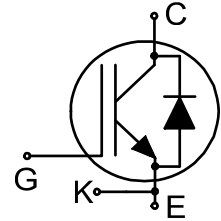


Sixth generation, high speed soft switching series

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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Sixth generation, high speed soft switching series

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

Sixth generation, high speed soft switching series

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	$t_{d(\text{on})}$	$T_{vj} = 25^{\circ}\text{C}$, $V_{CC} = 600\text{V}$, $I_C = 40.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(\text{on})} = 9.0\Omega$, $R_{G(\text{off})} = 9.0\Omega$, $L\sigma = 70\text{nH}$, $C\sigma = 67\text{pF}$ $L\sigma$, $C\sigma$ 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	-	$\text{A}/\mu\text{s}$

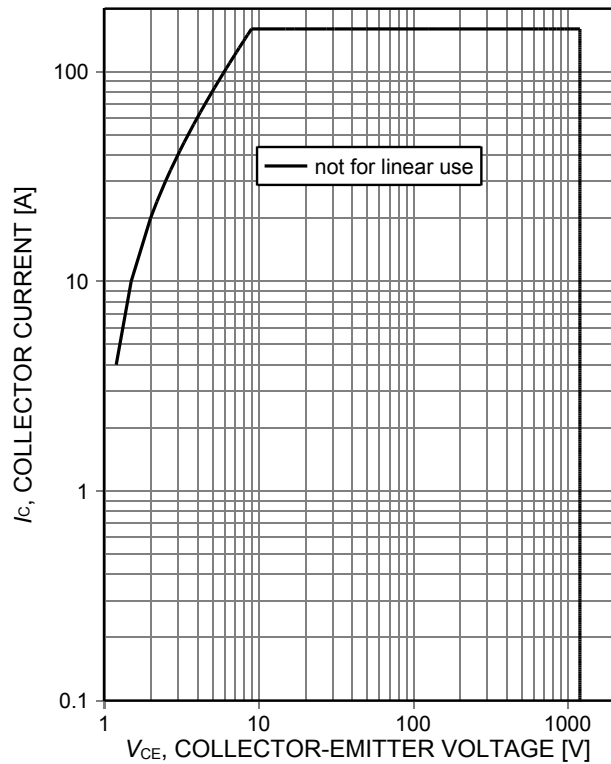


Figure 1. **Forward bias safe operating area**
($D=0$, $T_{vj} \leq 175^\circ\text{C}$; $V_{GE}=15\text{V}$, pulse width limited by T_{vjmax})

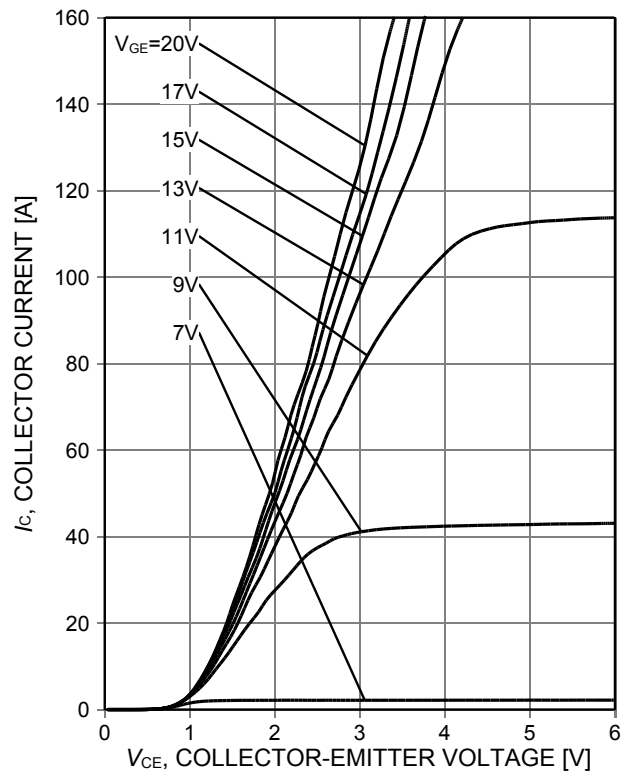


Figure 2. **Typical output characteristic**
($T_{vj}=25^\circ\text{C}$)

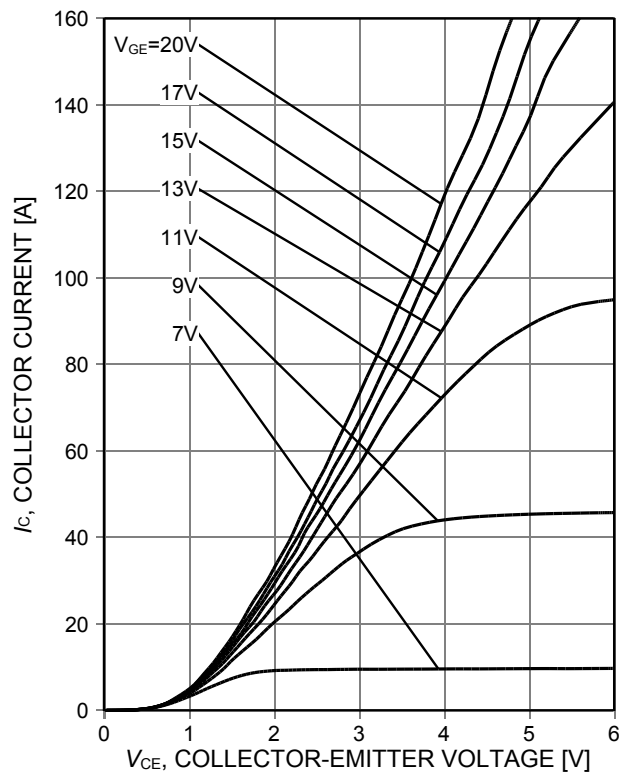


Figure 3. **Typical output characteristic**
($T_{vj}=175^\circ\text{C}$)

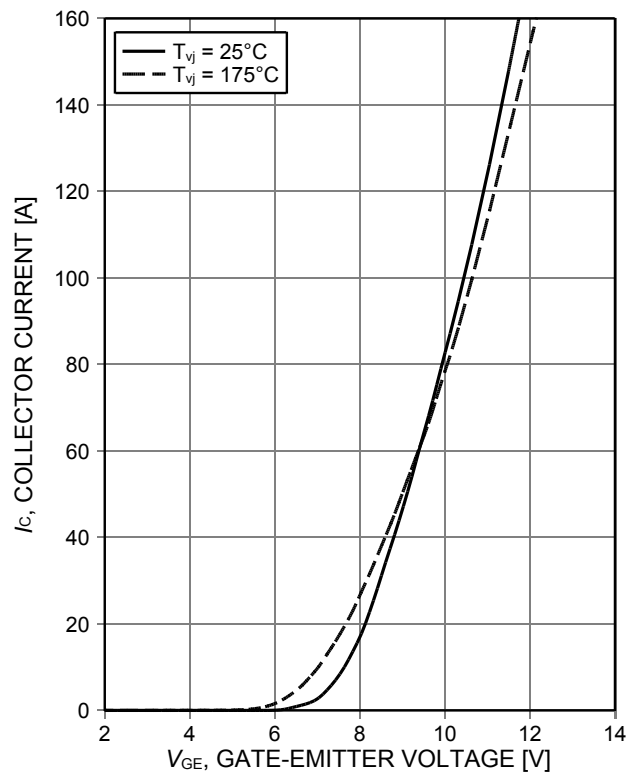


Figure 4. **Typical transfer characteristic**
($V_{CE}=20\text{V}$)

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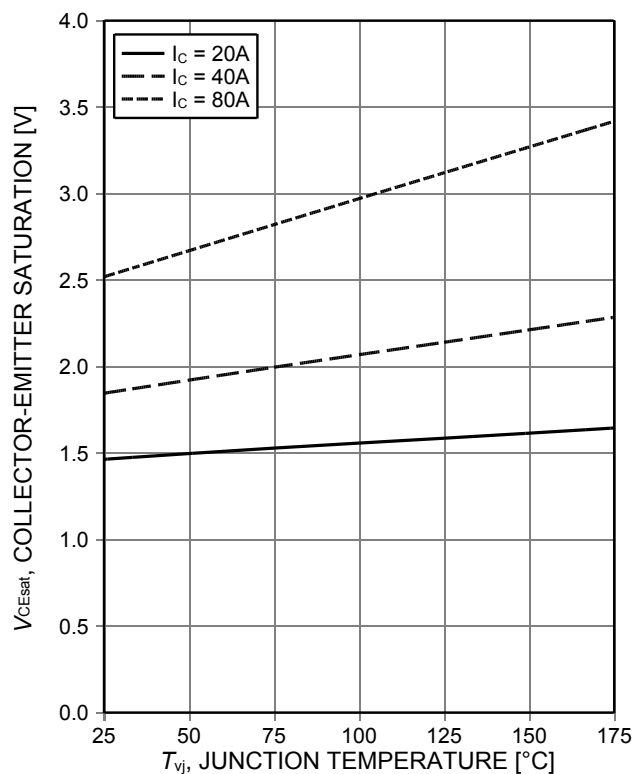


Figure 5. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}=15V$)

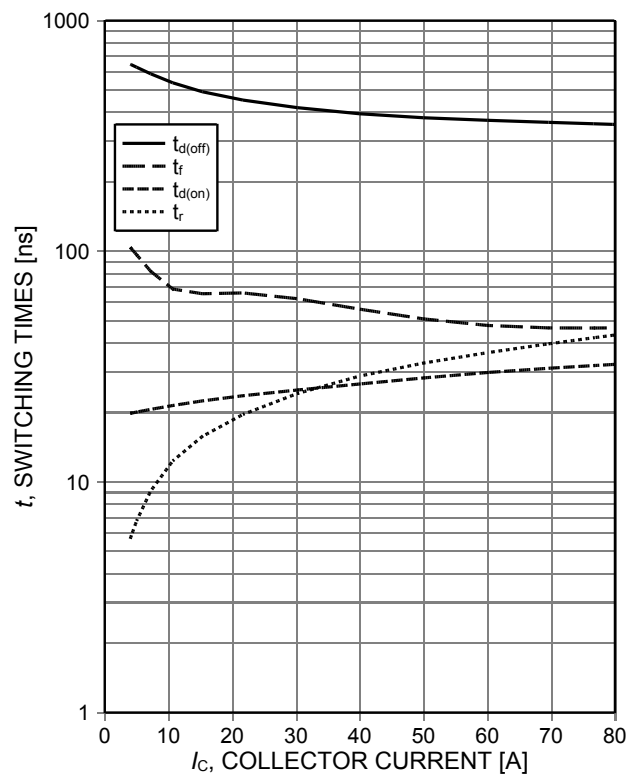


Figure 6. **Typical switching times as a function of collector current**
(inductive load, $T_{vj}=175^{\circ}C$, $V_{CE}=600V$, $V_{GE}=0/15V$, $R_G=9\Omega$, Dynamic test circuit in Figure E)

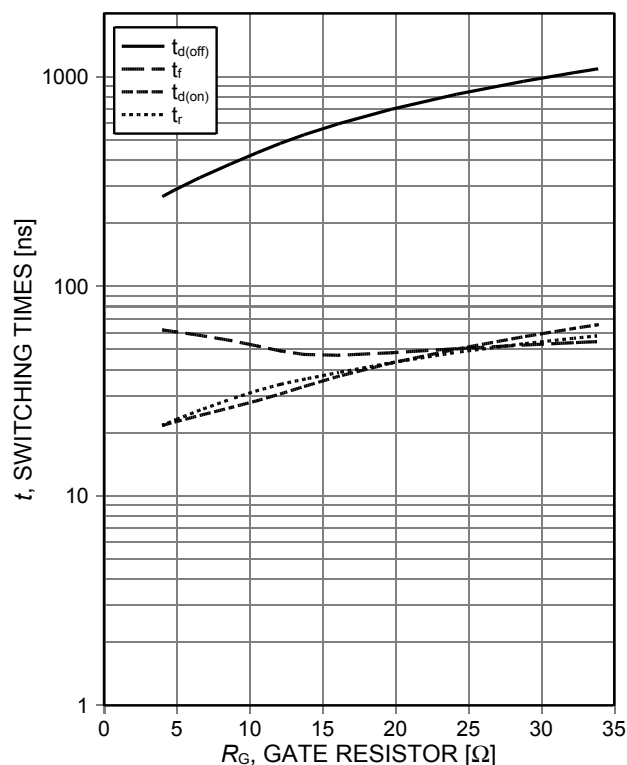


Figure 7. **Typical switching times as a function of gate resistor**
(inductive load, $T_{vj}=175^{\circ}C$, $V_{CE}=600V$, $V_{GE}=0/15V$, $I_C=40A$, Dynamic test circuit in Figure E)

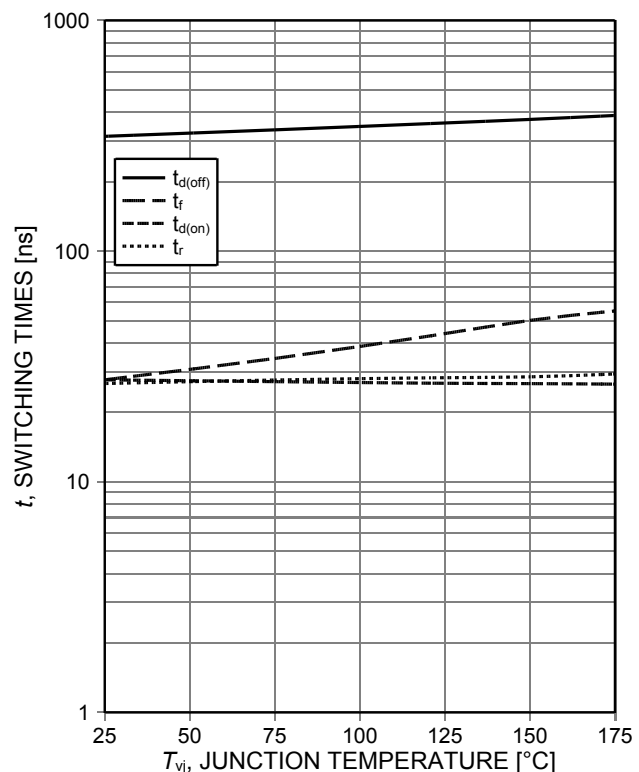


Figure 8. **Typical switching times as a function of junction temperature**
(inductive load, $V_{CE}=600V$, $V_{GE}=0/15V$, $I_C=40A$, $R_G=9\Omega$, Dynamic test circuit in Figure E)

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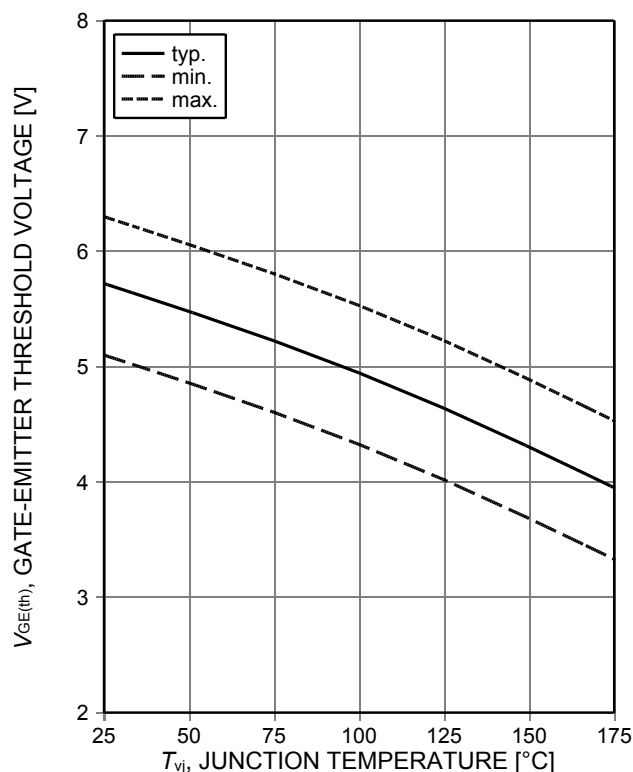


Figure 9. Gate-emitter threshold voltage as a function of junction temperature ($I_C=1.9\text{mA}$)

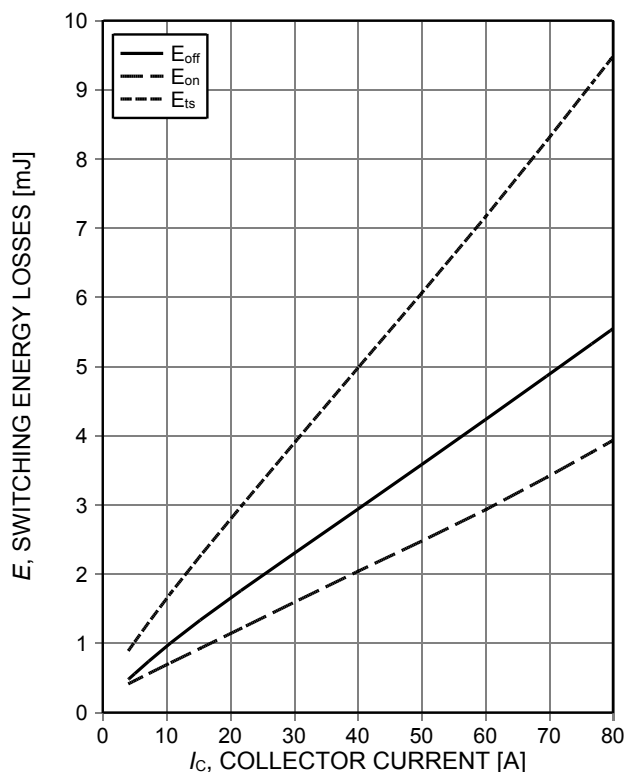


Figure 10. Typical switching energy losses as a function of collector current (inductive load, $T_{vj}=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=9\Omega$, Dynamic test circuit in Figure E)

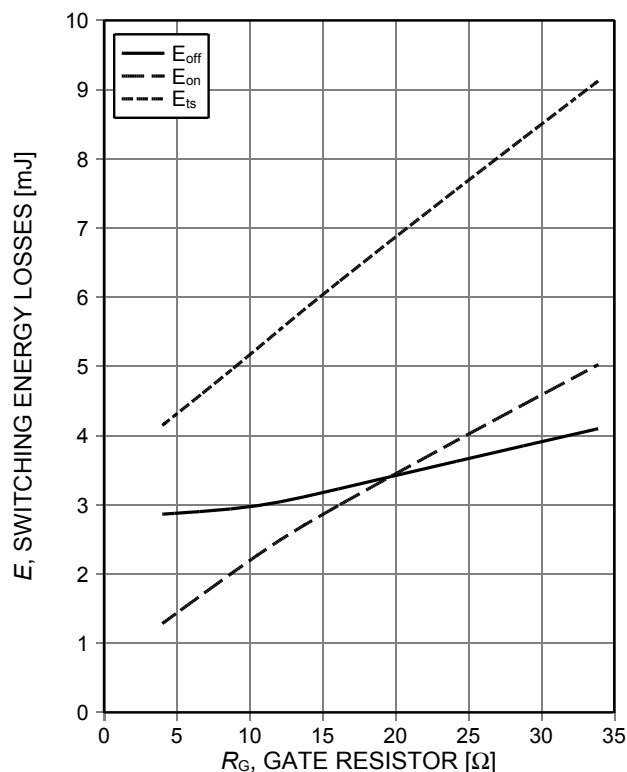


Figure 11. Typical switching energy losses as a function of gate resistor (inductive load, $T_{vj}=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, Dynamic test circuit in Figure E)

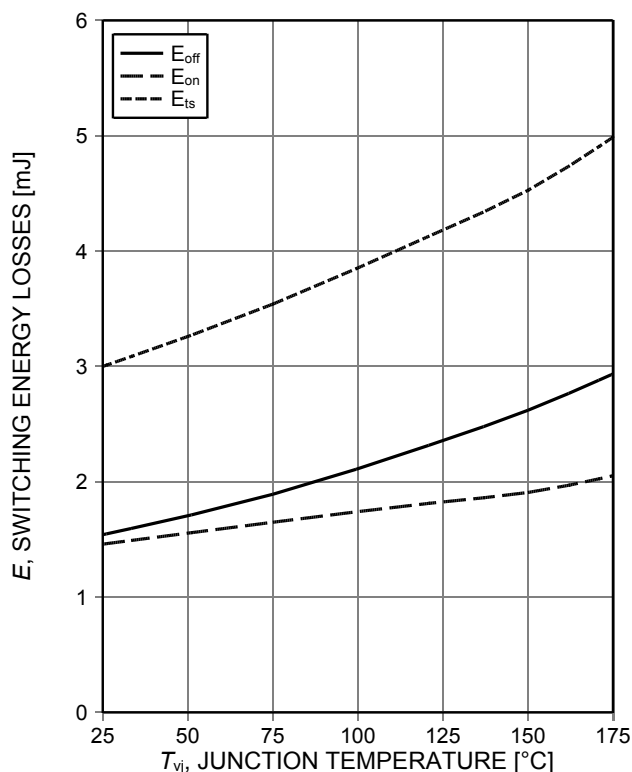


Figure 12. Typical switching energy losses as a function of junction temperature (inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, $R_G=9\Omega$, Dynamic test circuit in Figure E)

Sixth generation, high speed soft switching series

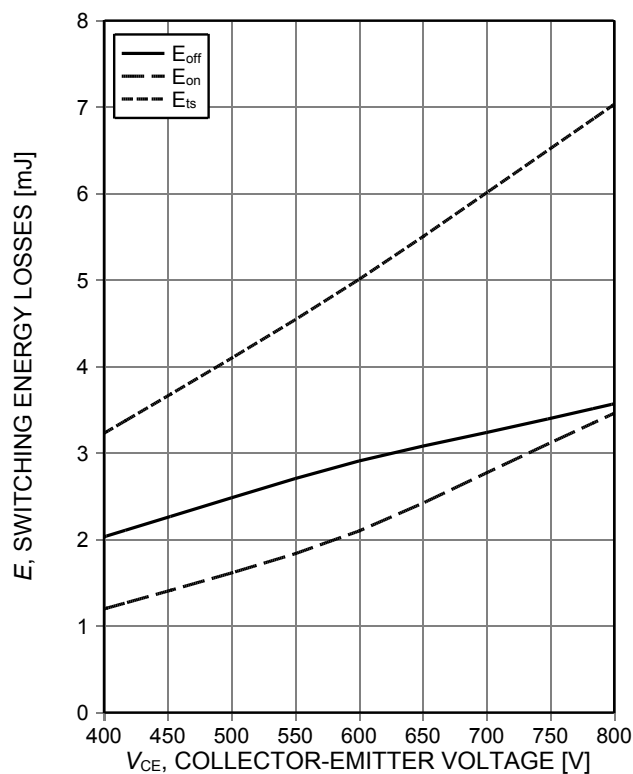


Figure 13. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, $R_G=9\Omega$, Dynamic test circuit in Figure E)

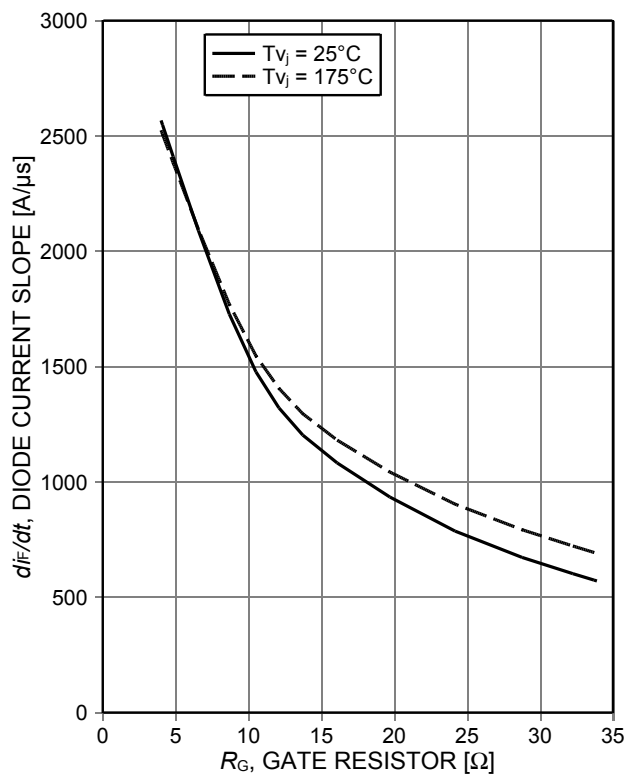


Figure 14. **Typical diode current slope as a function of gate resistor**
(inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, Dynamic test circuit in Figure E)

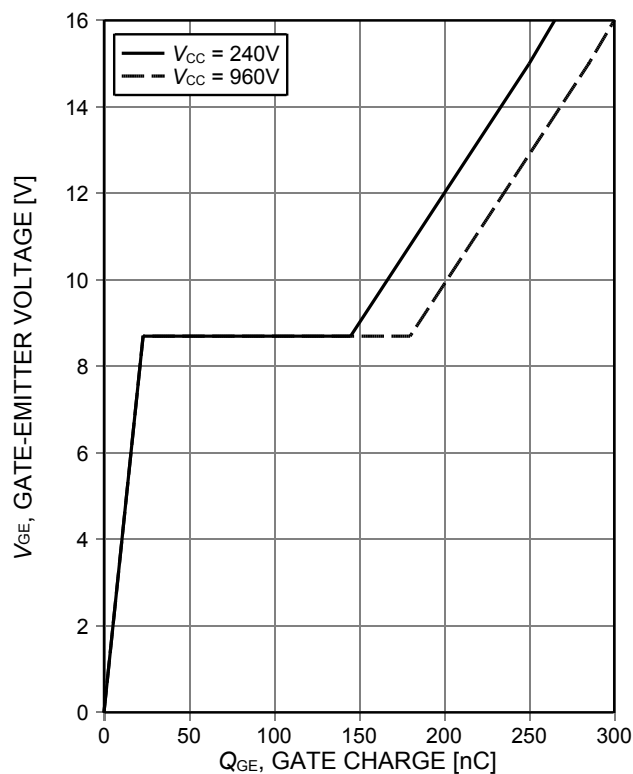


Figure 15. **Typical gate charge**
($I_C=40\text{A}$)

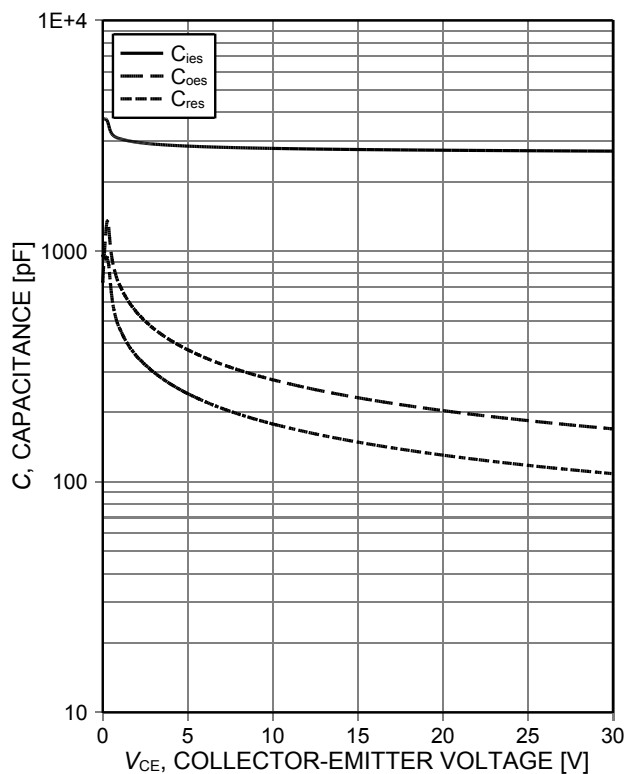
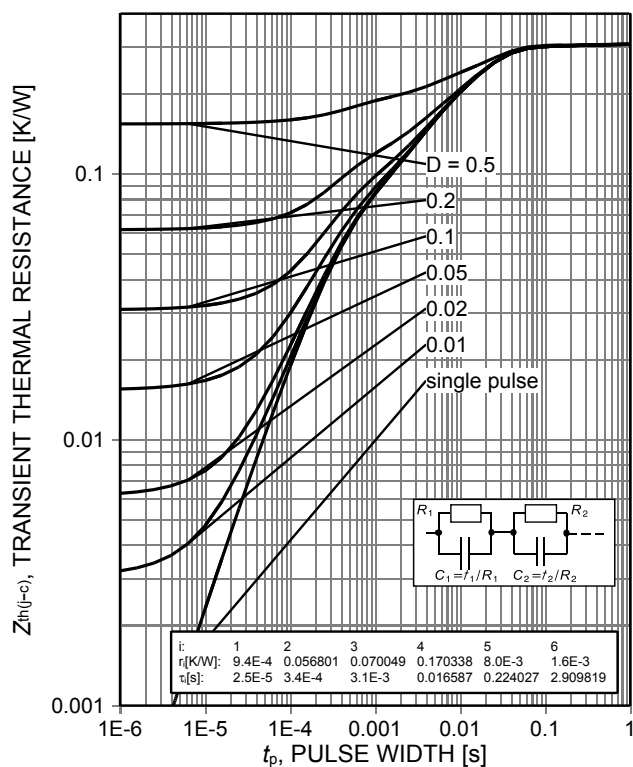
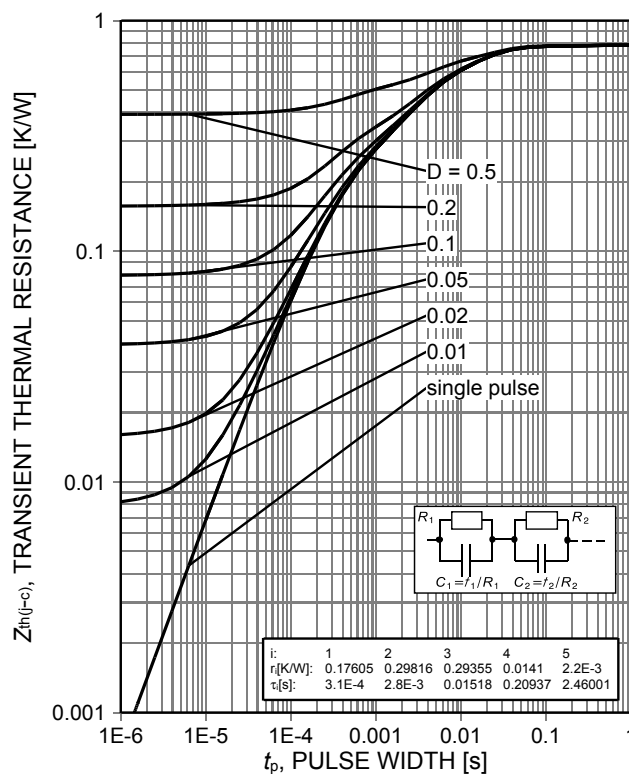
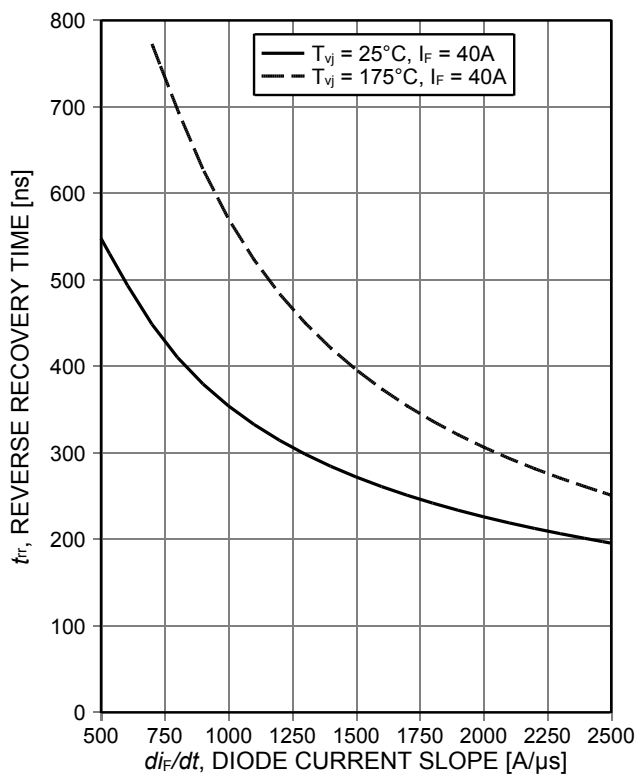
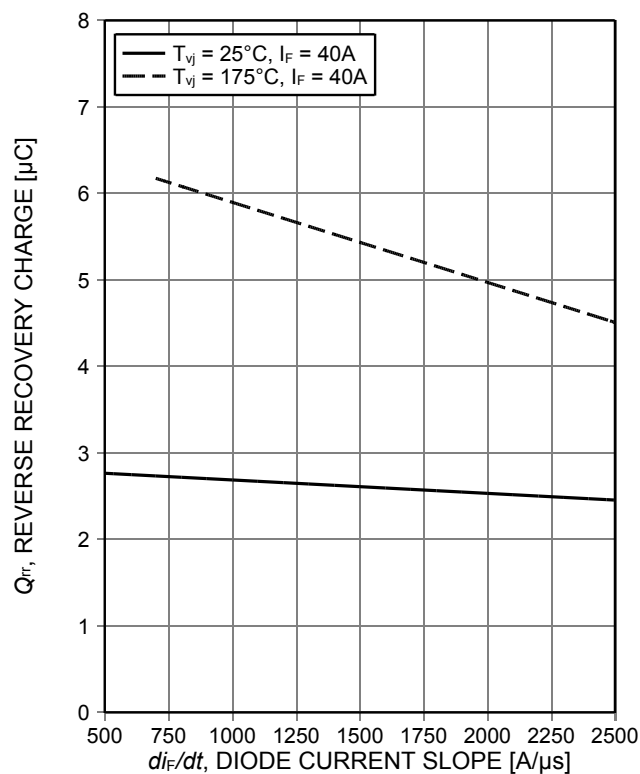


Figure 16. **Typical capacitance as a function of collector-emitter voltage**
($V_{GE}=0\text{V}$, $f=1\text{MHz}$)

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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 ($V_R=600V$)

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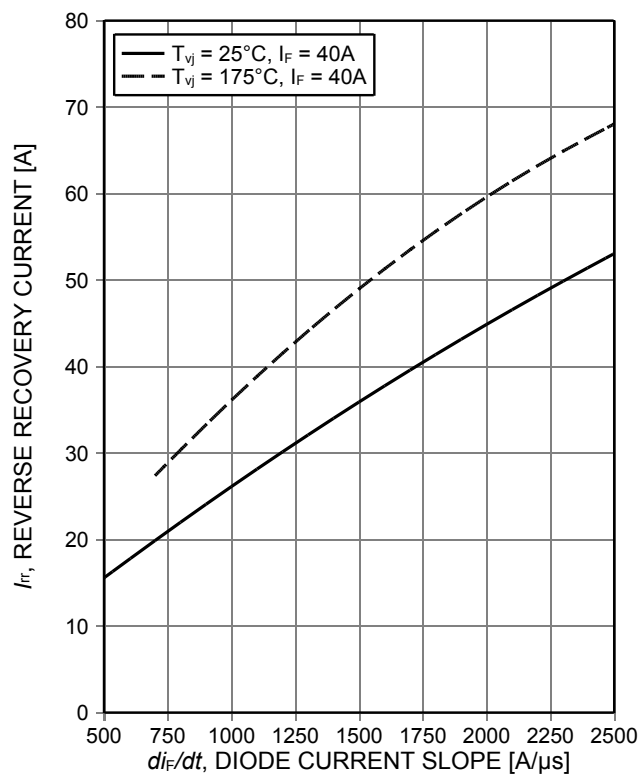


Figure 21. **Typical reverse recovery current as a function of diode current slope**
($V_R=600V$)

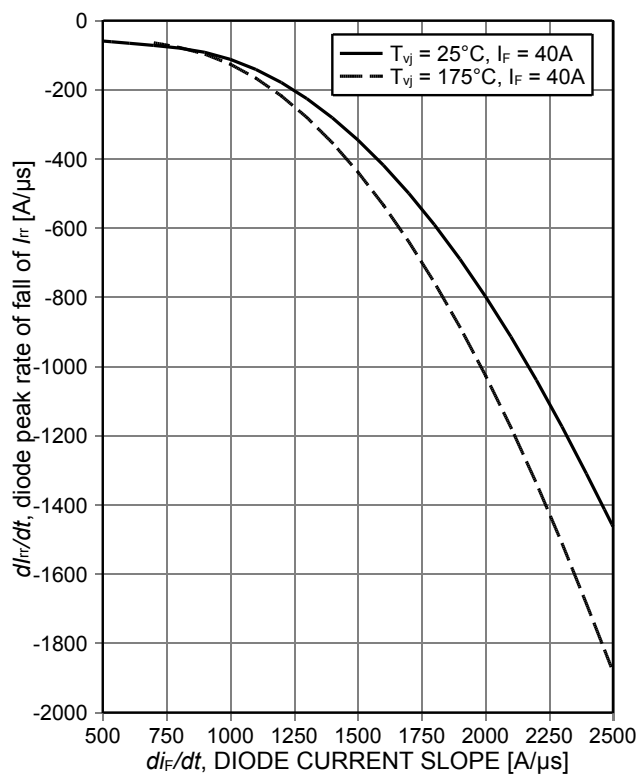


Figure 22. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
($V_R=600V$)

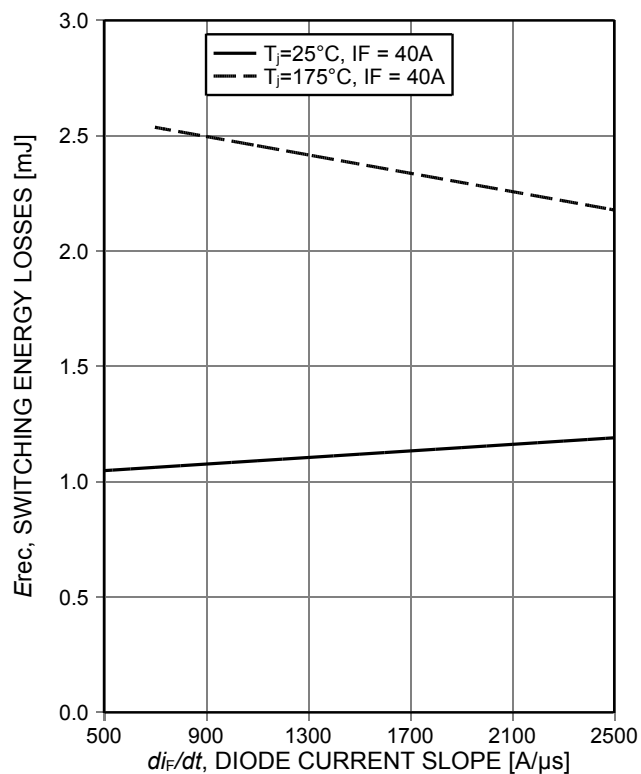


Figure 23. **Typical reverse energy losses as a function of diode current slope**
($V_R=600V$)

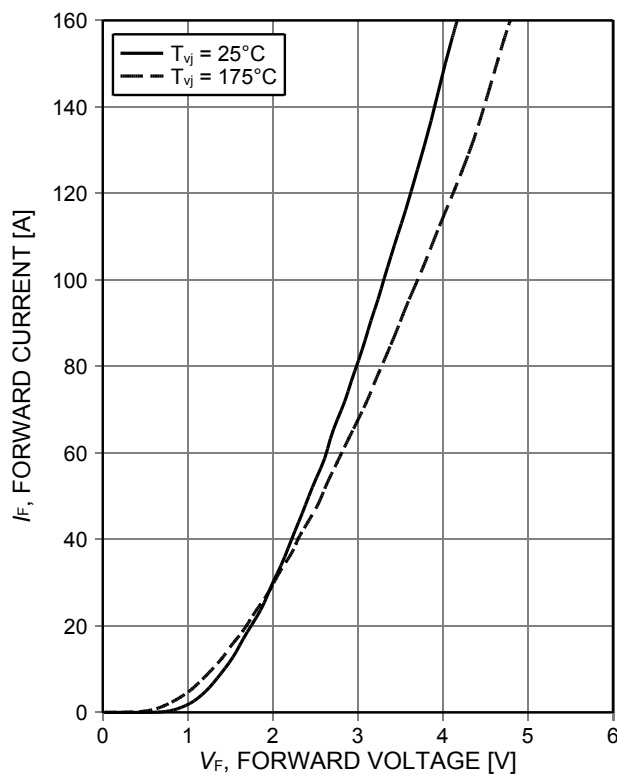


Figure 24. **Typical diode forward current as a function of forward voltage**

Sixth generation, high speed soft switching series

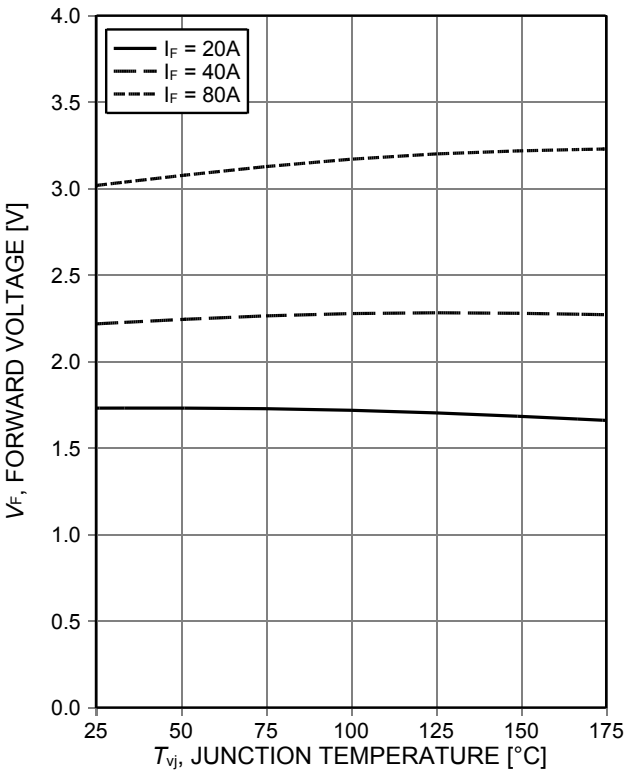
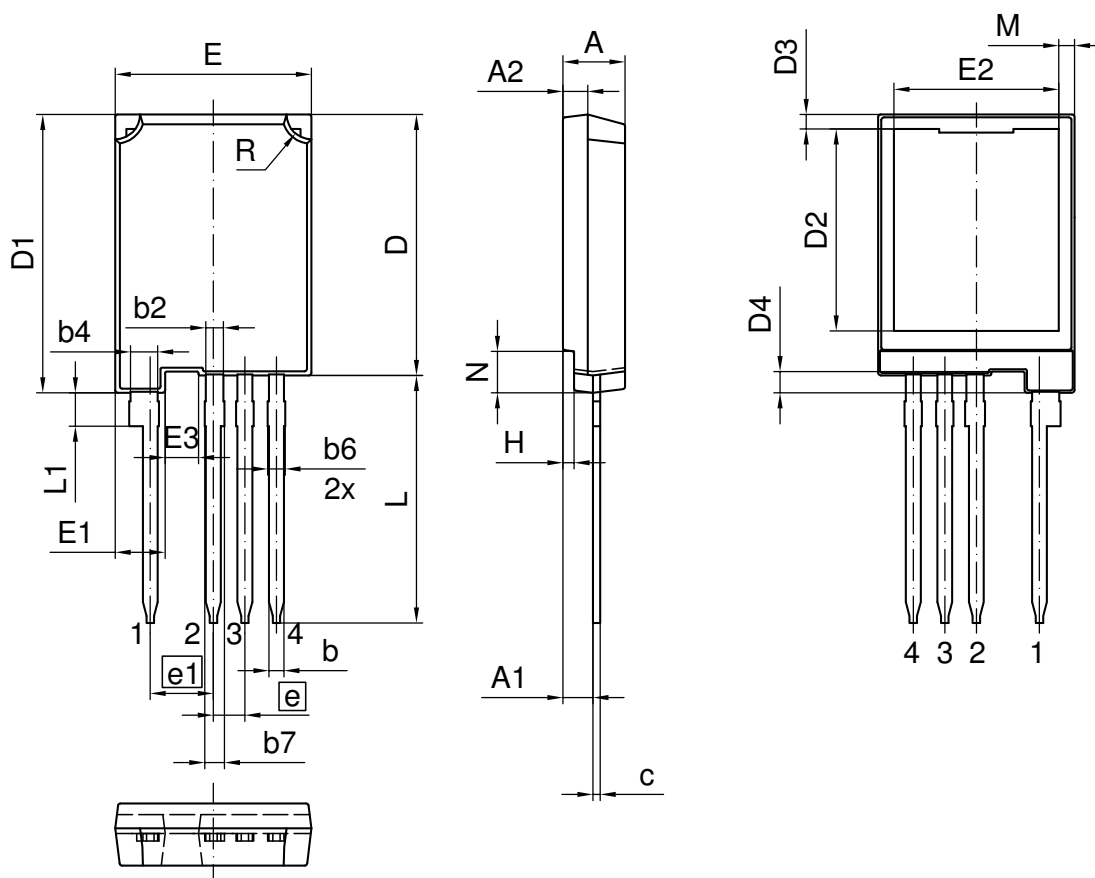


Figure 25. Typical diode forward voltage as a function of junction temperature

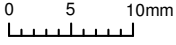
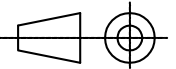
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**NOTES:**

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

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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

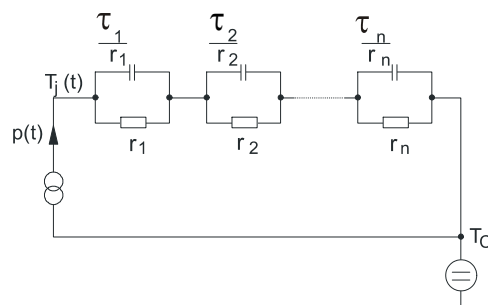


Figure D. Thermal equivalent circuit

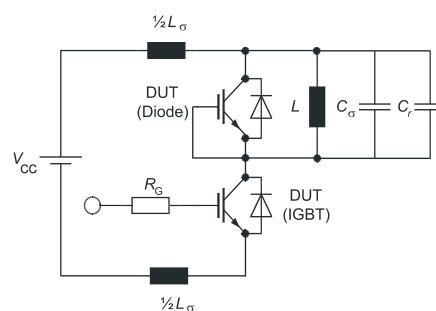


Figure E. **Dynamic test circuit**
Parasitic inductance L_{σ} ,
parasitic capacitor C_{σ} ,
relief capacitor C_r ,
(only for ZVT switching)

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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