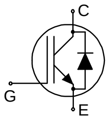
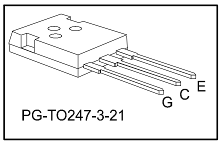
Low Loss DuoPack : IGBT in TrenchStop® and Fieldstop technology with soft, fast recovery anti-parallel diode





- TrenchStop® and Fieldstop technology for 1000 V applications offers:
  - low $V_{CE(sat)}$
  - very tight parameter distribution
  - high ruggedness, temperature stable behavior
  - positive temperature coefficient in $V_{CE(sat)}$
- Designed for:
  - frequency Converters
  - uninterrupted Power Supply
- Low EMI
- Low gate charge
- Very soft, fast recovery anti-parallel diode
- Qualified according to JEDEC for target applications
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models: http://www.infineon.com/igbt/

Type	**V_{CE}**	**I_C**	**$V_{CE(sat)}$ T_j=25°C**	**T_{jmax}**	**Marking**	**Package**
IKW30N100T	1000V	30A	1.55V	175°C	K30T100	PG-TO247-3-21

Maximum ratings

Parameter	**Symbol**	**Value**	**Unit**
Collector-emitter voltage	V_{CE}	1000	V
DC collector current, limited by T_{jmax} T_C = 25°C T_C = 100°C	I_C	60.0 30.0	A
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	90.0	A
Turn off safe operating area V_{CE} = 1000V, T_j= 175°C	-	90.0	A
Diode forward current, limited by T_{jmax} T_C = 25°C T_C = 100°C	I_F	60.0 30.0	A
Diode pulsed current, t_p limited by T_{jmax}	I_{Fpuls}	90.0	A
Gate-emitter voltage Transient Gate-emitter voltage (t_p = 5µs, D < 0.010)	V_{GE}	±20 ±25	V
Power dissipation T_C = 25°C	P_{tot}	412.0	W
Operating junction temperature	T_j	-55...+175	°C
Storage temperature	T_{stg}	-55...+175	°C
Soldering temperature, wavesoldering 1.6 mm (0.063 in.) from case for 10s	PG-TO247-3-21	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_{thJC}		0.36	K/W
Diode thermal resistance, junction - case	R_{thJCD}		0.80	K/W
Thermal resistance junction - ambient	R_{thJA}	PG-TO247-3-21	40	K/W

Electrical Characteristic, at T_j = 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	1000	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_{GE} = 15.0V, I_C = 30.0A T_j = 25°C T_j = 150°C T_j = 175°C	- - -	1.55 1.70 1.80	1.90 - -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 30.0A T_j = 25°C T_j = 150°C T_j = 175°C	- - -	1.65 1.70 1.65	2.20 -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.80mA, V_{CE} = V_{GE}	5.1	5.8	6.4	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 1000V, V_{GE} = 0V T_j = 25°C T_j = 175°C	- -	- -	50.0 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 = 30.0A	-	28.0	-	S
Integrated gate resistor	R_{Gint}			none		Ω

Electrical Characteristic, at T_j = 25°C, unless otherwise specified

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Dynamic Characteristic						
Input capacitance	C_{iss}	V_{CE} = 25V, V_{GE} = 0V, f = 1MHz	-	3575	-	pF
Output capacitance	C_{oss}		-	98	-	
Reverse transfer capacitance	C_{rss}		-	76	-	
Gate charge	Q_{Gate}	V_{CC} = 800V, I_C = 30.0A, V_{GE} = 15V	-	217.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E	PG-TO247-3-21	-	13.0	-	nH

Switching Characteristic, Inductive Load, at T_j = 25°C

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	T_j = 25°C, V_{CC} = 600V, I_C = 30.0A, V_{GE} = 0.0/15.0V, R_G = 16.0Ω, L_σ = 105nH, C_σ = 50pF L_σ, C_σ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	33	-	ns
Rise time	t_r		-	21	-	ns
Turn-off delay time	$t_{d(off)}$		-	535	-	ns
Fall time	t_f		-	34	-	ns
Turn-on energy	E_{on}		-	2.20	-	mJ
Turn-off energy	E_{off}		-	1.60	-	mJ
Total switching energy	E_{ts}		-	3.80	-	mJ

Anti-Parallel Diode Characteristic, at T_j = 25°C

Diode reverse recovery time	t_{rr}	T_j = 25°C, V_R = 600V, I_F = 30.0A, di_F/dt = 1000A/µs	-	230	-	ns
Diode reverse recovery charge	Q_{rr}		-	2.10	-	µC
Diode peak reverse recovery current	I_{rrm}		-	21.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	560	-	A/µs

Switching Characteristic, Inductive Load, at T_j = 175°C

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	T_j = 175°C, V_{CC} = 600V, I_C = 30.0A, V_{GE} = 0.0/15.0V, R_G = 16.0Ω, L_σ = 105nH, C_σ = 50pF L_σ, C_σ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	33	-	ns
Rise time	t_r		-	30	-	ns
Turn-off delay time	$t_{d(off)}$		-	610	-	ns
Fall time	t_f		-	60	-	ns
Turn-on energy	E_{on}		-	3.20	-	mJ
Turn-off energy	E_{off}		-	2.40	-	mJ
Total switching energy	E_{ts}		-	5.60	-	mJ

Anti-Parallel Diode Characteristic, at T_j = 175°C

Diode reverse recovery time	t_{rr}	T_j = 175°C, V_R = 600V, I_F = 30.0A, di_F/dt = 1000A/µs	-	340	-	ns
Diode reverse recovery charge	Q_{rr}		-	4.70	-	µC
Diode peak reverse recovery current	I_{rrm}		-	28.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	290	-	A/µs

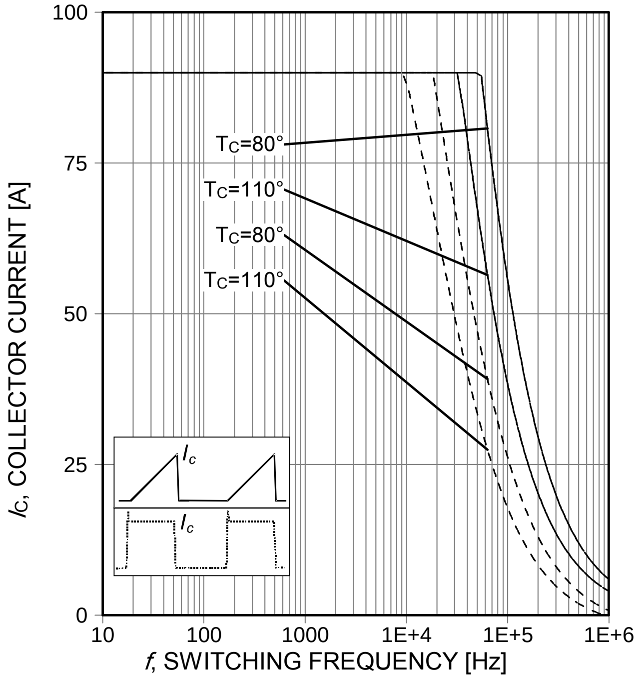


Figure 1. Collector current as a function of switching frequency
(T_j≤175°C, D=0.5, V_{CE}=600V, V_{GE}=15/0V, R_G=16Ω)

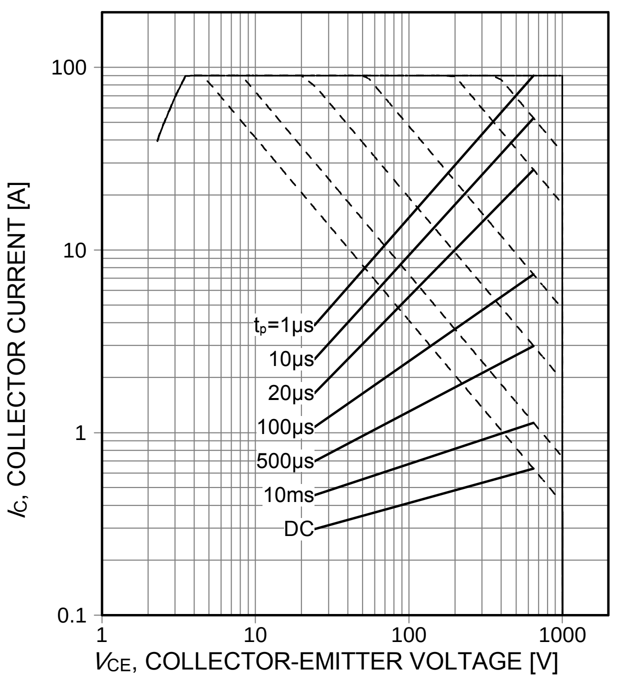


Figure 2. Forward bias safe operating area
(D=0, T_C=25°C, T_j≤175°C; V_{GE}=15V)

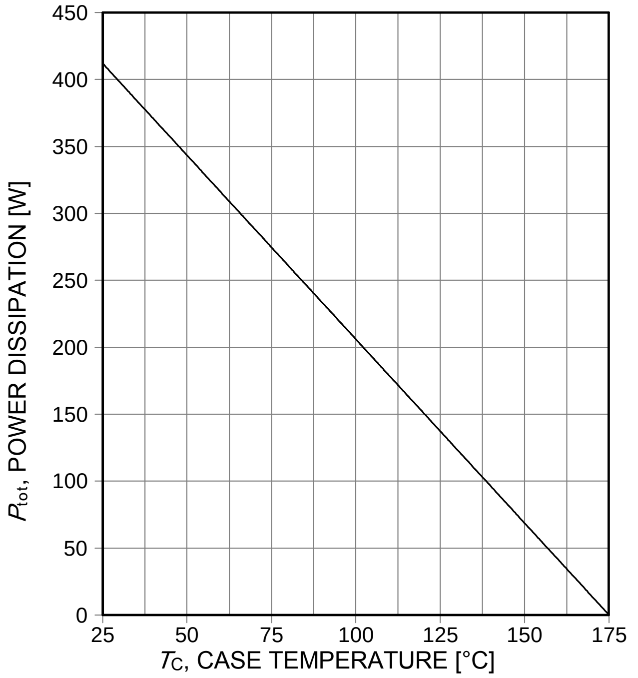


Figure 3. Power dissipation as a function of case temperature
(T_j≤175°C)

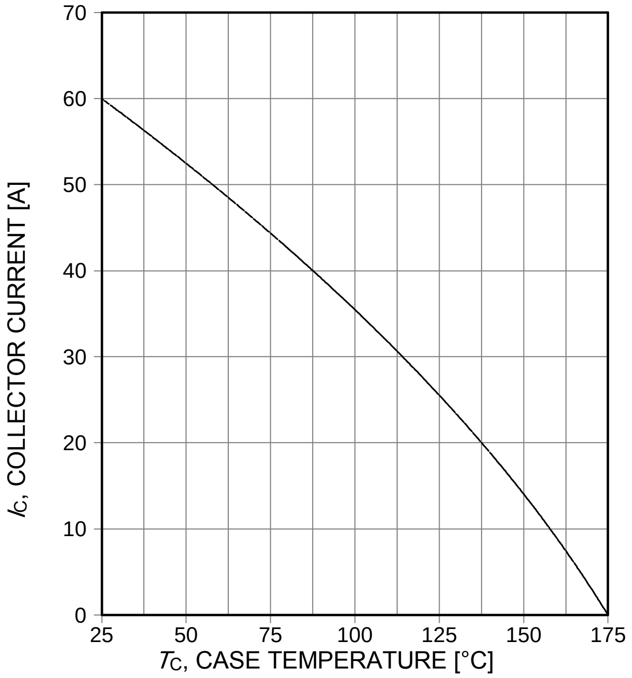


Figure 4. Collector current as a function of case temperature
(V_{GE}≥15V, T_j≤175°C)

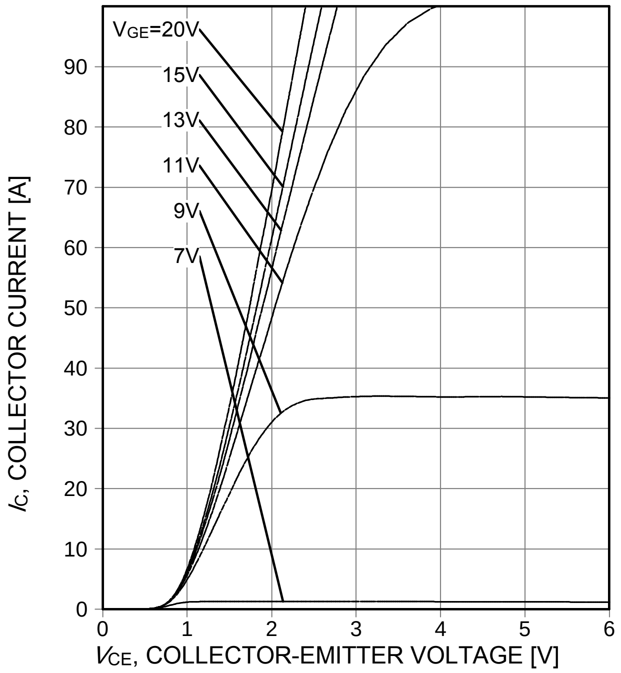


Figure 5. Typical output characteristic
(T_j=25°C)

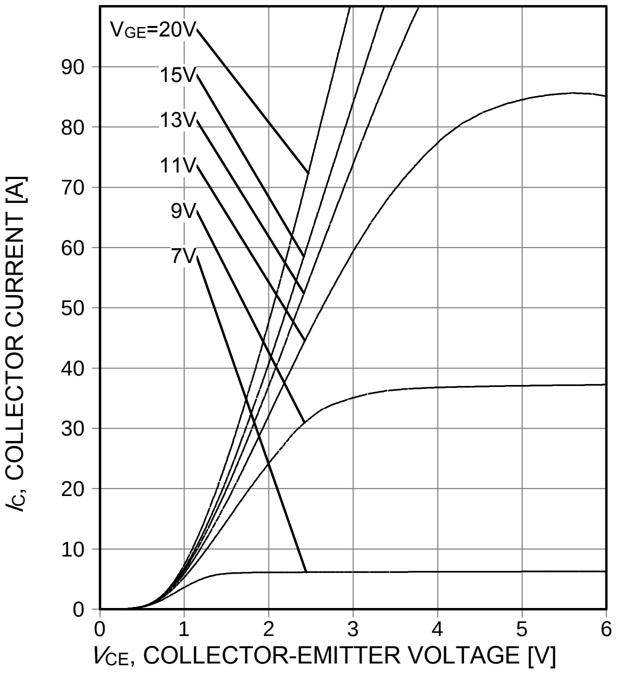


Figure 6. Typical output characteristic
(T_j=175°C)

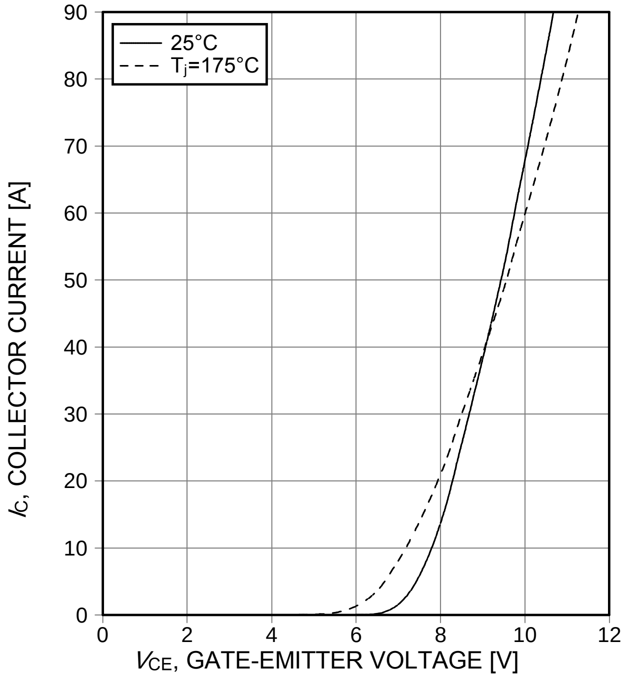


Figure 7. Typical transfer characteristic
(V_{CE}=20V)

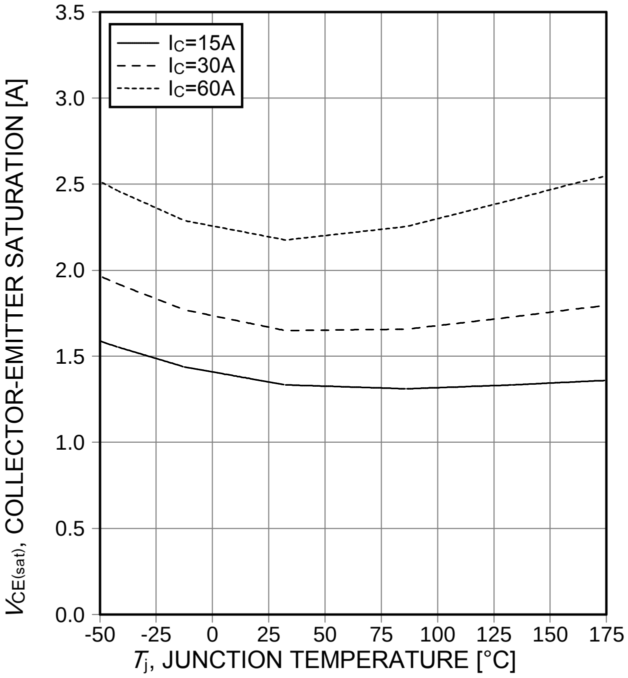


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE}=15V)

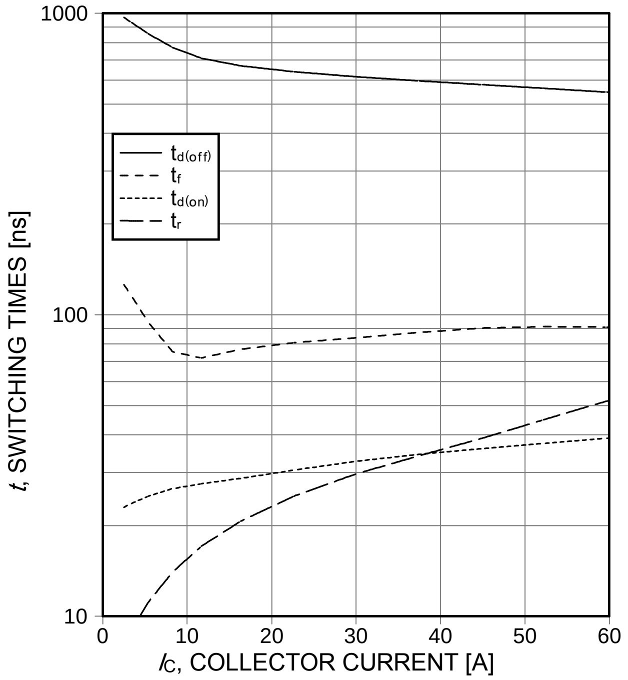


Figure 9. Typical switching times as a function of collector current
(inductive load, T_j=175°C, V_{CE}=600V, V_{GE}=15/0V, R_G=16Ω,Dynamic test circuit in Figure E)

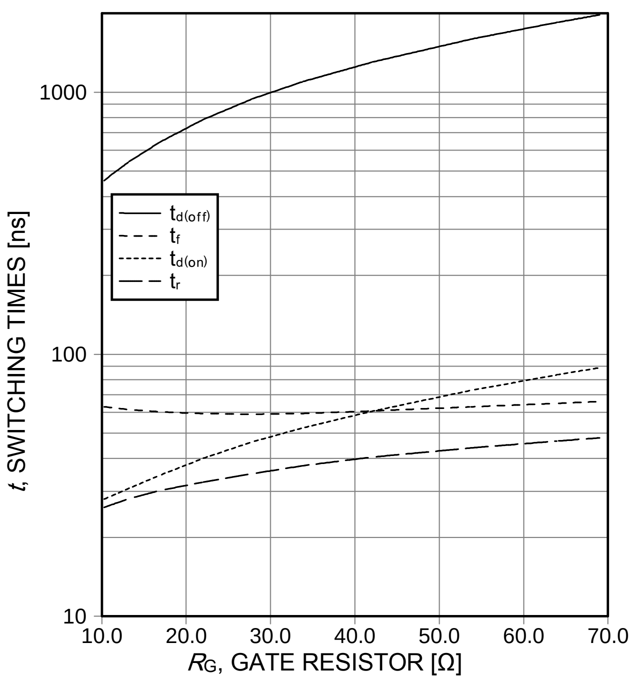


Figure 10. Typical switching times as a function of gate resistor
(inductive load, T_j=175°C, V_{CE}=600V, V_{GE}=15/0V, I_C=30A,Dynamic test circuit in Figure E)

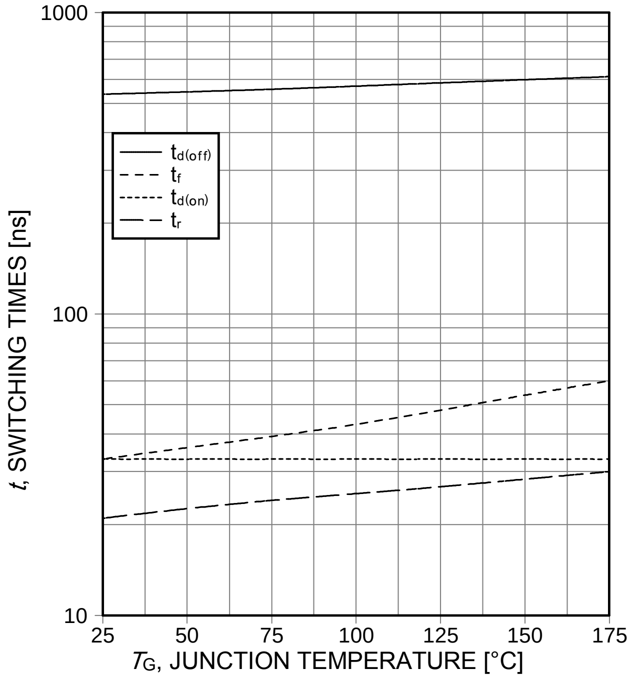


Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE}=600V, V_{GE}=15/0V, I_C=30A, R_G=16Ω,Dynamic test circuit in Figure E)

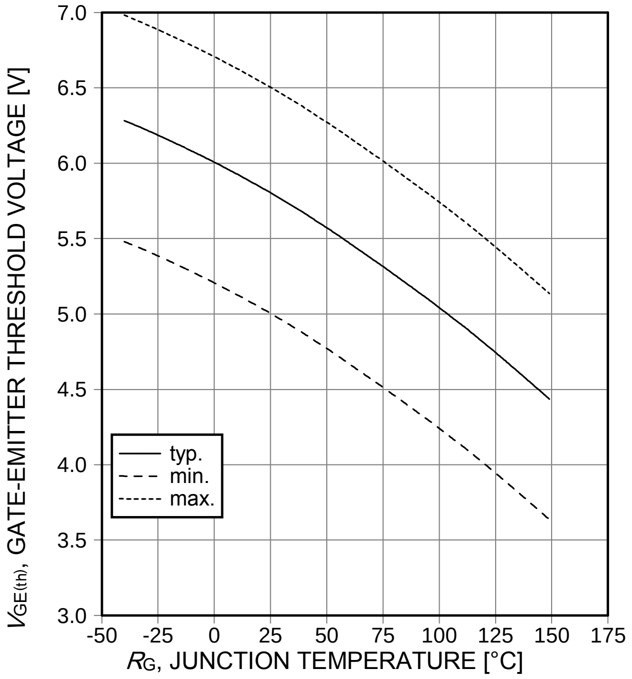


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C=0.7mA)

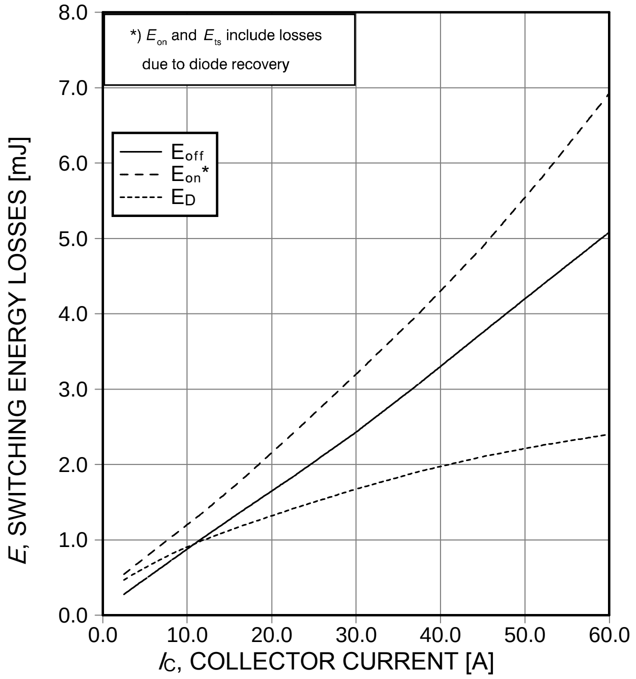


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, T_j=175°C, V_{CE}=600V, V_{GE}=15/0V, R_G=16Ω,Dynamic test circuit in Figure E)

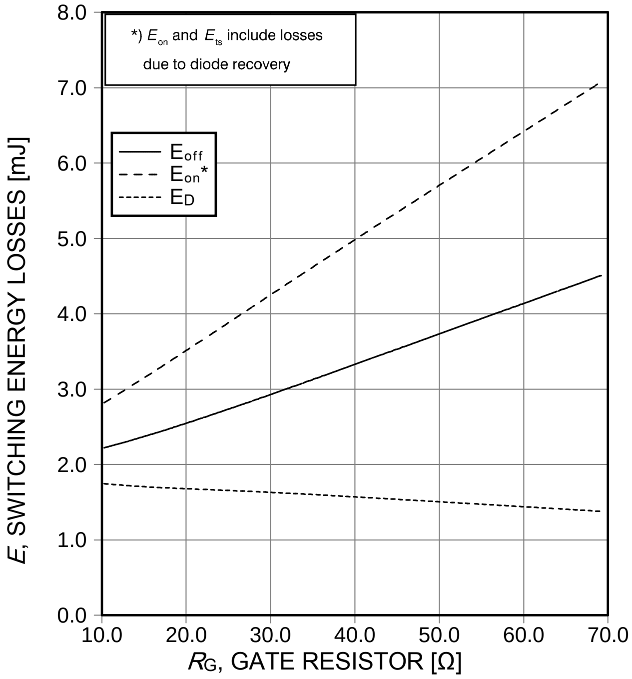


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, T_j=175°C, V_{CE}=600V, V_{GE}=15/0V, R_G=16Ω,Dynamic test circuit in Figure E)

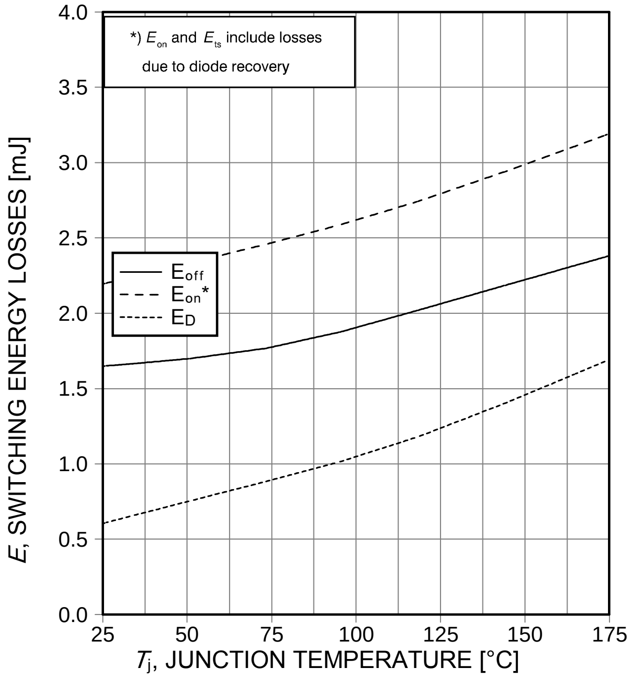


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE}=600V, V_{GE}=15/0V, I_C=30A, R_G=16Ω,Dynamic test circuit in Figure E)

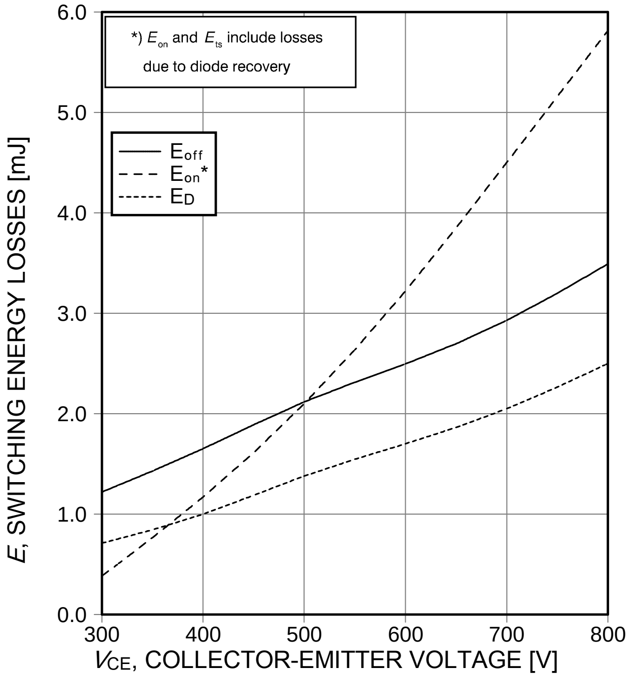


Figure 16. Typical switching energy losses as a function of collector emitter voltage
(inductive load, T_j=175°C, V_{GE}=15/0V, I_C=30A, R_G=16Ω,Dynamic test circuit in Figure E)

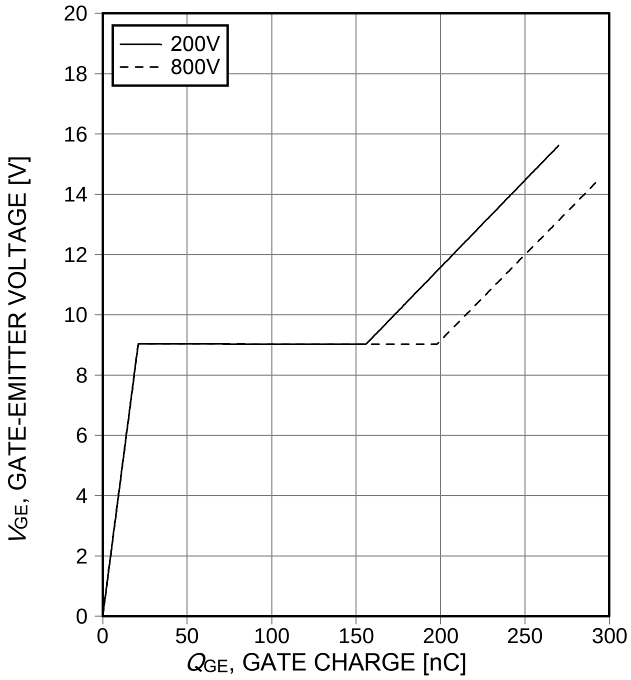


Figure 17. Typical gate charge
(I_C=30A)

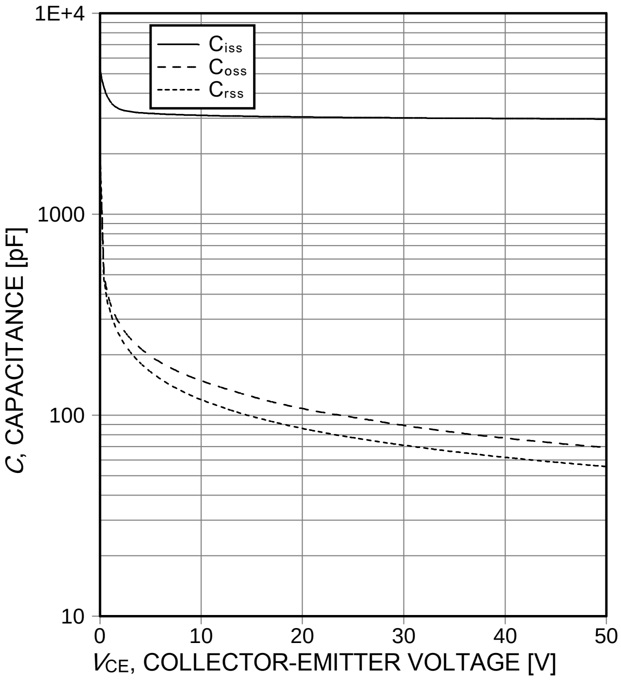
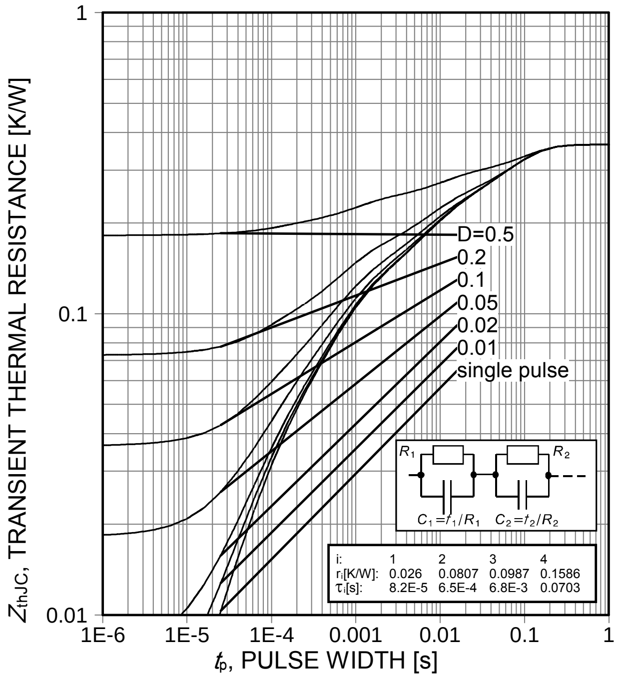
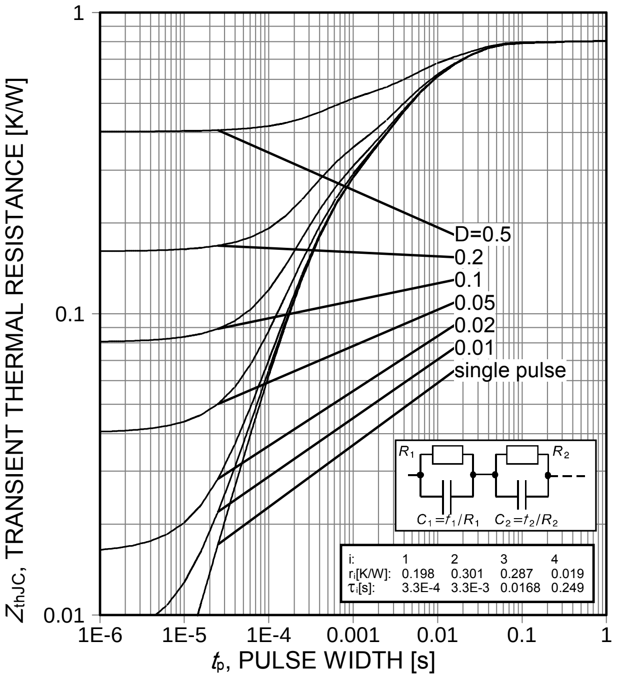


Figure 18. Typical capacitance as a function of collector-emitter voltage
(V_{GE}=0V, f=1MHz)



i:	1	2	3	4
r_i[K/W]:	0.026	0.0807	0.0987	0.1586
τ_i[s]:	8.2E-5	6.5E-4	6.8E-3	0.0703

Figure 19. IGBT transient thermal resistance
($D=t_p$/T)



i:	1	2	3	4
r_i[K/W]:	0.198	0.301	0.287	0.019
τ_i[s]:	3.3E-4	3.3E-3	0.0168	0.249

Figure 20. Diode transient thermal impedance as a function of pulse width
($D=t_p$/T)

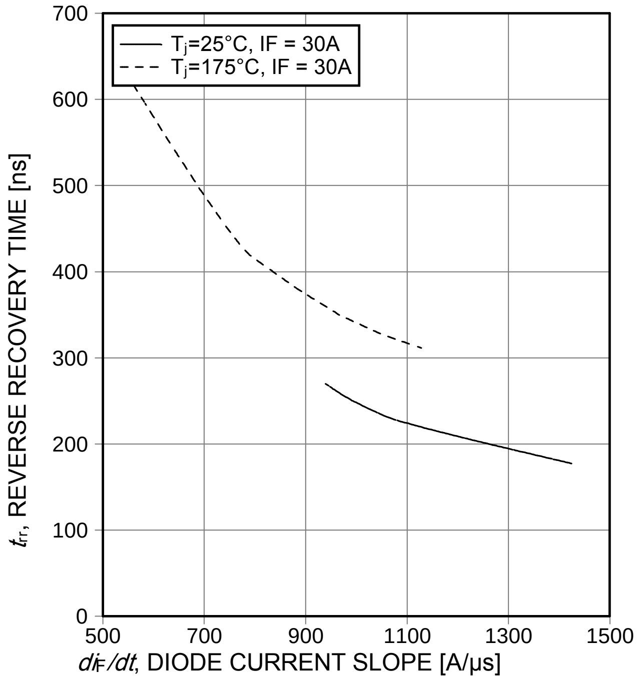


Figure 21. Typical reverse recovery time as a function of diode current slope
(V_R=600V)

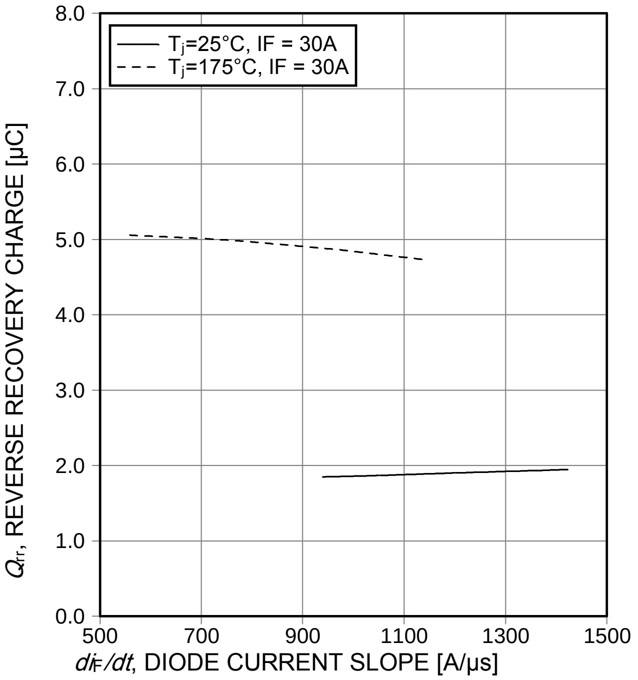


Figure 22. Typical reverse recovery charge as a function of diode current slope
(V_R=600V)

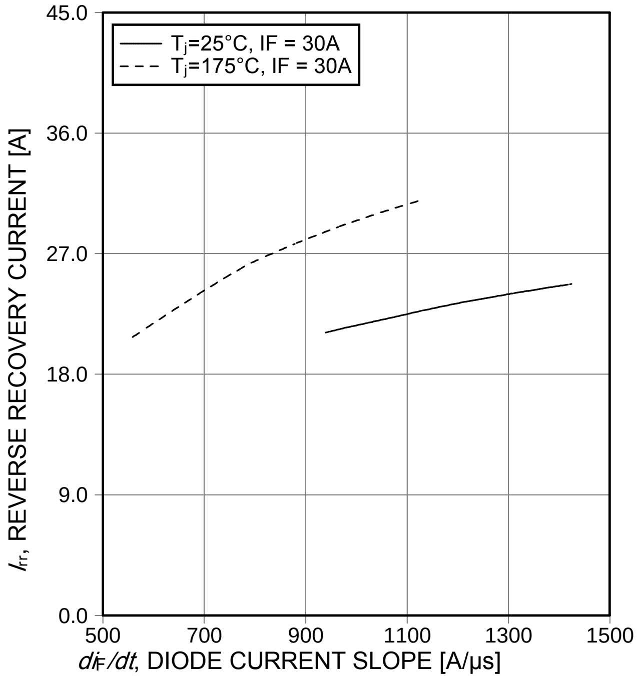


Figure 23. Typical reverse recovery current as a function of diode current slope
(V_R=600V)

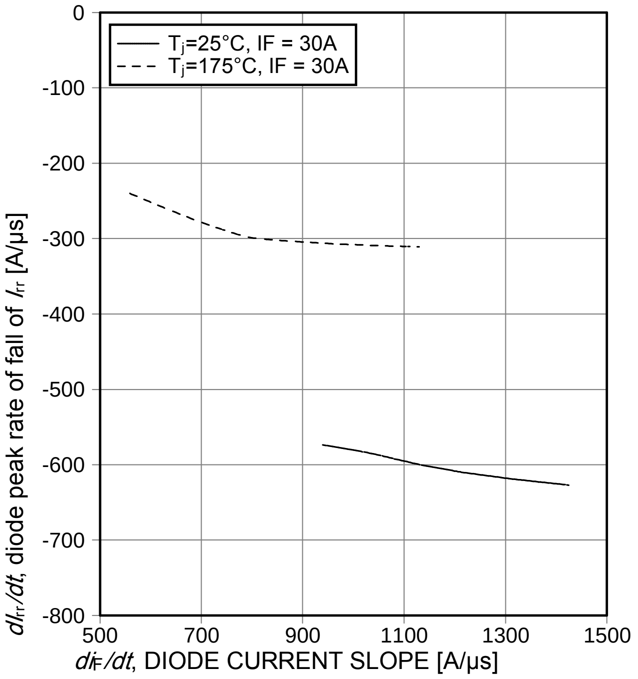


Figure 24. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope
(V_R=600V)

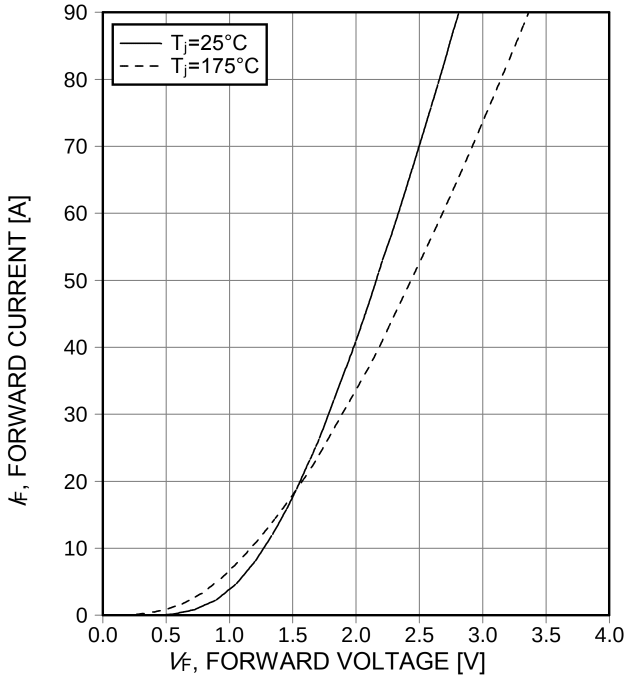


Figure 25. Typical diode forward current as a function of forward voltage

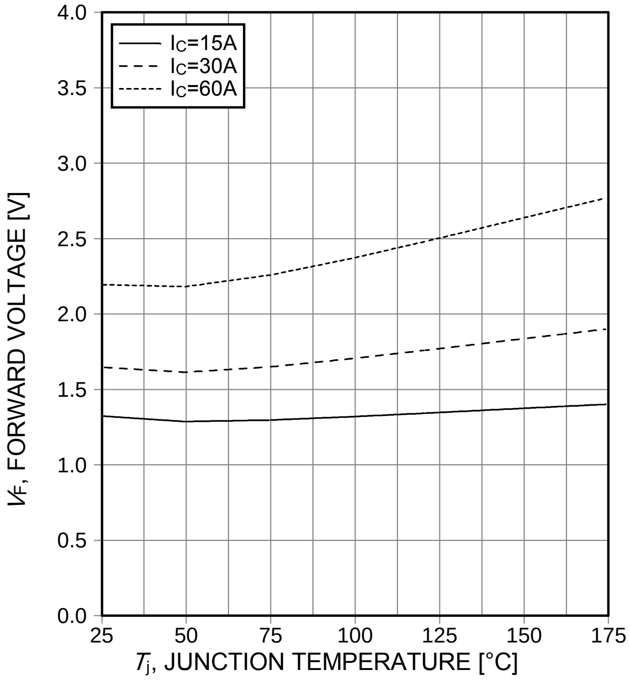
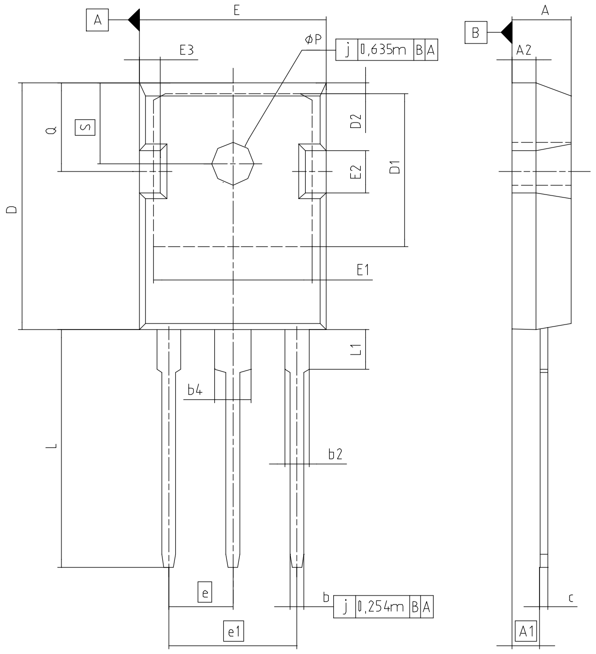


Figure 26. Typical diode forward voltage as a function of junction temperature



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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
b2	1.90	2.39	0.075	0.094
b4	2.87	3.45	0.113	0.136
c	0.55	0.75	0.022	0.030
D	20.82	21.10	0.820	0.831
D1	16.25	17.83	0.640	0.702
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	
e1	10.90		0.429	
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

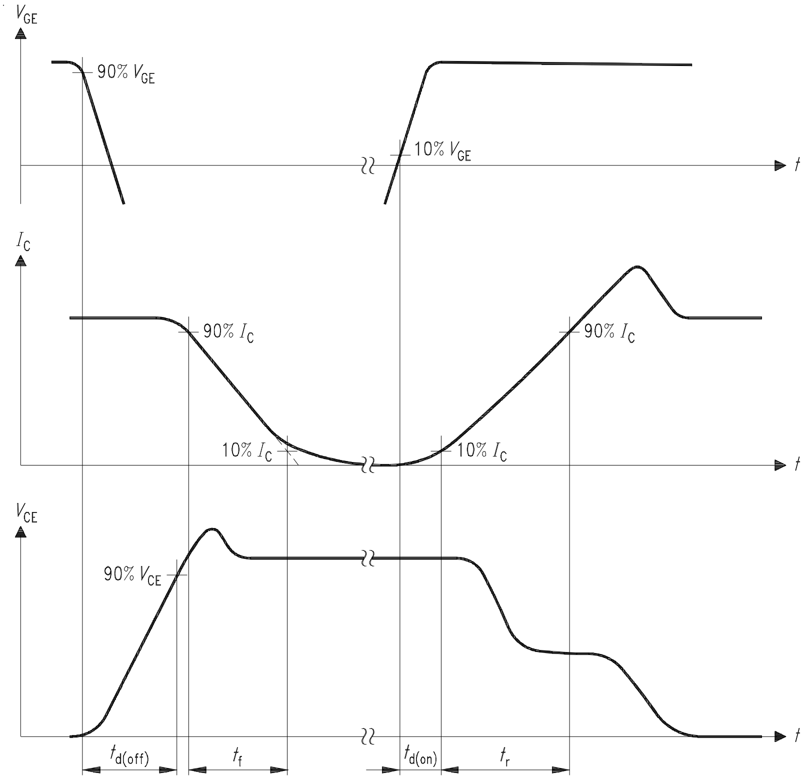

Figure A. Definition of switching times

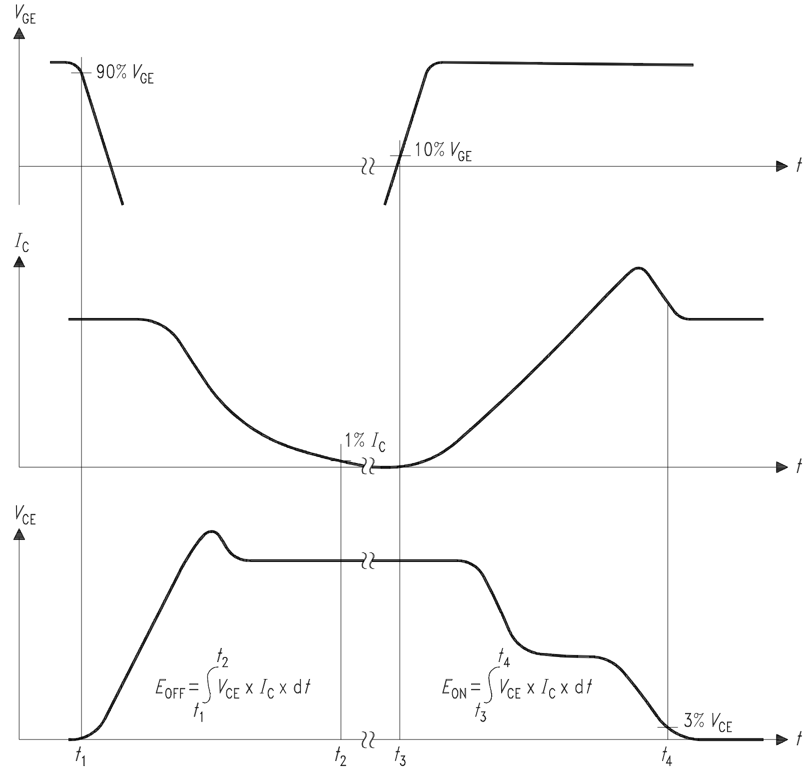

Figure B. Definition of switching losses

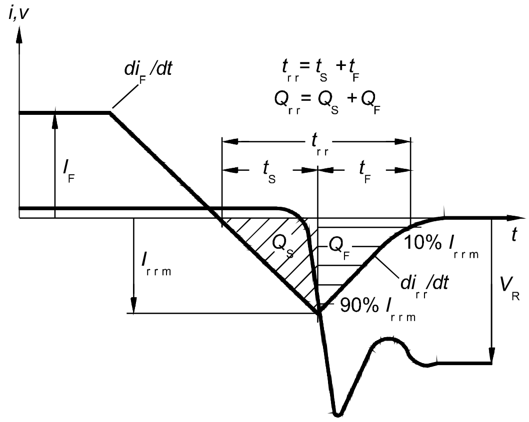

Figure C. Definition of diodes switching characteristics

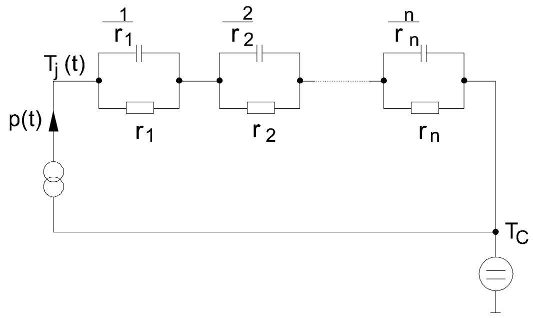

Figure D. Thermal equivalent circuit

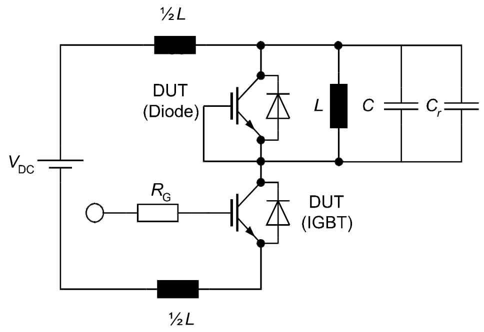

Figure E. Dynamic test circuit
Leakage inductance L= 180nH,
Stray capacitor C_σ = 40pF,
Relief capacitor C_r = 1nF
(only for ZVT switching)

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