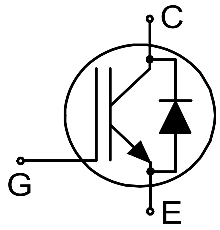
TRENCHSTOP™ IGBT 7

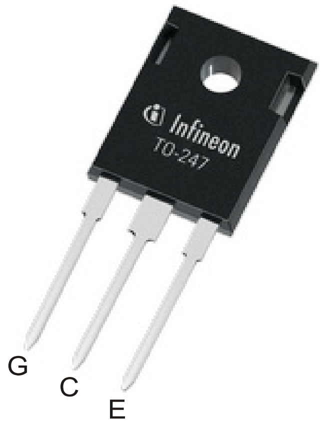
Low Loss Duopack: IGBT with Trench and Fieldstop technology



Features:

TRENCHSTOP™ IGBT 7 technology offering
- Very low V_{CEsat}
- Low turn-off losses
- Short tail current
- Reduced EMI
- Humidity robust design
- 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/igbt7/



Applications:

- Drives
  - -Servo
  - -GPD
- Industrial Power Supplies
  - -Industrial UPS
  - -Residential UPS
- Energy Generation
  - -Solar Central Inverter
  - -Solar String Inverter
  - -Solar Pump

Product Validation:

Qualified for industrial applications according to the relevant tests of JEDEC47/20/22

Package pin definition:

- Pin C & backside - Collector
- Pin E - Emitter
- Pin G - Gate

Key Performance and Package Parameters

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
IKW20N65ET7	650V	20A	1.35V	175°C	K20EET7	PG-TO247-3

Table of Contents

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}	650	V
DC collector current, limited by T_{vjmax} $T_c = 25°C$ value limited by bondwire $T_c = 100°C$	I_C	40.0 27.5	A
Pulsed collector current, t_p limited by T_{vjmax} [1]	I_{Cpuls}	60.0	A
Turn off safe operating area $V_{CE} \leq 650V$, $T_{vj} \leq 175°C$, $t_p = 1µs$ [2]	-	60.0	A
Diode forward current, limited by T_{vjmax} $T_c = 25°C$ value limited by bondwire $T_c = 100°C$	I_F	40.0 27.5	A
Diode pulsed current, t_p limited by T_{vjmax} [1]	I_{Fpuls}	60.0	A
Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 10µs$, $D < 0.010$)	V_{GE}	±20 ±30	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}	3	µs
Short circuit withstand time $V_{GE} = 15.0V$, $V_{CC} \leq 330V$ Allowed number of short circuits < 1000 Time between short circuits: ≥ 1.0s $T_{vj} = 100°C$	t_{SC}	5	µs
Power dissipation $T_c = 25°C$ Power dissipation $T_c = 100°C$	P_{tot}	136.0 68.0	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	$R_{th(j-c)}$		-	-	1.10	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		-	-	1.40	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		-	-	40	K/W

[1] Defined by design. Not subject to production test.
[2] Clamped inductive load current test for each device, I_C=60A, V_{CC}=400V, T_c=25°C, V_{GE}=20V, L=80µH, R_G=10Ω.

Electrical Characteristic, at T_{vj} = 25°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 = 20.0A T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	- - -	1.35 1.50 1.60	1.65 - -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 20.0A T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	- - -	1.65 1.60 1.55	2.00 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.20mA, V_{CE} = V_{GE}	4.3	5.0	5.7	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 650V, V_{GE} = 0V T_{vj} = 25°C T_{vj} = 175°C	- -	- 700	40 -	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 20.0A	-	10.0	-	S

Electrical Characteristic, at T_{vj} = 25°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 = 1000kHz	-	1310	-	pF
Output capacitance	C_{oes}		-	42	-	
Reverse transfer capacitance	C_{res}		-	13	-	
Gate charge	Q_G	V_{CC} = 520V, I_C = 20.0A, V_{GE} = 15V	-	128.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	13.0	-	nH
Short circuit collector current[1)] Max. 1000 short circuits Time between short circuits: ≥ 1.0s	$I_{C(SC)}$	V_{GE} = 15.0V, V_{CC} ≤ 400V, t_{SC} ≤ 3µs T_{vj} = 150°C	-	110	-	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 = 20.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 12.0Ω, $R_{G(off)}$ = 12.0Ω, $L\sigma$ = 32nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	16	-	ns
Rise time	t_r		-	10	-	ns
Turn-off delay time	$t_{d(off)}$		-	210	-	ns
Fall time	t_f		-	20	-	ns
Turn-on energy	E_{on}		-	0.36	-	mJ
Turn-off energy	E_{off}		-	0.36	-	mJ
Total switching energy	E_{ts}		-	0.72	-	mJ

1) Allowed number of short circuits: <1000; time between short circuits >1s.

Turn-on delay time	$t_{d(on)}$	T_{vj} = 25°C, V_{CC} = 400V, I_C = 10.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 12.0Ω, $R_{G(off)}$ = 12.0Ω, $L\sigma$ = 32nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	15	-	ns
Rise time	t_r		-	6	-	ns
Turn-off delay time	$t_{d(off)}$		-	235	-	ns
Fall time	t_f		-	18	-	ns
Turn-on energy	E_{on}		-	0.16	-	mJ
Turn-off energy	E_{off}		-	0.21	-	mJ
Total switching energy	E_{ts}		-	0.37	-	mJ

Diode Characteristic, at T_{vj} = 25°C

Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R = 400V, I_F = 20.0A, di_F/dt = 1420A/μs	-	70	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.44	-	μC
Diode peak reverse recovery current	I_{rrm}		-	13.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-210	-	A/μs
Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R = 400V, I_F = 10.0A, di_F/dt = 1800A/μs	-	42	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.28	-	μC
Diode peak reverse recovery current	I_{rrm}		-	14.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-420	-	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 = 20.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 12.0Ω, $R_{G(off)}$ = 12.0Ω, $L\sigma$ = 32nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	17	-	ns
Rise time	t_r		-	12	-	ns
Turn-off delay time	$t_{d(off)}$		-	255	-	ns
Fall time	t_f		-	75	-	ns
Turn-on energy	E_{on}		-	0.58	-	mJ
Turn-off energy	E_{off}		-	0.65	-	mJ
Total switching energy	E_{ts}		-	1.23	-	mJ
Turn-on delay time	$t_{d(on)}$	T_{vj} = 175°C, V_{CC} = 400V, I_C = 10.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 12.0Ω, $R_{G(off)}$ = 12.0Ω, $L\sigma$ = 32nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	15	-	ns
Rise time	t_r		-	7	-	ns
Turn-off delay time	$t_{d(off)}$		-	310	-	ns
Fall time	t_f		-	80	-	ns
Turn-on energy	E_{on}		-	0.30	-	mJ
Turn-off energy	E_{off}		-	0.38	-	mJ
Total switching energy	E_{ts}		-	0.68	-	mJ

Diode Characteristic, at T_{vj} = 175°C

Diode reverse recovery time	t_{rr}	T_{vj} = 175°C, V_R = 400V, I_F = 20.0A, di_F/dt = 1420A/µs	-	120	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.18	-	µC
Diode peak reverse recovery current	I_{rrm}		-	19.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-180	-	A/µs

Diode reverse recovery time	t_{rr}	T_{vj} = 175°C, V_R = 400V, I_F = 10.0A, di_F/dt = 1450A/µs	-	88	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.85	-	µC
Diode peak reverse recovery current	I_{rrm}		-	20.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-265	-	A/µs

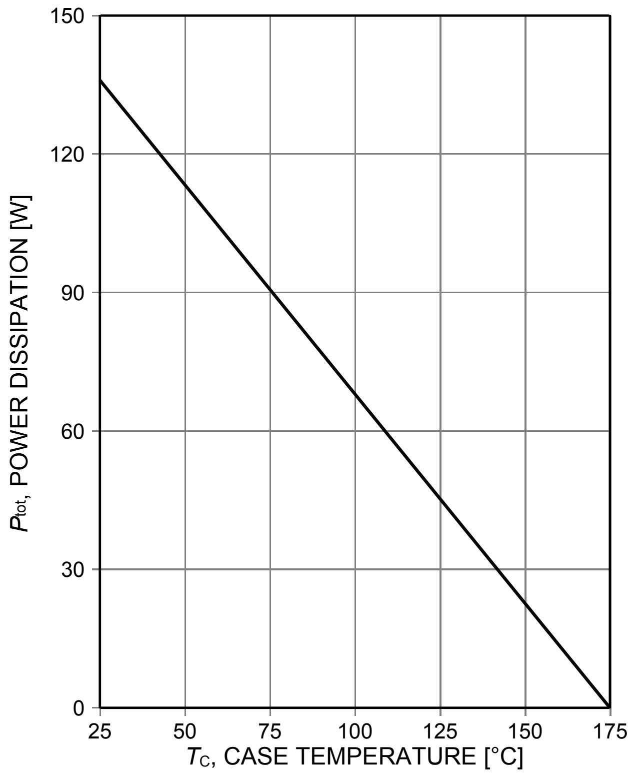


Figure 1. **Power dissipation as a function of case temperature**
(T_{vj}≤175°C)

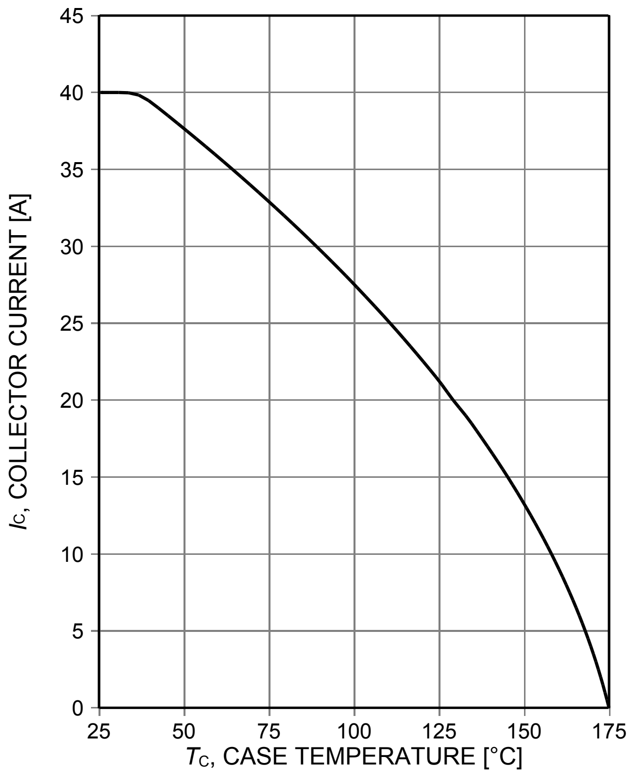


Figure 2. **Collector current as a function of case temperature**
(V_{GE}≥15V, T_{vj}≤175°C)

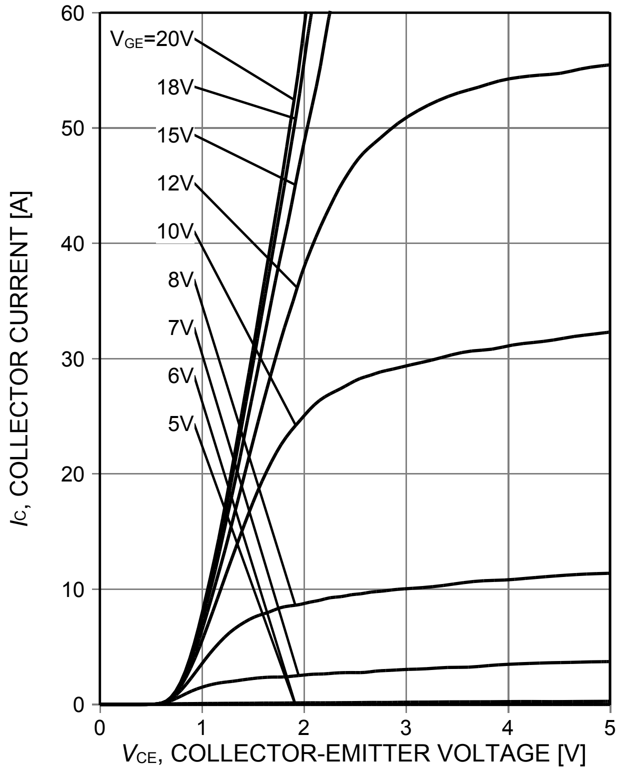


Figure 3. **Typical output characteristic**
(T_{vj}=25°C)

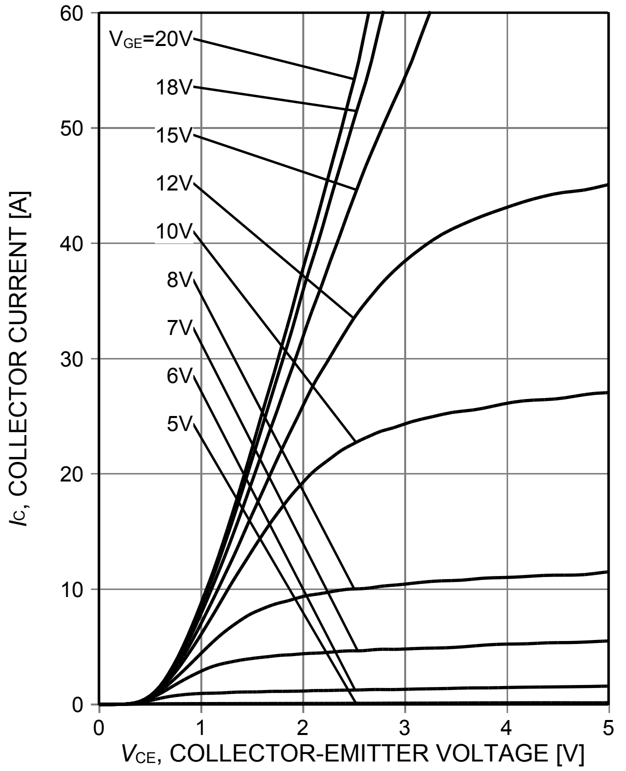


Figure 4. **Typical output characteristic**
(T_{vj}=175°C)

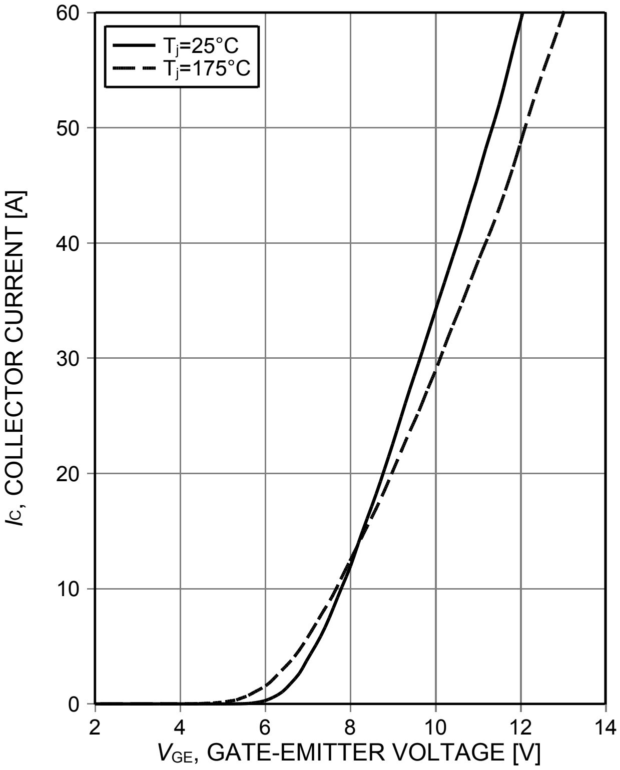


Figure 5. **Typical transfer characteristic**
(V_{CE}=20V)

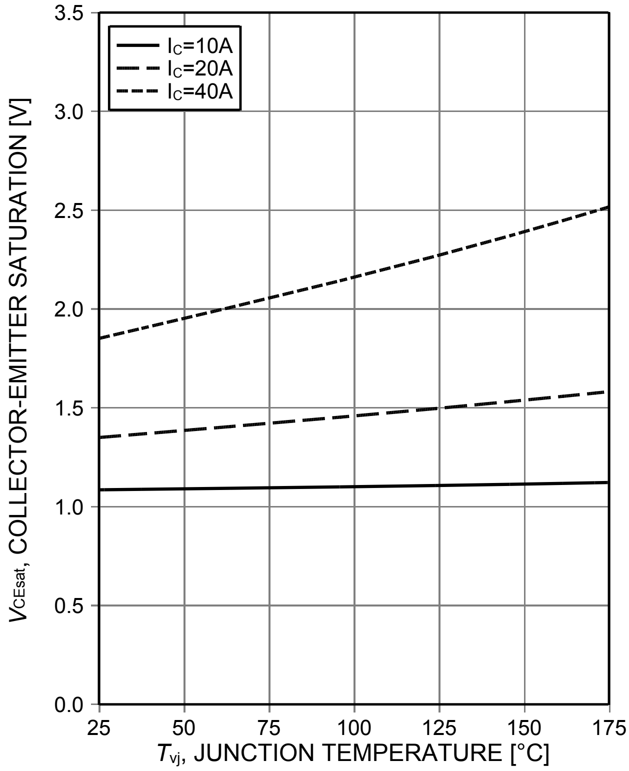


Figure 6. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)

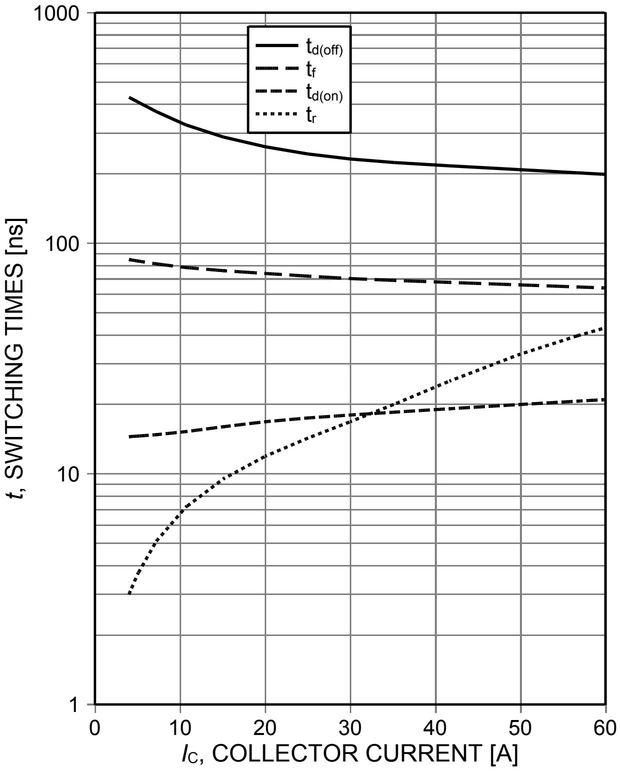


Figure 7. **Typical switching times as a function of collector current**
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=15/0V, r_G=12Ω, Dynamic test circuit in Figure E)

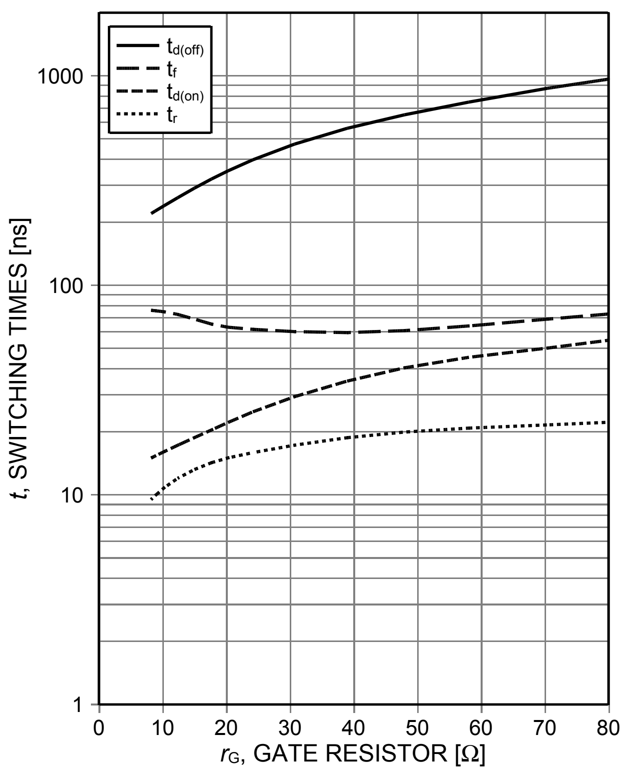


Figure 8. **Typical switching times as a function of gate resistor**
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=20A, Dynamic test circuit in Figure E)

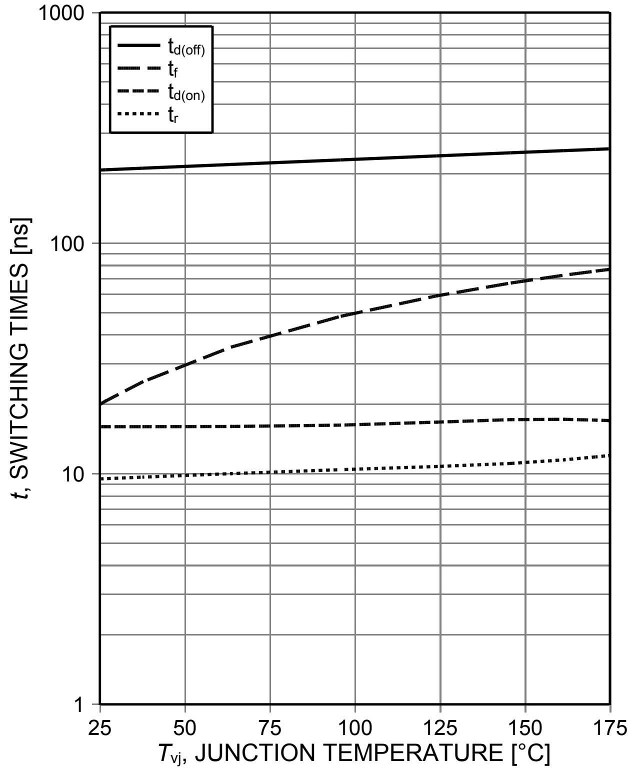


Figure 9. **Typical switching times as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=20A, r_G=12Ω, Dynamic test circuit in Figure E)

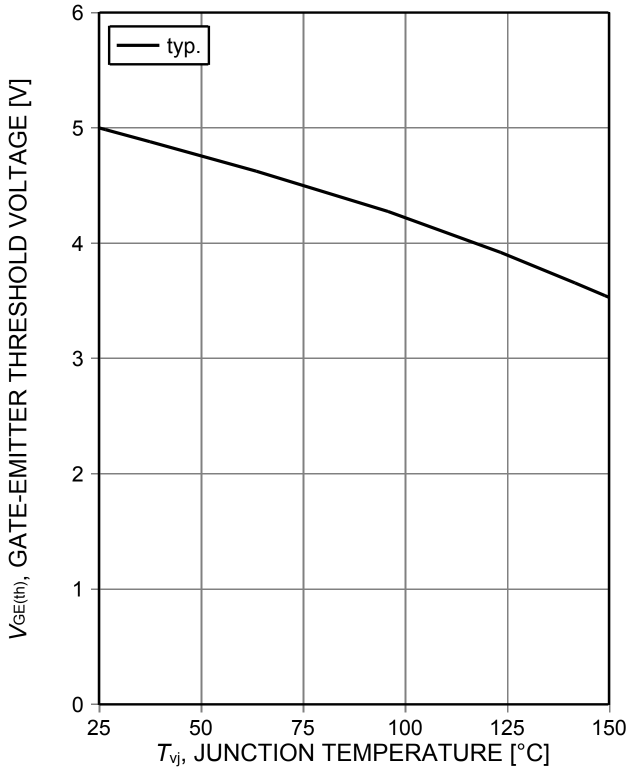


Figure 10. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=0.2mA)

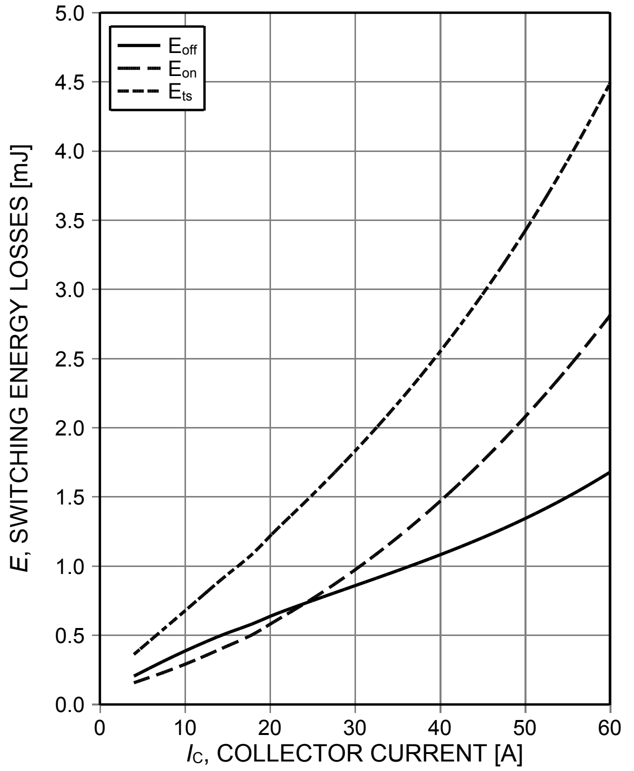


Figure 11. **Typical switching energy losses as a function of collector current**
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=15/0V, r_G=12Ω, Dynamic test circuit in Figure E)

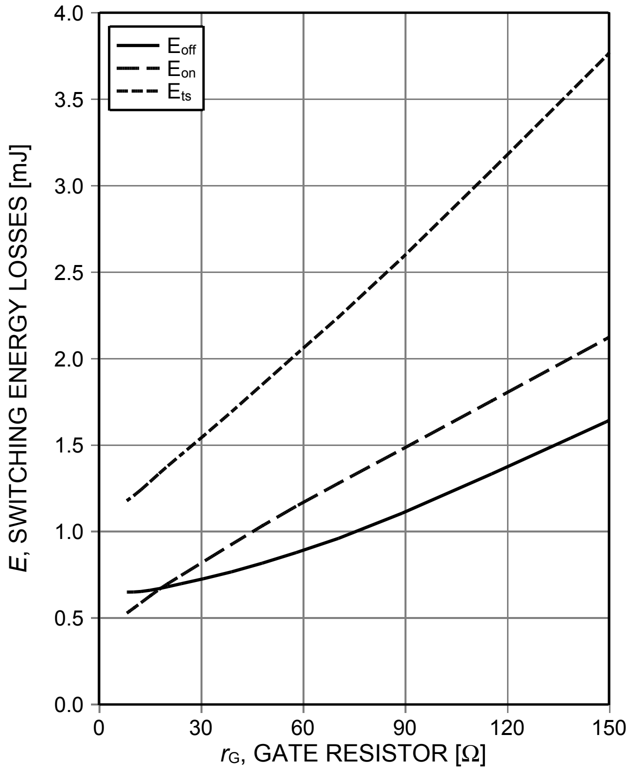


Figure 12. **Typical switching energy losses as a function of gate resistor**
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=20A, Dynamic test circuit in Figure E)

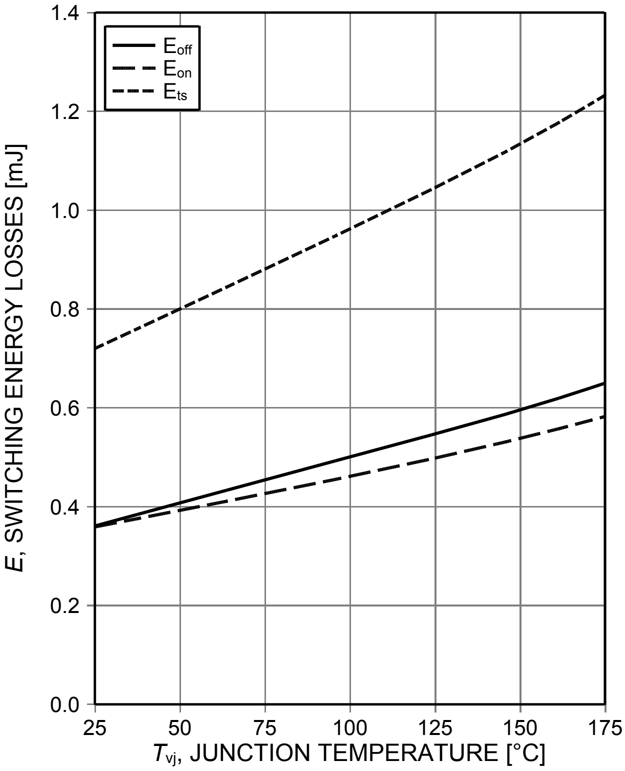


Figure 13. **Typical switching energy losses as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=20A, r_G=12Ω, Dynamic test circuit in Figure E)

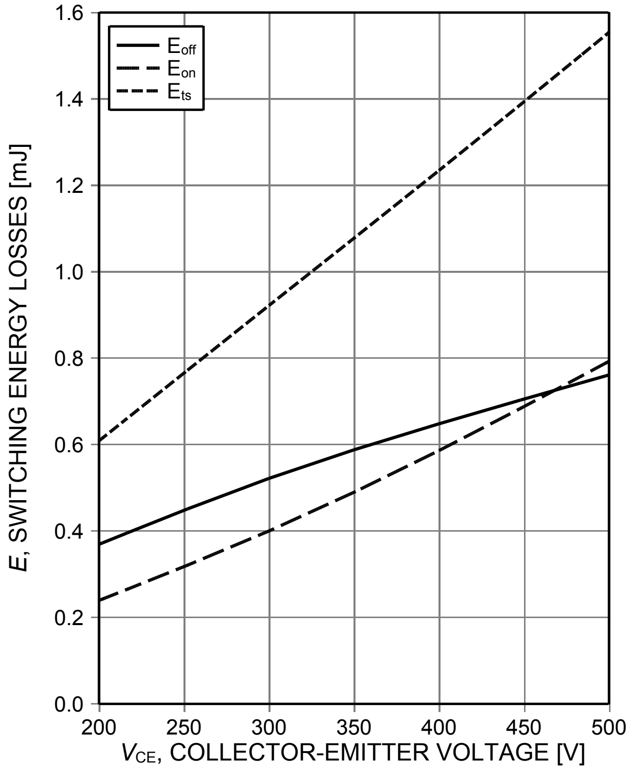


Figure 14. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, T_{vj}=175°C, V_{GE}=15/0V, I_C=20A, r_G=12Ω, Dynamic test circuit in Figure E)

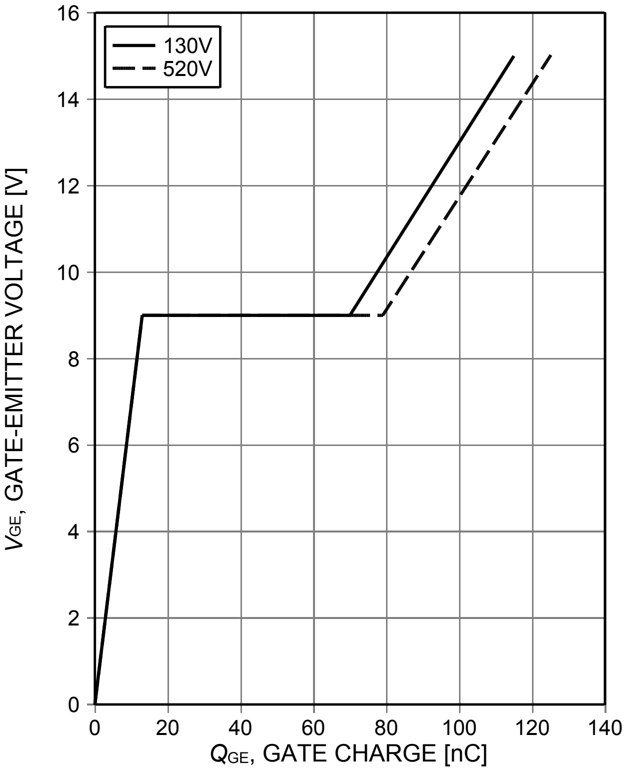


Figure 15. **Typical gate charge**
(I_C=20A)

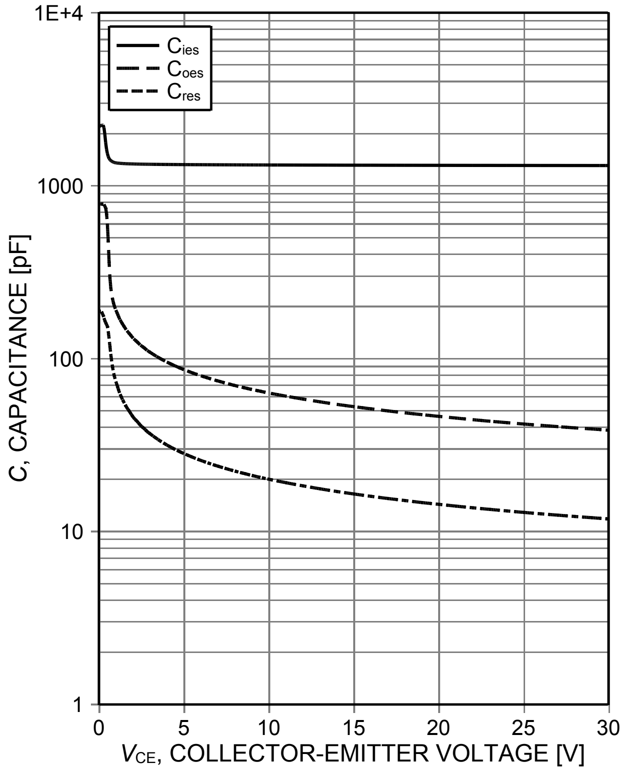


Figure 16. **Typical capacitance as a function of collector-emitter voltage**
(V_{GE}=0V, f=1MHz)

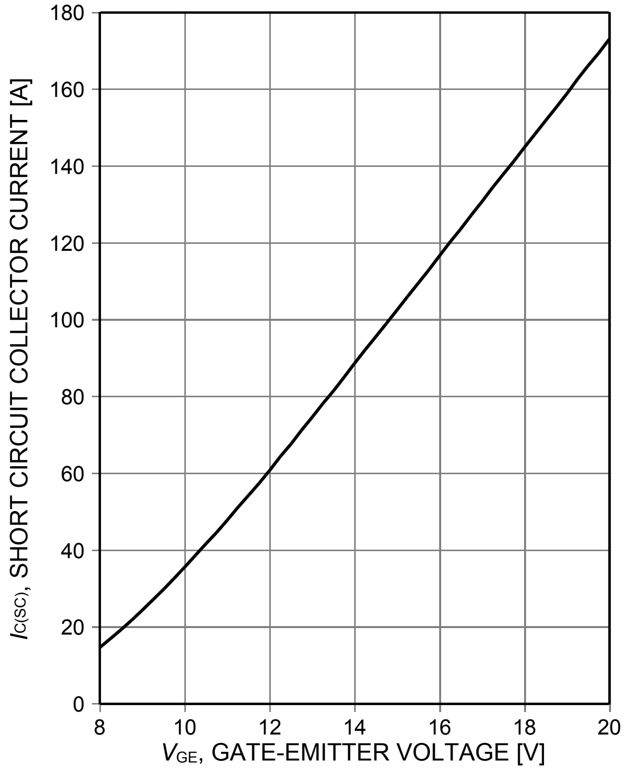


Figure 17. **Typical short circuit collector current as a function of gate-emitter voltage**
(V_{CE}≤400V, T_{vj}≤150°C)

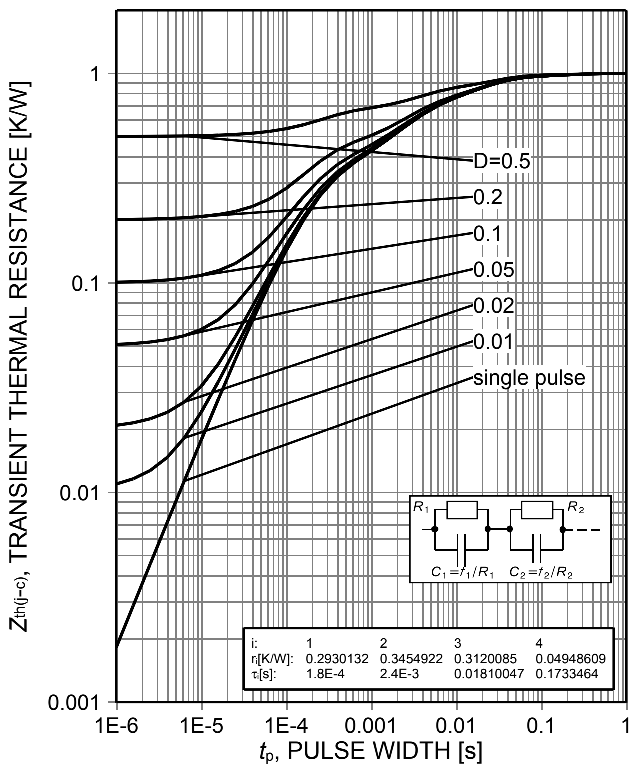


Figure 18. **IGBT transient thermal resistance**
(D=t_p/T)

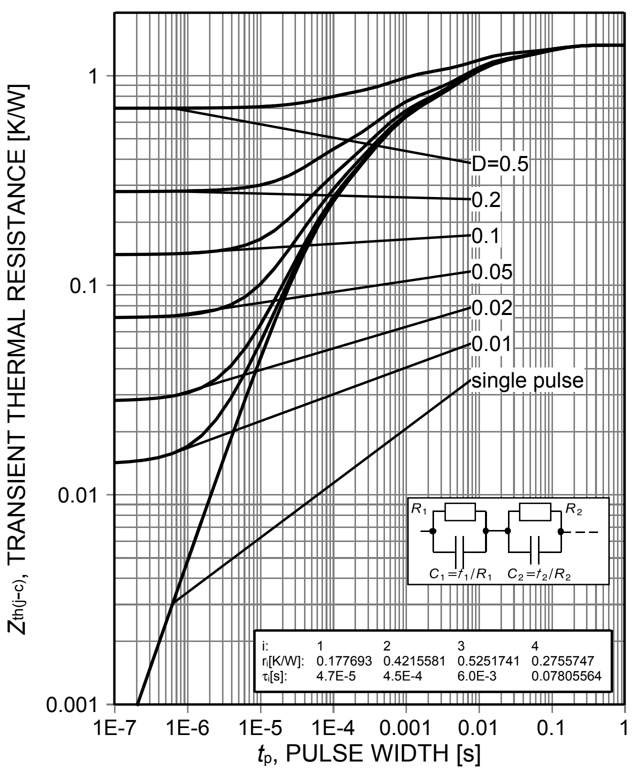


Figure 19. **Diode transient thermal impedance as a function of pulse width**
(D=t_p/T)

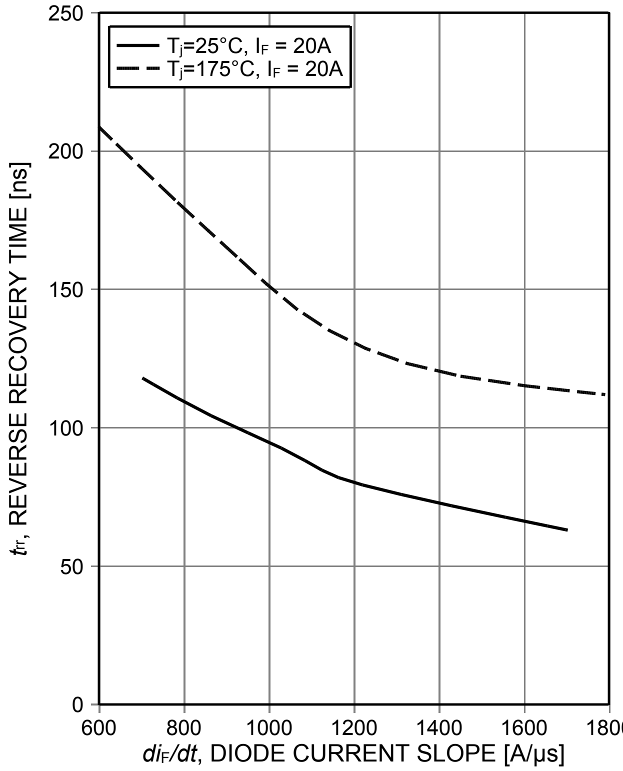


Figure 20. **Typical reverse recovery time as a function of diode current slope**
(V_R=400V)

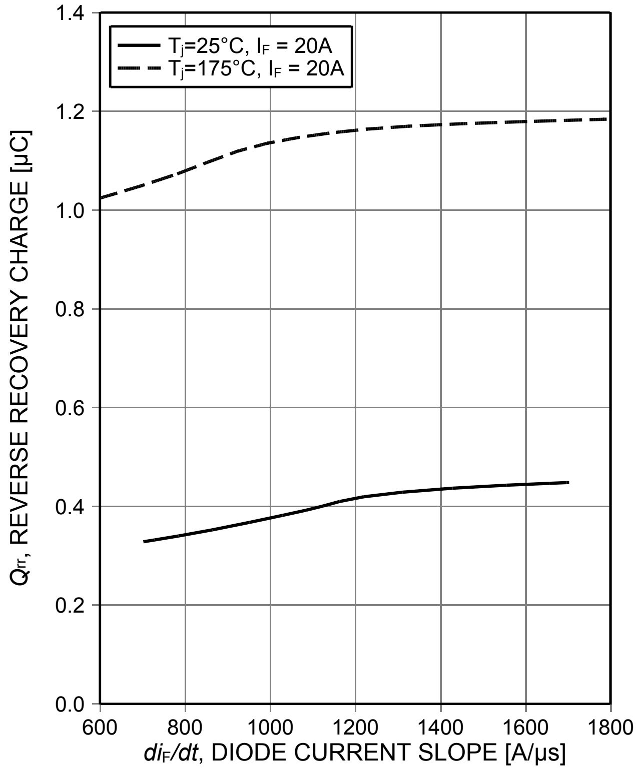


Figure 21. **Typical reverse recovery charge as a function of diode current slope** (V_R=400V)

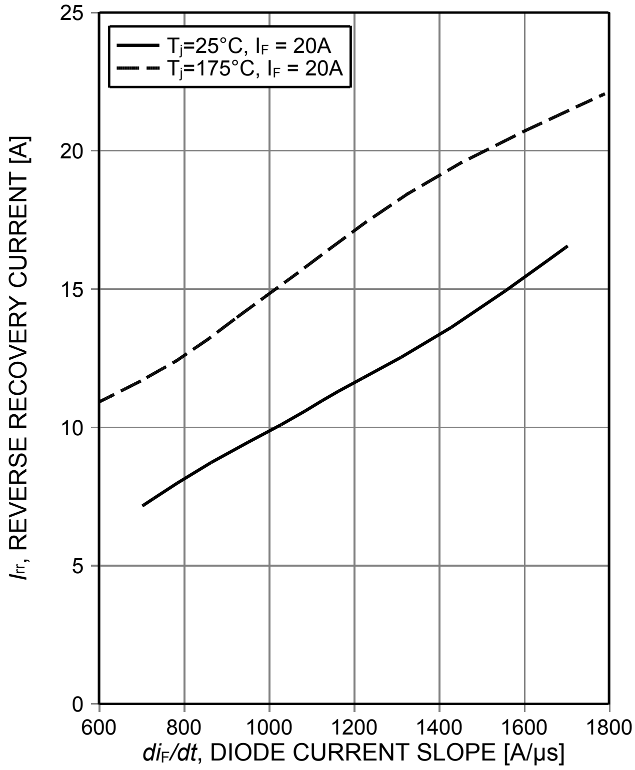


Figure 22. **Typical reverse recovery current as a function of diode current slope** (V_R=400V)

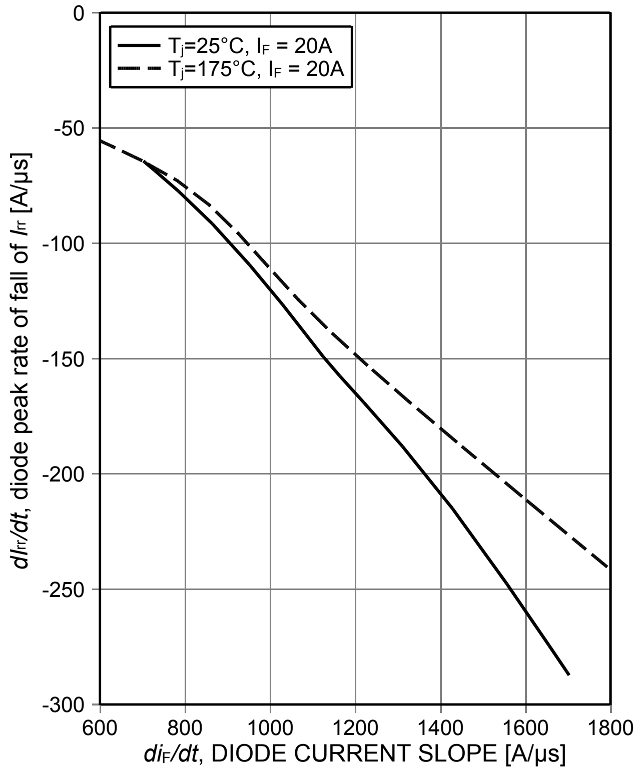


Figure 23. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope** (V_R=400V)

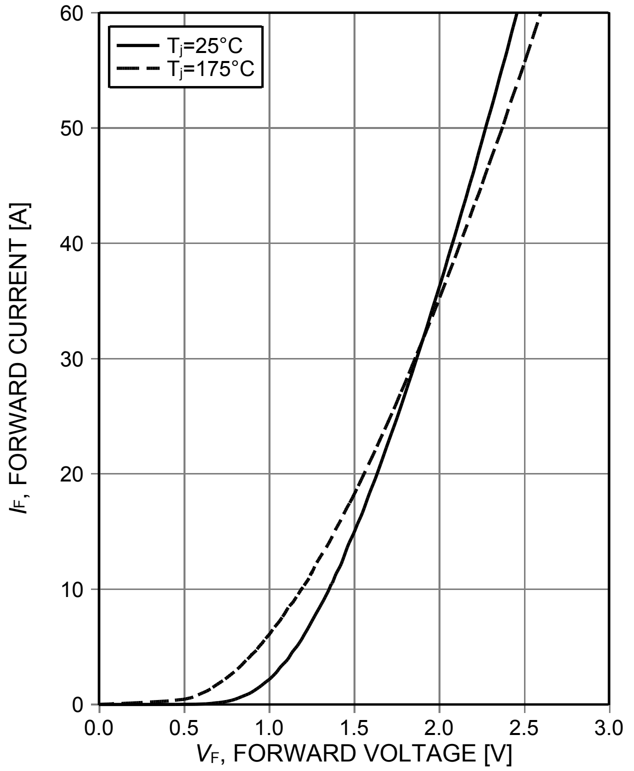


Figure 24. **Typical diode forward current as a function of forward voltage**

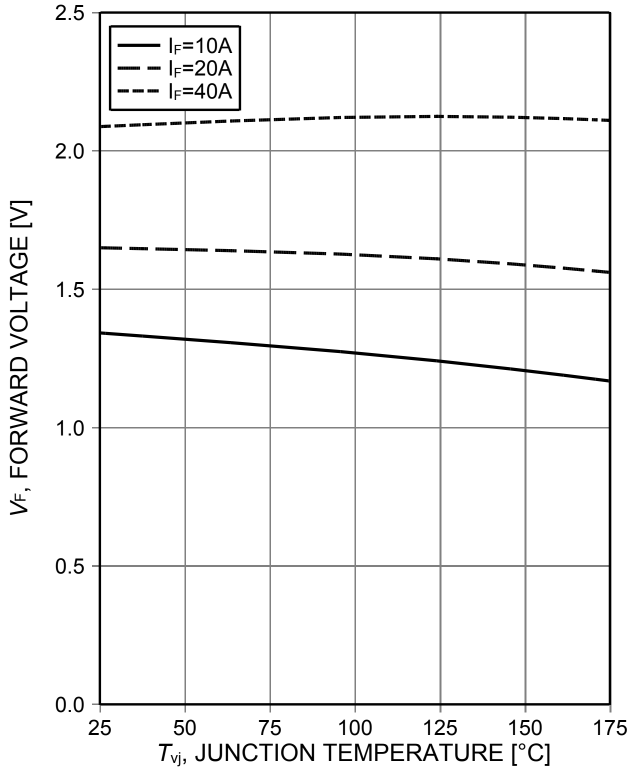
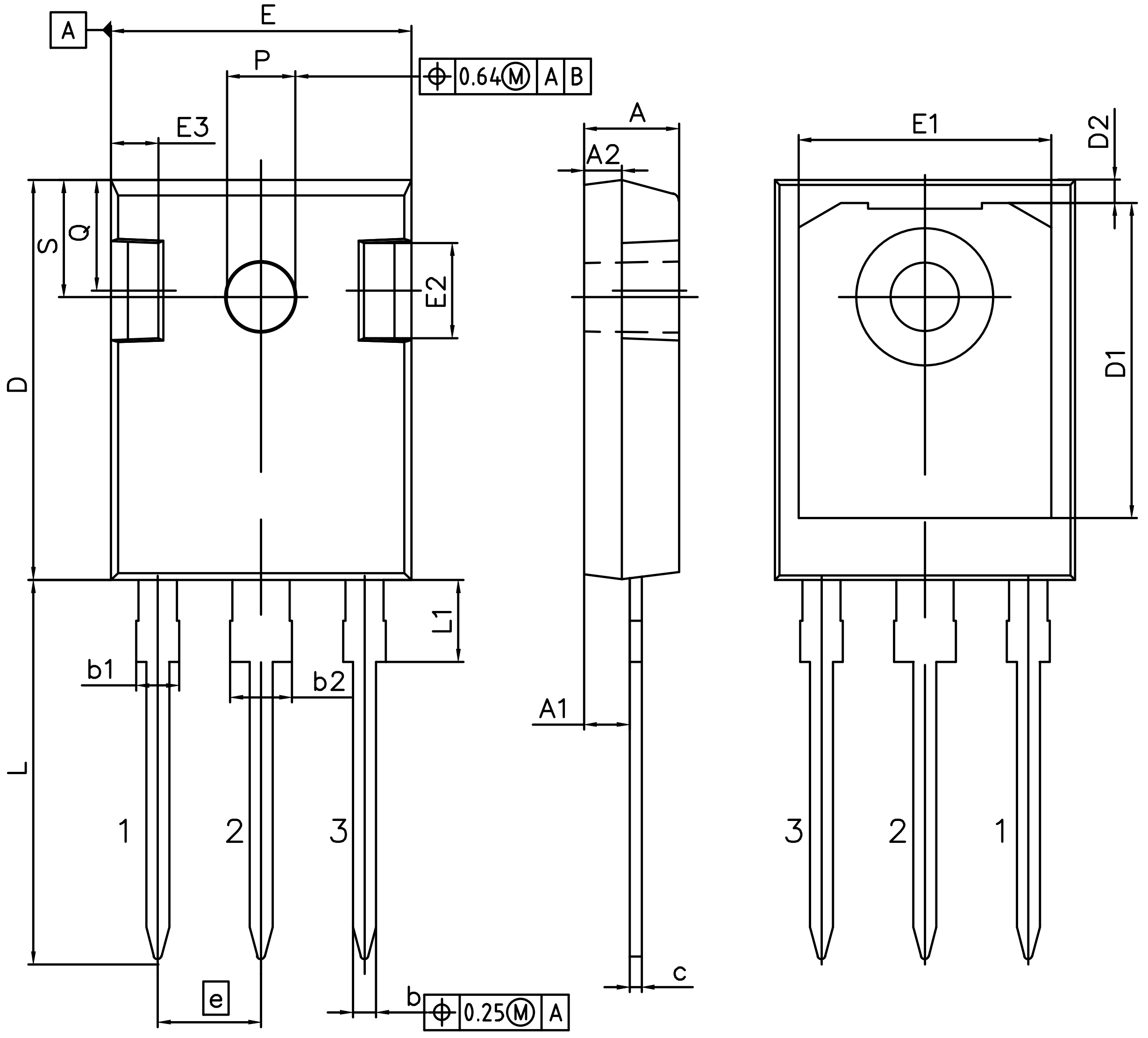


Figure 25. **Typical diode forward voltage as a function of junction temperature**

Package Drawing PG-TO247-3



DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.70	5.30
A1	2.20	2.60
A2	1.50	2.50
b	1.00	1.40
b1	1.60	2.41
b2	2.57	3.43
c	0.38	0.89
D	20.70	21.50
D1	13.08	17.65
D2	0.51	1.35
E	15.50	16.30
E1	12.38	14.15
E2	3.40	5.10
E3	1.00	2.60
e	5.44	
L	19.80	20.40
L1	3.85	4.50
P	3.50	3.70
Q	5.35	6.25
S	6.04	6.30

DOCUMENT NO.
Z8B00003327

REVISION
06

SCALE 3:1
0 1 2 3 4 5mm

EUROPEAN PROJECTION

ISSUE DATE
25.07.2018

Testing Conditions

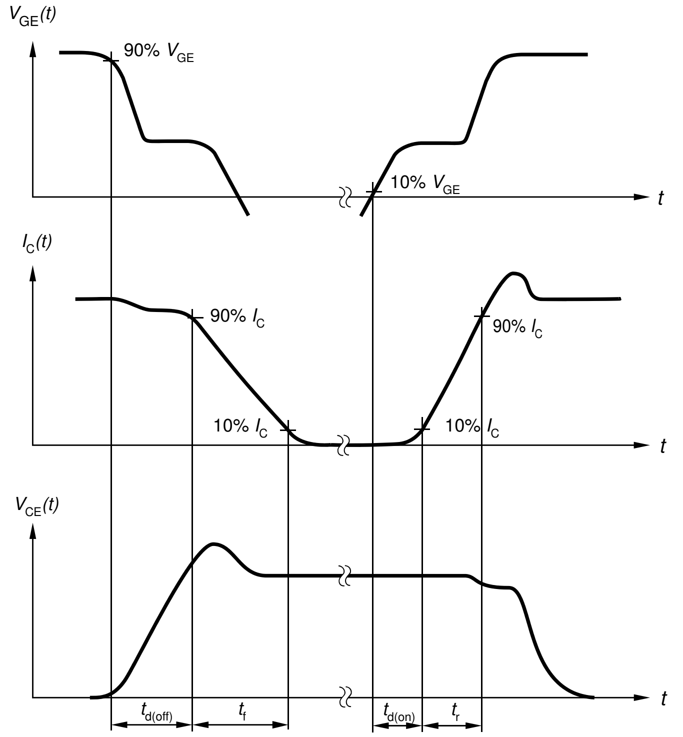


Figure A. **Definition of switching times**

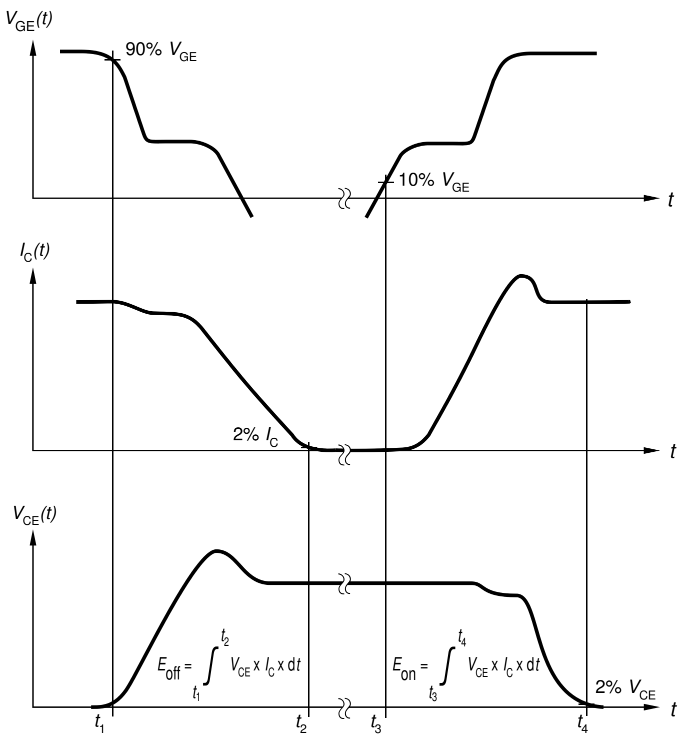


Figure B. **Definition of switching losses**

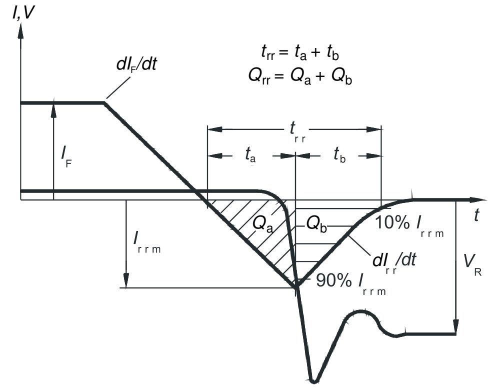


Figure C. **Definition of diode switching characteristics**

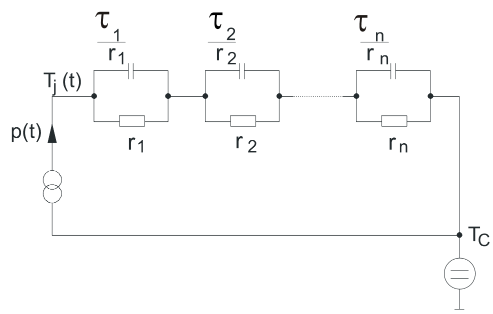


Figure D. **Thermal equivalent circuit**

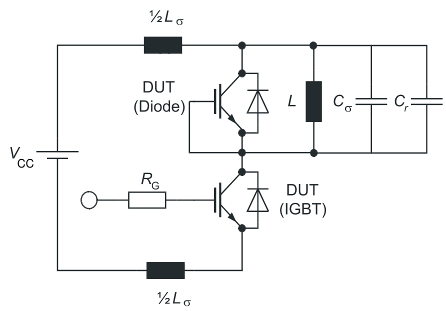


Figure E. **Dynamic test circuit**
Parasitic inductance L_{σ},
parasitic capacitor C_{σ},
relief capacitor C_r,
(only for ZVT switching)

Revision History

IKW20N65ET7

Revision: 2020-11-11, Rev. 2.3

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2020-05-12	Final data sheet
2.2	2020-06-29	Increase of forward current rating at Tc=100°C to 27.5A
2.3	2020-11-11	Additional short circuit specification

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