

High speed series fifth generation

High speed 5 IGBT in TRENCHSTOP™ 5 technology copacked with full-rated RAPID 1 fast and soft antiparallel diode

Features and Benefits:

High speed H5 technology offering

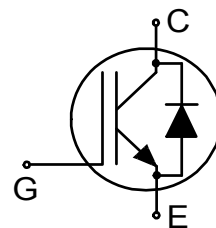
- Best-in-Class efficiency in hard switching and resonant topologies
- Plug and play replacement of previous generation IGBTs
- 650V breakdown voltage
- Low gate charge Q_G
- IGBT copacked with full-rated RAPID 1 fast and soft antiparallel diode
- Maximum junction temperature 175°C
- Qualified according to JEDEC for target applications
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models:
<http://www.infineon.com/igbt/>

Applications:

- Uninterruptible power supplies
- Solar converters
- Welding converters
- Mid to high range switching frequency converters

Package pin definition:

- Pin 1 - gate
- Pin 2 & backside - collector
- Pin 3 - emitter



Key Performance and Package Parameters

Type	V_{CE}	I_C	$V_{CEsat}, T_{vj}=25^{\circ}C$	T_{vjmax}	Marking	Package
IKW75N65EH5	650V	75A	1.65V	175°C	K75EEH5	PG-TO247-3

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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}	650	V
DC collector current, limited by T_{vjmax} $T_C = 25^{\circ}\text{C}$ value limited by bondwire $T_C = 100^{\circ}\text{C}$	I_C	90.0 75.0	A
Pulsed collector current, t_p limited by $T_{vjmax}^{1)}$	I_{Cpuls}	300.0	A
Turn off safe operating area $V_{CE} \leq 650\text{V}$, $T_{vj} \leq 175^{\circ}\text{C}$, $t_p = 1\mu\text{s}^{1)}$	-	300.0	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	90.0 75.0	A
Diode pulsed current, t_p limited by $T_{vjmax}^{1)}$	I_{Fpuls}	300.0	A
Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 10\mu\text{s}$, $D < 0.010$)	V_{GE}	± 20 ± 30	V
Power dissipation $T_C = 25^{\circ}\text{C}$ Power dissipation $T_C = 100^{\circ}\text{C}$	P_{tot}	395.0 198.0	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	$^{\circ}\text{C}$
Mounting torque, M3 screw, PG-TO247-pin123 Maximum of mounting processes: 3	M	0.6	Nm

Thermal Resistance

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
R _{th} Characteristics						
IGBT thermal resistance, junction - case	R _{th(j-C)}		-	-	0.38	K/W
Diode thermal resistance, junction - case	R _{th(j-C)}		-	-	0.45	K/W
Thermal resistance junction - ambient	R _{th(j-a)}		-	-	40	K/W

¹⁾ Defined by design. Not subject to production test.

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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	$V_{(BR)CES}$	$V_{GE} = 0V, I_C = 0.20mA$	650	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	$V_{GE} = 15.0V, I_C = 75.0A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 125^{\circ}C$ $T_{vj} = 175^{\circ}C$	- - -	1.65 1.85 1.95	2.10 - -	V
Diode forward voltage	V_F	$V_{GE} = 0V, I_F = 75.0A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 125^{\circ}C$ $T_{vj} = 175^{\circ}C$	- - -	1.35 1.33 1.30	1.70 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 0.75mA, V_{CE} = V_{GE}$	3.2	4.0	4.8	V
Zero gate voltage collector current	I_{CES}	$V_{CE} = 650V, V_{GE} = 0V$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$	- -	1 3000	75 -	μA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0V, V_{GE} = 20V$	-	-	100	nA
Transconductance	g_{fs}	$V_{CE} = 20V, I_C = 75.0A$	-	104.0	-	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	-	4200	-	pF
Output capacitance	C _{oes}		-	130	-	
Reverse transfer capacitance	C _{res}		-	17	-	
Gate charge	Q _G	V _{CC} = 520V, I _C = 75.0A, V _{GE} = 15V	-	160.0	-	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	$t_{d(\text{on})}$	$T_{vj} = 25^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_C = 75.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(\text{on})} = 8.0\Omega, R_{G(\text{off})} = 8.0\Omega,$ $L\sigma = 30\text{nH}, C\sigma = 25\text{pF}$ $L\sigma, C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	28	-	ns
Rise time	t_r		-	33	-	ns
Turn-off delay time	$t_{d(\text{off})}$		-	174	-	ns
Fall time	t_f		-	41	-	ns
Turn-on energy	E_{on}		-	2.30	-	mJ
Turn-off energy	E_{off}		-	0.90	-	mJ
Total switching energy	E_{ts}		-	3.20	-	mJ

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Turn-on delay time	$t_{d(on)}$	$T_{vj} = 25^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 37.5\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(on)} = 8.0\Omega$, $R_{G(off)} = 8.0\Omega$, $L\sigma = 30\text{nH}$, $C\sigma = 20\text{pF}$ $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	25	-	ns
Rise time	t_r		-	14	-	ns
Turn-off delay time	$t_{d(off)}$		-	178	-	ns
Fall time	t_f		-	15	-	ns
Turn-on energy	E_{on}		-	0.90	-	mJ
Turn-off energy	E_{off}		-	0.30	-	mJ
Total switching energy	E_{ts}		-	1.20	-	mJ

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

Diode reverse recovery time	t_{rr}	$T_{vj} = 25^{\circ}\text{C}$, $V_R = 400\text{V}$, $I_F = 75.0\text{A}$, $di_F/dt = 1000\text{A}/\mu\text{s}$, $L\sigma = 30\text{nH}$, $C\sigma = 25\text{pF}$	-	92	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.33	-	μC
Diode peak reverse recovery current	I_{rrm}		-	20.5	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-600	-	A/ μs
Diode reverse recovery time	t_{rr}	$T_{vj} = 25^{\circ}\text{C}$, $V_R = 400\text{V}$, $I_F = 37.5\text{A}$, $di_F/dt = 1000\text{A}/\mu\text{s}$, $L\sigma = 30\text{nH}$, $C\sigma = 25\text{pF}$	-	59	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.00	-	μC
Diode peak reverse recovery current	I_{rrm}		-	25.8	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-1750	-	A/ μs

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at $T_{vj} = 150^{\circ}\text{C}$						
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 150^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 75.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(on)} = 8.0\Omega$, $R_{G(off)} = 8.0\Omega$, $L\sigma = 30\text{nH}$, $C\sigma = 25\text{pF}$ $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	27	-	ns
Rise time	t_r		-	34	-	ns
Turn-off delay time	$t_{d(off)}$		-	194	-	ns
Fall time	t_f		-	38	-	ns
Turn-on energy	E_{on}		-	3.00	-	mJ
Turn-off energy	E_{off}		-	1.00	-	mJ
Total switching energy	E_{ts}		-	4.00	-	mJ
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 150^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 37.5\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(on)} = 8.0\Omega$, $R_{G(off)} = 8.0\Omega$, $L\sigma = 30\text{nH}$, $C\sigma = 20\text{pF}$ $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	25	-	ns
Rise time	t_r		-	16	-	ns
Turn-off delay time	$t_{d(off)}$		-	207	-	ns
Fall time	t_f		-	18	-	ns
Turn-on energy	E_{on}		-	1.80	-	mJ
Turn-off energy	E_{off}		-	0.40	-	mJ
Total switching energy	E_{ts}		-	2.20	-	mJ

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Diode Characteristic, at $T_{vj} = 150^{\circ}\text{C}$

Diode reverse recovery time	t_{rr}	$T_{vj} = 150^{\circ}\text{C},$ $V_R = 400\text{V},$ $I_F = 75.0\text{A},$ $di_F/dt = 1000\text{A}/\mu\text{s},$ $L\sigma = 30\text{nH},$ $C\sigma = 25\text{pF}$	-	123	-	ns
Diode reverse recovery charge	Q_{rr}		-	3.70	-	μC
Diode peak reverse recovery current	I_{rrm}		-	43.8	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-2000	-	A/ μs
Diode reverse recovery time	t_{rr}	$T_{vj} = 150^{\circ}\text{C},$ $V_R = 400\text{V},$ $I_F = 37.5\text{A},$ $di_F/dt = 1000\text{A}/\mu\text{s},$ $L\sigma = 30\text{nH},$ $C\sigma = 25\text{pF}$	-	108	-	ns
Diode reverse recovery charge	Q_{rr}		-	2.70	-	μC
Diode peak reverse recovery current	I_{rrm}		-	38.7	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-1050	-	A/ μs

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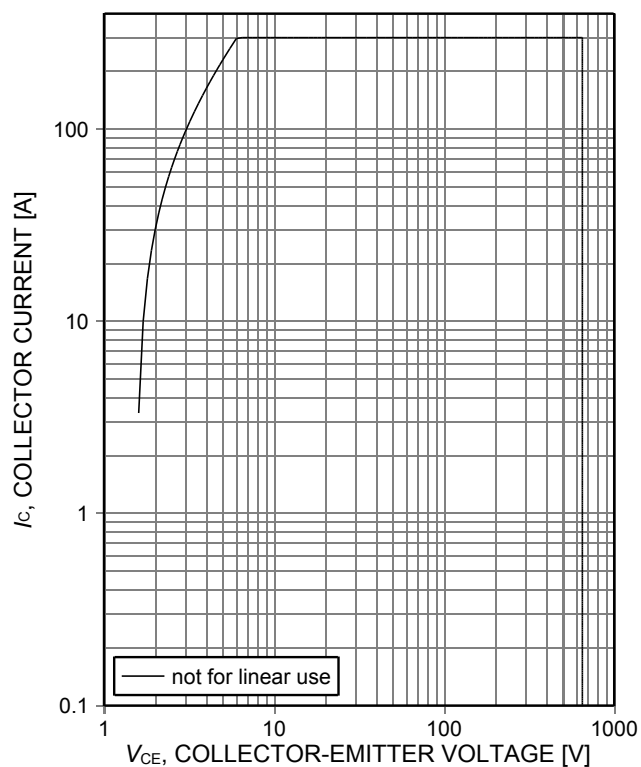


Figure 1. **Forward bias safe operating area**
($D=0$, $T_C=25^\circ\text{C}$, $T_{vj}\leq 175^\circ\text{C}$, $V_{GE}=15\text{V}$, $t_p=1\mu\text{s}$,
 I_{Cmax} defined by design - not subject to
production test)

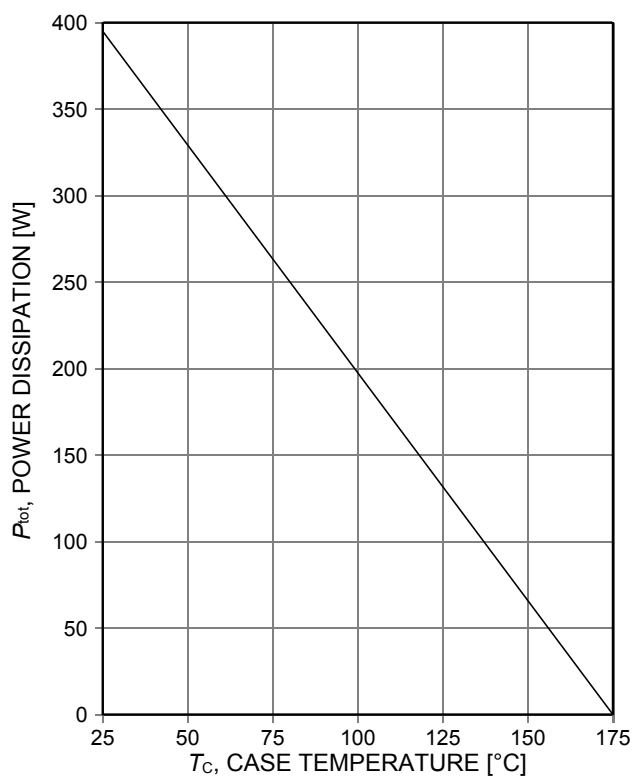


Figure 2. **Power dissipation as a function of case temperature**
($T_{vj}\leq 175^\circ\text{C}$)

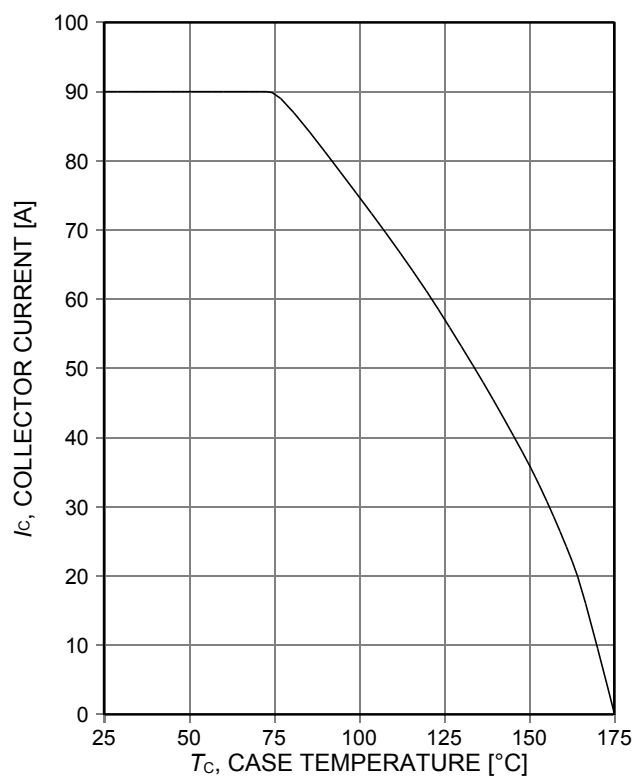


Figure 3. **Collector current as a function of case temperature**
($V_{GE}\geq 15\text{V}$, $T_{vj}\leq 175^\circ\text{C}$)

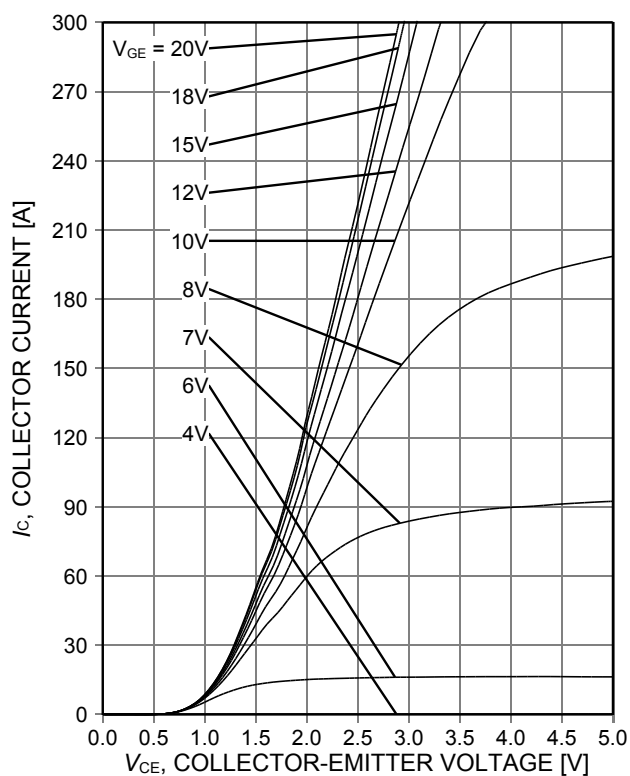


Figure 4. **Typical output characteristic**
($T_{vj}=25^\circ\text{C}$)

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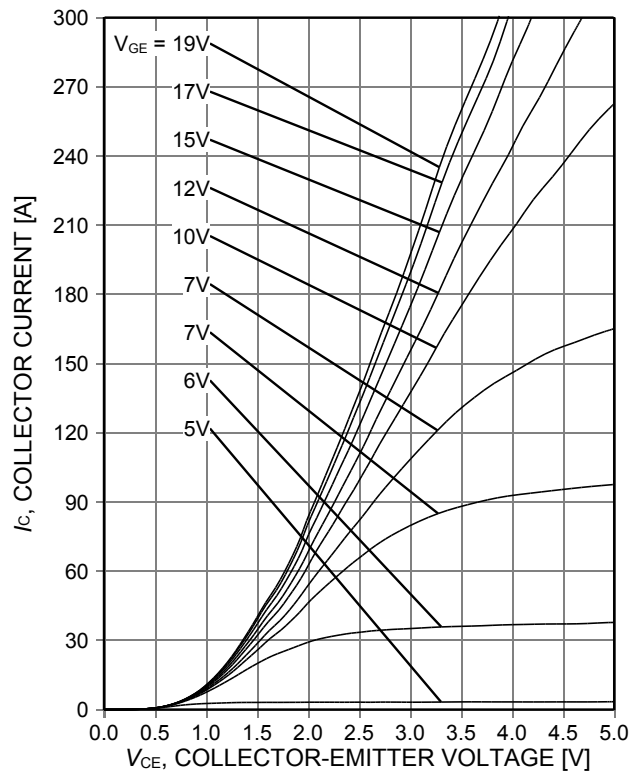


Figure 5. **Typical output characteristic**
($T_{vj}=150^{\circ}\text{C}$)

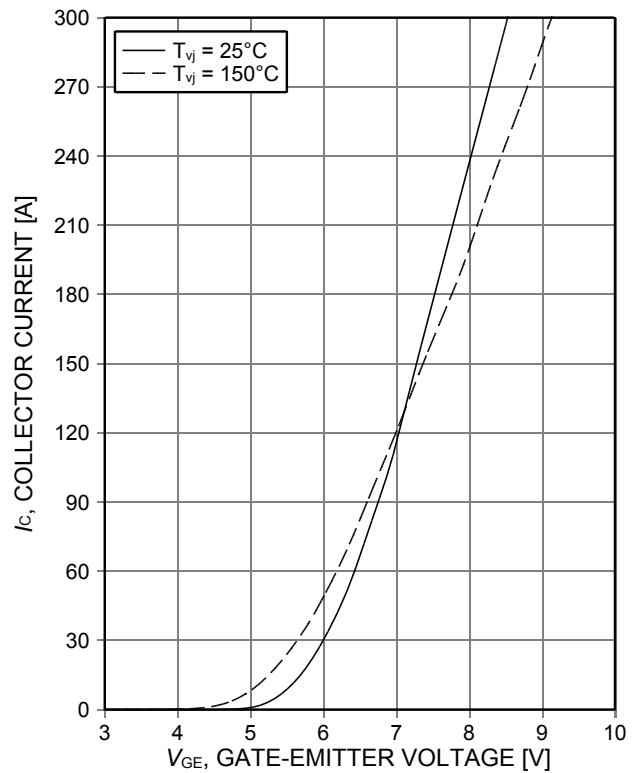


Figure 6. **Typical transfer characteristic**
($V_{ce}=20\text{V}$)

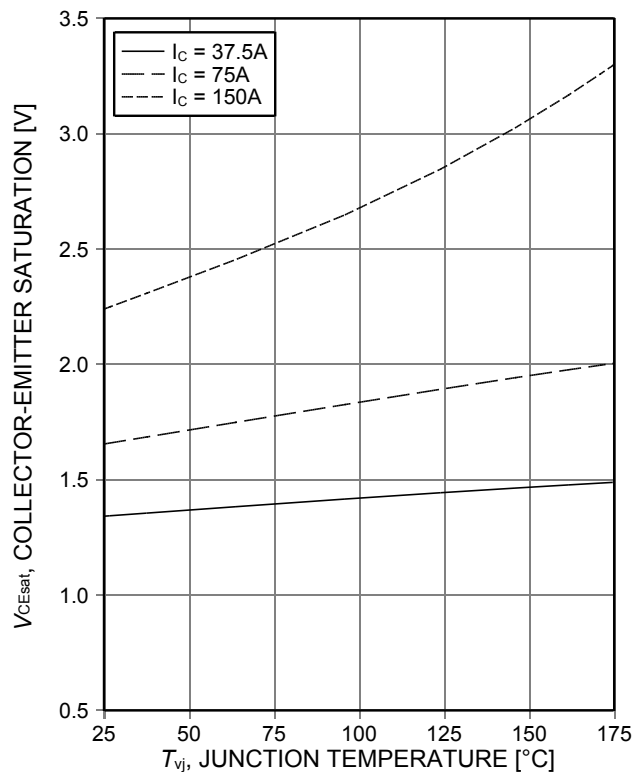


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{ge}=15\text{V}$)

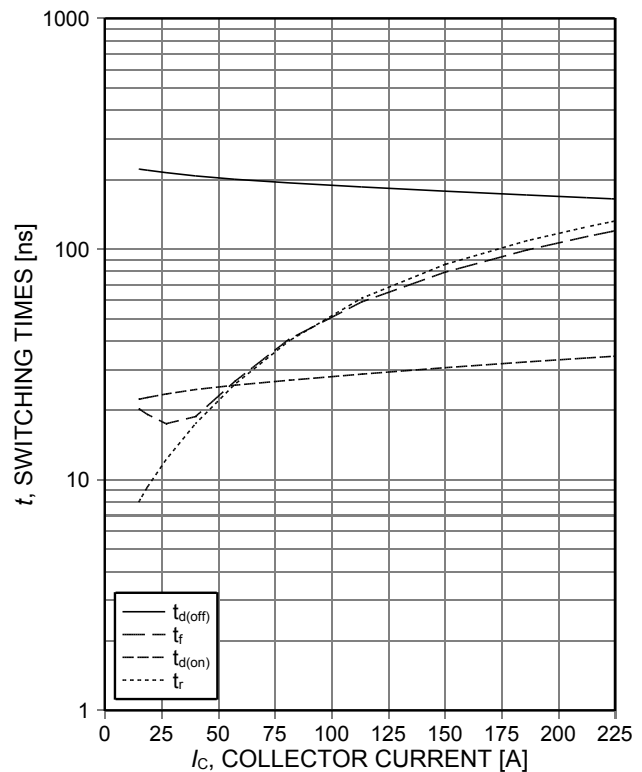


Figure 8. **Typical switching times as a function of collector current**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{ce}=400\text{V}$, $V_{ge}=0/15\text{V}$, $R_{G(on)}=8\Omega$, $R_{G(off)}=8\Omega$, dynamic test circuit in Figure E)

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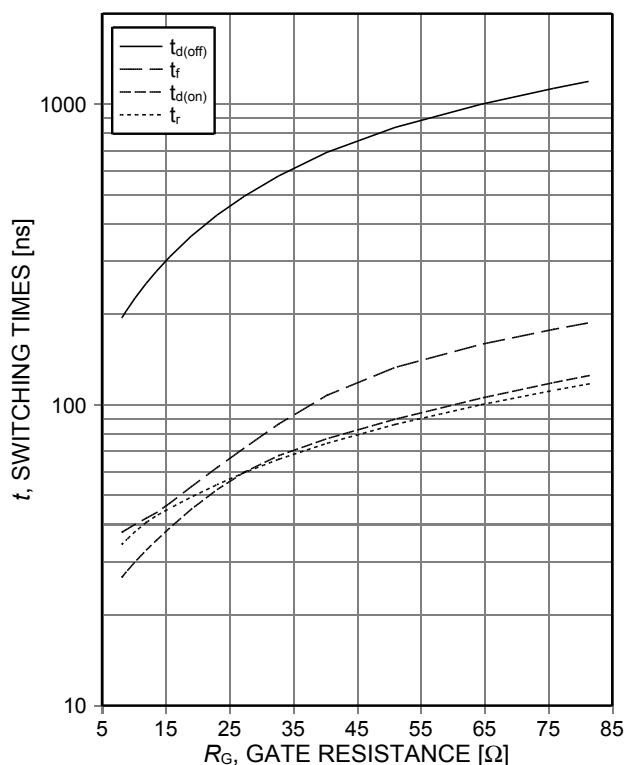


Figure 9. **Typical switching times as a function of gate resistance**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=75\text{A}$, dynamic test circuit in Figure E)

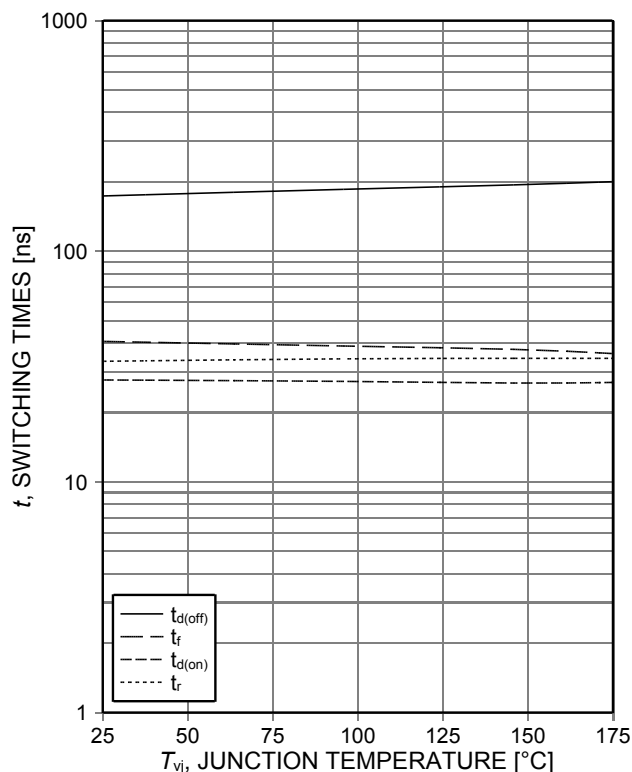


Figure 10. **Typical switching times as a function of junction temperature**
(inductive load, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=75\text{A}$, $R_{G(on)}=8\Omega$, $R_{G(off)}=8\Omega$, dynamic test circuit in Figure E)

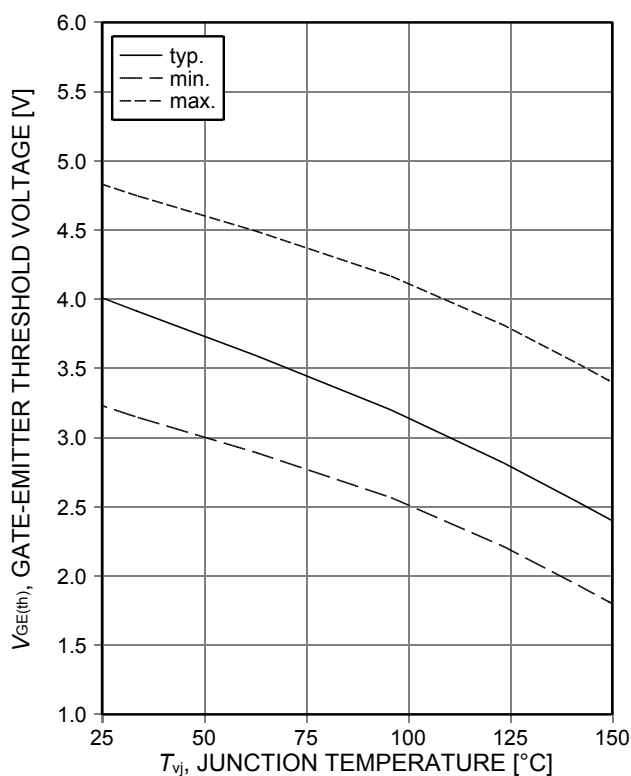


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
($I_C=0.75\text{mA}$)

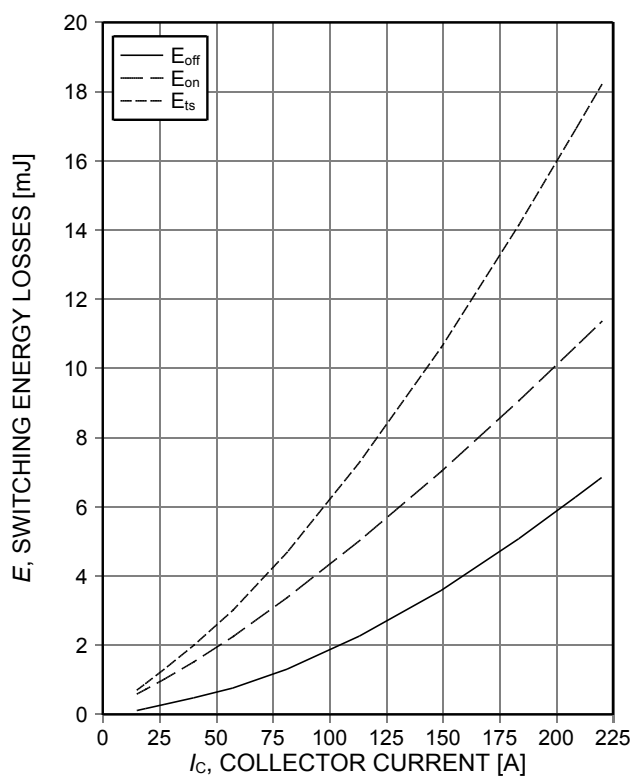


Figure 12. **Typical switching energy losses as a function of collector current**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $R_{G(on)}=8\Omega$, $R_{G(off)}=8\Omega$, dynamic test circuit in Figure E)

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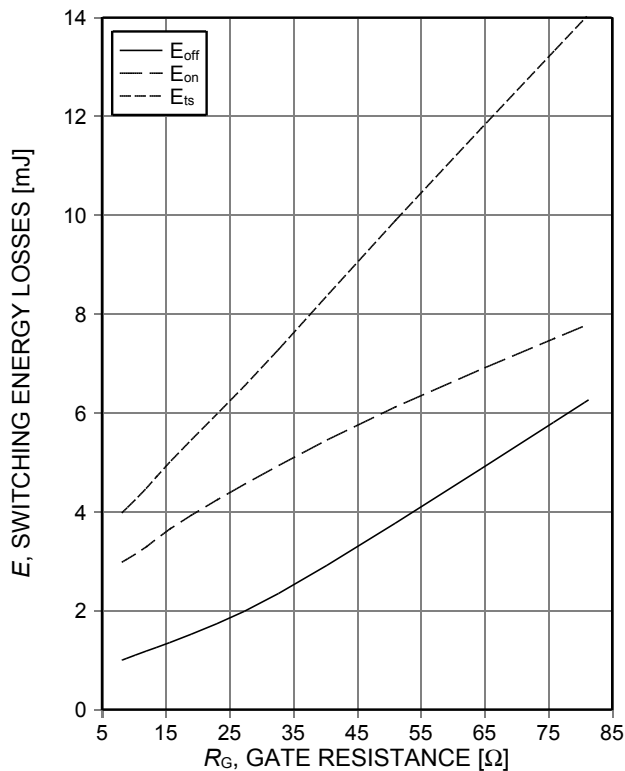


Figure 13. **Typical switching energy losses as a function of gate resistance**
(inductive load, $T_{vj}=150^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=75\text{A}$, dynamic test circuit in Figure E)

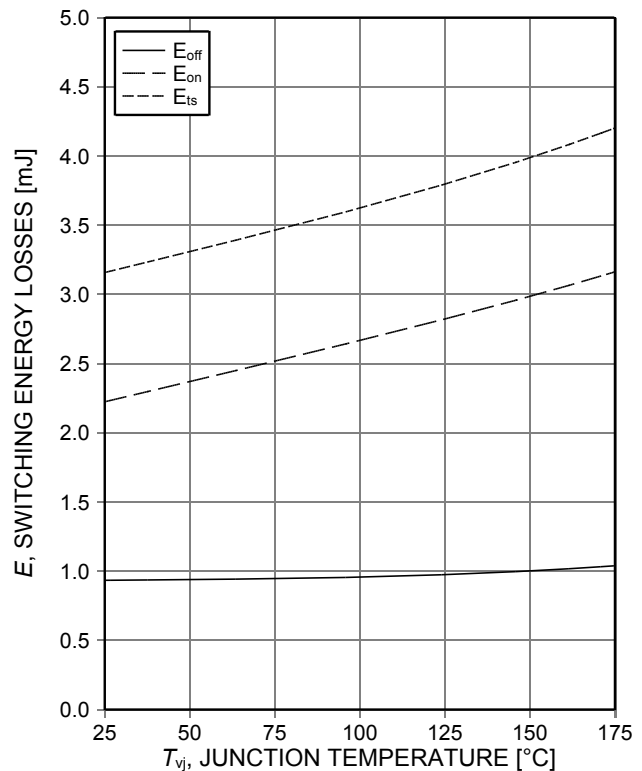


Figure 14. **Typical switching energy losses as a function of junction temperature**
(inductive load, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=75\text{A}$, $R_{G(on)}=8\Omega$, $R_{G(off)}=8\Omega$, dynamic test circuit in Figure E)

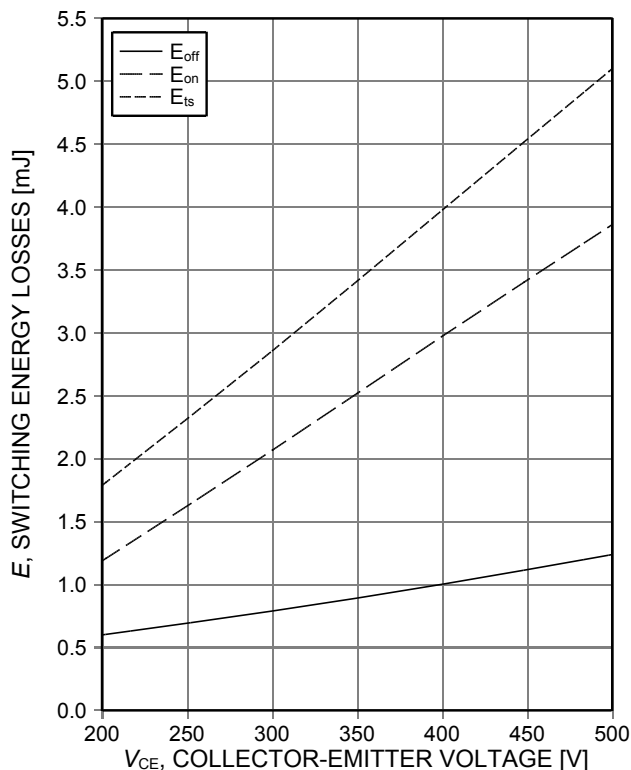


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, $T_{vj}=150^\circ\text{C}$, $V_{GE}=0/15\text{V}$, $I_C=75\text{A}$, $R_{G(on)}=8\Omega$, $R_{G(off)}=8\Omega$, dynamic test circuit in Figure E)

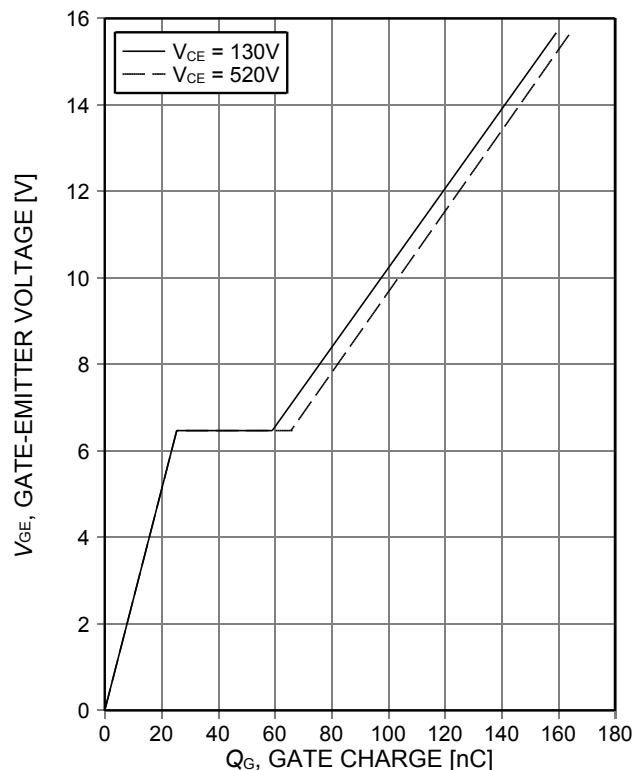


Figure 16. **Typical gate charge**
($I_C=75\text{A}$)

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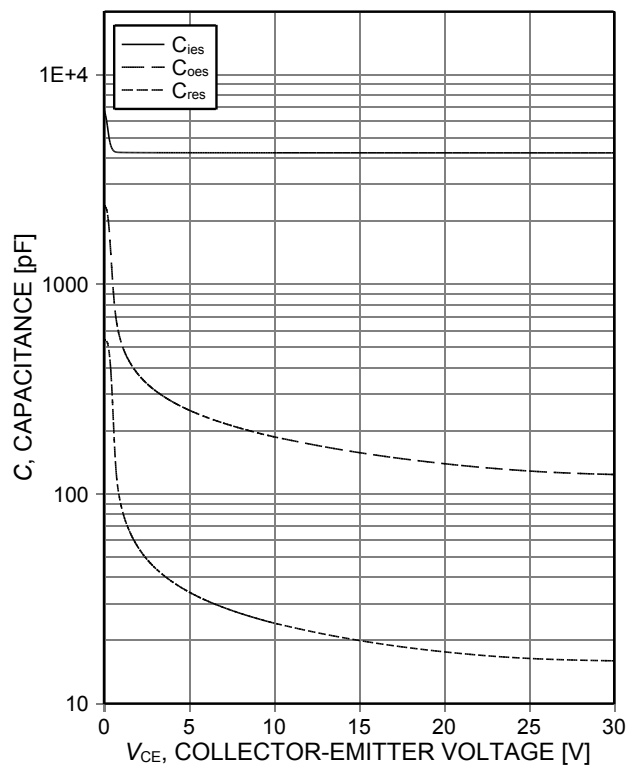


Figure 17. **Typical capacitance as a function of collector-emitter voltage**
($V_{GE}=0V$, $f=1MHz$)

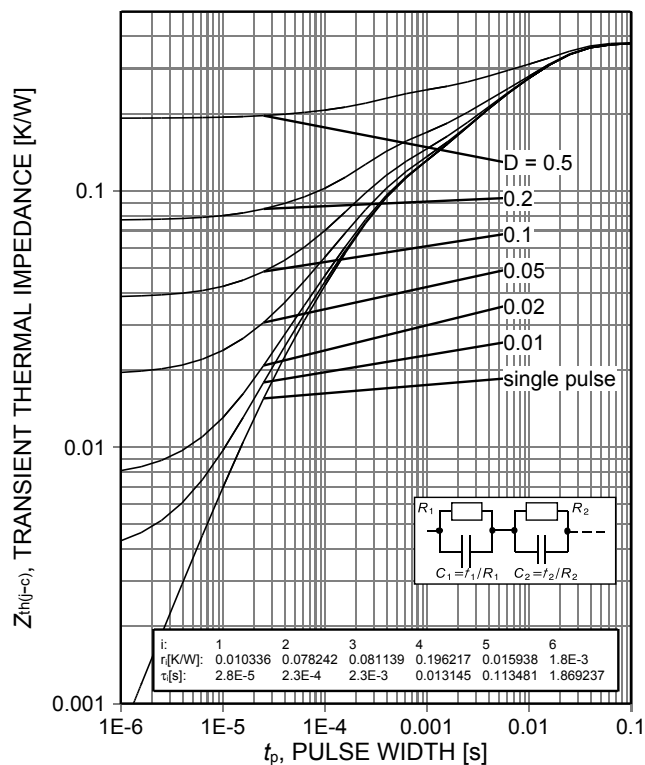


Figure 18. **IGBT transient thermal impedance**
($D=t_p/T$)

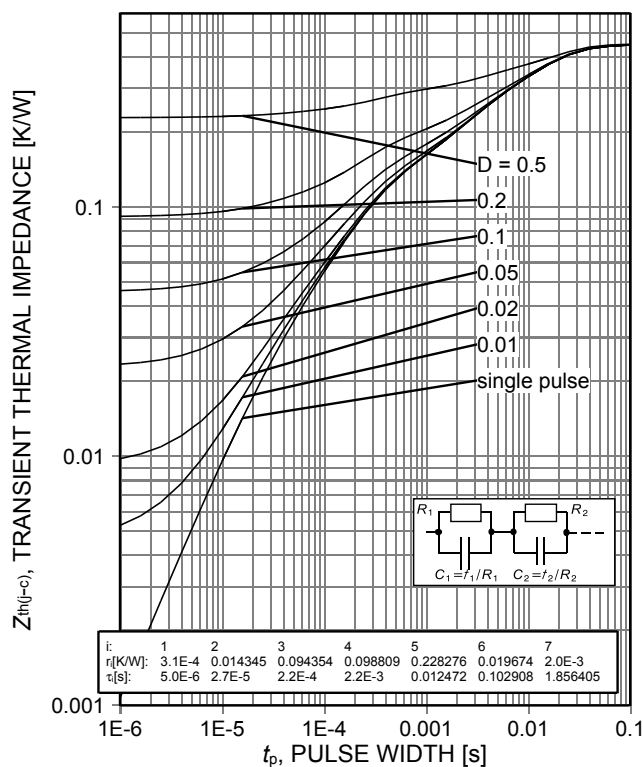


Figure 19. **Diode transient thermal impedance as a function of pulse width**
($D=t_p/T$)

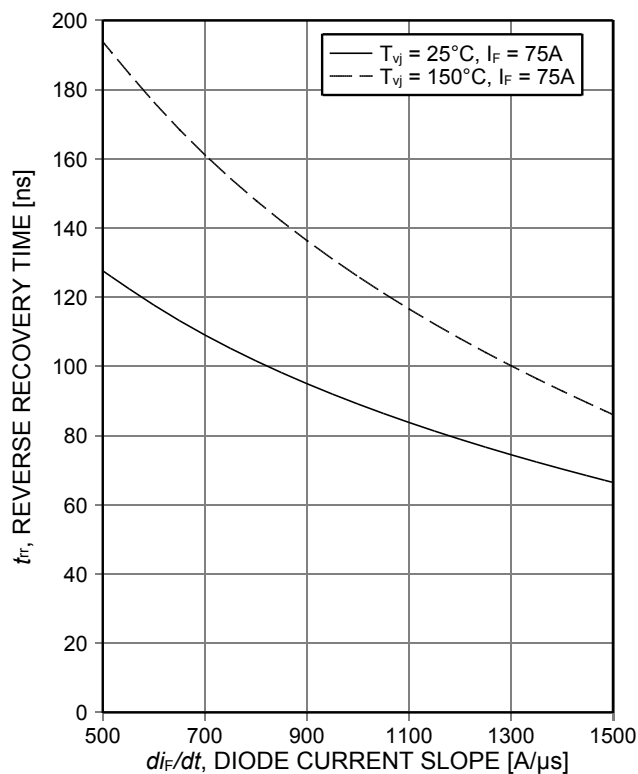


Figure 20. **Typical reverse recovery time as a function of diode current slope**
($V_R=400V$)

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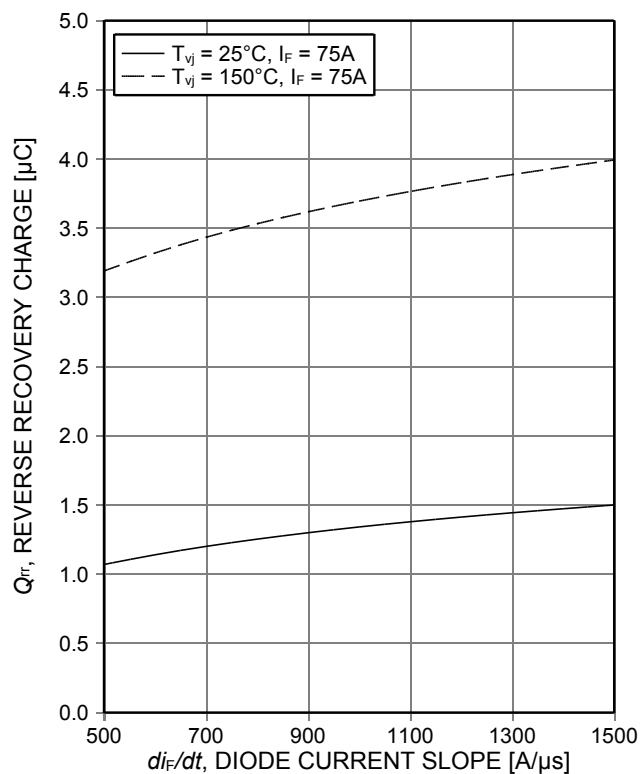


Figure 21. **Typical reverse recovery charge as a function of diode current slope**
($V_R=400V$)

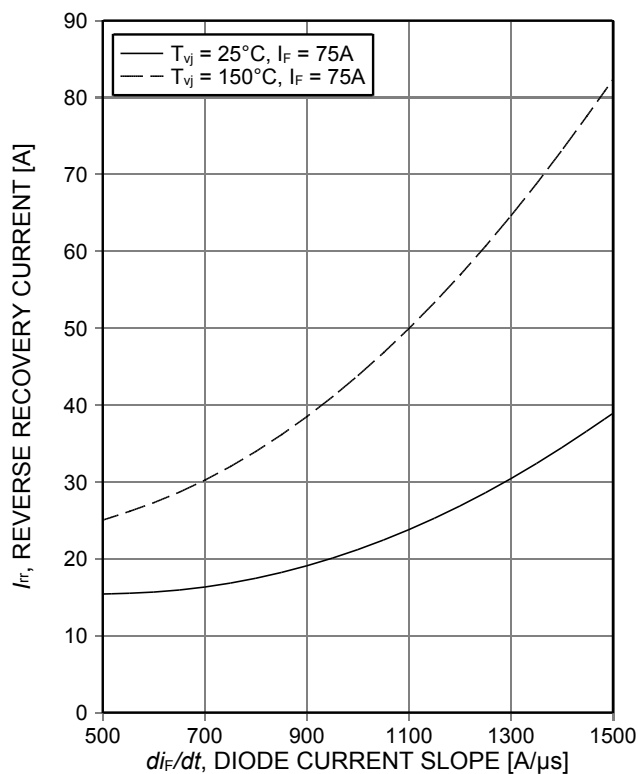


Figure 22. **Typical reverse recovery current as a function of diode current slope**
($V_R=400V$)

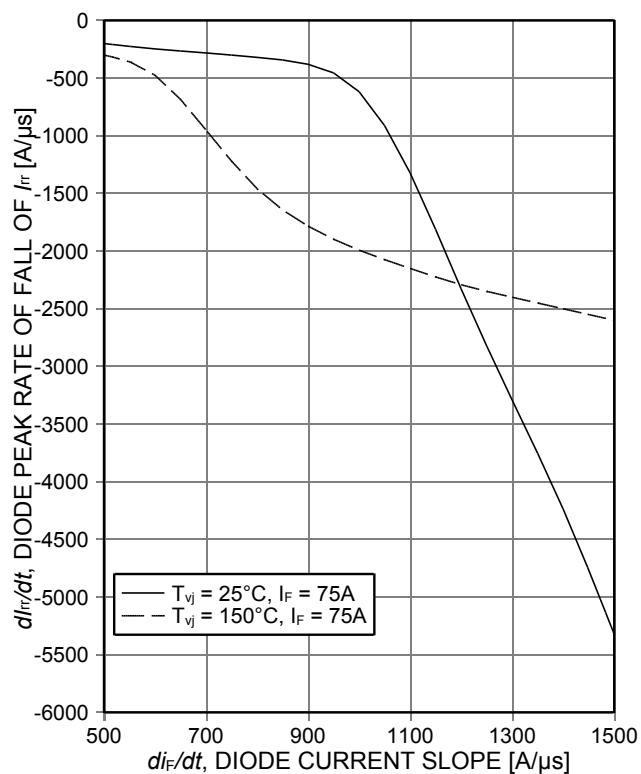


Figure 23. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
($V_R=400V$)

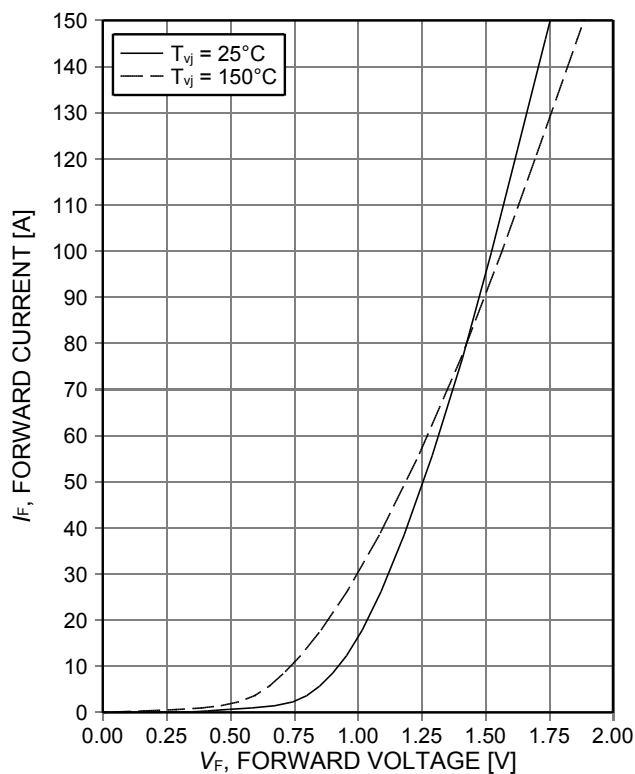


Figure 24. **Typical diode forward current as a function of forward voltage**

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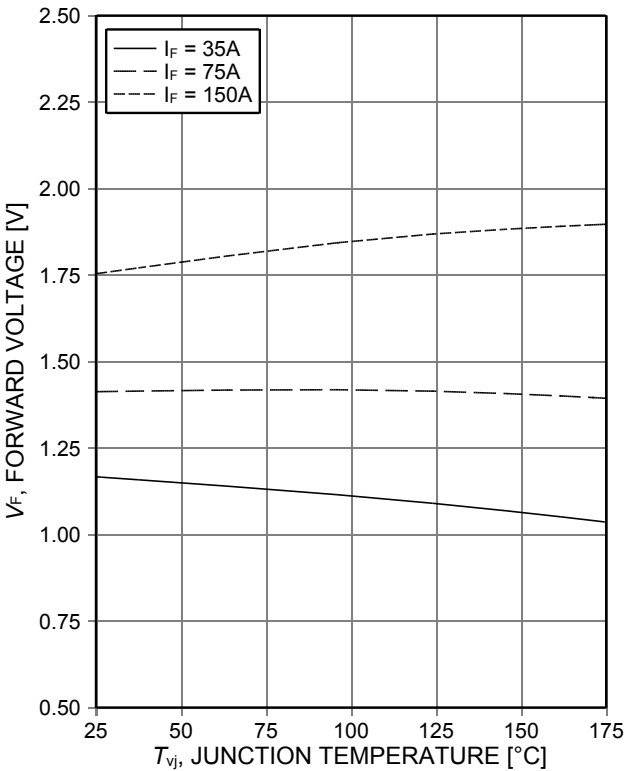
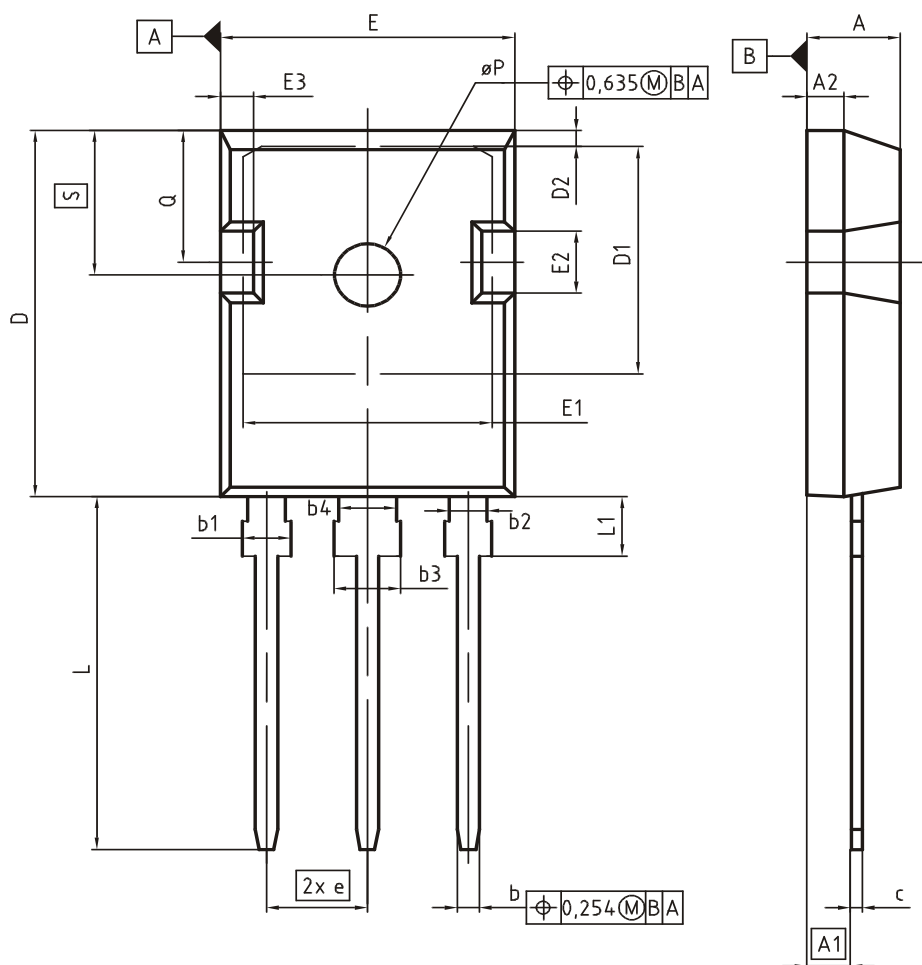
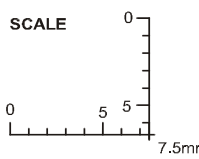
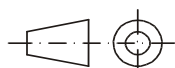


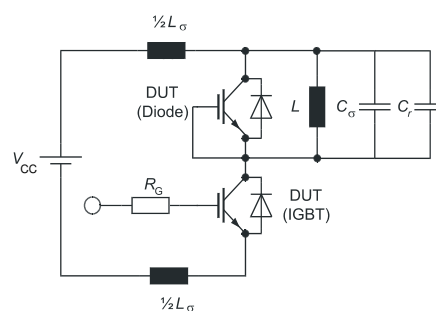
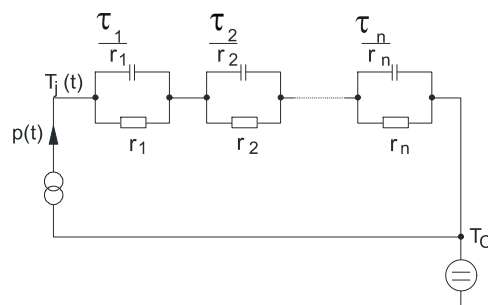
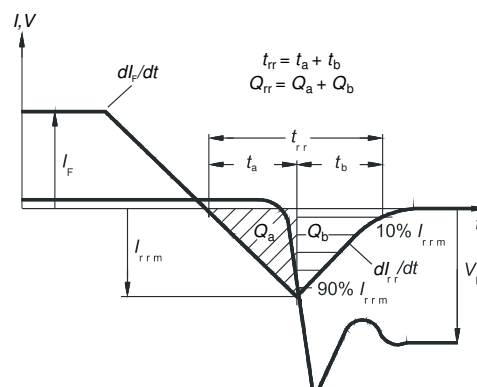
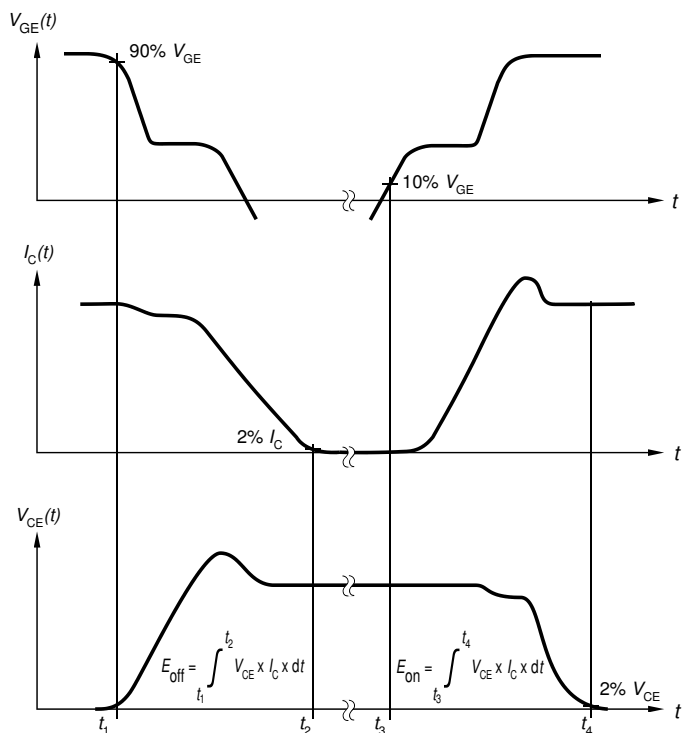
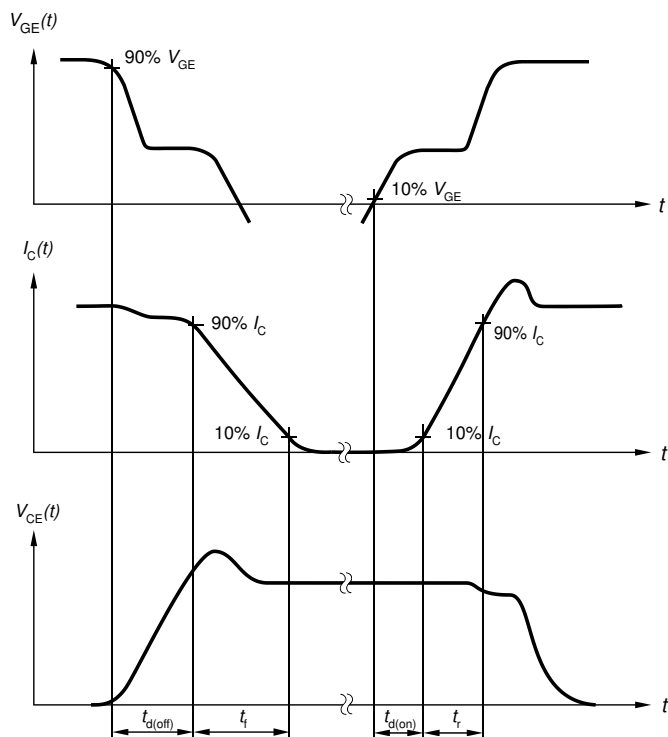
Figure 25. Typical diode forward voltage as a function of junction temperature

Package Drawing PG-TO247-3



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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REVISION 05



High speed series fifth generation

Revision History

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Revision: 2017-07-27, Rev. 2.2

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2015-05-20	Final data sheet
2.2	2017-07-27	Correction Fig.1

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