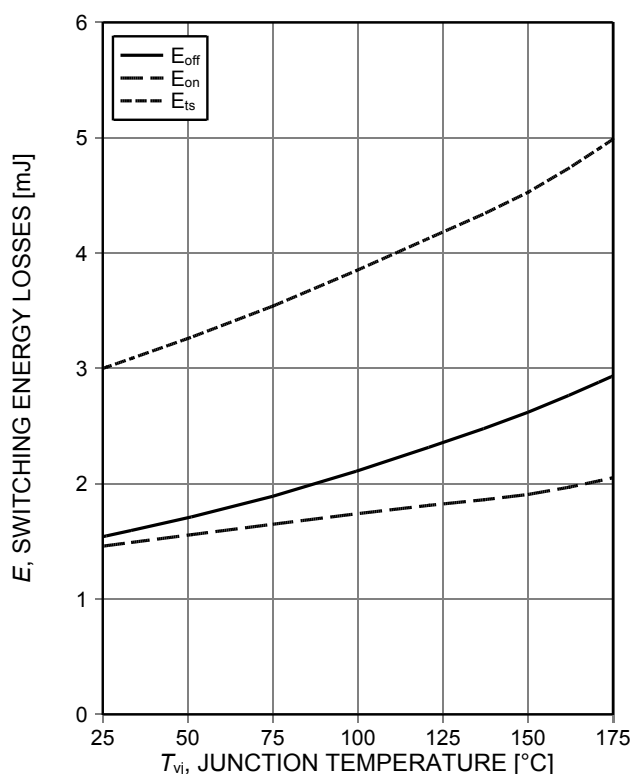


Figure 12. Typical switching energy losses as a function of junction temperature (inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, $R_G=9\Omega$, Dynamic test circuit in Figure E)

Sixth generation, high speed soft switching series

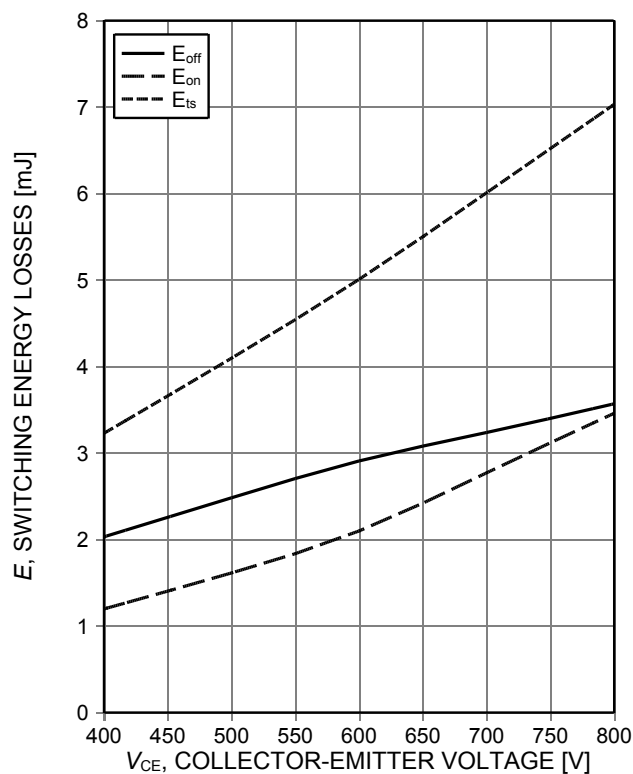


Figure 13. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, $R_G=9\Omega$, Dynamic test circuit in Figure E)

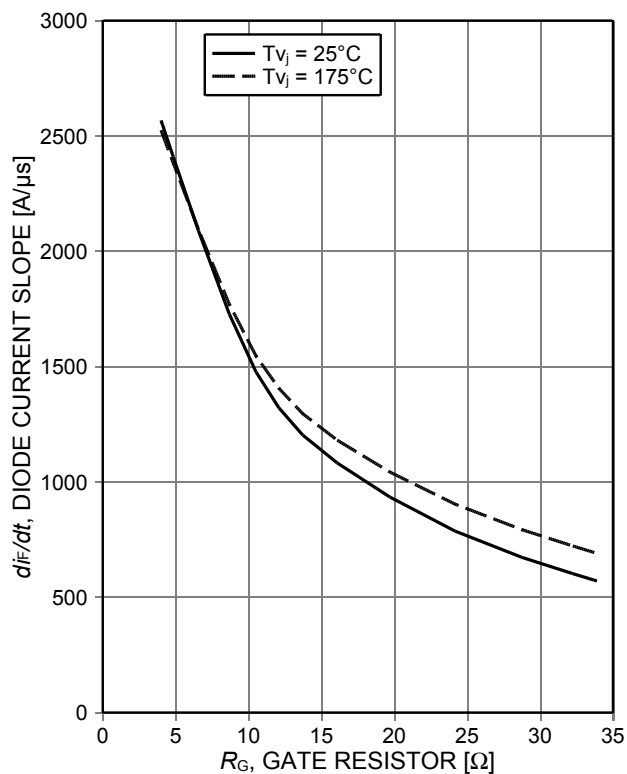


Figure 14. **Typical diode current slope as a function of gate resistor**
(inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, Dynamic test circuit in Figure E)

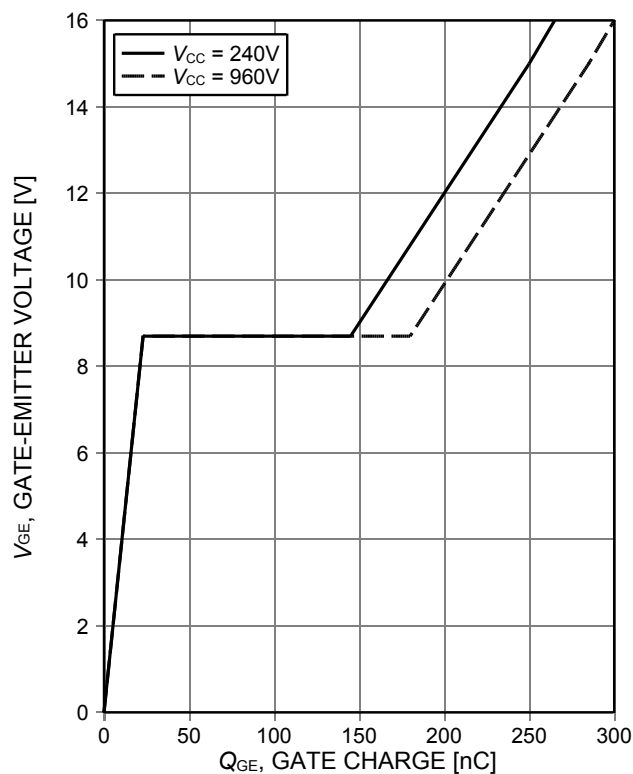


Figure 15. **Typical gate charge**
($I_C=40\text{A}$)

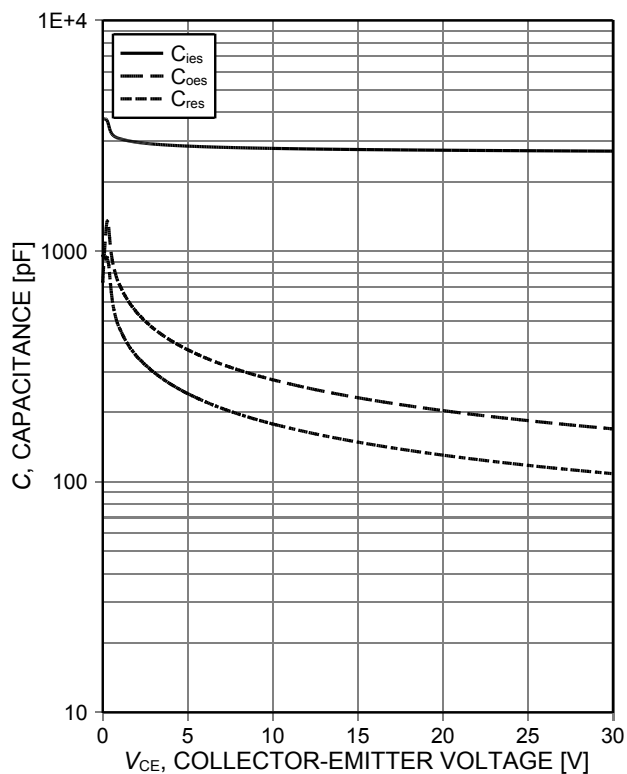
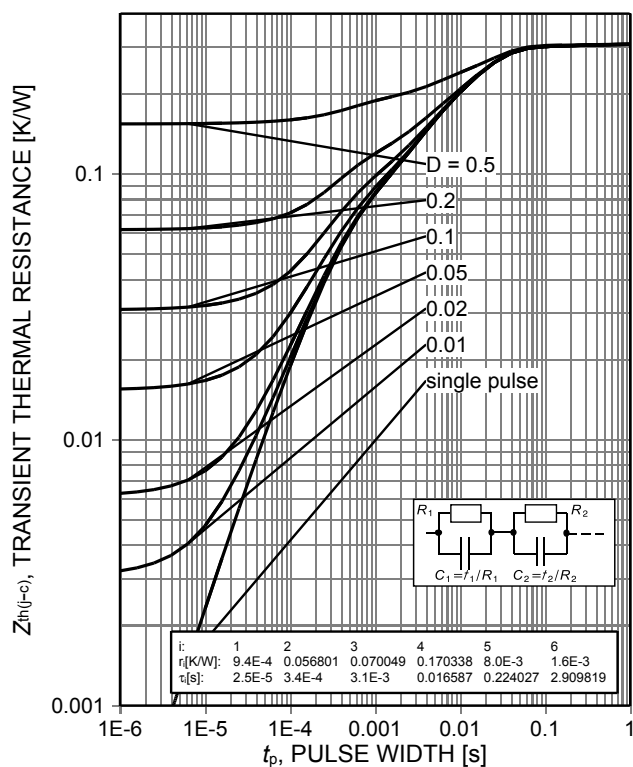
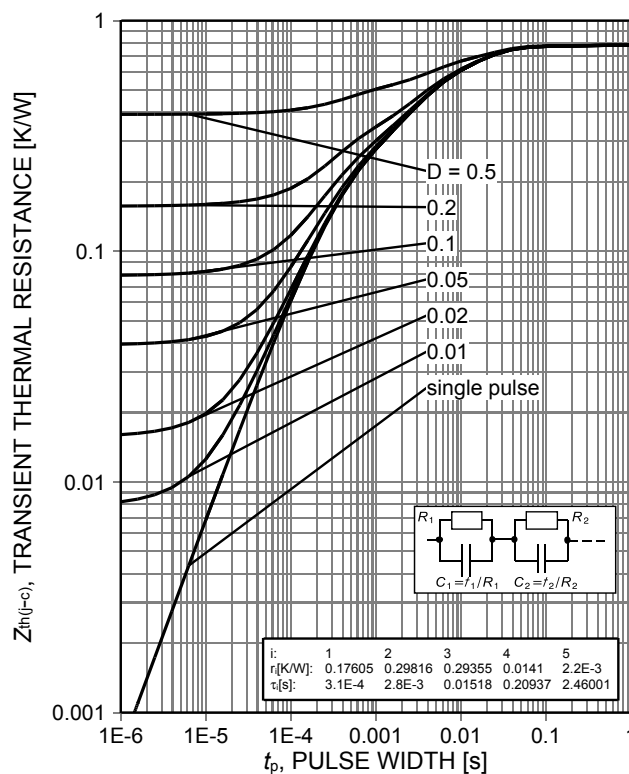
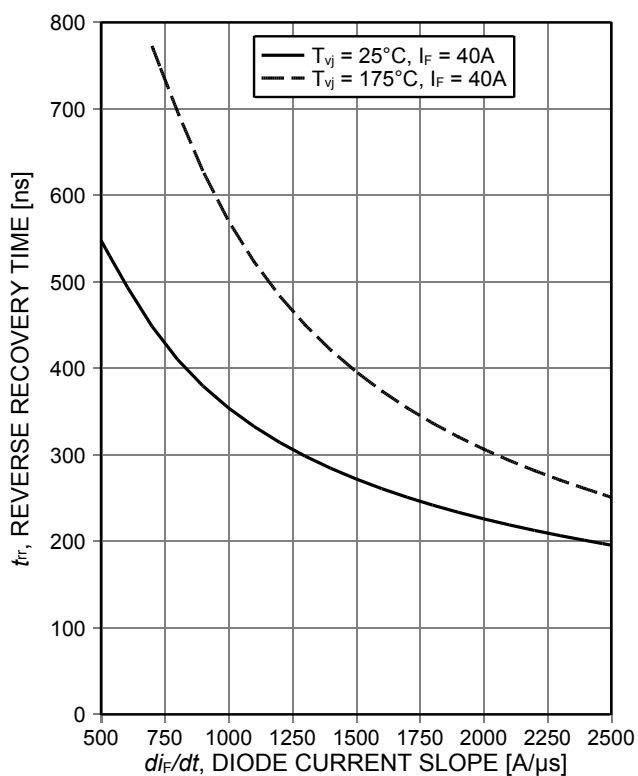
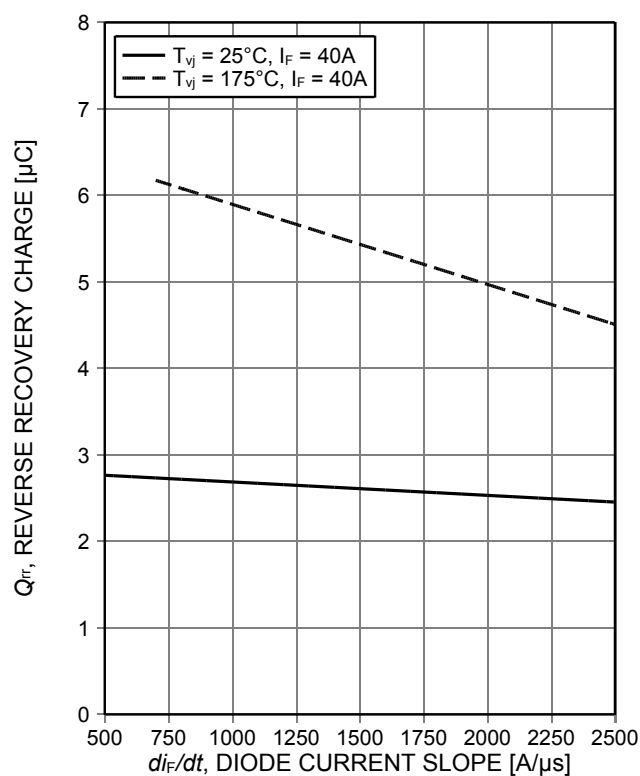


Figure 16. **Typical capacitance as a function of collector-emitter voltage**
($V_{GE}=0\text{V}$, $f=1\text{MHz}$)

Sixth generation, high speed soft switching series

Figure 17. IGBT transient thermal resistance ($D=t_p/T$)Figure 18. Diode transient thermal impedance as a function of pulse width ($D=t_p/T$)Figure 19. Typical reverse recovery time as a function of diode current slope ($V_R=600V$)Figure 20. Typical reverse recovery charge as a function of diode current slope ($V_R=600V$)

Sixth generation, high speed soft switching series

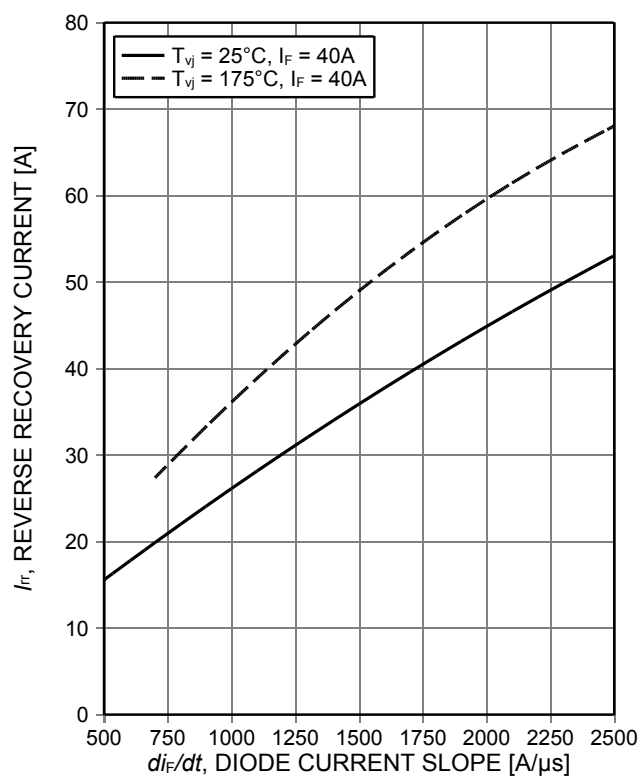


Figure 21. Typical reverse recovery current as a function of diode current slope
($V_R=600V$)

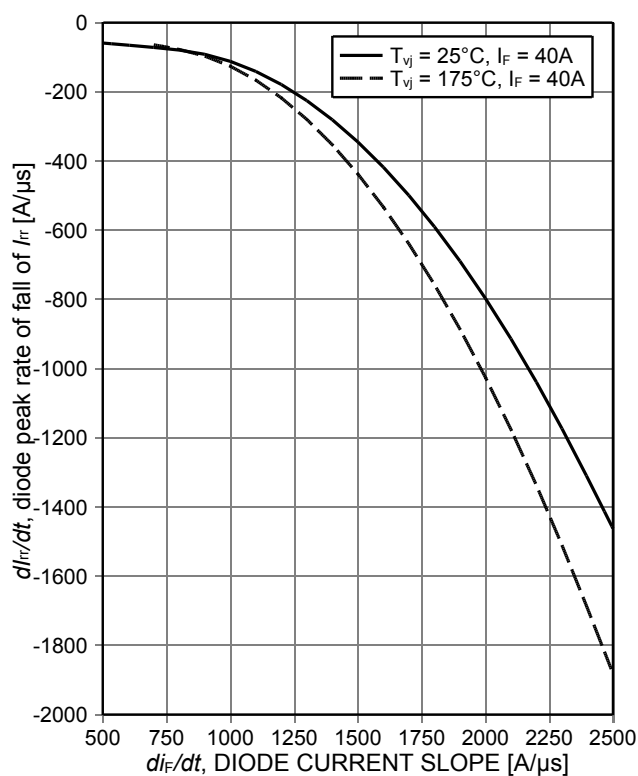


Figure 22. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope
($V_R=600V$)

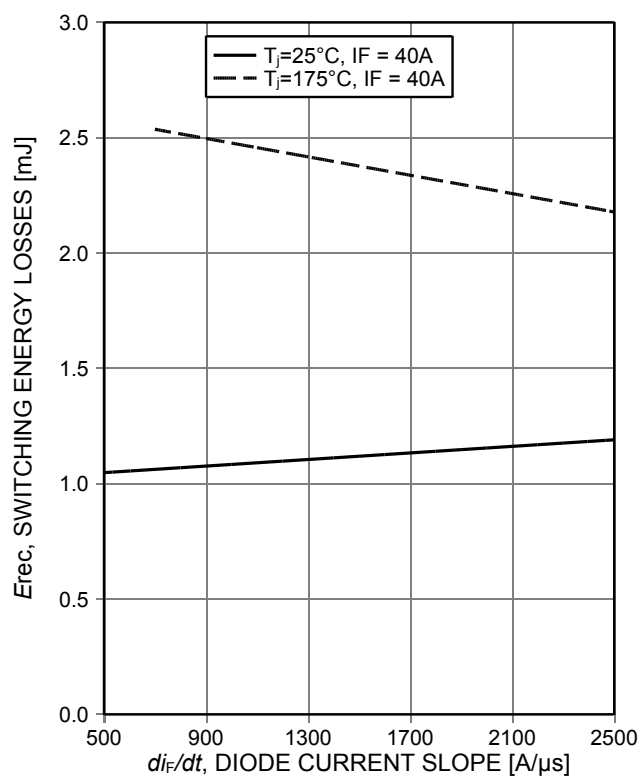


Figure 23. Typical reverse energy losses as a function of diode current slope
($V_R=600V$)

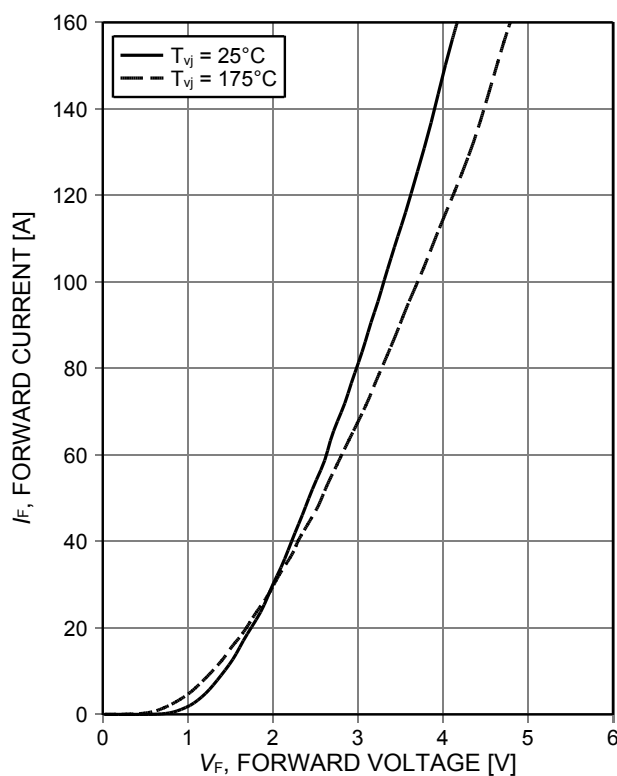


Figure 24. Typical diode forward current as a function of forward voltage

Sixth generation, high speed soft switching series

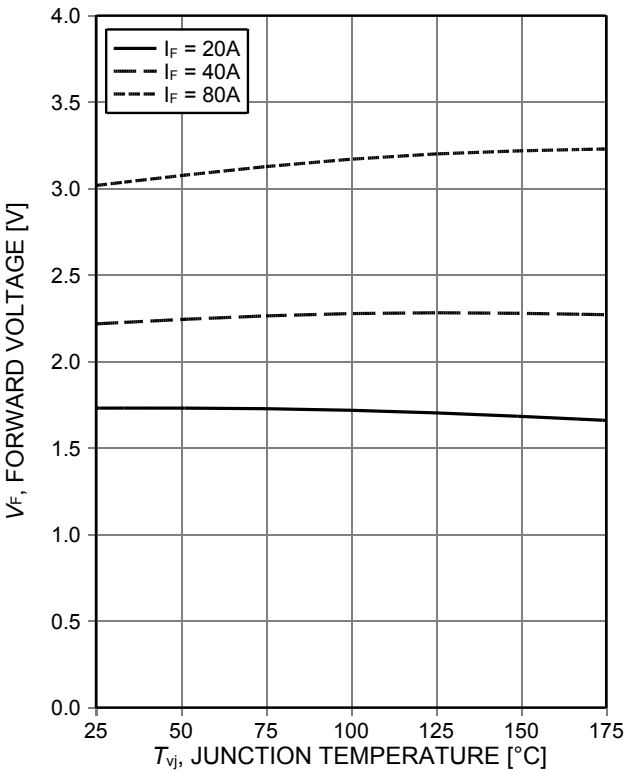
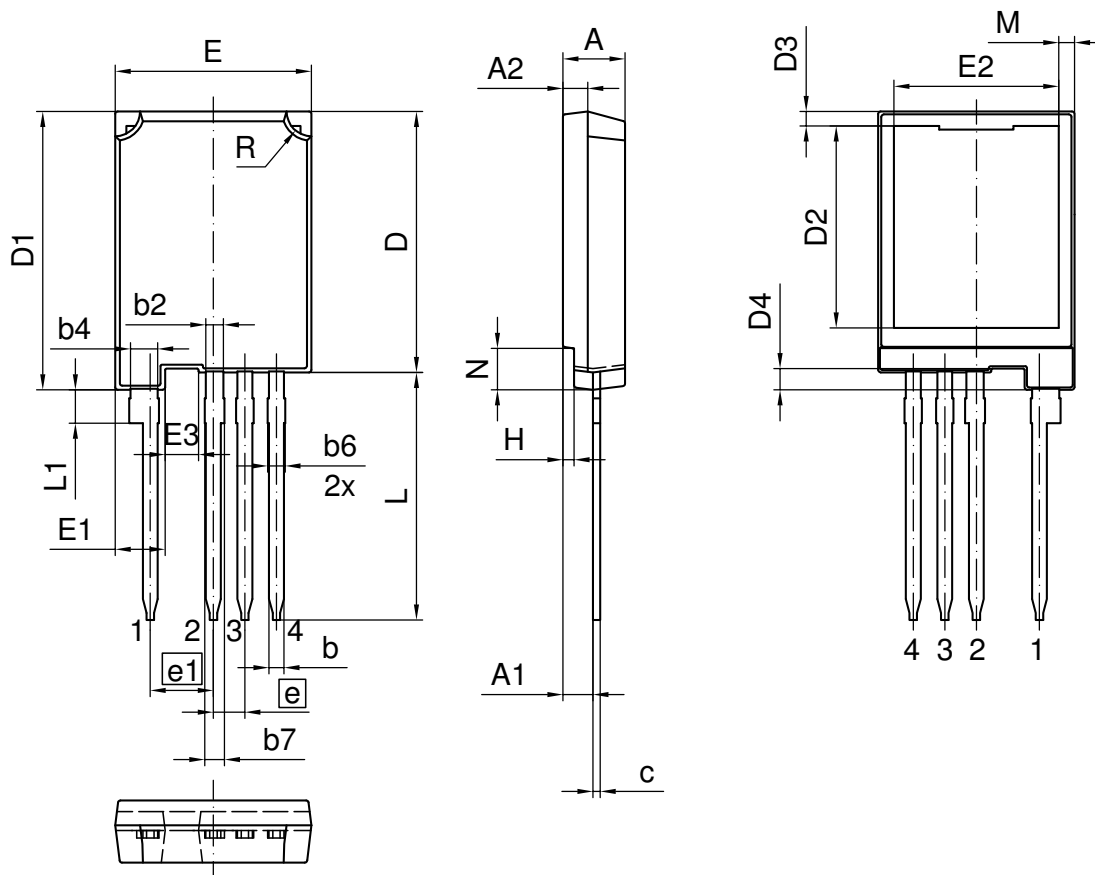


Figure 25. Typical diode forward voltage as a function of junction temperature

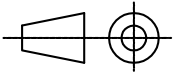
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**NOTES:**

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

DOCUMENT NO. Z8B00182798
REVISION 01
SCALE 2:1 0 5 10mm
EUROPEAN PROJECTION 
ISSUE DATE 23.09.2016

Testing Conditions

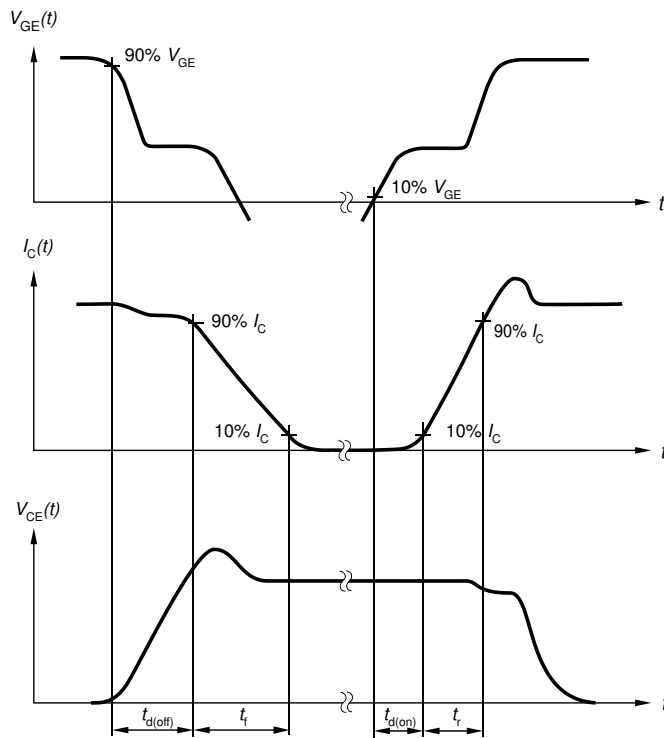


Figure A. Definition of switching times

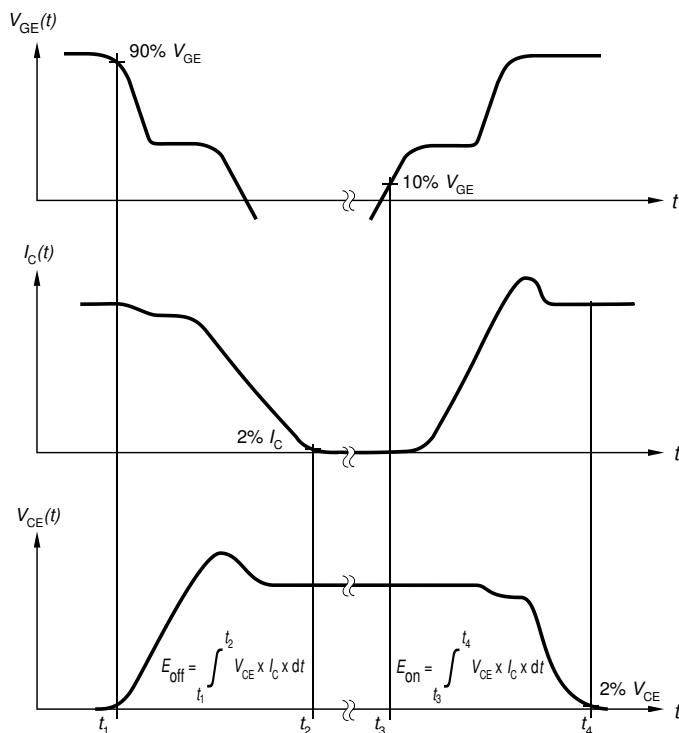


Figure B. Definition of switching losses

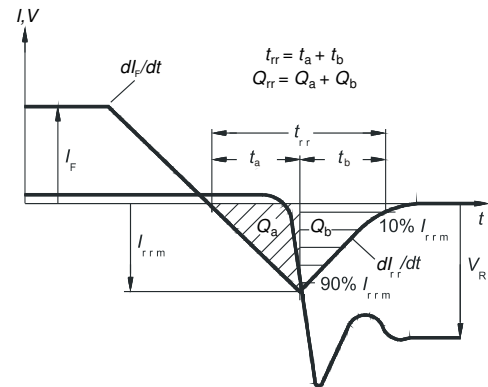


Figure C. Definition of diode switching characteristics

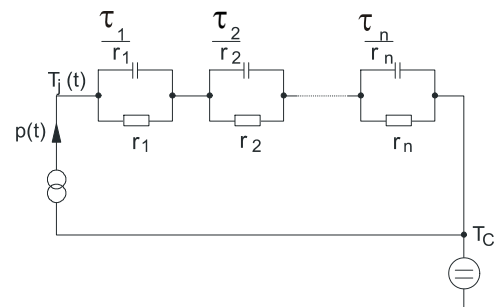


Figure D. Thermal equivalent circuit

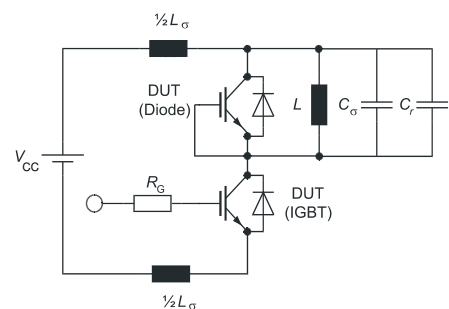


Figure E. Dynamic test circuit
Parasitic inductance L_{σ} ,
parasitic capacitor C_{σ} ,
relief capacitor C_r ,
(only for ZVT switching)

Sixth generation, high speed soft switching series

Revision History

IKY40N120CS6

Revision: 2018-05-07, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2018-05-07	Final data sheet

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