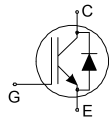
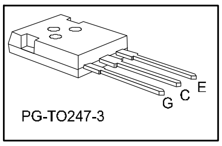
High speed DuoPack: IGBT in Trench and Fieldstop technology with soft, fast recovery anti-parallel diode



Features:
TRENCHSTOP™ 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

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
IKW15N120H3	1200V	15A	2.05V	175°C	K15H1203	PG-TO247-3

Maximum ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
DC collector current, limited by T_{vjmax} T_C = 25°C T_C = 100°C	I_C	 30.0 15.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	60.0	A
Turn off safe operating area V_{CE} ≤ 1200V, T_{vj} ≤ 175°C	-	60.0	A
Diode forward current, limited by T_{vjmax} T_C = 25°C T_C = 100°C	I_F	 15.0 7.5	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	60.0	A
Gate-emitter voltage	V_{GE}	±20	V
Short circuit withstand time V_{GE} = 15.0V, V_{CC} ≤ 600V, T_{vj} ≤ 175°C Allowed number of short circuits < 1000 Time between short circuits: ≥ 1.0s	t_{SC}	10	µs
Power dissipation T_C = 25°C Power dissipation T_C = 100°C	P_{tot}	217.0 105.0	W
Operating junction temperature	T_{vj}	-40...+175	°C
Storage temperature	T_{stg}	-55...+150	°C
Soldering temperature, wavesoldering 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	$R_{th(j-c)}$		0.70	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		2.12	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			Unit
			min.	typ.	max.	
Static Characteristic						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	V_{GE} = 0V, I_C = 0.50mA	1200	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	V_{GE} = 15.0V, I_C = 15.0A T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	- - -	2.05 2.50 2.70	2.40 - -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 7.5A T_{vj} = 25°C T_{vj} = 175°C	- -	1.80 1.85	2.35	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	- - -	2.40 2.60 2.60	3.05 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.50mA, V_{CE} = V_{GE}	5.0	5.8	6.5	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 1200V, V_{GE} = 0V T_{vj} = 25°C T_{vj} = 175°C	- -	- -	250.0 2500.0	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	600	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 15.0A	-	7.5	-	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 = 1MHz	-	875	-	pF
Output capacitance	C_{oes}		-	75	-	
Reverse transfer capacitance	C_{res}		-	45	-	
Gate charge	Q_G	V_{CC} = 960V, I_C = 15.0A, V_{GE} = 15V	-	75.0	-	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} ≤ 600V, T_{vj} ≤ 175°C, t_{SC} ≤ 10µs	-	52	-	A

Switching Characteristic, Inductive Load, at T_{vj} = 25°C

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 25°C, V_{CC} = 600V, I_C = 15.0A, V_{GE} = 0.0/15.0V, r_G = 35.0Ω, $L_σ$ = 95nH, $C_σ$ = 67pF $L_σ$, $C_σ$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	21	-	ns
Rise time	t_r		-	34	-	ns
Turn-off delay time	$t_{d(off)}$		-	260	-	ns
Fall time	t_f		-	14	-	ns
Turn-on energy	E_{on}		-	1.10	-	mJ
Turn-off energy	E_{off}		-	0.45	-	mJ
Total switching energy	E_{ts}		-	1.55	-	mJ

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

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R = 600V, I_F = 15.0A, di_F/dt = 500A/µs	-	260	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.80	-	µC
Diode peak reverse recovery current	I_{rrm}		-	7.7	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-110	-	A/µs

Switching Characteristic, Inductive Load, at T_{vj} = 175°C

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 175°C, V_{CC} = 600V, I_C = 15.0A, V_{GE} = 0.0/15.0V, r_G = 35.0Ω, L_σ = 95nH, C_σ = 67pF L_σ, C_σ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	19	-	ns
Rise time	t_r		-	30	-	ns
Turn-off delay time	$t_{d(off)}$		-	327	-	ns
Fall time	t_f		-	43	-	ns
Turn-on energy	E_{on}		-	1.60	-	mJ
Turn-off energy	E_{off}		-	0.90	-	mJ
Total switching energy	E_{ts}		-	2.50	-	mJ

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

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Diode reverse recovery time	t_{rr}	T_{vj} = 175°C, V_R = 600V, I_F = 15.0A, di_F/dt = 500A/µs	-	470	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.70	-	µC
Diode peak reverse recovery current	I_{rrm}		-	9.8	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-80	-	A/µs

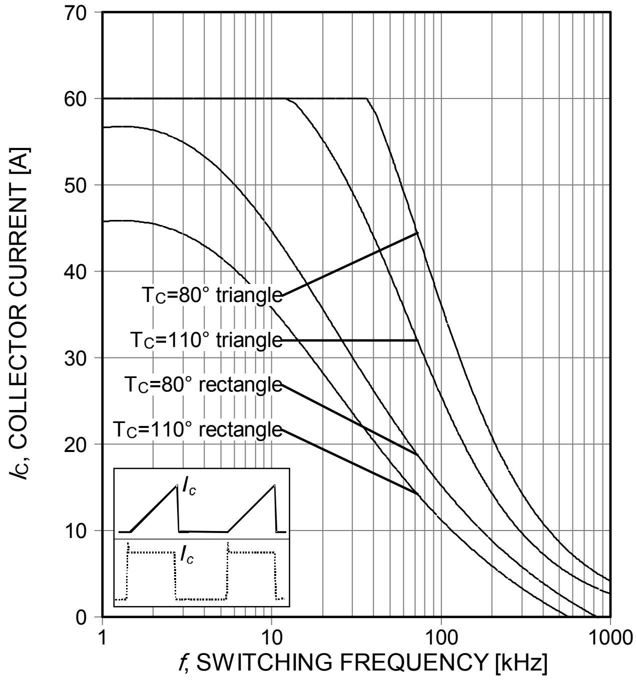


Figure 1. Collector current as a function of switching frequency
(T_j≤175°C, D=0.5, V_{CE}=600V, V_{GE}=15/0V, R_G=35Ω)

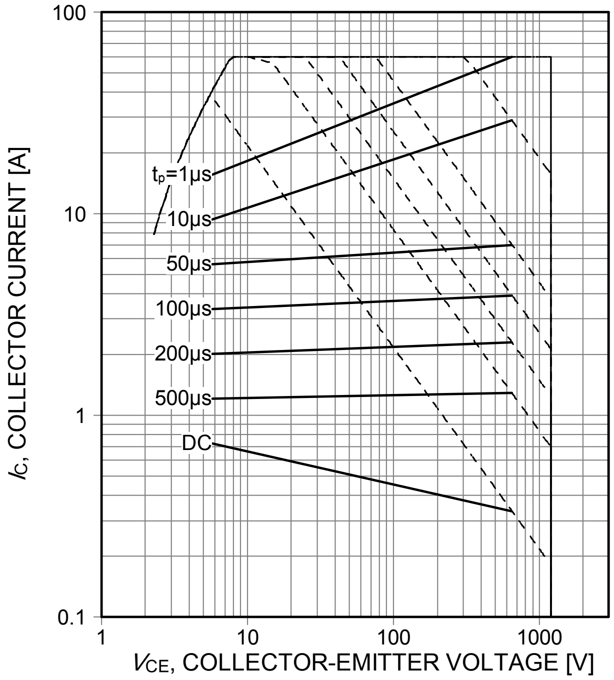


Figure 2. Forward bias safe operating area
(D=0, T_C=25°C, T_j≤175°C; V_{GE}=15V)

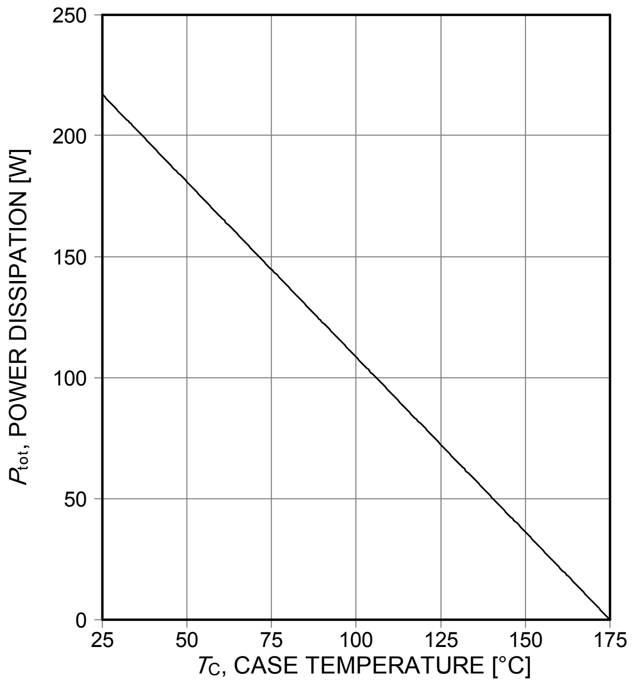


Figure 3. Power dissipation as a function of case temperature
(T_j≤175°C)

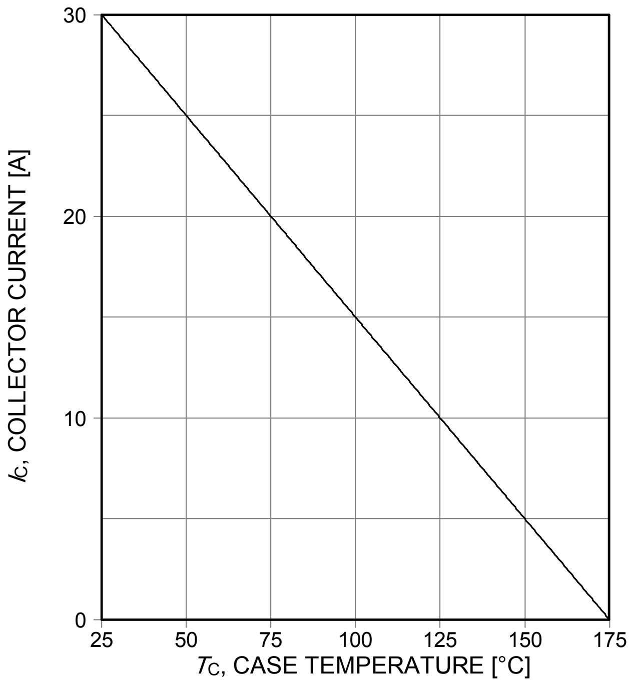


Figure 4. Collector current as a function of case temperature
(V_{GE}≥15V, T_j≤175°C)

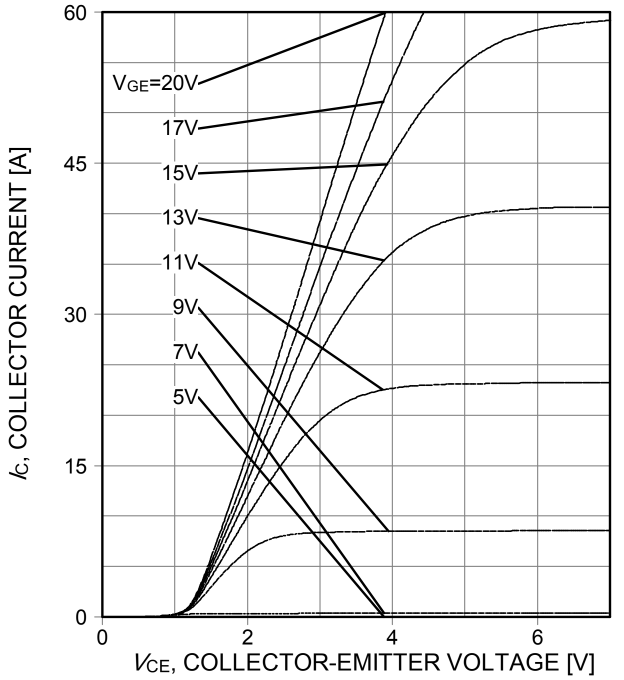


Figure 5. Typical output characteristic
(T_j=25°C)

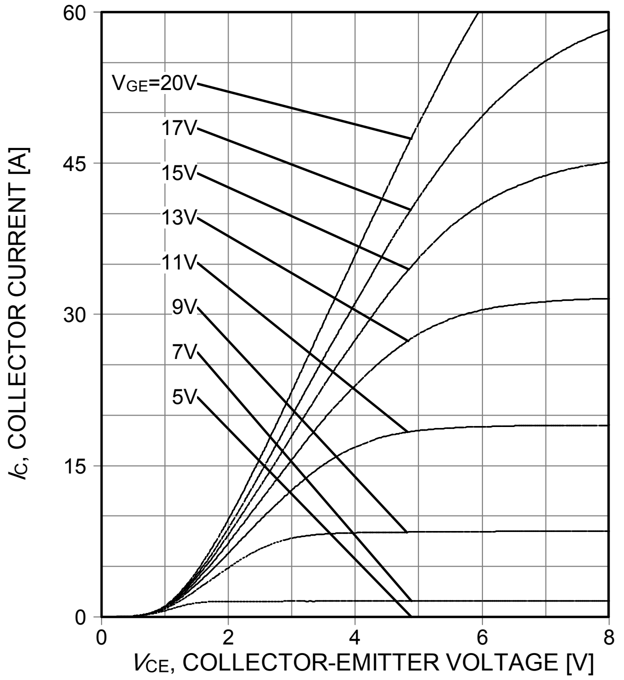


Figure 6. Typical output characteristic
(T_j=175°C)

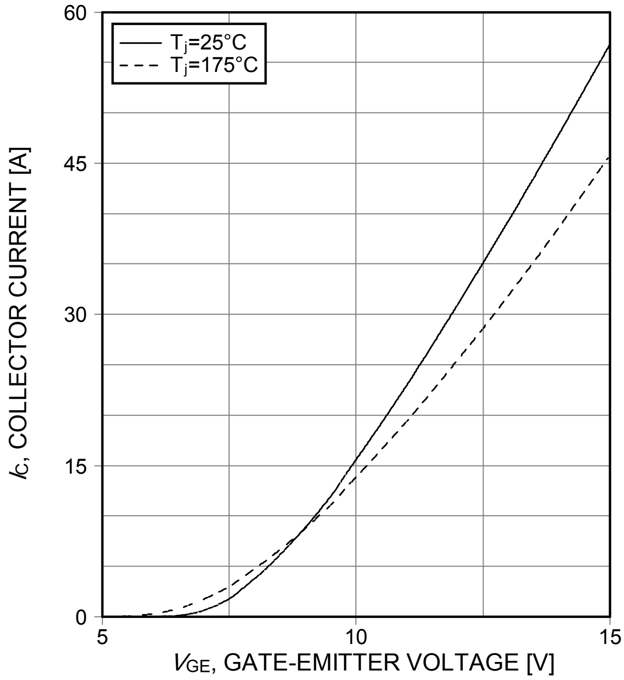


Figure 7. Typical transfer characteristic
(V_{CE}=20V)

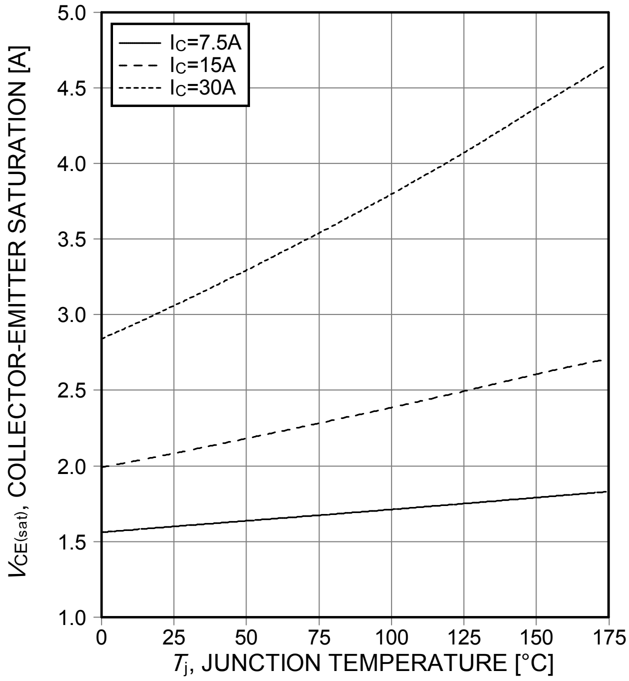


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE}=15V)

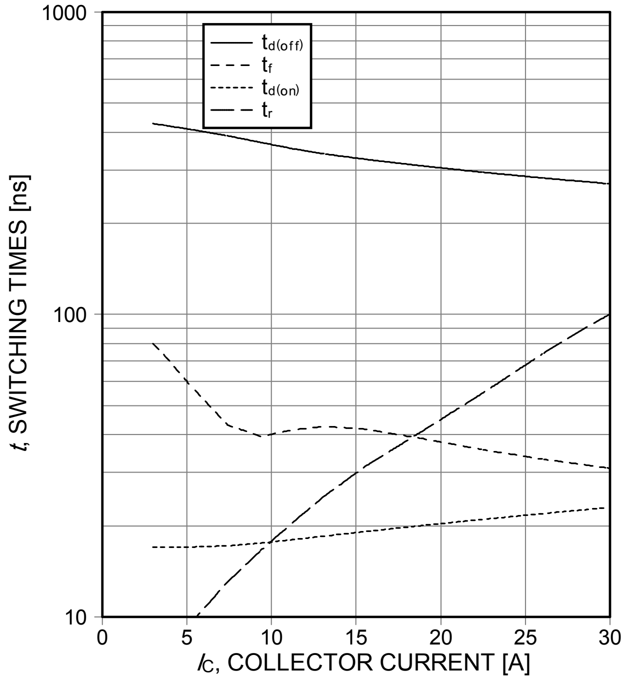


Figure 9. Typical switching times as a function of collector current
(ind. load, T_j=175°C, V_{CE}=600V, V_{GE}=15/0V, R_G=35Ω, test circuit in Fig. E)

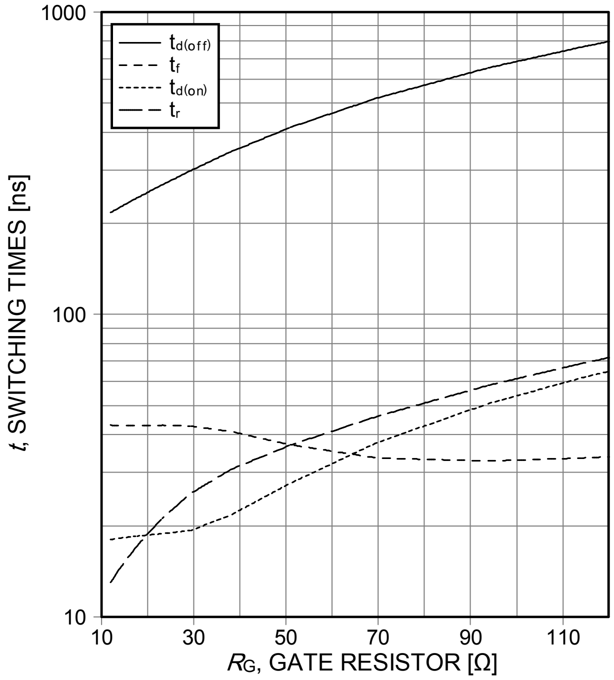


Figure 10. Typical switching times as a function of gate resistor
(ind. load, T_j=175°C, V_{CE}=600V, V_{GE}=15/0V, I_C=15A, test circuit in Fig. E)

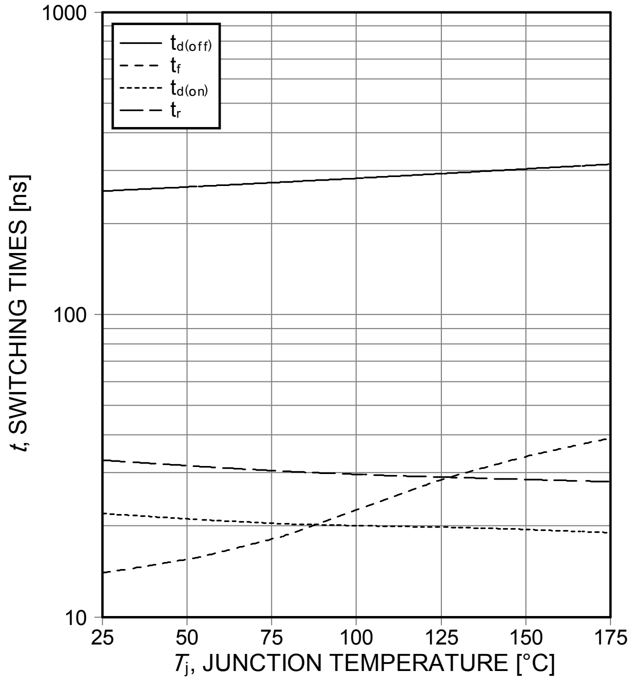


Figure 11. Typical switching times as a function of junction temperature
(ind. load, V_{CE}=600V, V_{GE}=15/0V, I_C=15A, R_G=35Ω, test circuit in Fig. E)

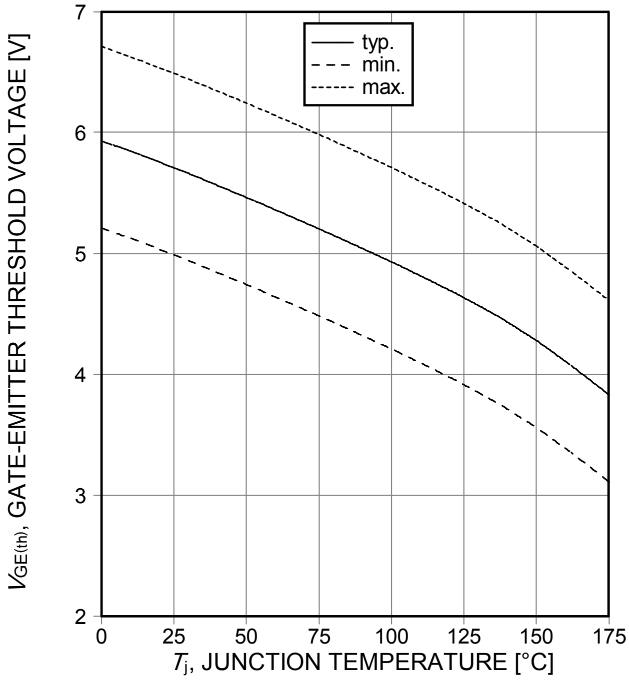


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C=0.5mA)

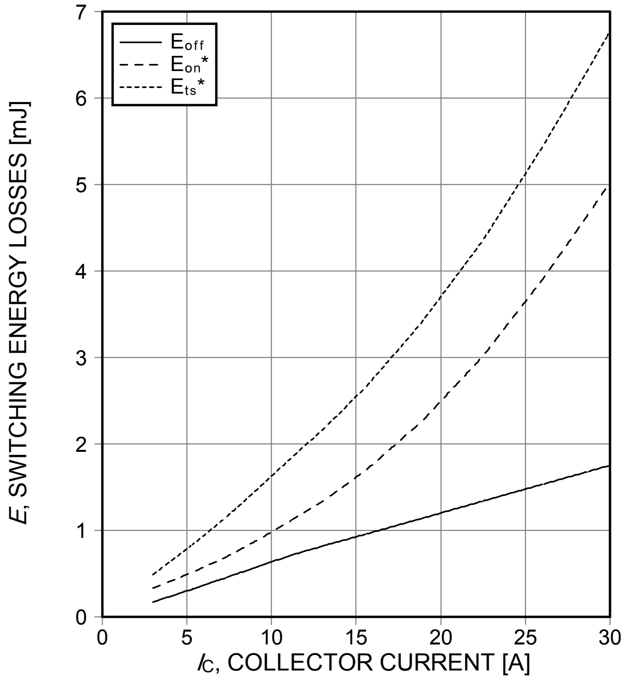


Figure 13. Typical switching energy losses as a function of collector current
(ind. load, T_j=175°C, V_{CE}=600V, V_{GE}=15/0V, R_G=35Ω, test circuit in Fig. E)

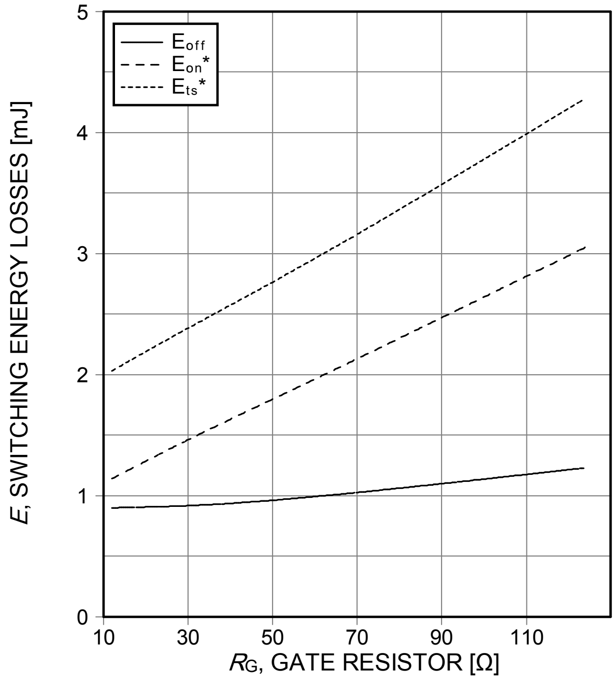


Figure 14. Typical switching energy losses as a function of gate resistor
(ind. load, T_j=175°C, V_{CE}=600V, V_{GE}=15/0V, I_C=15A, test circuit in Fig. E)

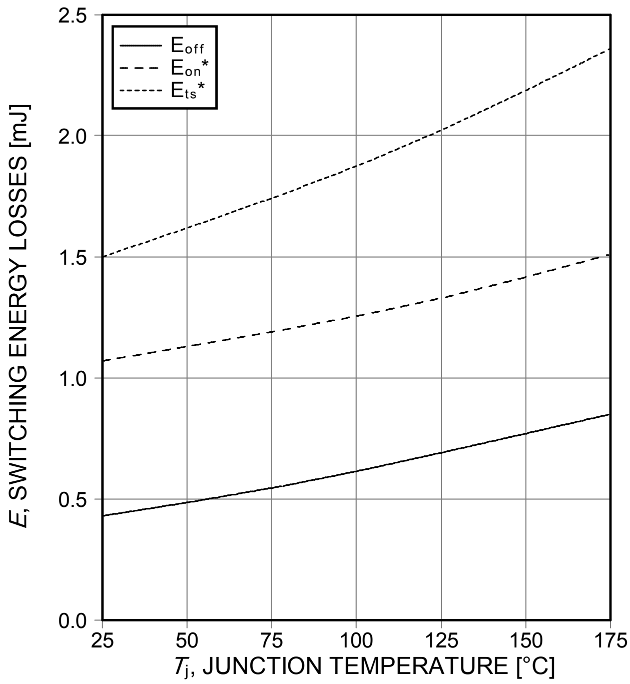


Figure 15. Typical switching energy losses as a function of junction temperature
(ind load, V_{CE}=600V, V_{GE}=15/0V, I_C=15A, R_G=35Ω, test circuit in Fig. E)

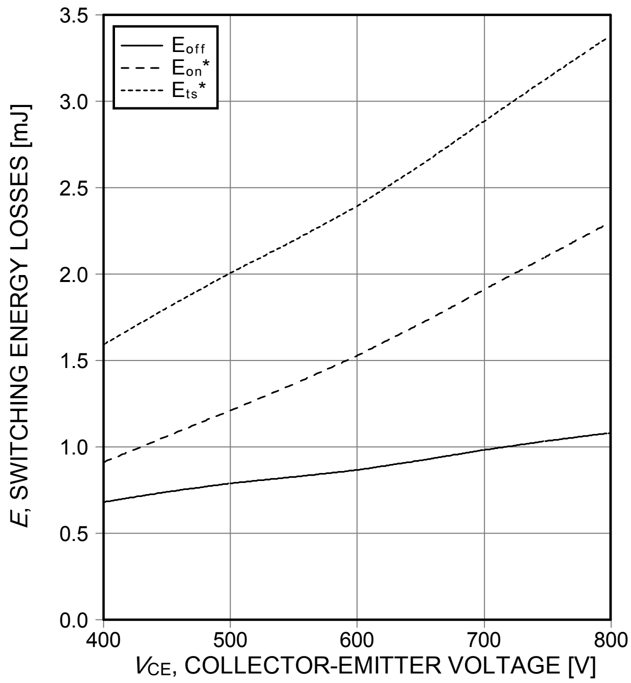


Figure 16. Typical switching energy losses as a function of collector emitter voltage
(ind. load, T_j=175°C, V_{GE}=15/0V, I_C=15A, R_G=35Ω, test circuit in Fig. E)

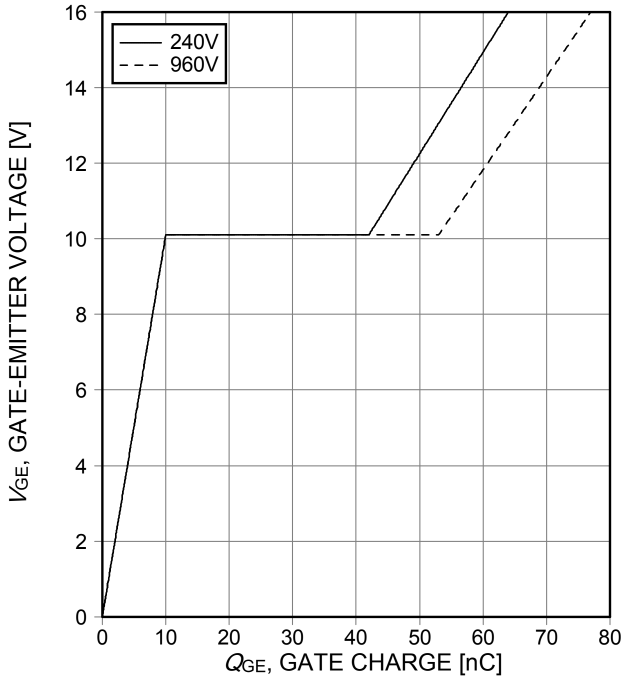


Figure 17. Typical gate charge
(I_C=15A)

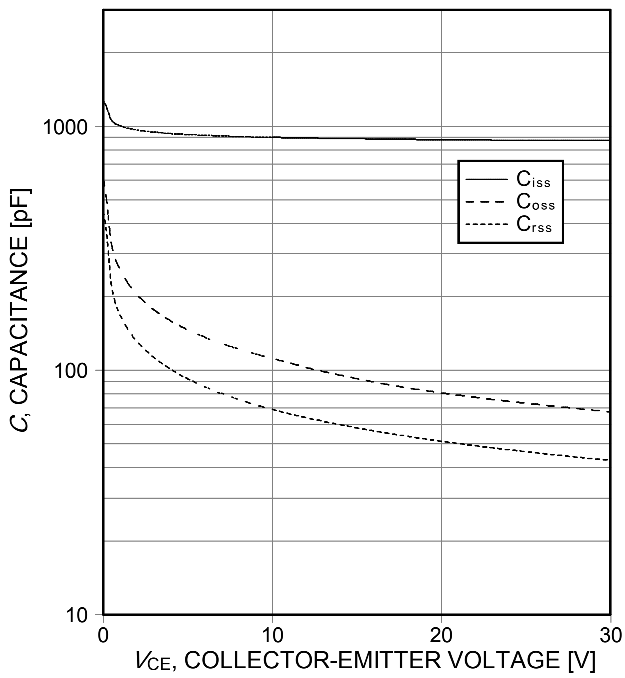


Figure 18. Typical capacitance as a function of collector-emitter voltage
(V_{GE}=0V, f=1MHz)

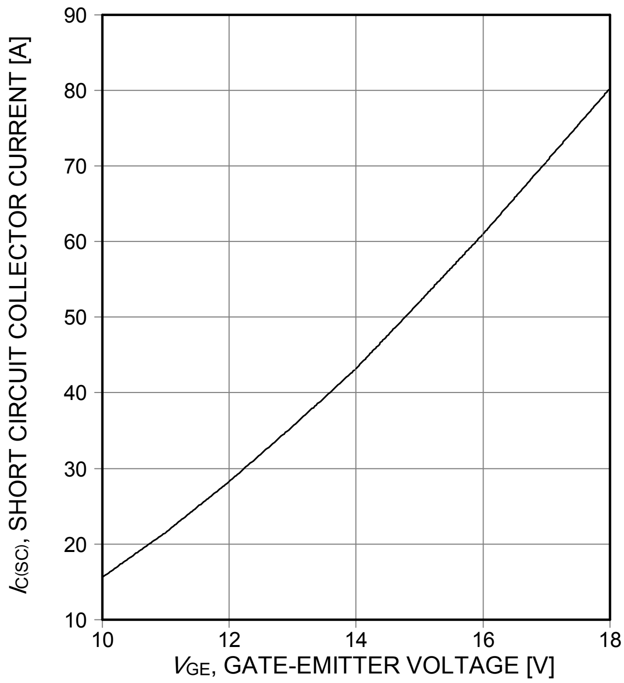


Figure 19. Typical short circuit collector current as a function of gate-emitter voltage
(V_{CE}≤600V, start at T_j=25°C)

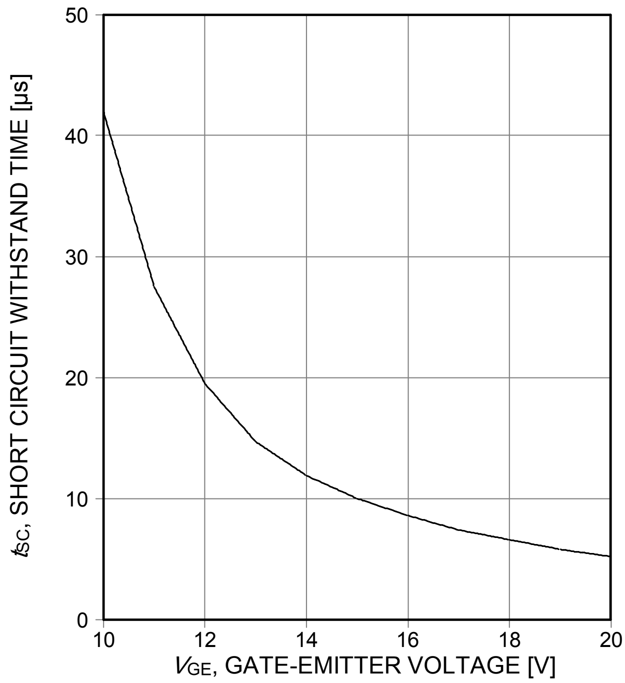


Figure 20. Short circuit withstand time as a function of gate-emitter voltage
(V_{CE}≤600V, start at T_j≤150°C)

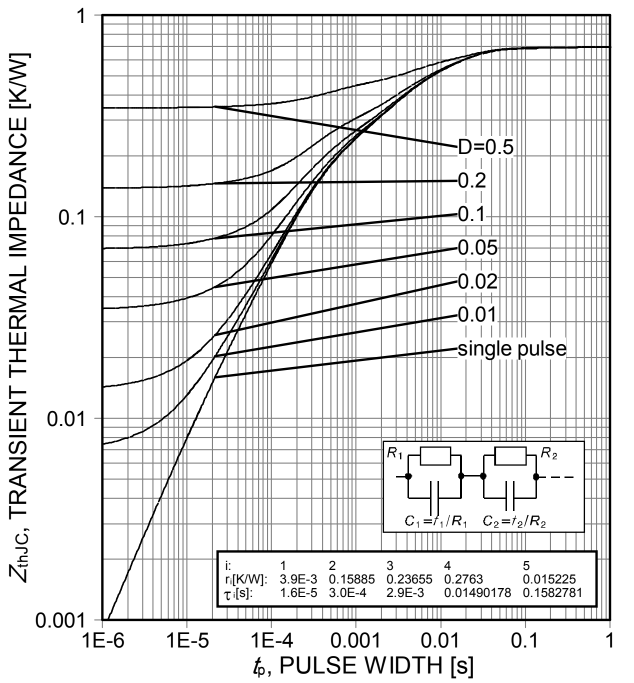


Figure 21. IGBT transient thermal impedance
($D=t_p/T$)

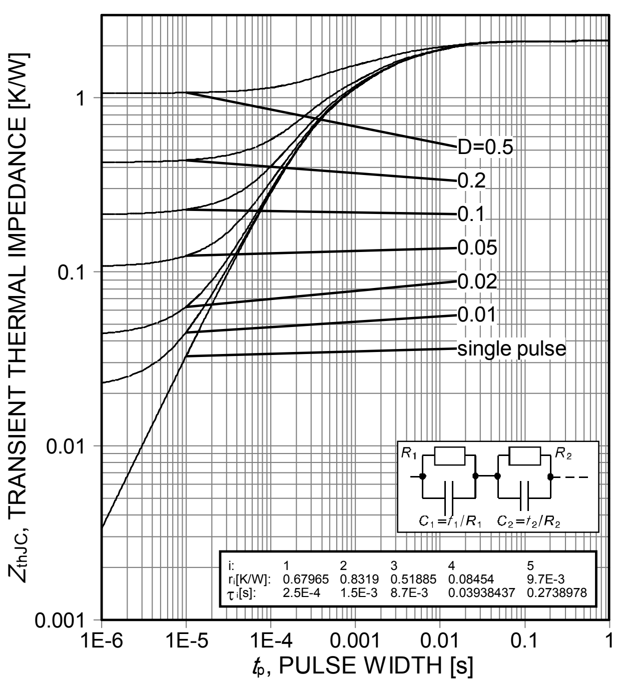


Figure 22. Diode transient thermal impedance as a function of pulse width
($D=t_p/T$)

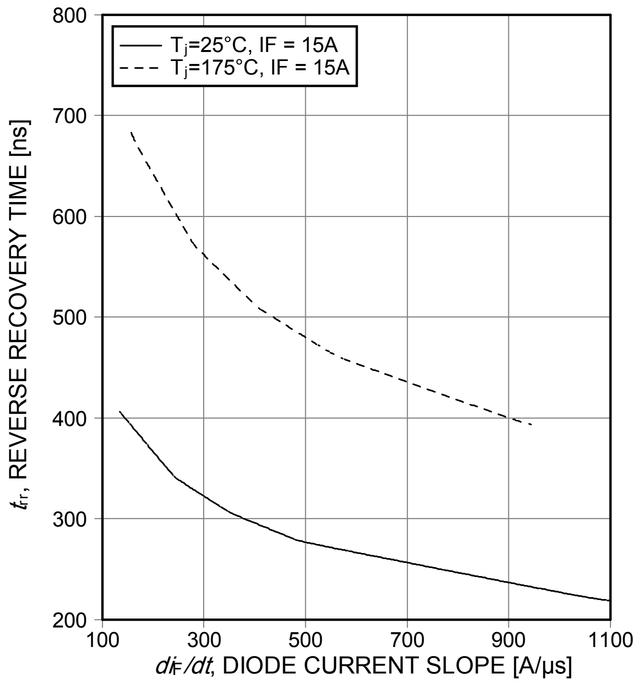


Figure 23. Typical reverse recovery time as a function of diode current slope
(V_R=600V)

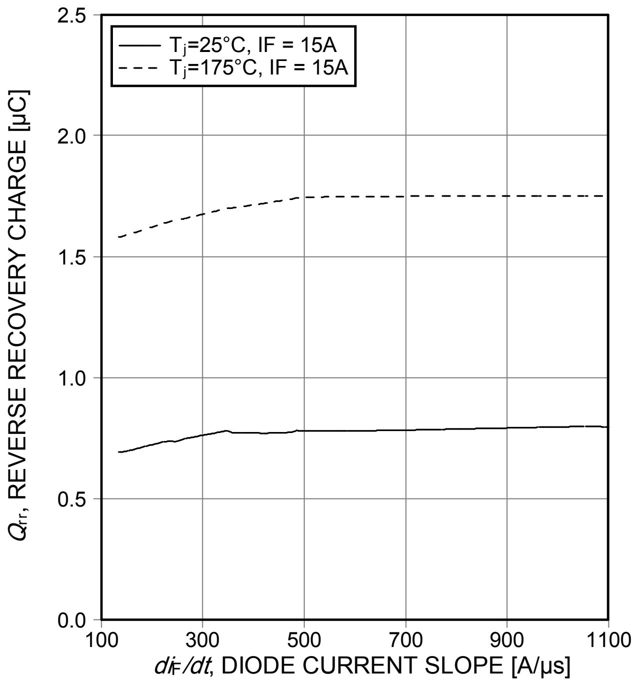


Figure 24. Typical reverse recovery charge as a function of diode current slope
(V_R=600V)

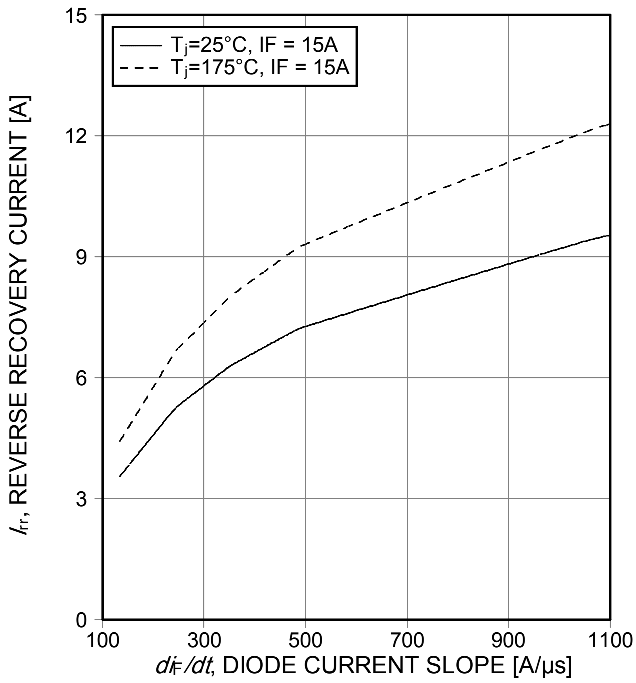


Figure 25. Typical reverse recovery current as a function of diode current slope
(V_R=600V)

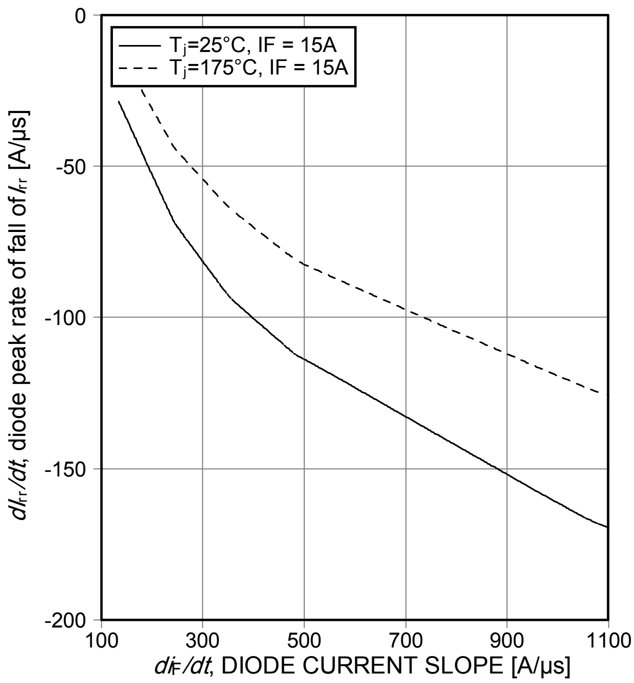


Figure 26. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope
(V_R=600V)

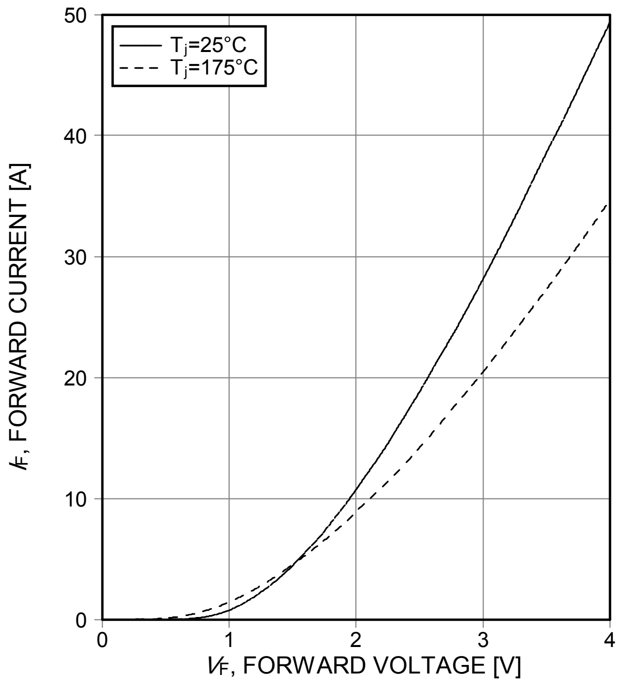


Figure 27. Typical diode forward current as a function of forward voltage

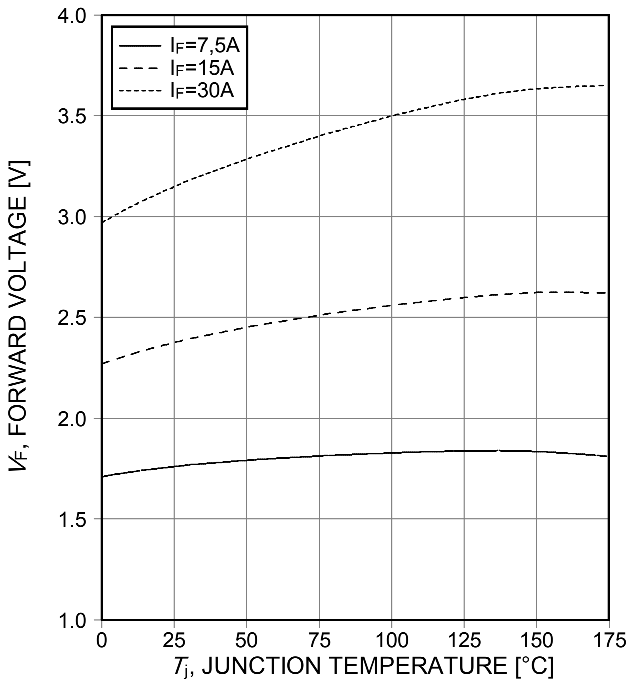


Figure 28. Typical diode forward voltage as a function of junction temperature

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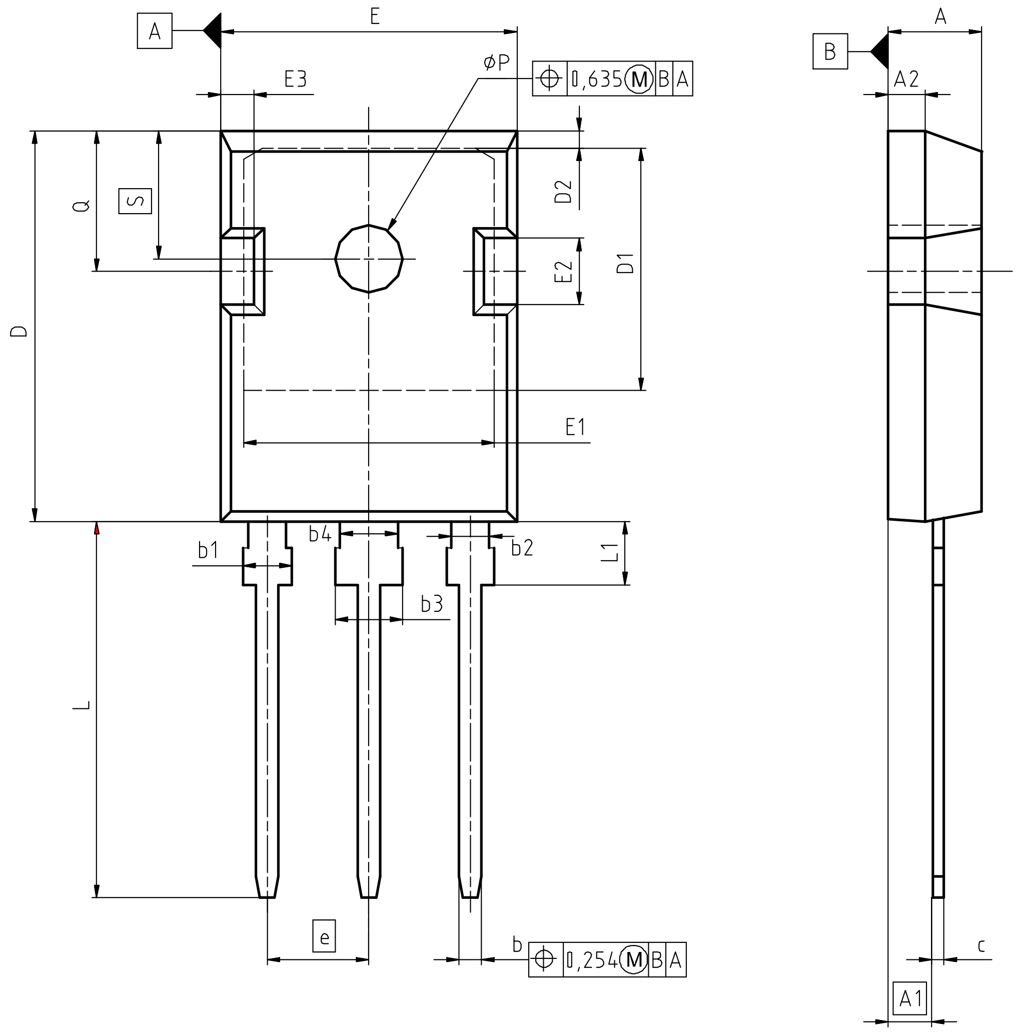

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.90	5.16	0.193	0.203
A1	2.27	2.53	0.089	0.099
A2	1.85	2.11	0.073	0.083
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.82	21.10	0.820	0.831
D1	16.25	17.65	0.640	0.695
D2	1.05	1.35	0.041	0.053
E	15.70	16.03	0.618	0.631
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.68	2.60	0.066	0.102
e	5.44		0.214	
N	3		3	
L	19.80	20.31	0.780	0.799
L1	4.17	4.47	0.164	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.
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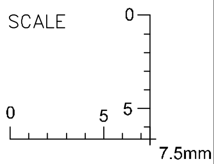
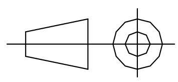
SCALE



EUROPEAN PROJECTION



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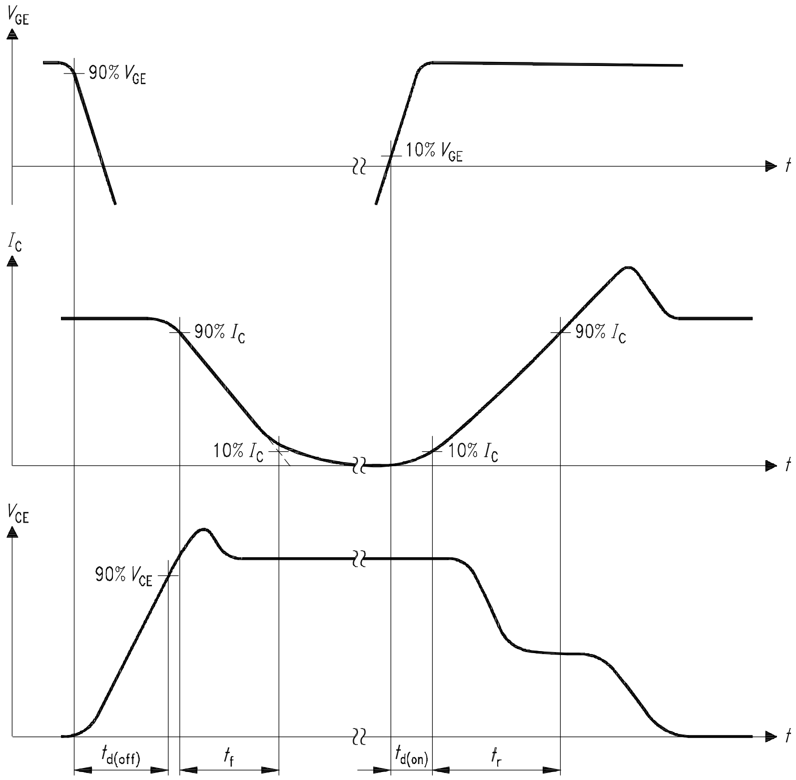

Figure A. Definition of switching times

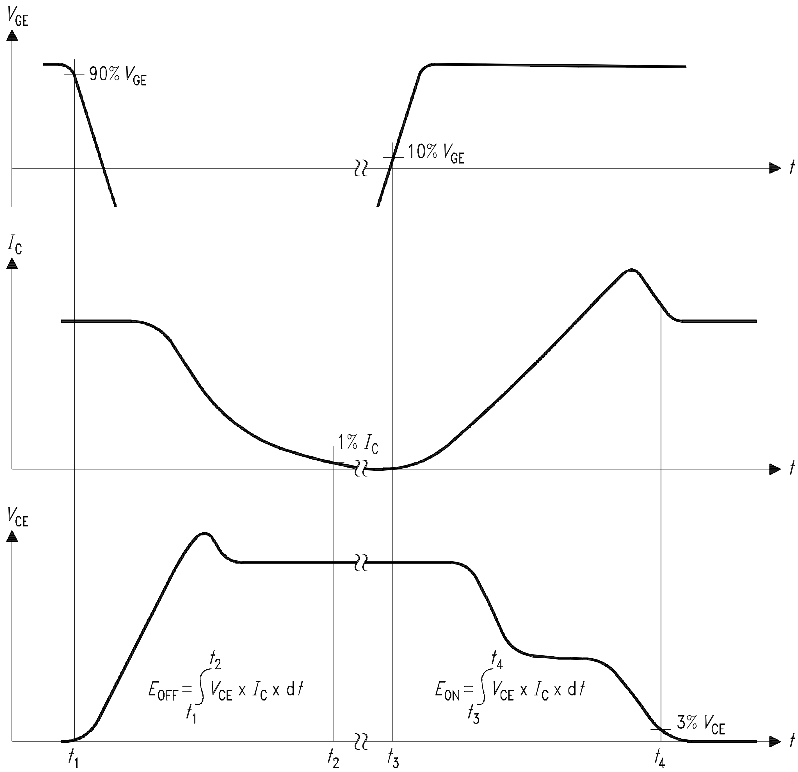

Figure B. Definition of switching losses

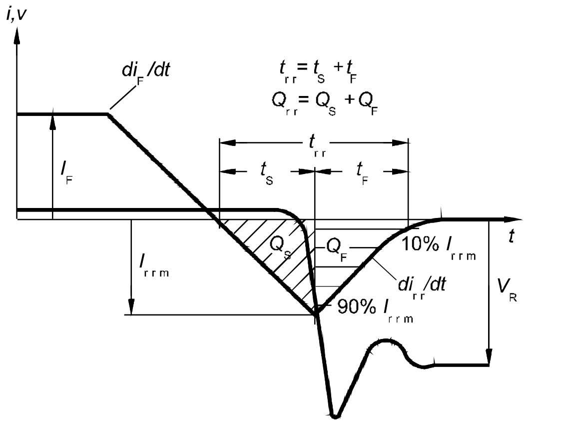

Figure C. Definition of diodes switching characteristics

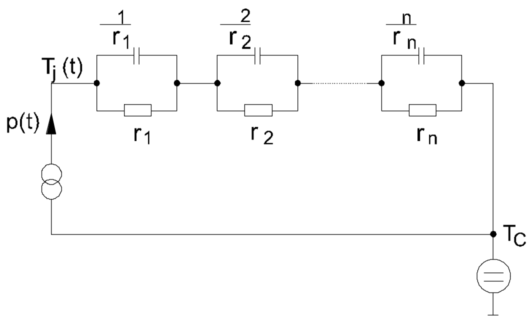

Figure D. Thermal equivalent circuit

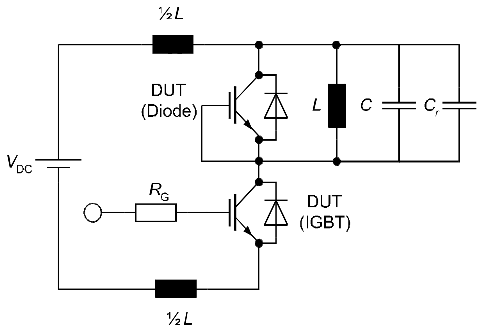

Figure E. Dynamic test circuit

Leakage inductance L= 180nH,
Stray capacitor C_{σ} = 40pF,
Relief capacitor C_r = 1nF
(only for ZVT switching)

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Information
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Warnings
Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office. Infineon Technologies components may be used in life-support devices or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.