IGBT

TRENCHSTOP™ Performance technology copacked with RAPID 1 fast anti-parallel diode

IKW40N60DTP

600V DuoPack IGBT and diode
TRENCHSTOP™ Performance series

Data sheet

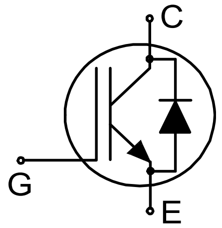
Industrial Power Control

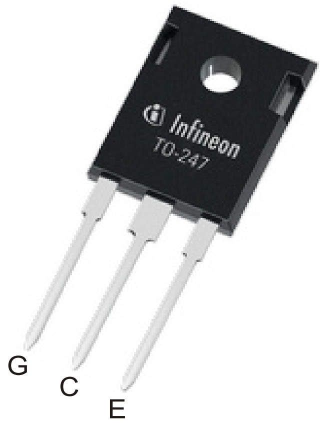
600V DuoPack IGBT and diode
TRENCHSTOP™ Performance series

Features:

TRENCHSTOP™ technology offering
- very low V_{CEsat}
- low turn-off losses
- short tail current
- 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:

- drives
- solar inverters
- uninterruptible power supplies
- converters with medium switching frequency

Green

Halogen-Free

RoHS

Key Performance and Package Parameters

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
IKW40N60DTP	600V	40A	1.6V	175°C	K40DDTP	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, $T_{vj} \geq 25°C$	V_{CE}	600	V
DC collector current, limited by T_{vjmax} $T_C = 25°C$ $T_C = 100°C$	I_C	67.0 48.0	A
Pulsed collector current, t_p limited by T_{vjmax} [1)]	I_{Cpuls}	120.0	A
Turn off safe operating area $V_{CE} \leq 600V$, $T_{vj} \leq 175°C$, $t_p = 1\mu s$ [1)]	-	120.0	A
Diode forward current, limited by T_{vjmax} $T_C = 25°C$ $T_C = 100°C$	I_F	58.0 35.0	A
Diode pulsed current, t_p limited by T_{vjmax} [1)]	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: ≥ 1.0s $T_{vj} = 150°C$	t_{SC}	5	µs
Power dissipation $T_C = 25°C$ Power dissipation $T_C = 100°C$	P_{tot}	246.0 123.0	W
Operating junction temperature	T_{vj}	-40...+175	°C
Storage temperature	T_{stg}	-55...+150	°C
Soldering temperature, wave soldering 1.6mm (0.063in.) from case for 10s		260	°C
Mounting torque, M3 screw 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	$R_{th(j-c)}$		-	0.41	0.61	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		-	0.83	1.29	K/W

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

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 = 40.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.60 1.94	1.80 -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 20.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.45 1.39	1.70 -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.64mA, 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 -	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	-	40.0	-	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	-	1400	-	pF
Output capacitance	C_{oes}		-	76	-	
Reverse transfer capacitance	C_{res}		-	48	-	
Gate charge	Q_G	V_{CC} = 480V, I_C = 40.0A, V_{GE} = 15V	-	177.0	-	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	-	183	-	A

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value min.	Value typ.	Value max.	Unit
IGBT Characteristic, at T_{vj} = 25°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 25°C, V_{CC} = 400V, I_C = 40.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 10.1Ω, $R_{G(off)}$ = 10.1Ω, $L\sigma$ = 32nH, $C\sigma$ = 60pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	18	-	ns
Rise time	t_r		-	30	-	ns
Turn-off delay time	$t_{d(off)}$		-	222	-	ns
Fall time	t_f		-	18	-	ns
Turn-on energy	E_{on}		-	1.06	-	mJ
Turn-off energy	E_{off}		-	0.61	-	mJ
Total switching energy	E_{ts}		-	1.67	-	mJ

Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R = 400V, I_F = 20.0A, di_F/dt = 1175A/µs	-	87	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.56	-	µC
Diode peak reverse recovery current	I_{rrm}		-	11.5	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	144	-	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 = 40.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 10.1Ω, $R_{G(off)}$ = 10.1Ω, $L\sigma$ = 32nH, $C\sigma$ = 60pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	19	-	ns
Rise time	t_r		-	30	-	ns
Turn-off delay time	$t_{d(off)}$		-	273	-	ns
Fall time	t_f		-	47	-	ns
Turn-on energy	E_{on}		-	1.63	-	mJ
Turn-off energy	E_{off}		-	1.05	-	mJ
Total switching energy	E_{ts}		-	2.68	-	mJ

Diode reverse recovery time	t_{rr}	T_{vj} = 175°C, V_R = 400V, I_F = 20.0A, di_F/dt = 1175A/µs	-	144	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.52	-	µC
Diode peak reverse recovery current	I_{rrm}		-	18.3	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	142	-	A/µs

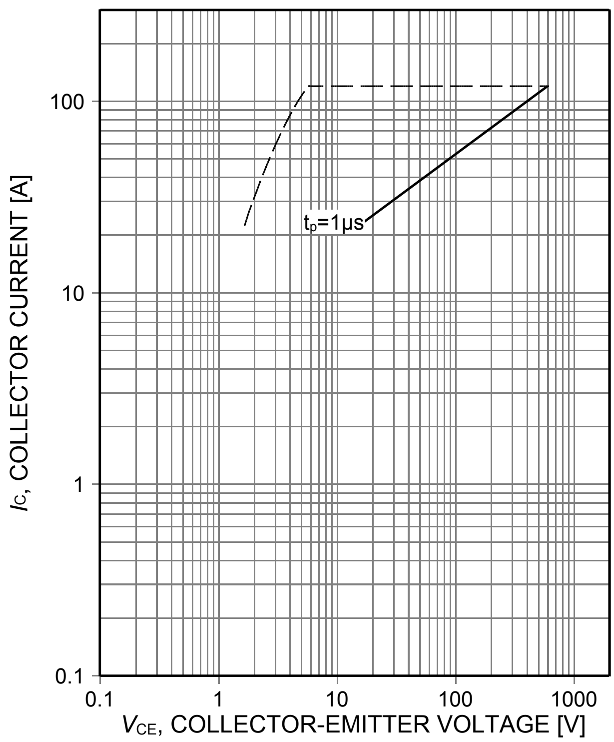


Figure 1. **Forward bias safe operating area**
(D=0, T_C=25°C, T_j≤175°C; V_{GE}=15V)

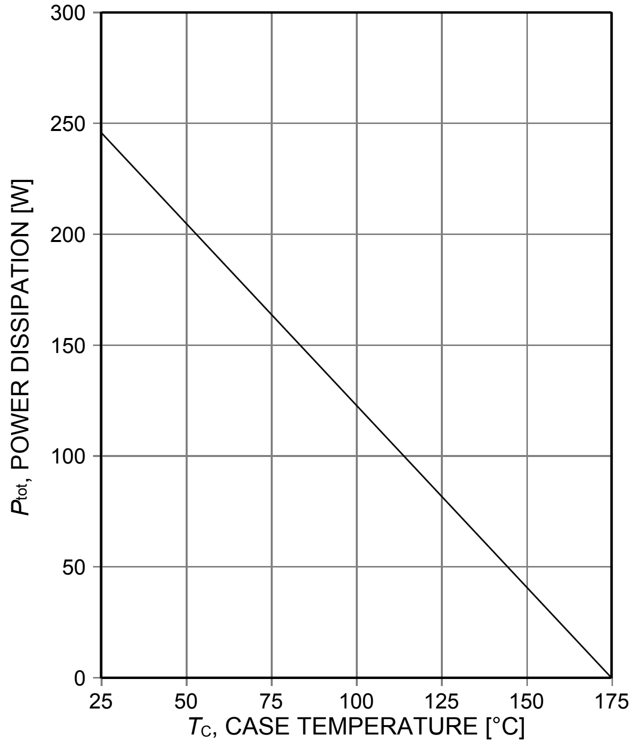


Figure 2. **Power dissipation as a function of case temperature**
(T_j≤175°C)

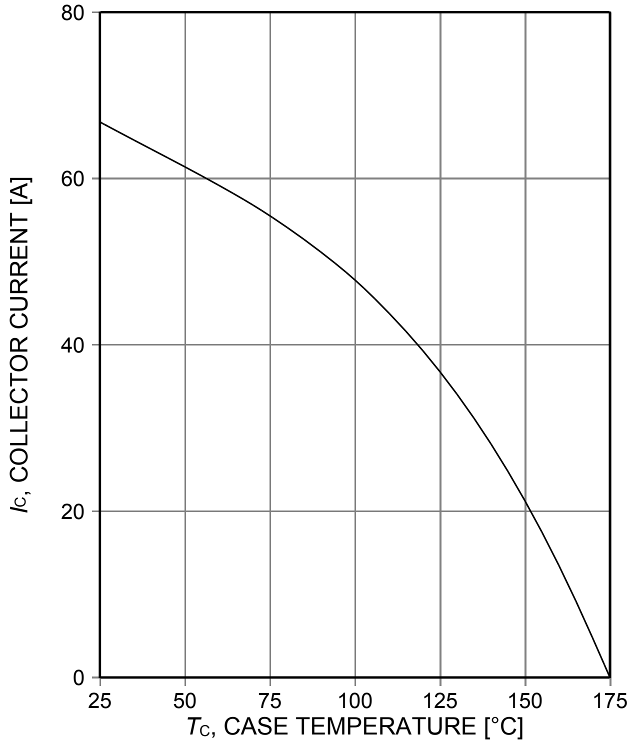


Figure 3. **Collector current as a function of case temperature**
(V_{GE}≥15V, T_j≤175°C)

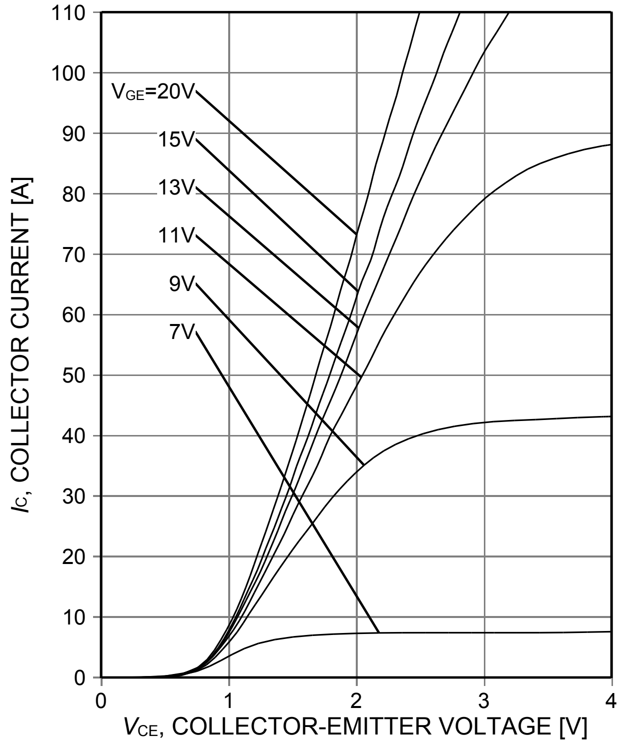


Figure 4. **Typical output characteristic**
(T_j=25°C)

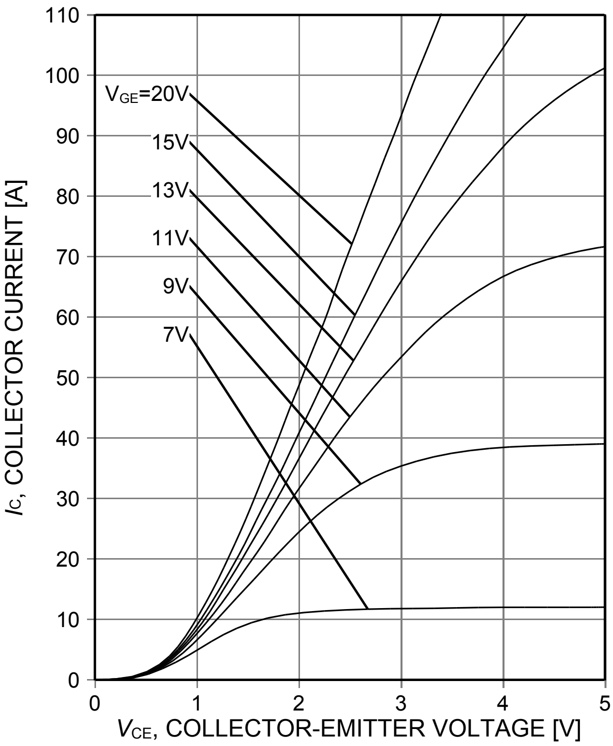


Figure 5. **Typical output characteristic**
(T_j=175°C)

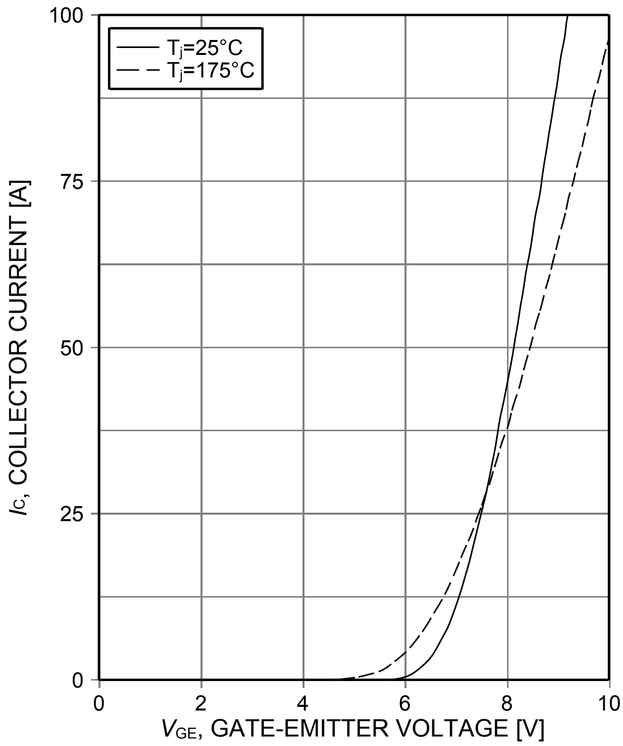


Figure 6. **Typical transfer characteristic**
(V_{CE}=20V)

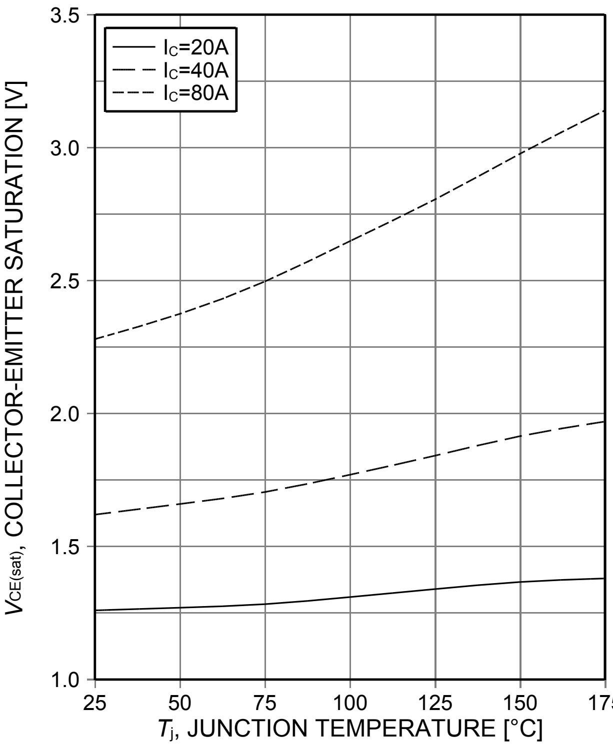


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)

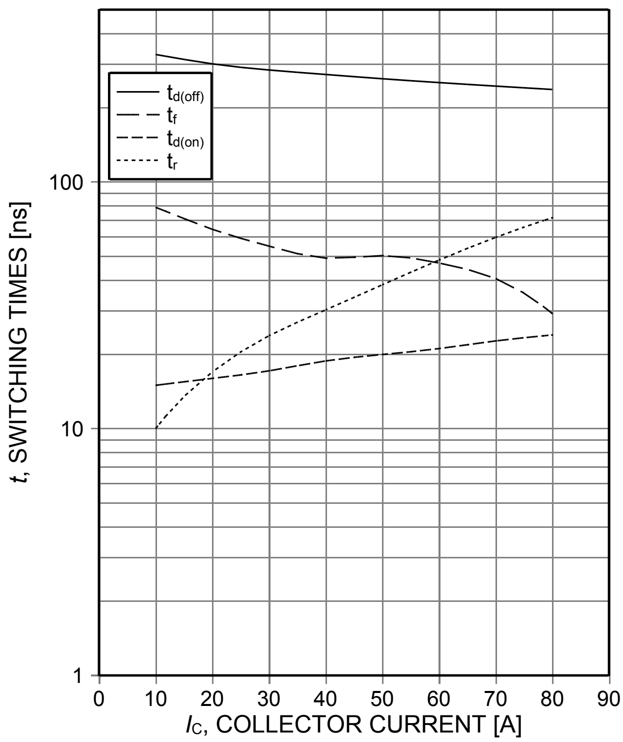


Figure 8. **Typical switching times as a function of collector current**
(ind. load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, r_G=10,1Ω, test circuit in Fig. E)

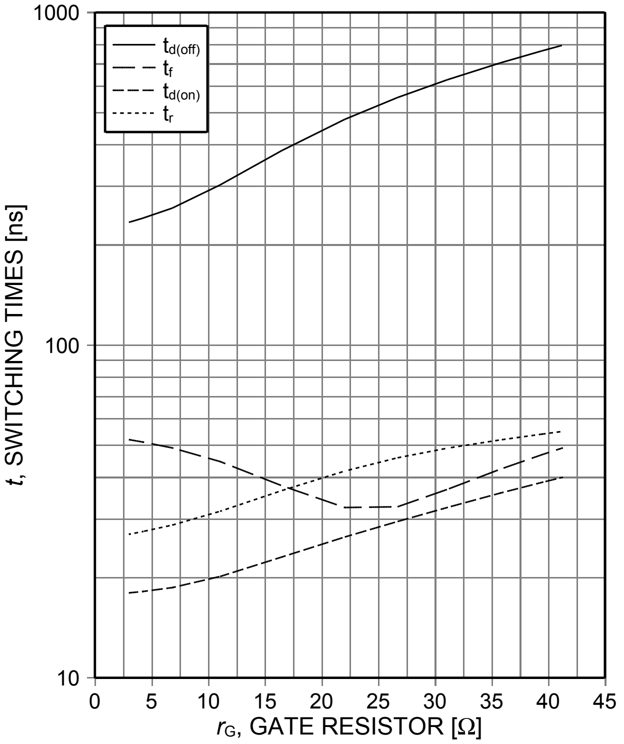


Figure 9. **Typical switching times as a function of gate resistor**
(ind. load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=40A, test circuit in Fig. E)

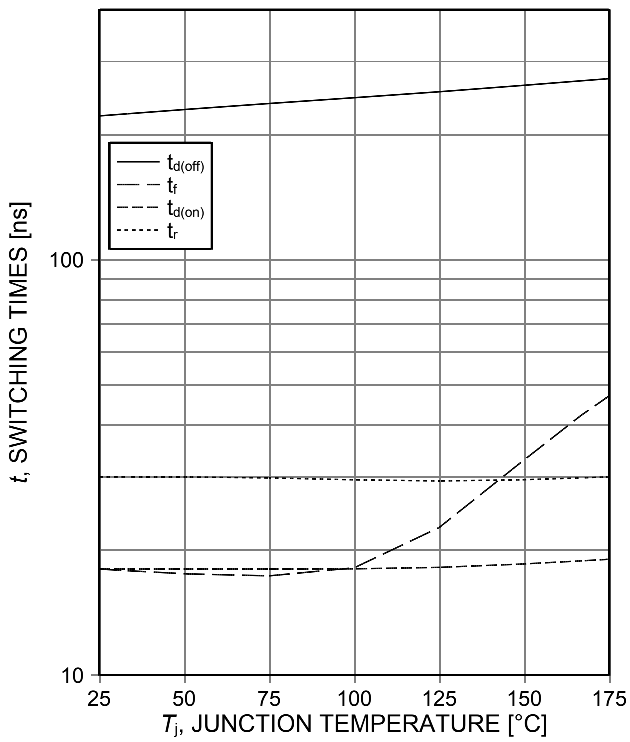


Figure 10. **Typical switching times as a function of junction temperature**
(ind. load, V_{CE}=400V, V_{GE}=15/0V, I_C=40A, r_G=10,1Ω, test circuit in Fig. E)

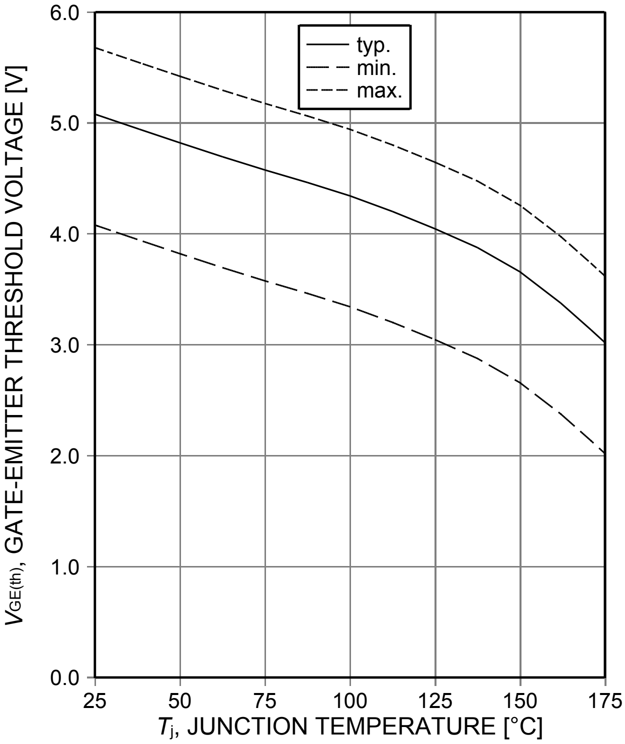


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=0,64mA)

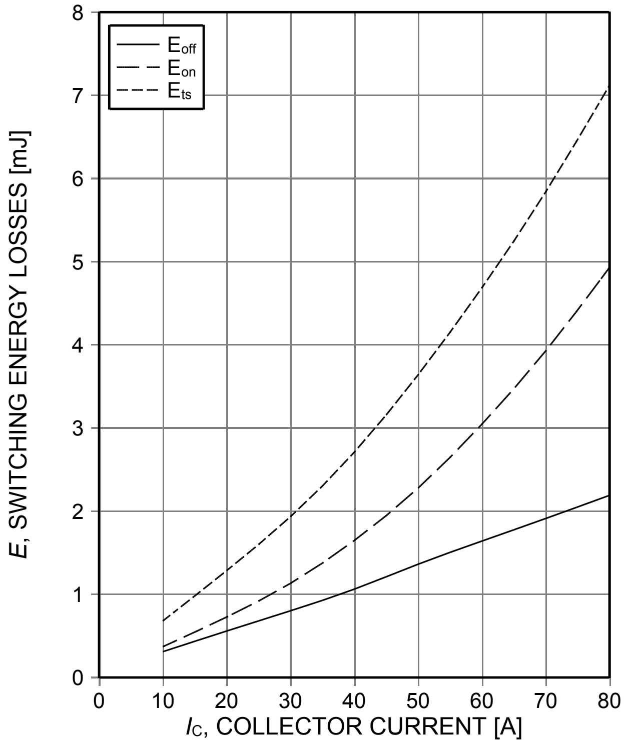


Figure 12. **Typical switching energy losses as a function of collector current**
(ind. load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, r_G=10,1Ω, test circuit in Fig. E)

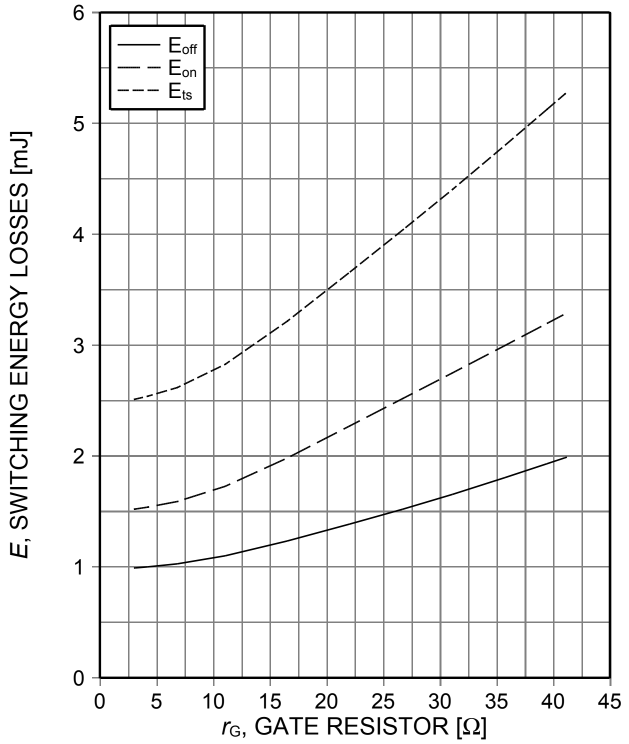


Figure 13. **Typical switching energy losses as a function of gate resistor**
(ind. load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=40A, test circuit in Fig. E)

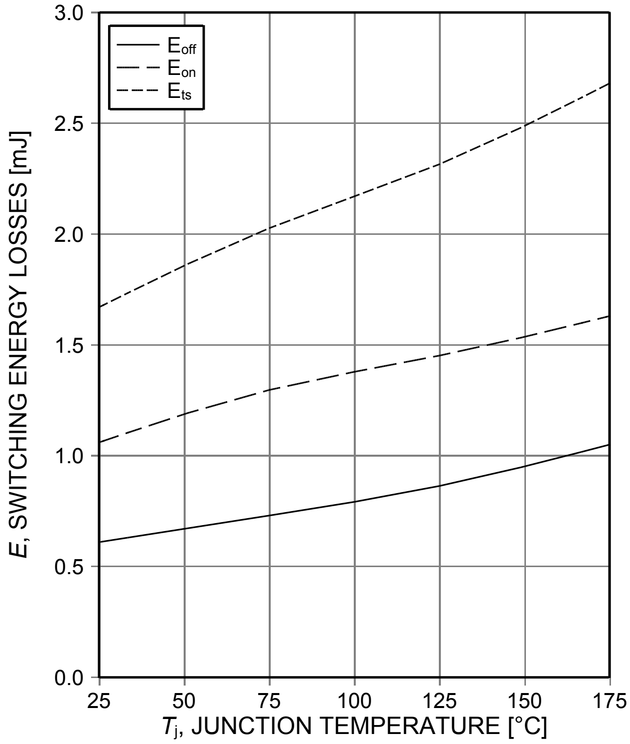


Figure 14. **Typical switching energy losses as a function of junction temperature**
(ind load, V_{CE}=400V, V_{GE}=15/0V, I_C=40A, r_G=10,1Ω, test circuit in Fig. E)

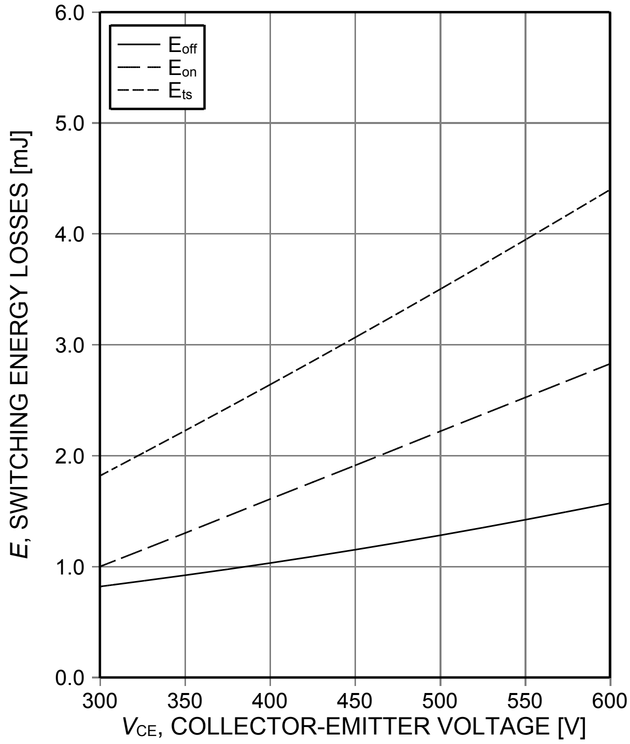


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**
(ind. load, T_j=175°C, V_{GE}=15/0V, I_C=40A, r_G=10,1Ω, test circuit in Fig. E)

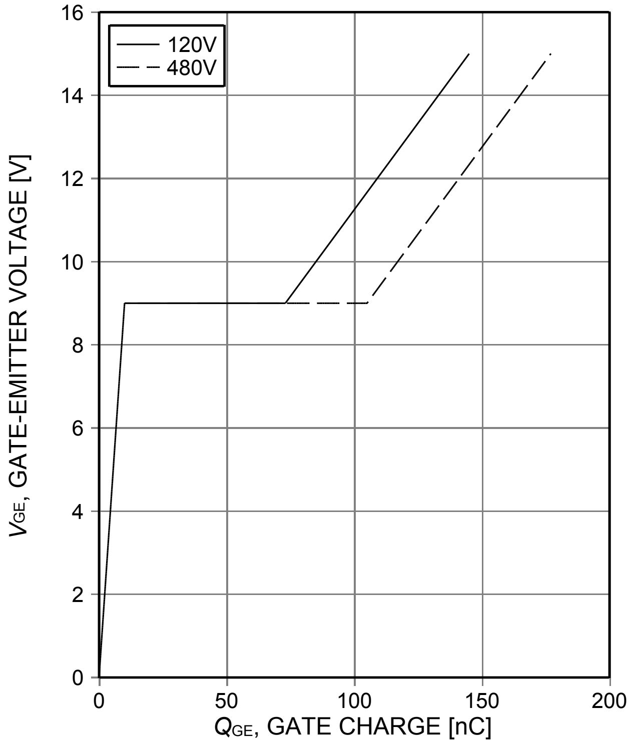


Figure 16. **Typical gate charge**
(I_C=40A)

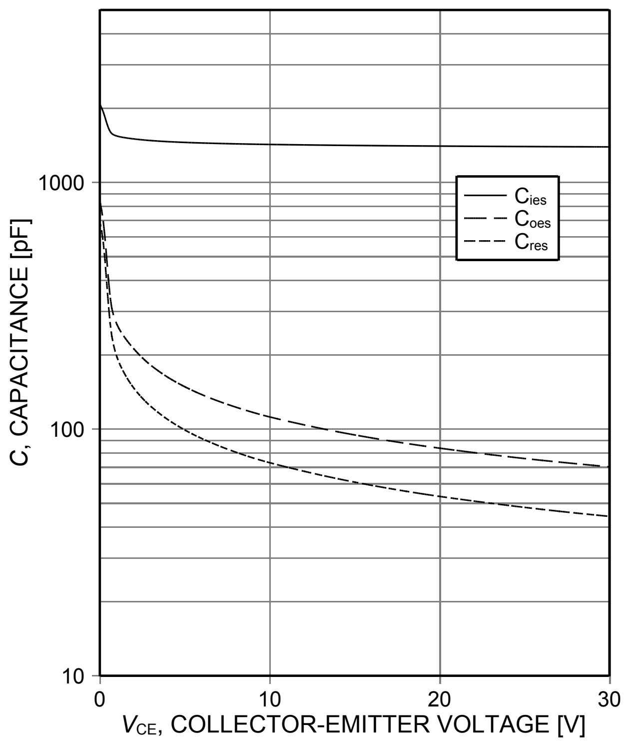


Figure 17. **Typical capacitance as a function of collector-emitter voltage**
(V_{GE}=0V, f=1MHz)

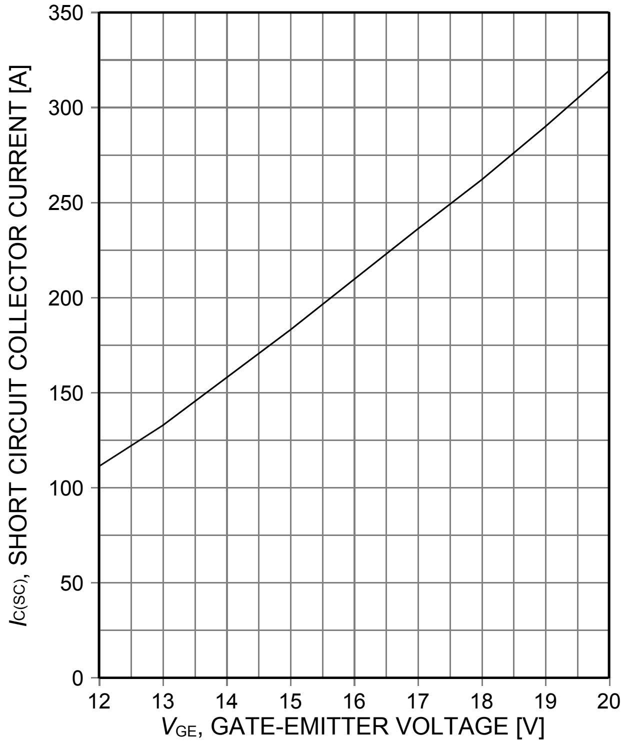


Figure 18. **Typical short circuit collector current as a function of gate-emitter voltage**
(V_{CE}≤400V, start at T_j=25°C)

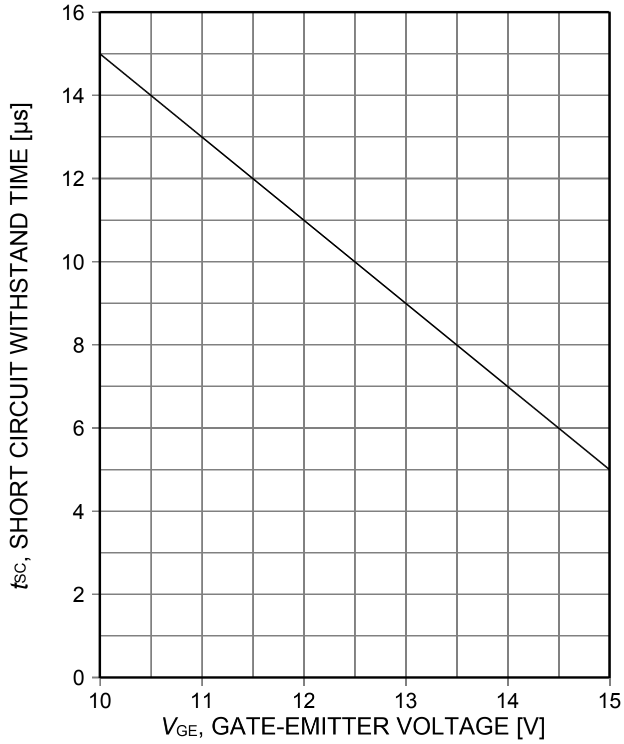
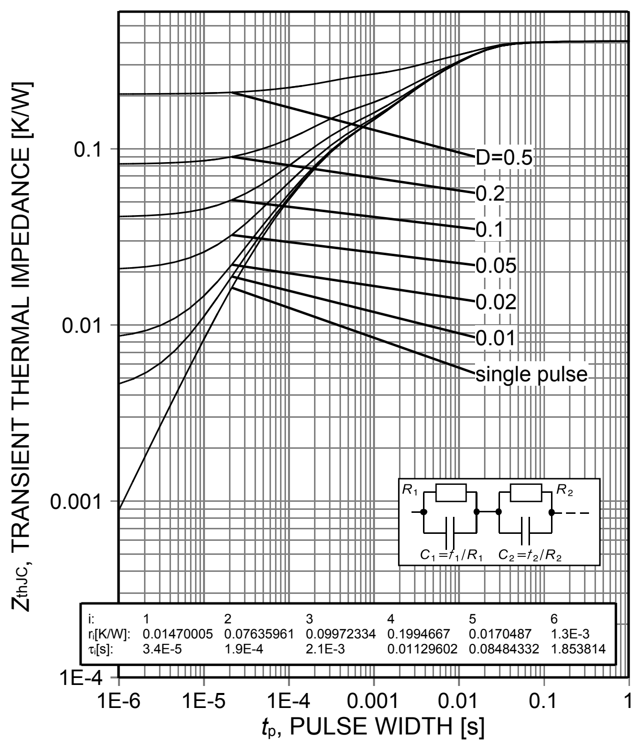
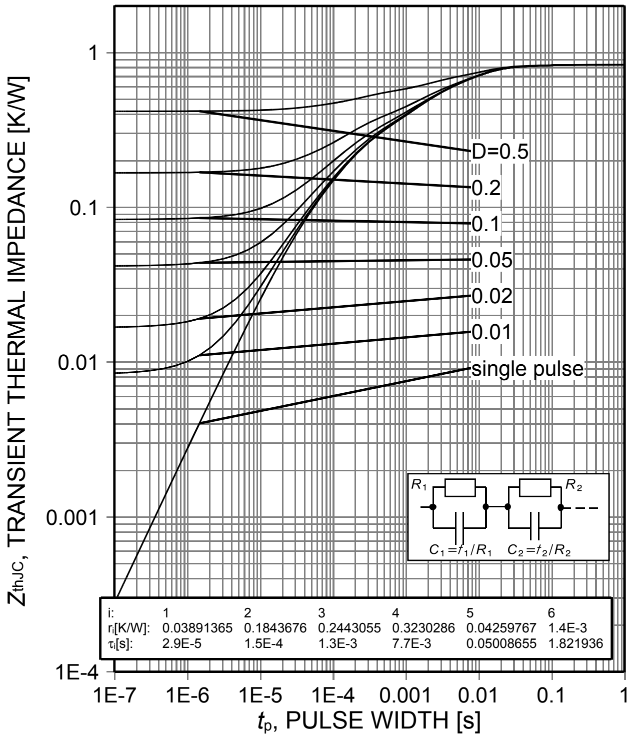


Figure 19. **Short circuit withstand time as a function of gate-emitter voltage**
(V_{CE}≤400V, start at T_j≤150°C)



i:	1	2	3	4	5	6
r_i[K/W]:	0.01470005	0.07635961	0.09972334	0.1994667	0.0170487	1.3E-3
τ_i[s]:	3.4E-5	1.9E-4	2.1E-3	0.01129602	0.08484332	1.853814

Figure 20. **Typical IGBT transient thermal impedance**
(D=t_p/T)



i:	1	2	3	4	5	6
r_i[K/W]:	0.03891365	0.1843676	0.2443055	0.3230286	0.04259767	1.4E-3
τ_i[s]:	2.9E-5	1.5E-4	1.3E-3	7.7E-3	0.05008655	1.821936

Figure 21. **Typical diode transient thermal impedance as a function of pulse width**
(D=t_p/T)

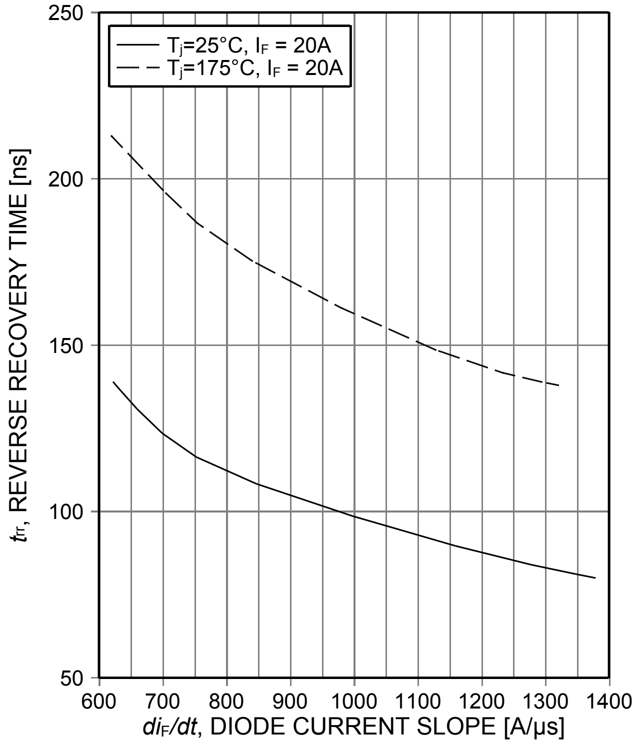


Figure 22. **Typical reverse recovery time as a function of diode current slope**
(V_R=400V)

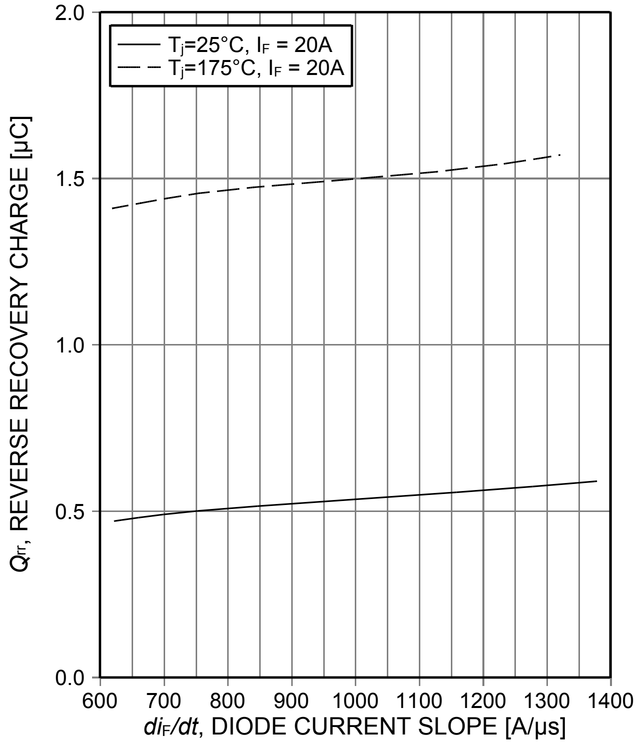


Figure 23. **Typical reverse recovery charge as a function of diode current slope**
(V_R=400V)

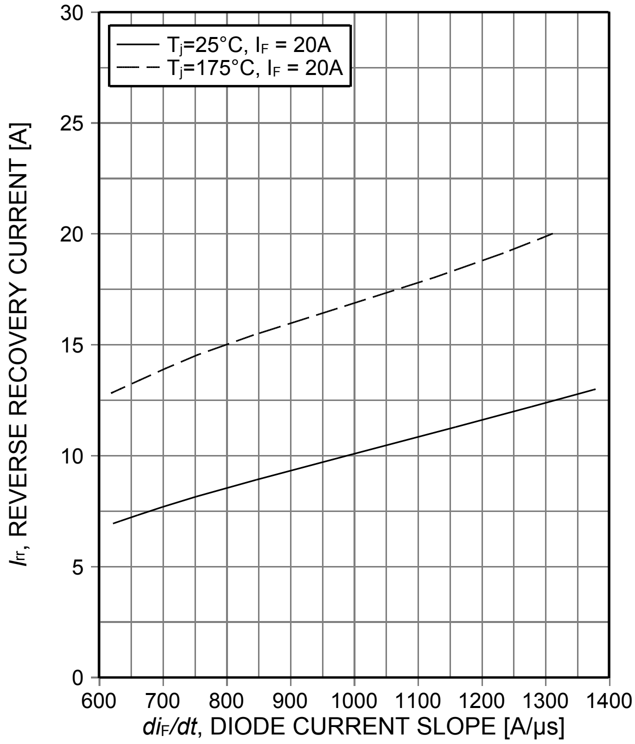


Figure 24. **Typical reverse recovery current as a function of diode current slope**
(V_R=400V)

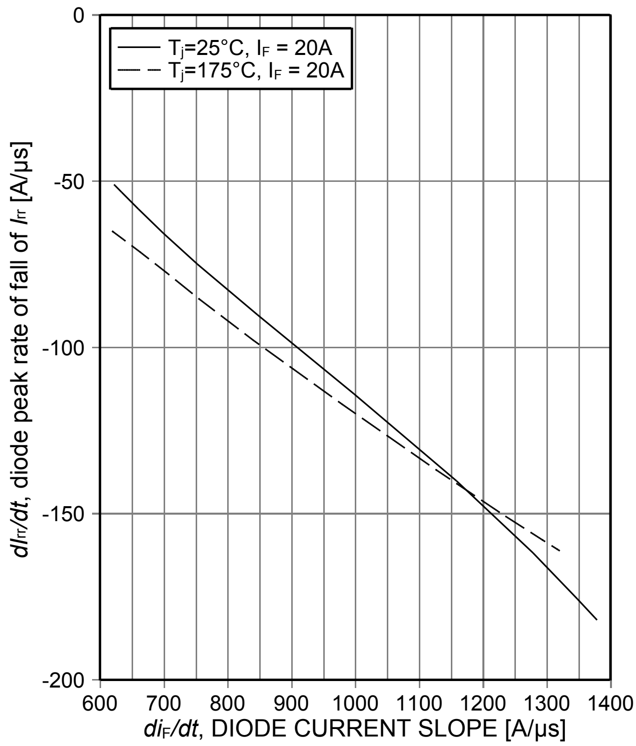


Figure 25. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
(V_R=400V)

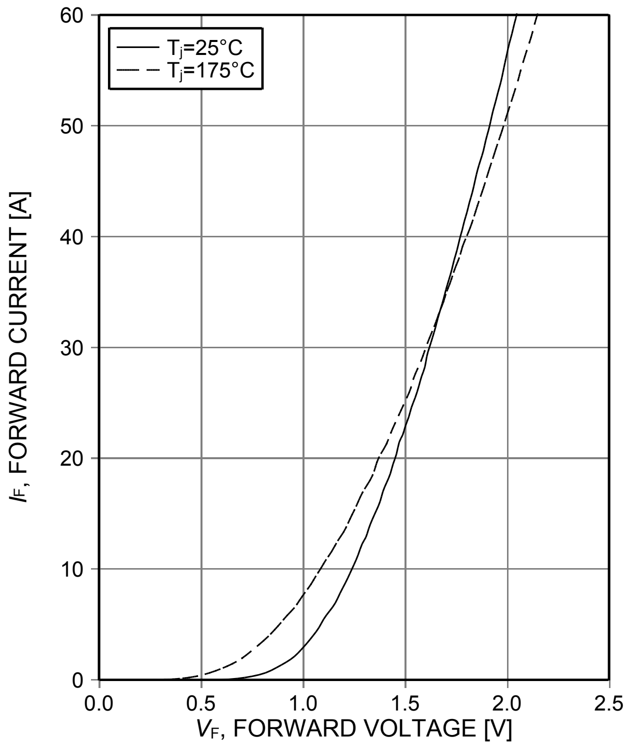


Figure 26. **Typical diode forward current as a function of forward voltage**

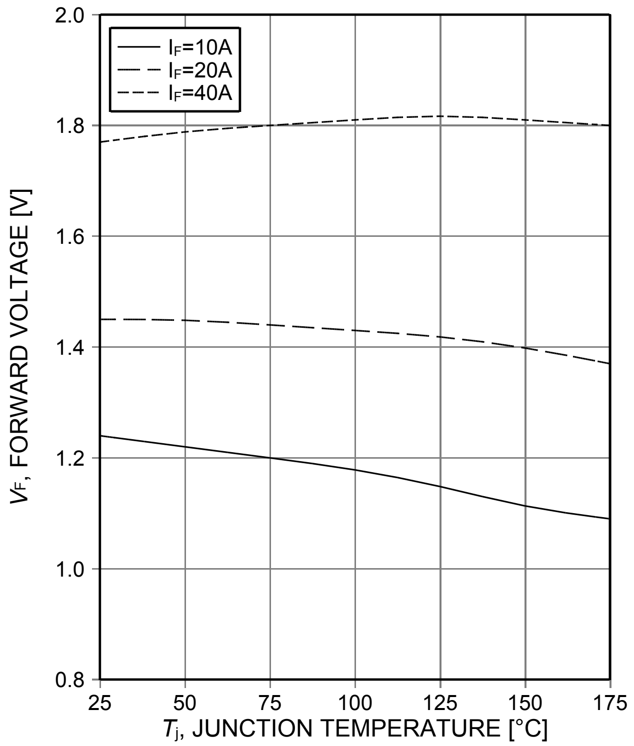
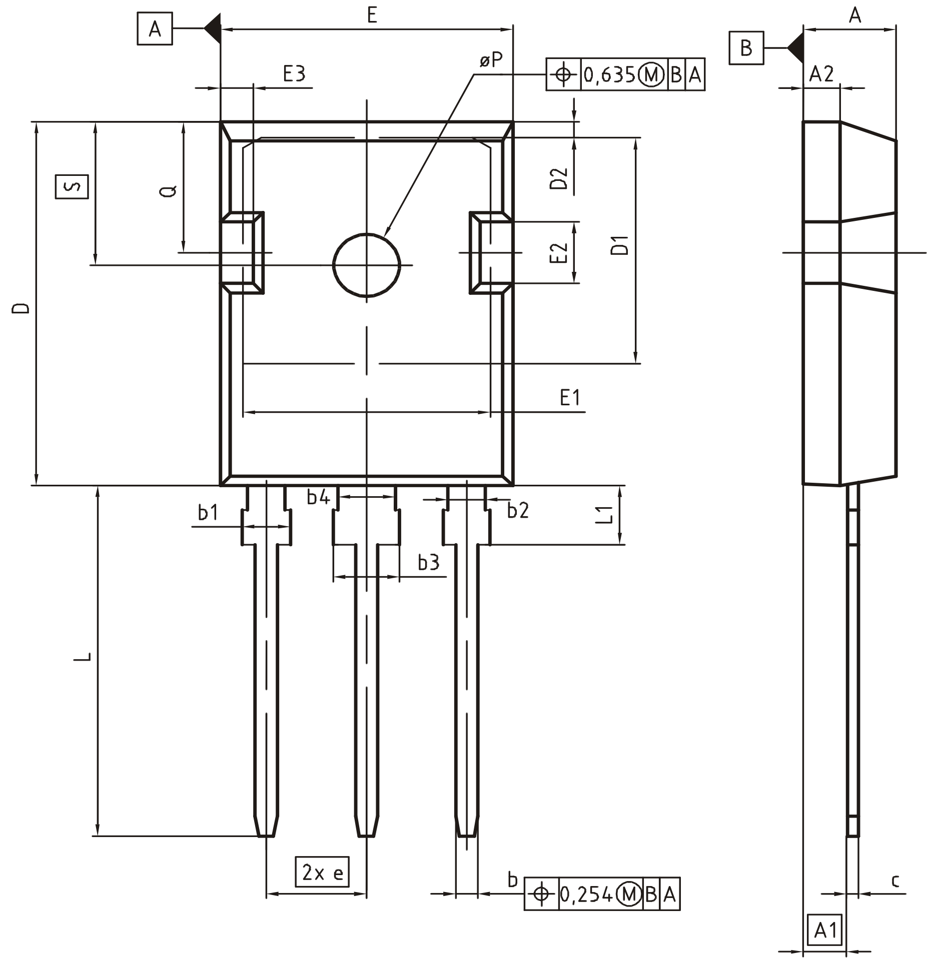


Figure 27. **Typical diode forward voltage as a function of junction temperature**

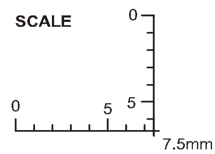
Package Drawing PG-TO247-3



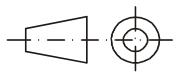
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.190	0.205
A1	2.27	2.54	0.089	0.100
A2	1.85	2.16	0.073	0.085
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65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

DOCUMENT NO.
Z8B00003327

SCALE



EUROPEAN PROJECTION



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REVISION
05

Testing Conditions

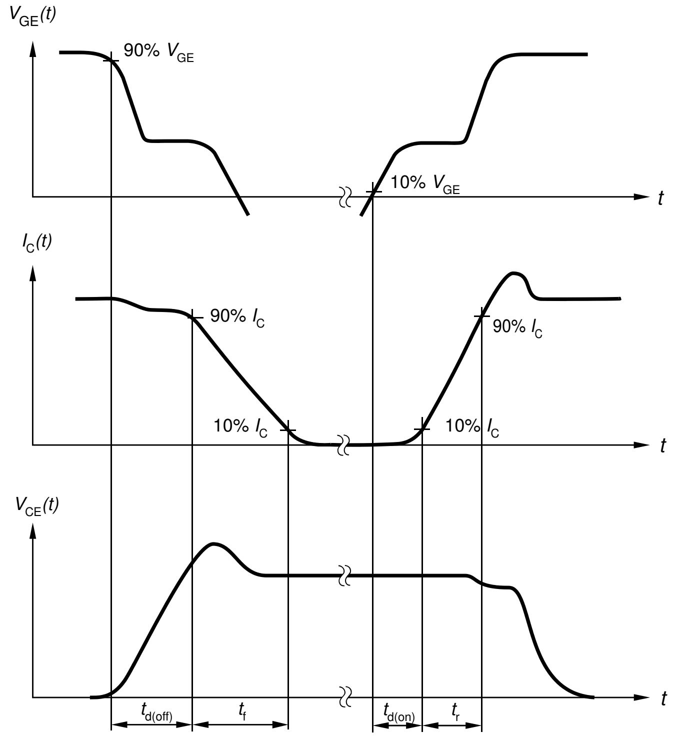

Figure A. **Definition of switching times**

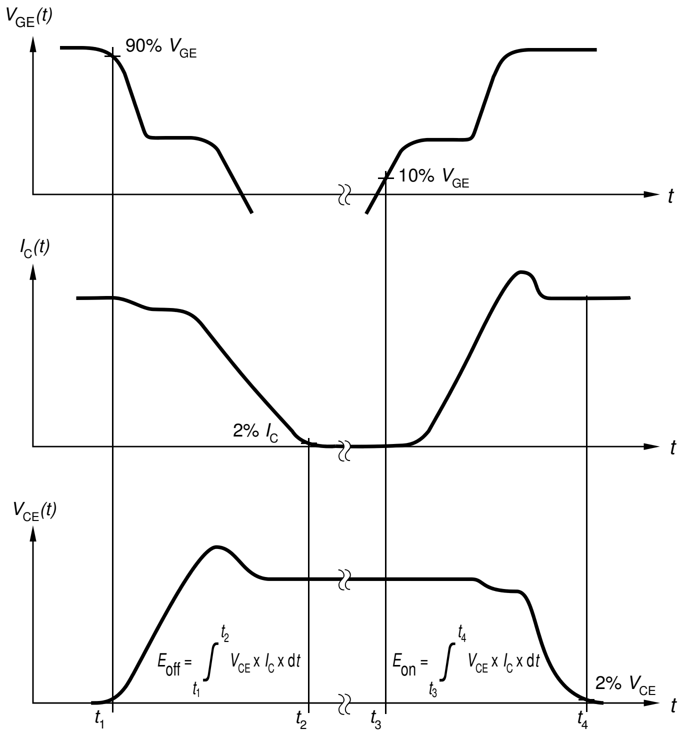

Figure B. **Definition of switching losses**

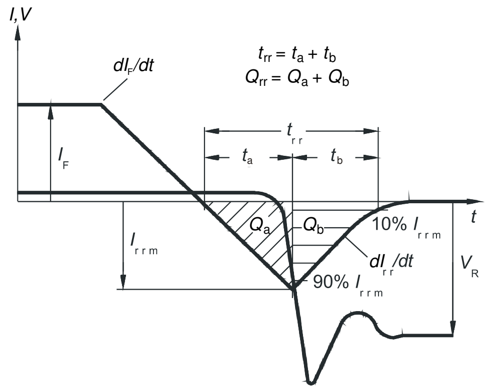

Figure C. **Definition of diode switching characteristics**

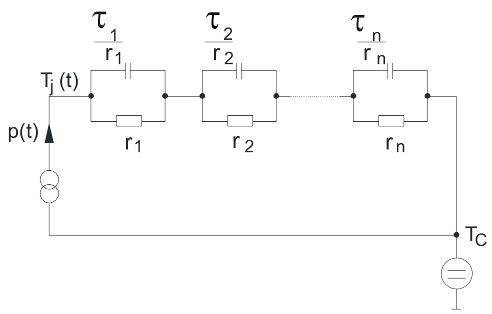

Figure D. **Thermal equivalent circuit**

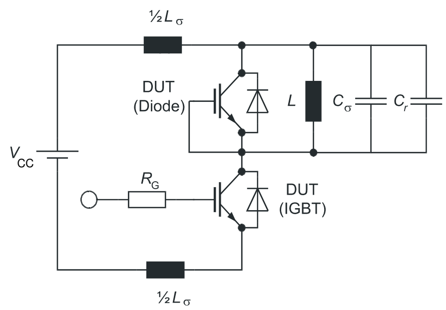

Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Revision History

IKW40N60DTP

Revision: 2016-02-08, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	-	Release final datasheet

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Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

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