IGBT

High speed DuoPack: IGBT in Trench and Fieldstop technology
with soft, fast recovery anti-parallel diode

IKW30N60H3

600V high speed switching series third generation

Data sheet

Industrial Power Control

High speed DuoPack: IGBT in Trench and Fieldstop technology with soft, fast recovery anti-parallel diode

Features:

TRENCHSTOP^{TM} technology offering
• very low V_{CEsat}
• 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
• complete product spectrum and PSpice Models:
http://www.infineon.com/igbt/
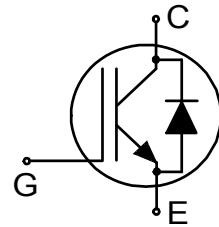
Applications:

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

Key Performance and Package Parameters

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
IKW30N60H3	600V	30A	1.95V	175°C	K30H603	PG-TO247-3

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IKW30N60H3

High speed switching series third generation

Maximum ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage, $T_{vj} \geq 25°C$	V_{CE}	600	V
DC collector current, limited by T_{vjmax} $T_C = 25°C$ $T_C = 100°C$	I_C	60.0 30.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	120.0	A
Turn off safe operating area $V_{CE} \leq 600V$, $T_{vj} \leq 175°C$, $t_p = 1\mu s$	-	120.0	A
Diode forward current, limited by T_{vjmax} $T_C = 25°C$ $T_C = 100°C$	I_F	30.0 15.0	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	120.0	A
Gate-emitter voltage	V_{GE}	±20	V
Short circuit withstand time $V_{GE} = 15.0V$, $V_{CC} \leq 400V$ Allowed number of short circuits < 1000 Time between short circuits: $\geq 1.0s$ $T_{vj} = 150°C$	t_{SC}	 5	μs
Power dissipation $T_C = 25°C$ Power dissipation $T_C = 100°C$	P_{tot}	187.0 94.0	W
Operating junction temperature	T_{vj}	-40...+175	°C
Storage temperature	T_{stg}	-55...+150	°C
Soldering temperature, wave soldering 1.6 mm (0.063 in.) from case for 10s		260	°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	$R_{th(j-c)}$		0.80	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		1.90	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		40	K/W

Electrical Characteristic, at T_{vj} = 25°C, unless otherwise specified

Parameter	Symbol	Conditions	Value min.	Value typ.	Value max.	Unit
Static Characteristic						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	V_{GE} = 0V, I_C = 2.00mA	600	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	V_{GE} = 15.0V, I_C = 30.0A T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	- - -	1.95 2.30 2.50	2.40 - -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 15.0A T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	- - -	1.65 1.67 1.65	2.05 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.43mA, V_{CE} = V_{GE}	4.1	5.1	5.7	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 600V, V_{GE} = 0V T_{vj} = 25°C T_{vj} = 175°C	- -	- -	40.0 2000.0	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 30.0A	-	16.0	-	S

Electrical Characteristic, at T_{vj} = 25°C, unless otherwise specified

Parameter	Symbol	Conditions	Value min.	Value typ.	Value max.	Unit
Dynamic Characteristic						
Input capacitance	C_{ies}	V_{CE} = 25V, V_{GE} = 0V, f = 1MHz	-	1630	-	pF
Output capacitance	C_{oes}		-	107	-	pF
Reverse transfer capacitance	C_{res}		-	50	-	pF
Gate charge	Q_G	V_{CC} = 480V, I_C = 30.0A, V_{GE} = 15V	-	165.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	13.0	-	nH
Short circuit collector current Max. 1000 short circuits Time between short circuits: ≥ 1.0s	$I_{C(SC)}$	V_{GE} = 15.0V, V_{CC} ≤ 400V, t_{SC} ≤ 5µs T_{vj} = 150°C	-	160	-	A

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at T_{vj} = 25°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 25°C, V_{CC} = 400V, I_C = 30.0A, V_{GE} = 0.0/15.0V, r_G = 10.5Ω, $L\sigma$ = 95nH, $C\sigma$ = 67pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	21	-	ns
Rise time	t_r		-	33	-	ns
Turn-off delay time	$t_{d(off)}$		-	207	-	ns
Fall time	t_f		-	22	-	ns
Turn-on energy	E_{on}		-	0.94	-	mJ
Turn-off energy	E_{off}		-	0.44	-	mJ
Total switching energy	E_{ts}		-	1.38	-	mJ
Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R = 400V, I_F = 15.0A, di_F/dt = 1000A/µs	-	38	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.32	-	µC
Diode peak reverse recovery current	I_{rrm}		-	12.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-765	-	A/µs

Switching Characteristic, Inductive Load

| Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at T_{vj} = 175°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 175°C, V_{CC} = 400V, I_C = 30.0A, V_{GE} = 0.0/15.0V, r_G = 10.5Ω, $L\sigma$ = 95nH, $C\sigma$ = 67pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	20	-	ns
Rise time	t_r		-	30	-	ns
Turn-off delay time	$t_{d(off)}$		-	239	-	ns
Fall time	t_f		-	23	-	ns
Turn-on energy	E_{on}		-	1.12	-	mJ
Turn-off energy	E_{off}		-	0.60	-	mJ
Total switching energy	E_{ts}		-	1.72	-	mJ
Diode reverse recovery time	t_{rr}	T_{vj} = 175°C, V_R = 400V, I_F = 15.0A, di_F/dt = 1000A/µs	-	117	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.08	-	µC
Diode peak reverse recovery current	I_{rrm}		-	16.6	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-530	-	A/µs
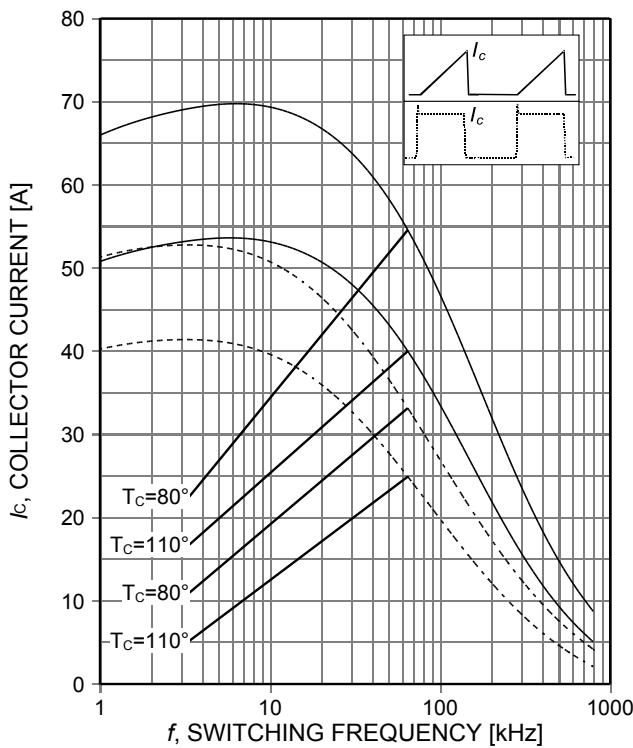
Figure 1. **Collector current as a function of switching frequency**
($T_j{\leq}175°C$, D=0.5, V_{CE}=400V, V_{GE}=15/0V, r_G=10,5Ω)
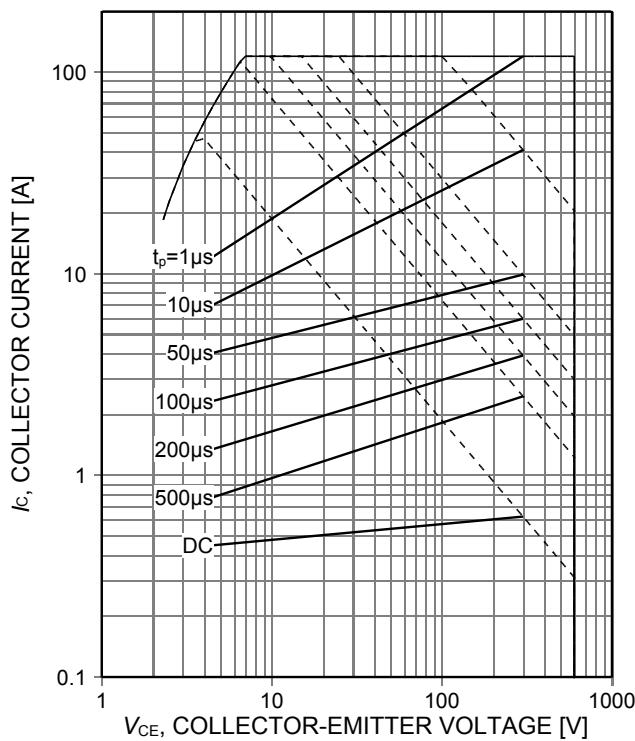
Figure 2. **Forward bias safe operating area**
(D=0, T_C=25°C, $T_j{\leq}175°C$; V_{GE}=15V)
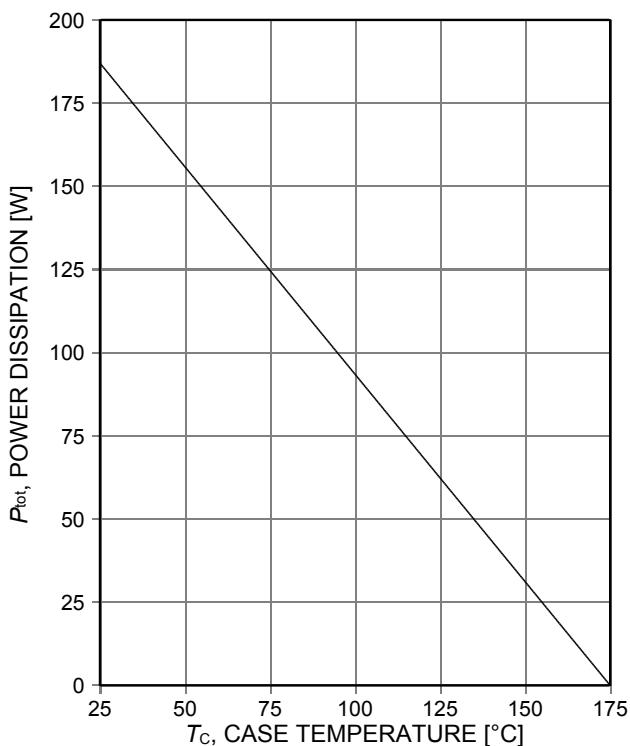
Figure 3. **Power dissipation as a function of case temperature**
($T_j{\leq}175°C$)
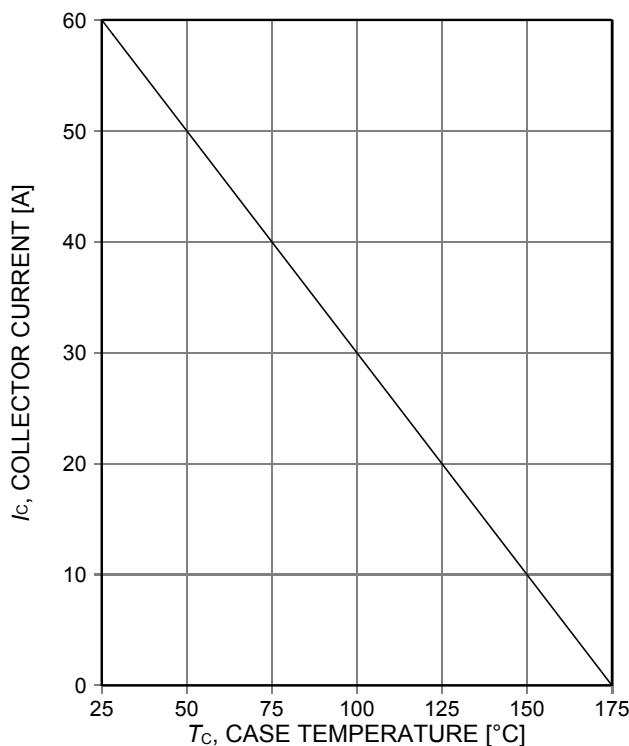
Figure 4. **Collector current as a function of case temperature**
($V_{GE}{\geq}15V$, $T_j{\leq}175°C$)
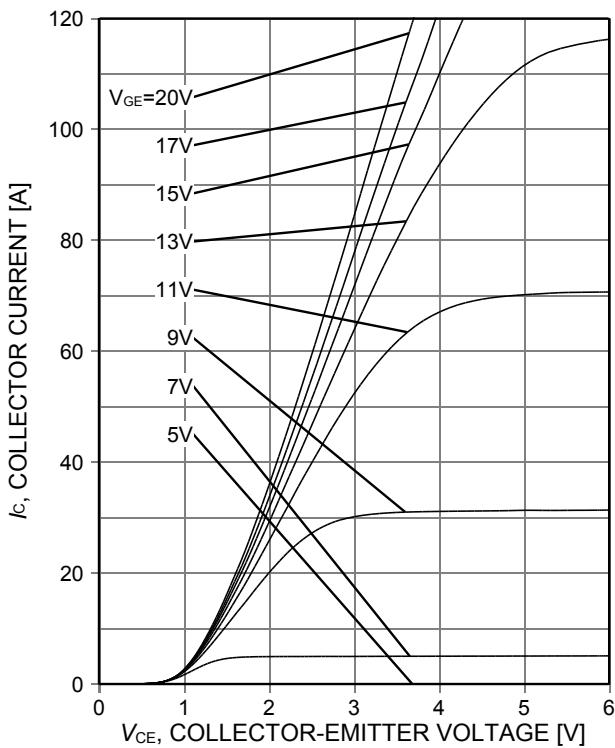
Figure 5. **Typical output characteristic**
(T_j=25°C)
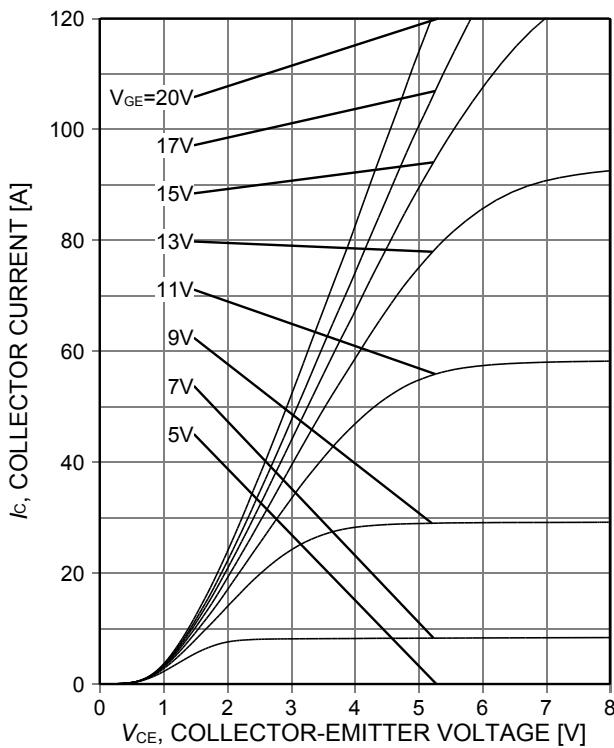
Figure 6. **Typical output characteristic**
(T_j=175°C)
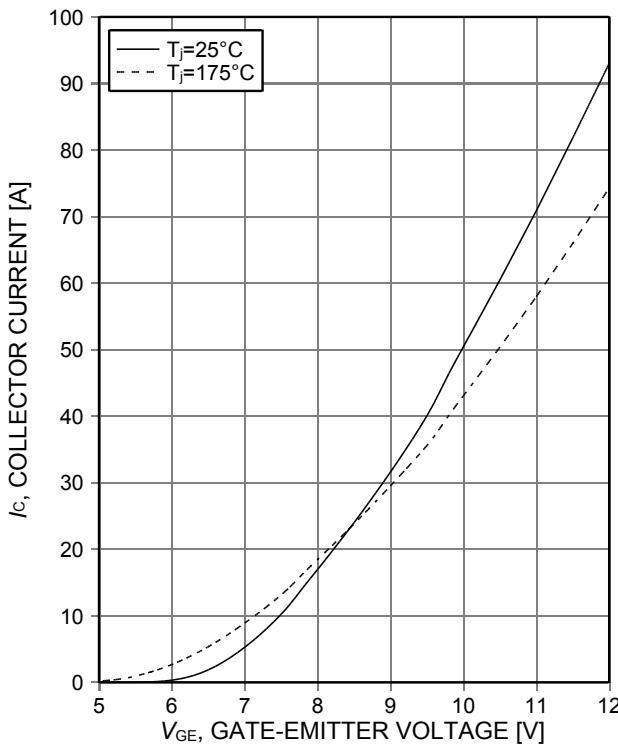
Figure 7. **Typical transfer characteristic**
(V_{CE}=20V)
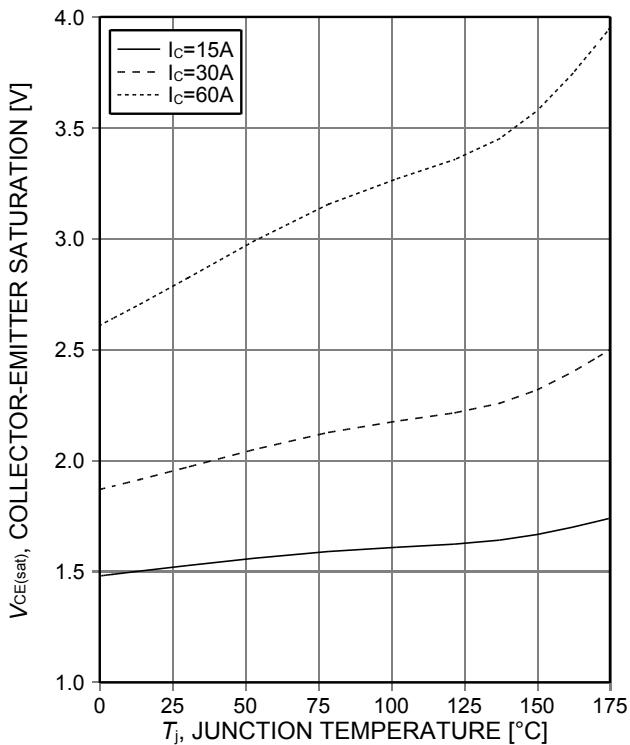
Figure 8. **Typical collector-emitter saturation voltage as
a function of junction temperature**
(V_{GE}=15V)

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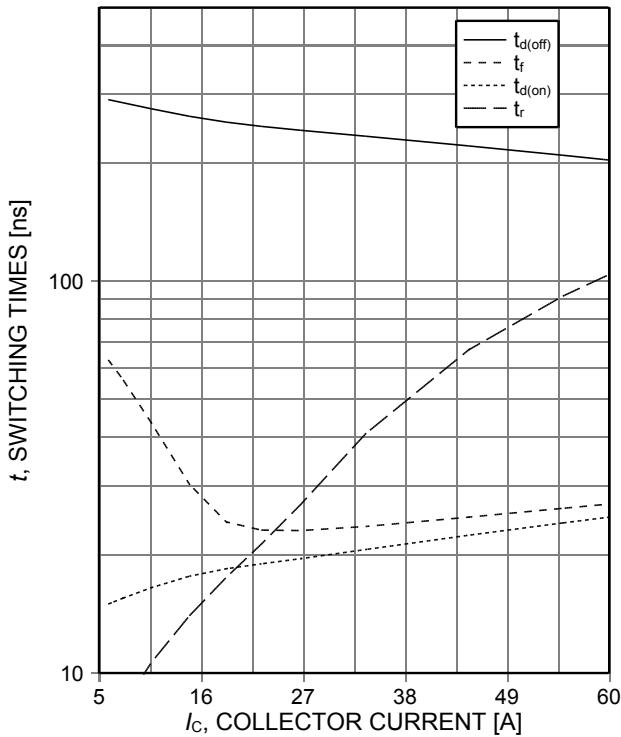
Figure 9. **Typical switching times as a function of collector current**
(ind. load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, r_G=10,5Ω, test circuit in Fig. E)
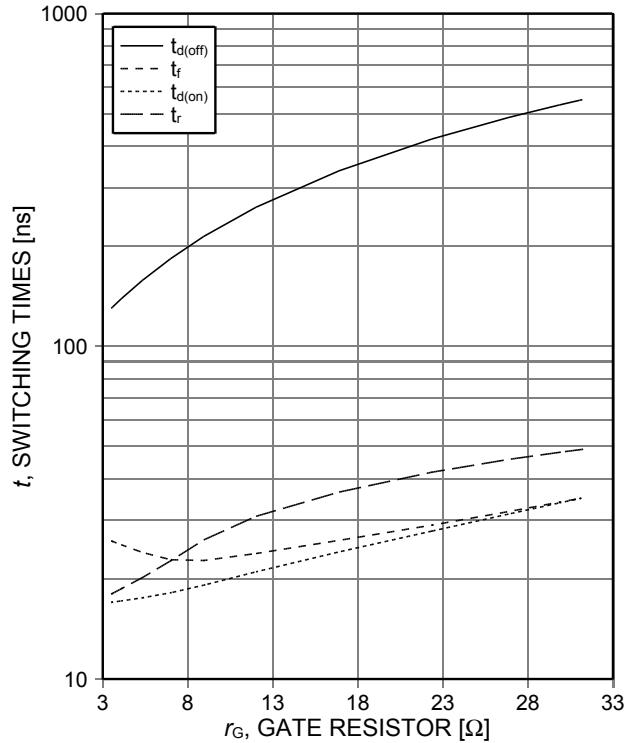
Figure 10. **Typical switching times as a function of gate resistor**
(ind. load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=30A, test circuit in Fig. E)
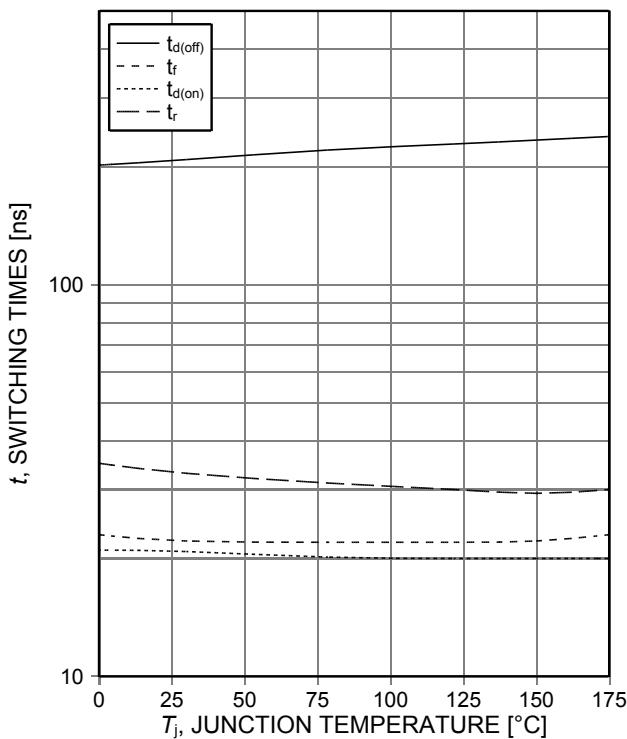
Figure 11. **Typical switching times as a function of junction temperature**
(ind. load, V_{CE}=400V, V_{GE}=15/0V, I_C=30A, r_G=10,5Ω, test circuit in Fig. E)
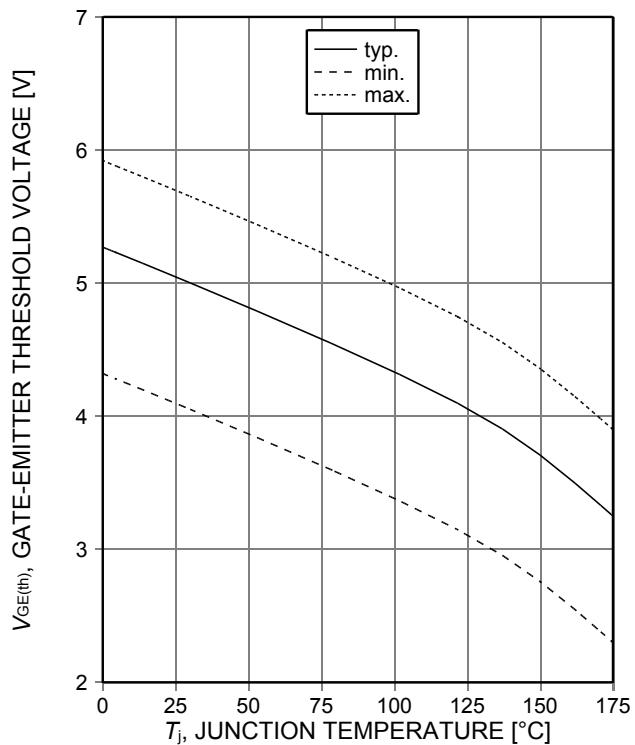
Figure 12. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=0.43mA)

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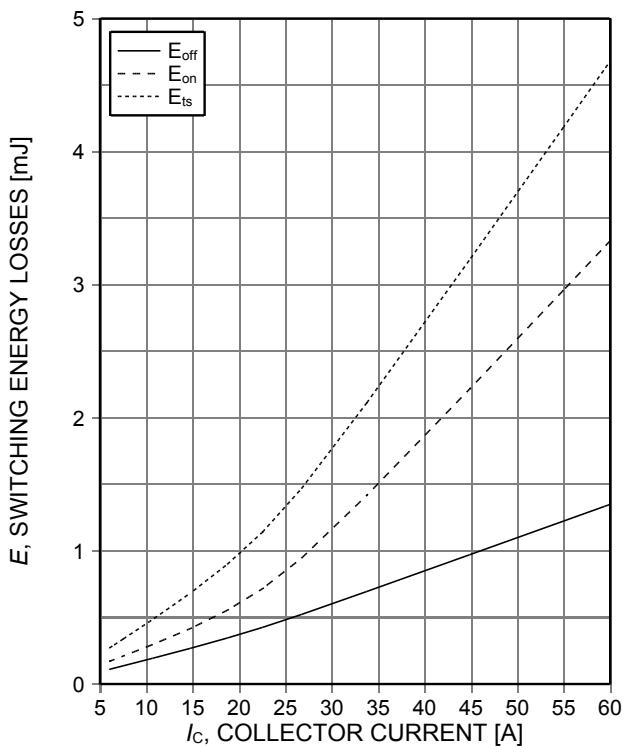
Figure 13. **Typical switching energy losses as a function of collector current** (ind. load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, r_G=10,5Ω, test circuit in Fig. E)
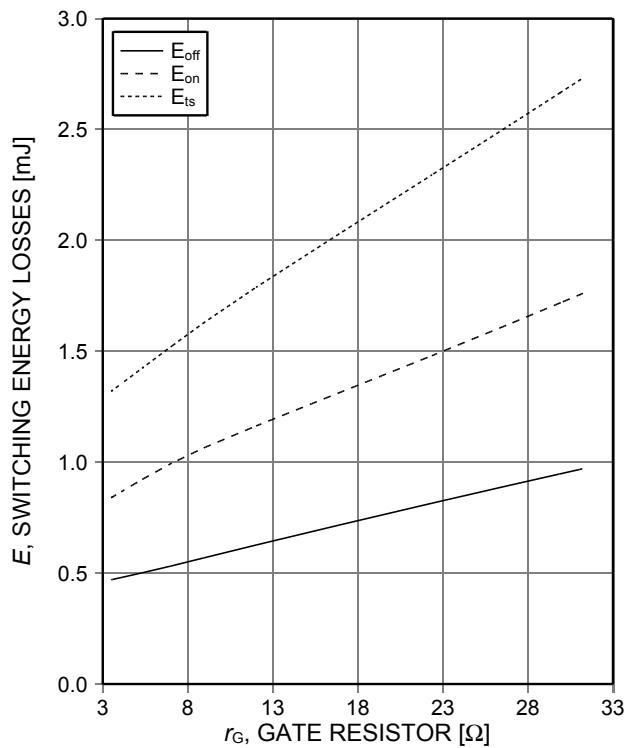
Figure 14. **Typical switching energy losses as a function of gate resistor** (ind. load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=30A, test circuit in Fig. E)
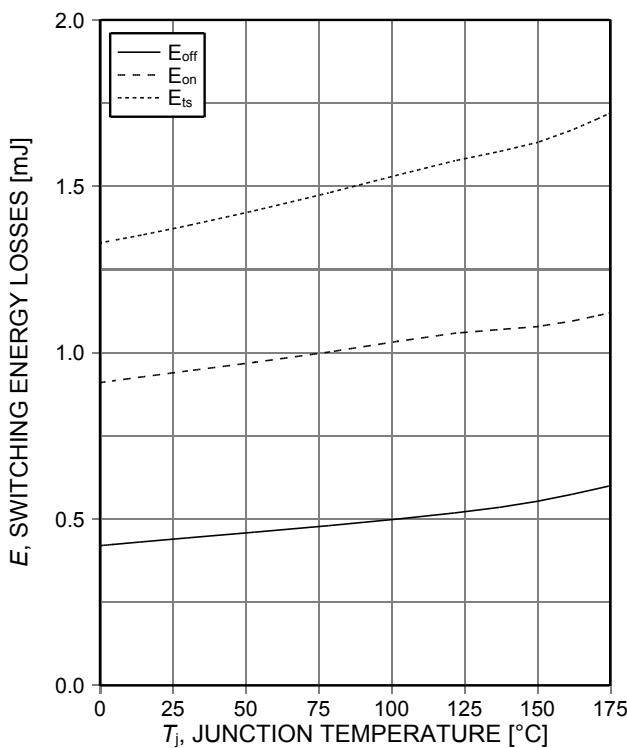
Figure 15. **Typical switching energy losses as a function of junction temperature** (ind load, V_{CE}=400V, V_{GE}=15/0V, I_C=30A, r_G=10,5Ω, test circuit in Fig. E)
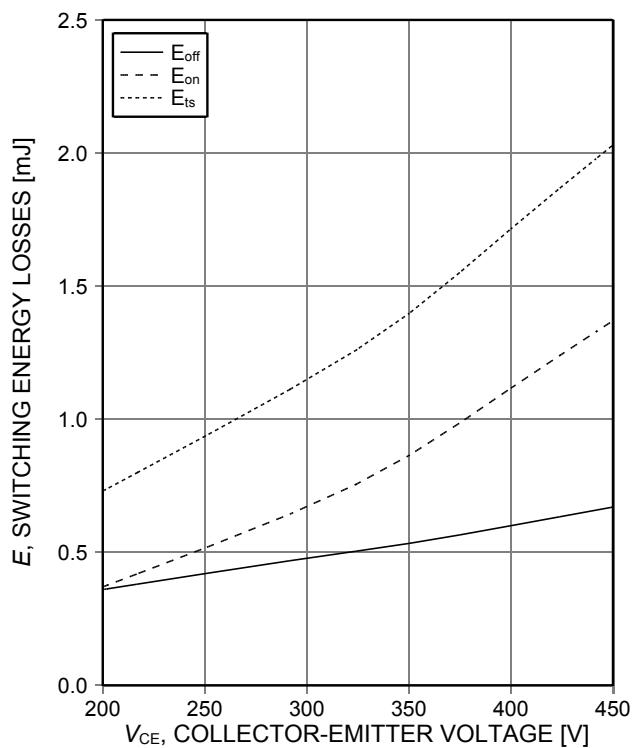
Figure 16. **Typical switching energy losses as a function of collector emitter voltage** (ind. load, T_j=175°C, V_{GE}=15/0V, I_C=30A, r_G=10,5Ω, test circuit in Fig. E)
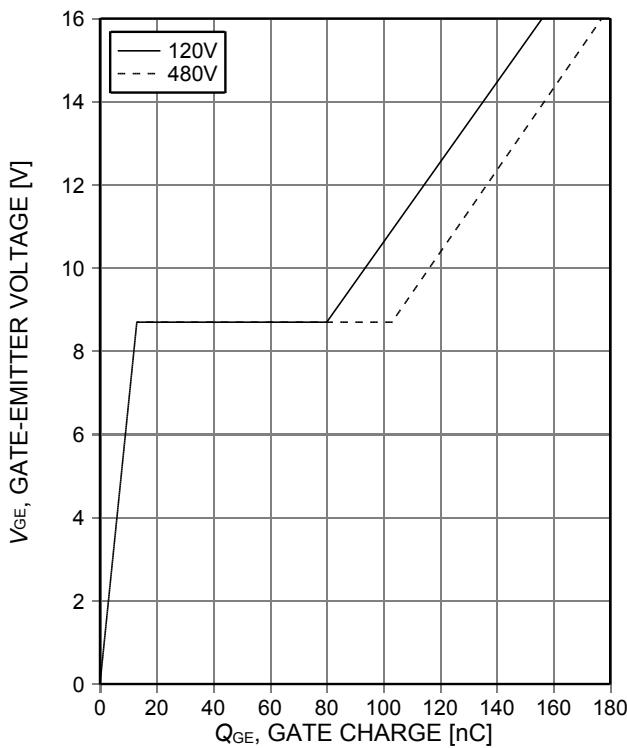
Figure 17. **Typical gate charge**
(I_C=30A)
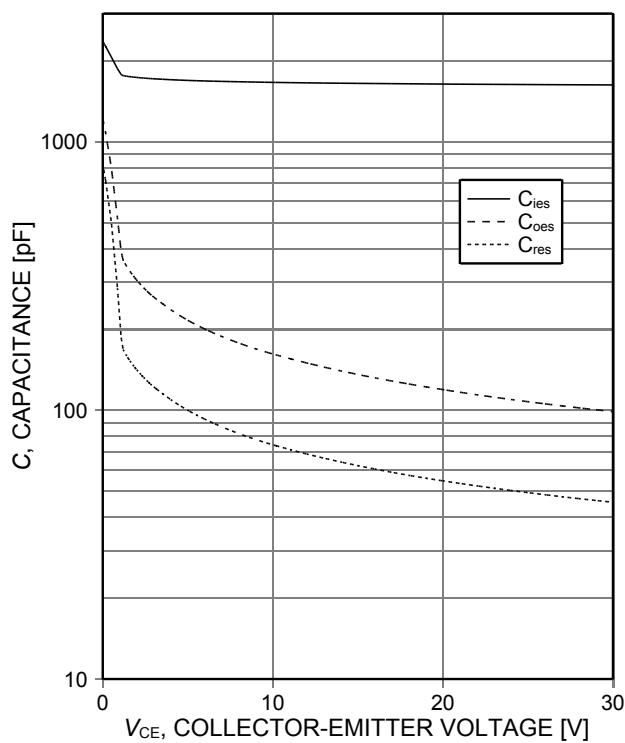
Figure 18. **Typical capacitance as a function of collector-emitter voltage**
(V_{GE}=0V, f=1MHz)
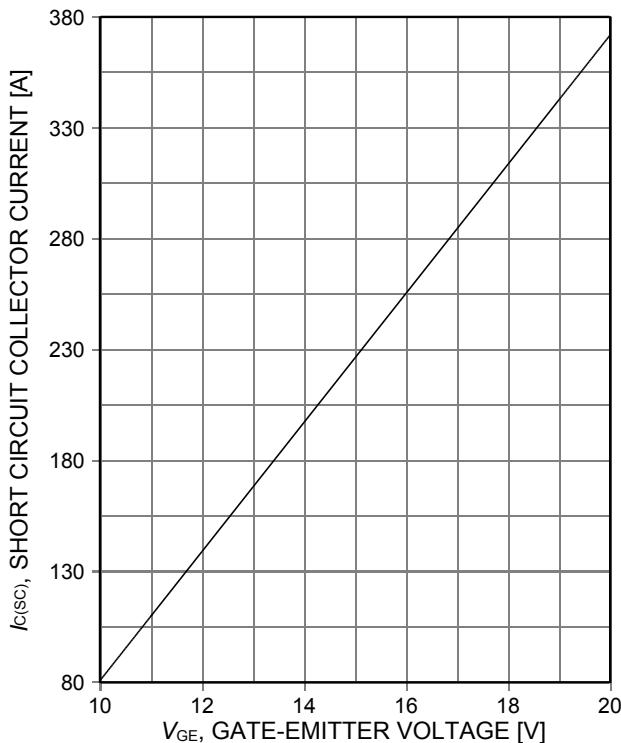
Figure 19. **Typical short circuit collector current as a function of gate-emitter voltage**
(V_{CE}≤400V, start at T_j=25°C)
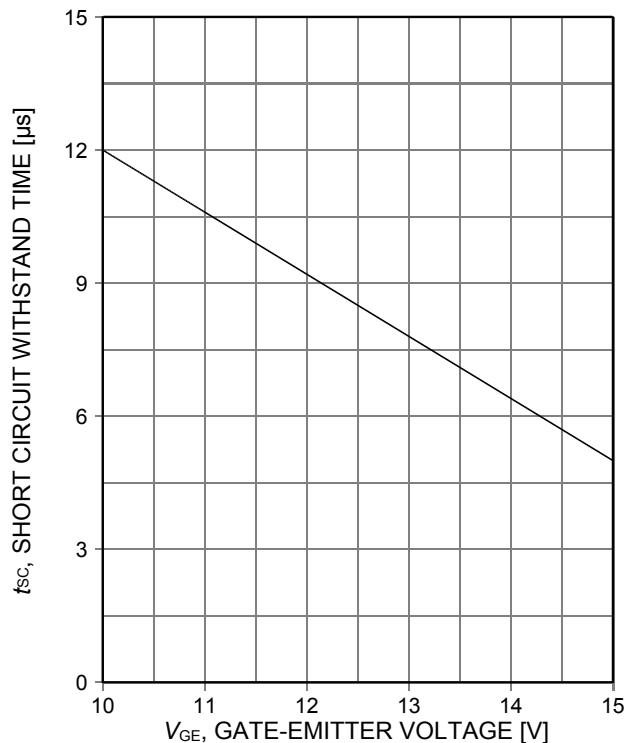
Figure 20. **Short circuit withstand time as a function of gate-emitter voltage**
(V_{CE}≤400V, start at T_j≤150°C)
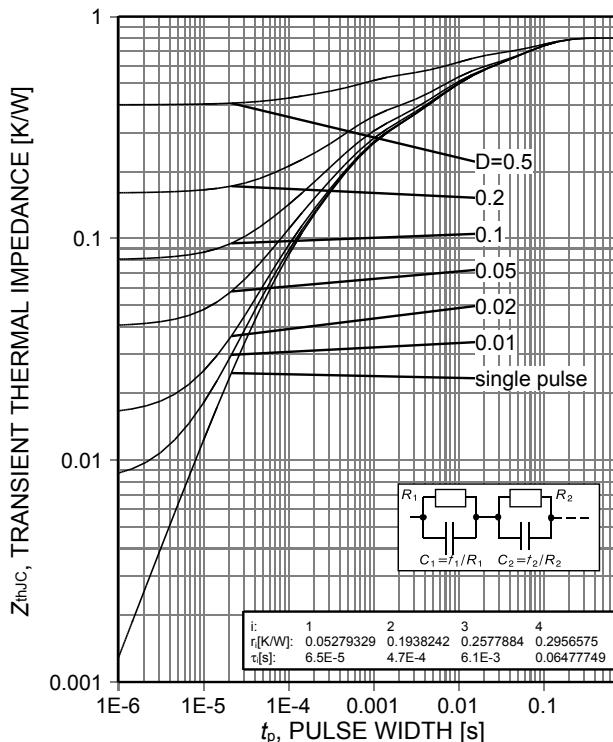
Figure 21. **IGBT transient thermal impedance** ($D=t_p$/T)

Data table for Figure 21:

i:	1	2	3	4
r_i[K/W]:	0.05279329	0.1938242	0.2577884	0.2956575
τ_i[s]:	6.5E-5	4.7E-4	6.1E-3	0.06477749
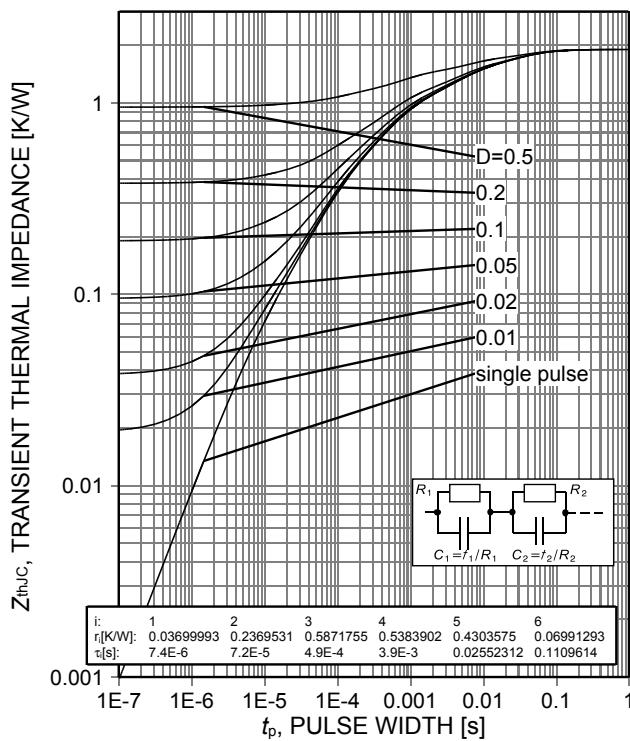
Figure 22. **Diode transient thermal impedance as a function of pulse width** ($D=t_p$/T)

Data table for Figure 22:

i:	1	2	3	4	5	6
r_i[K/W]:	0.03699993	0.2369531	0.5871755	0.5383902	0.4303575	0.06991293
τ_i[s]:	7.4E-6	7.2E-5	4.9E-4	3.9E-3	0.02552312	0.1109614
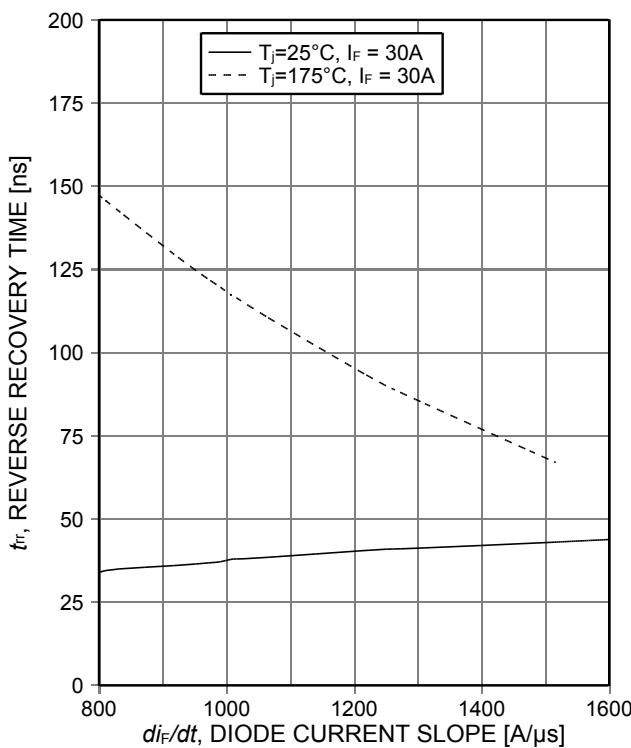
Figure 23. **Typical reverse recovery time as a function of diode current slope** (V_R=400V)
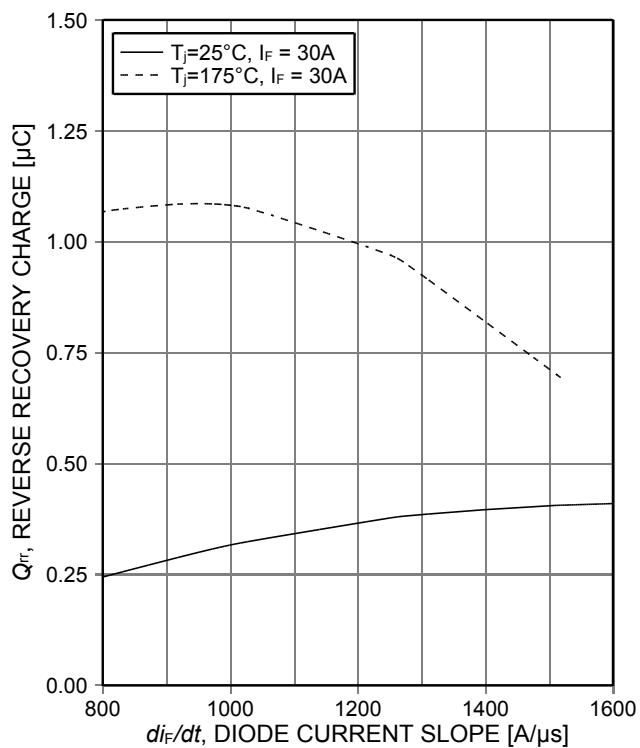
Figure 24. **Typical reverse recovery charge as a function of diode current slope** (V_R=400V)
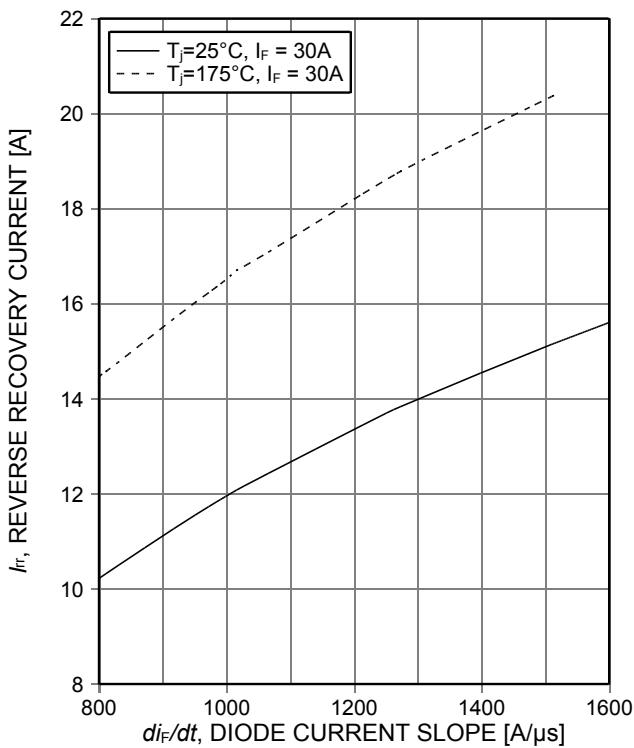
Figure 25. **Typical reverse recovery current as a function of diode current slope** (V_R=400V)
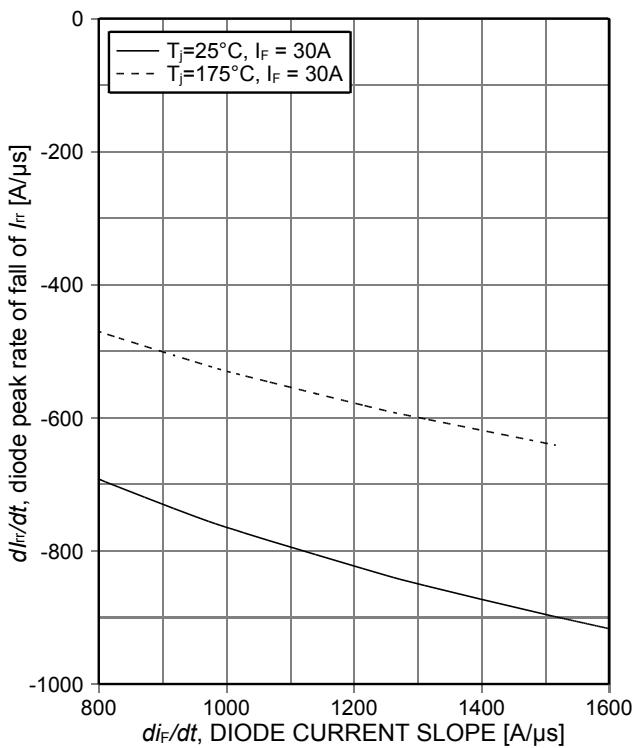
Figure 26. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope** (V_R=400V)
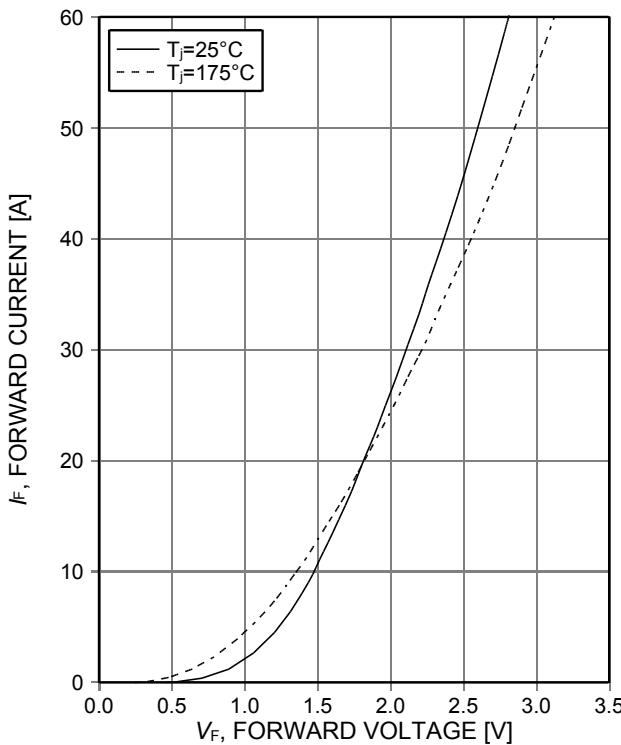
Figure 27. **Typical diode forward current as a function of forward voltage**
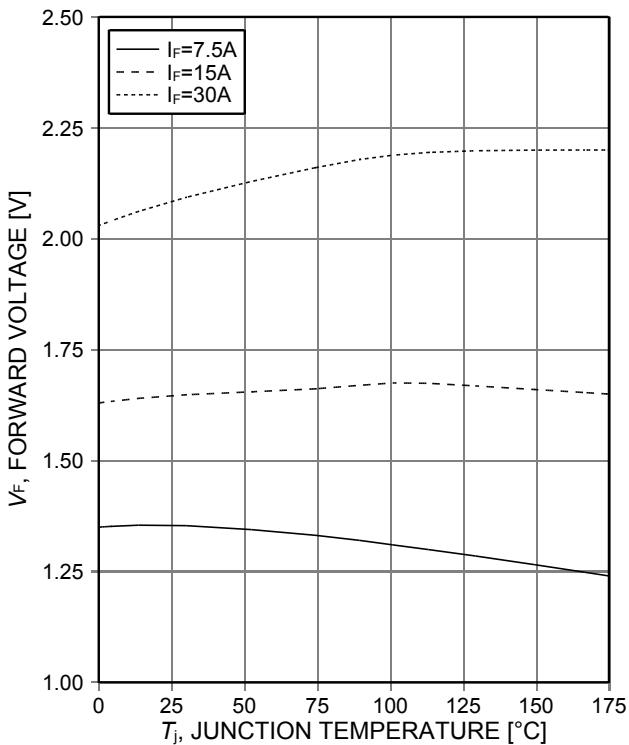
Figure 28. **Typical diode forward voltage as a function of junction temperature**

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PG-TO247-3
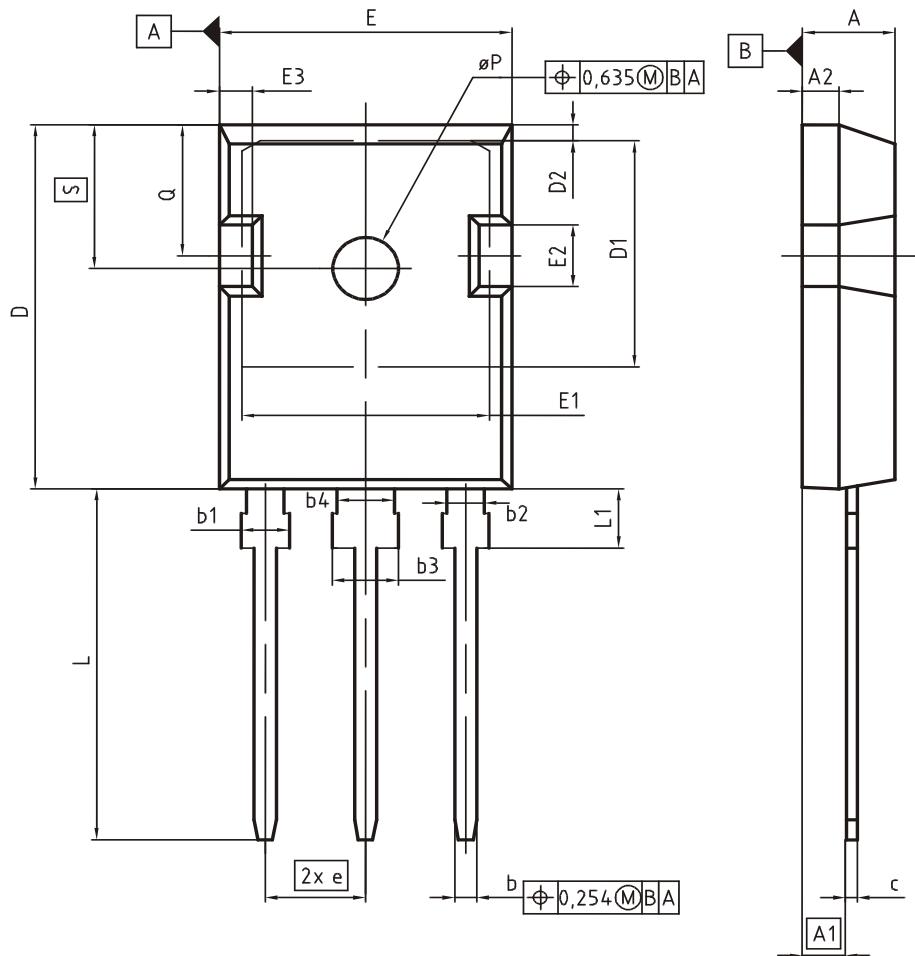
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.190	0.205
A1	2.27	2.54	0.089	0.100
A2	1.85	2.16	0.073	0.085
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	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

DOCUMENT NO.
Z8B00003327

SCALE

7.5mm

EUROPEAN PROJECTION

ISSUE DATE
09-07-2010

REVISION
05

$v_{GE}(t)$

90% V_{GE}

$i_C(t)$

90% I_C 90% I_C

10% I_C 10% I_C

$v_{CE}(t)$

$t_{d(off)}$ t_f $t_{d(on)}$ t_r
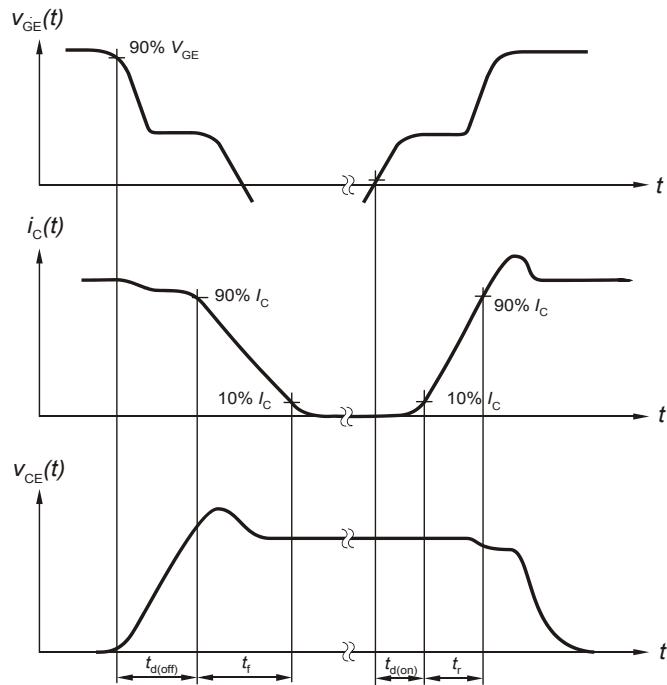
Figure A. Definition of switching times

$v_{GE}(t)$

90% V_{GE}

10% V_{GE}

$i_C(t)$

2% I_C

$v_{CE}(t)$

$$E_{off} = \int_{t_1}^{t_2} V_{CE} \times I_C \times dt \qquad E_{on} = \int_{t_3}^{t_4} V_{CE} \times I_C \times dt$$

2% V_{CE}

t_1 t_2 t_3 t_4
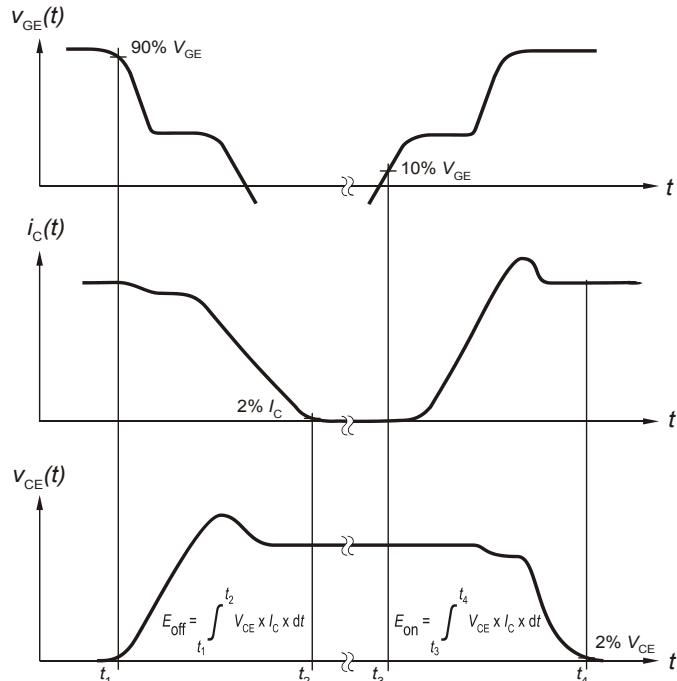
Figure B. Definition of switching losses

i, v

di_F/dt

$t_{rr} = t_a + t_b$
$Q_{rr} = Q_S + Q_F$

t_{rr}

t_a t_b

I_F

Q_S Q_F 10% I_{rrm}

I_{rrm}

di_{rr}/dt V_R

90% I_{rrm}
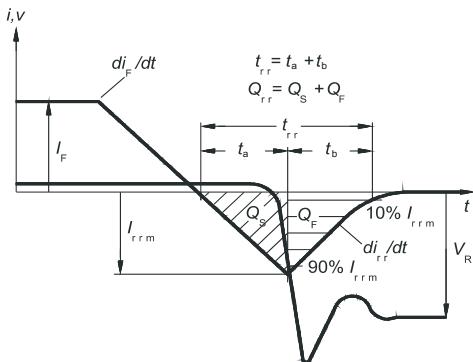
Figure C. Definition of diodes switching characteristics

$\dfrac{\tau_1}{r_1}$ $\dfrac{\tau_2}{r_2}$ $\dfrac{\tau_n}{r_n}$

$T_j(t)$

$p(t)$

r_1 r_2 r_n

T_C
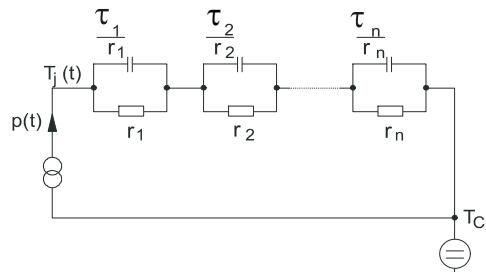
Figure D. Thermal equivalent circuit

½L_σ

DUT (Diode) L C_σ C_r

V_{DC}

R_G DUT (IGBT)

½L_σ
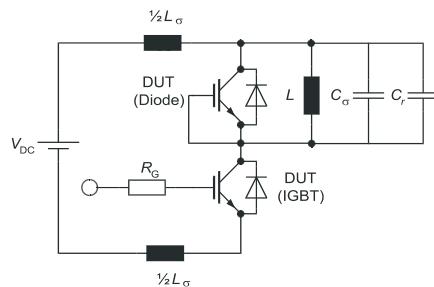
Figure E. Dynamic test circuit
Parasitic inductance L_σ,
Parasitic capacitor C_σ,
Relief capacitor C_r
(only for ZVT switching)

Revision History

IKW30N60H3

Revision: 2014-03-12, Rev. 2.2

Previous Revision

Revision	Date	Subjects (major changes since last revision)
1.1	2010-02-01	-
1.2	2010-07-26	Preliminary datasheet
2.1	2013-12-09	New value IRmax limit at 175°C
2.2	2014-03-12	Max ratings Vce, Tvj ≥ 25°C

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