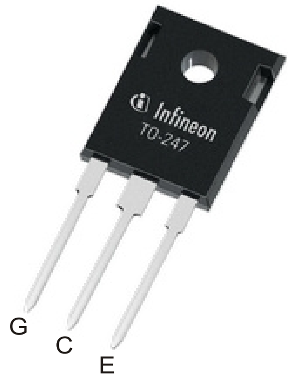
Short circuit rugged 1200 V TRENCHSTOP™ IGBT 7 technology copacked with soft and fast recovery Emitter Controlled 7 diode

Features

- V_{CE}=1200 V
- I_C=40 A
- IGBT co-packed with full current, soft and low Qrr diode
- Low saturation voltage $V_{CE(sat)}$ = 2.0 V at T_{vj}=175 °C
- Optimized for hard switching topologies (2-L inverter, 3-L NPC T-type, ...)
- Short circuit ruggedness 8 µsec
- Wide range of dv/dt controllability
- Complete product spectrum and PSpice Models: http://www.infineon.com/igbt/



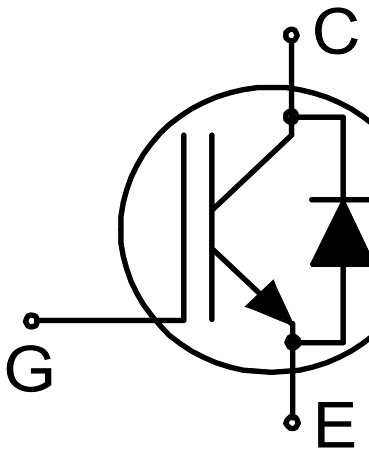
Potential applications

- Industrial Drives
- Industrial Power Supplies
- Solar Inverters

Product validation

- Product Validation: Qualified for industrial applications according to the relevant tests of JEDEC47/20/22

Description



Type	Package	Marking
IKW40N120CS7	PG-TO247-3	K40MCS7

Table of contents

1 Package

Table 1 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Internal emitter inductance measured 5mm. (0.197in) from case	L_E			13.0		nH
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 process: 3	M				0.6	Nm
Thermal resistance, junction-ambient	$R_{th(j-a)}$				40	K/W

2 IGBT

Table 2 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CE}	$T_{vj} \geq 25$ °C		1200	V
DC collector current, limited by T_{vjmax}	I_C		$T_C = 25$ °C	82	A
			$T_C = 100$ °C	56	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}			120	A
Turn-off safe operating area		$V_{CE} \leq$ 1200 V, $T_{vj} \leq$ 175 °C		120	A
Gate-emitter voltage	V_{GE}			±20	V
Transient gate-emitter voltage	V_{GE}	$t_p \leq$ 0.5 µs, $D < 0.001$		±25	V
Short circuit withstand time	t_{SC}	$V_{CC} \leq$ 600 V, $V_{GE} = 15$ V, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, $T_{vj} = 150$ °C		8	µs
Power dissipation	P_{tot}		$T_C = 25$ °C	357	W
			$T_C = 100$ °C	179	

Table 3 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\,sat}$	$I_C = 40.0$ A, $V_{GE} = 15$ V	$T_{vj} = 25$ °C		1.65	2.00	V
			$T_{vj} = 175$ °C		2.00		

Table 3 Characteristic values (continued)

Parameter	Symbol	Note or test condition		Values Min.	Values Typ.	Values Max.	Unit
Gate-emitter threshold voltage	V_{GEth}	I_C = 0.78 mA, $V_{CE} = V_{GE}$, T_{vj} = 25 °C		5.15	5.70	6.45	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			40	µA
			T_{vj} = 175 °C		3500		
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V				100	nA
Transconductance	g_{fs}	I_C = 40.0 A, V_{CE} = 20 V, T_{vj} = 175 °C			17.0		S
Short circuit collector current	I_{SC}	$V_{CC} \leq$ 600 V, V_{GE} = 15 V, $t_{SC} \leq$ 8 µs, Allowed number of short circuits < 1000 , Time between short circuits ≥ 1.0 s, T_{vj} = 25 °C			240		A
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			5.5		nF
Output capacitance	C_{oes}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			120		pF
Reverse transfer capacitance	C_{res}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			27		pF
Gate charge	Q_G	I_C = 40.0 A, V_{GE} = 15 V, V_{CE} = 960 V			230		nC
Turn-on delay time	t_{don}	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 4.0 Ω, R_{Goff} = 4.0 Ω	T_{vj} = 25 °C, I_C = 40.0 A		27		ns
			T_{vj} = 175 °C, I_C = 40.0 A		23		
Rise time (inductive load)	t_r	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 4.0 Ω, R_{Goff} = 4.0 Ω	T_{vj} = 25 °C, I_C = 40.0 A		21		ns
			T_{vj} = 175 °C, I_C = 40.0 A		22		
Turn-off delay time	t_{doff}	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 4.0 Ω, R_{Goff} = 4.0 Ω	T_{vj} = 25 °C, I_C = 40.0 A		190		ns
			T_{vj} = 175 °C, I_C = 40.0 A		250		
Fall time (inductive load)	t_f	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 4.0 Ω, R_{Goff} = 4.0 Ω	T_{vj} = 25 °C, I_C = 40.0 A		100		ns
			T_{vj} = 175 °C, I_C = 40.0 A		250		
Turn-on energy	E_{on}	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 4.0 Ω, R_{Goff} = 4.0 Ω	T_{vj} = 25 °C, I_C = 40.0 A		2.55		mJ
			T_{vj} = 175 °C, I_C = 40.0 A		3.85		
Turn-off energy	E_{off}	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 4.0 Ω, R_{Goff} = 4.0 Ω	T_{vj} = 25 °C, I_C = 40.0 A		1.75		mJ
			T_{vj} = 175 °C, I_C = 40.0 A		3.65		

Table 3 **Characteristic values (continued)**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Total switching energy	E_{ts}	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 4.0 Ω, R_{Goff} = 4.0 Ω	T_{vj} = 25 °C, I_C = 40.0 A		4.30		mJ
			T_{vj} = 175 °C, I_C = 40.0 A		7.50		
IGBT thermal resistance, junction-case	R_{thjc}				0.30	0.42	K/W
Operating junction temperature	T_{vj}			-40		175	°C

3 Diode

Table 4 **Maximum rated values**

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}	T_{vj} ≥ 25 °C		1200	V
Diode forward current, limited by T_{vjmax}	I_F		T_C = 25 °C	69	A
			T_C = 100 °C	46	
Diode pulsed current, limited by T_{vjmax}	I_{Fpuls}			120	A
Power dissipation	P_{tot}		T_C = 25 °C	208	W
			T_C = 100 °C	104	

Table 5 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 40.0 A	T_{vj} = 25 °C		1.65	2.15	V
			T_{vj} = 175 °C		1.60		
Reverse leakage current	I_R	V_R = 1200 V	T_{vj} = 25 °C			40	µA
			T_{vj} = 175 °C		3500		
Diode reverse recovery time	t_{rr}	V_R = 600 V, R_{Gon} = 4.0 Ω	T_{vj} = 25 °C, I_F = 40.0 A		175		ns
			T_{vj} = 175 °C, I_F = 40.0 A		315		
Diode reverse recovery charge	Q_{rr}	V_R = 600 V, R_{Gon} = 4.0 Ω	T_{vj} = 25 °C, I_F = 40.0 A		2.45		µC
			T_{vj} = 175 °C, I_F = 40.0 A		6.60		

Table 5 Characteristic values (continued)

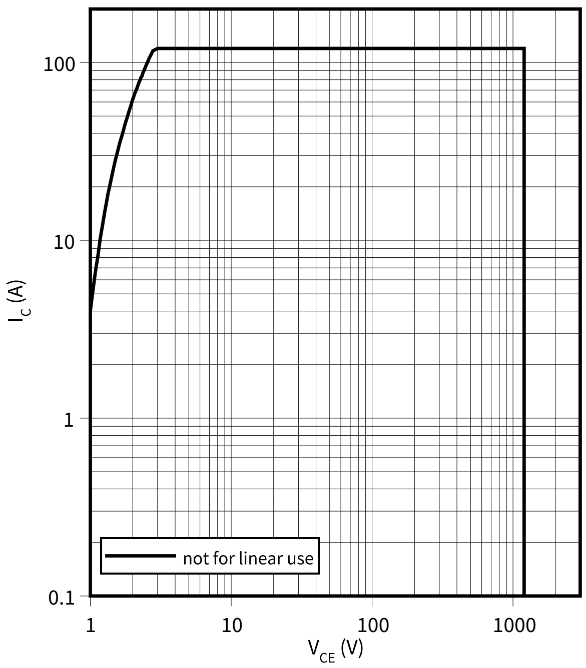
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode peak reverse recovery current	I_{rrm}	V_R = 600 V, R_{Gon} = 4.0 Ω	T_{vj} = 25 °C, I_F = 40.0 A		28.0		A
			T_{vj} = 175 °C, I_F = 40.0 A		42.0		
Diode peak rate off fall of reverse recovery current	dI_{rr}/dt	V_R = 600 V, R_{Gon} = 4.0 Ω	T_{vj} = 25 °C, I_F = 40.0 A		-190		A/µs
			T_{vj} = 150 °C, I_F = 40.0 A		-145		
Reverse recovery energy	E_{rec}	V_R = 600 V, R_{Gon} = 4.0 Ω	T_{vj} = 25 °C, I_F = 40.0 A		0.75		mJ
			T_{vj} = 175 °C, I_F = 40.0 A		2.40		
Diode thermal resistance, junction-case	R_{thjc}				0.55	0.75	K/W
Operating junction temperature	T_{vj}			-40		175	°C

Note: For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

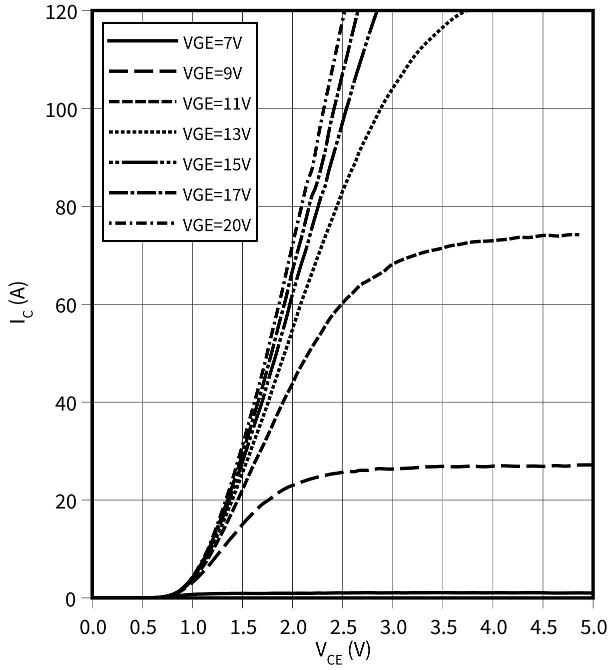
Dynamic test circuit, parasitic inductance L_σ = 30 nH, C_σ = 18 pF

4 Characteristics diagrams

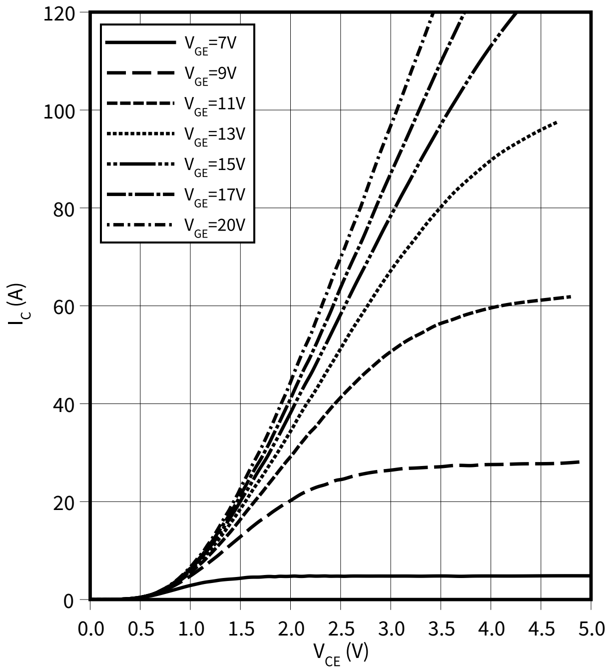
Reverse bias safe operating area, IGBT
$I_C = f(V_{CE})$
$T_{vj} \leq 175\ °C$, $V_{GE} = 15\ V$



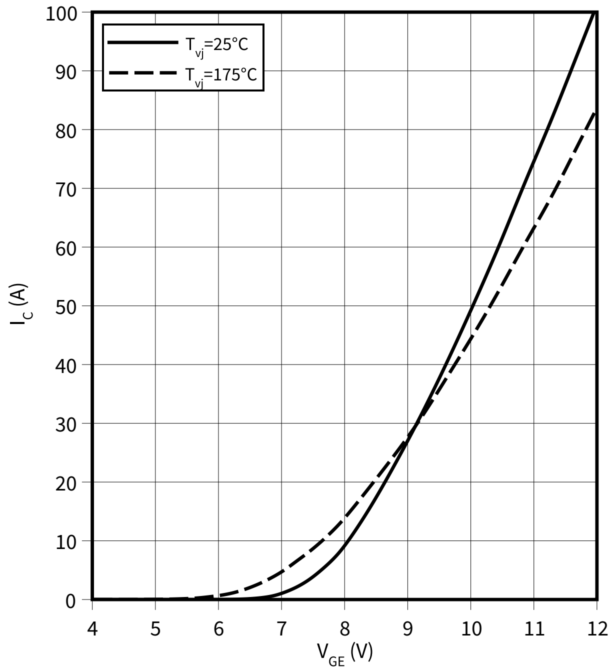
Typical output characteristic, IGBT
$I_C = f(V_{CE})$
$T_{vj} = 25\ °C$



Typical output characteristic, IGBT
$I_C = f(V_{CE})$
$T_{vj} = 175\ °C$



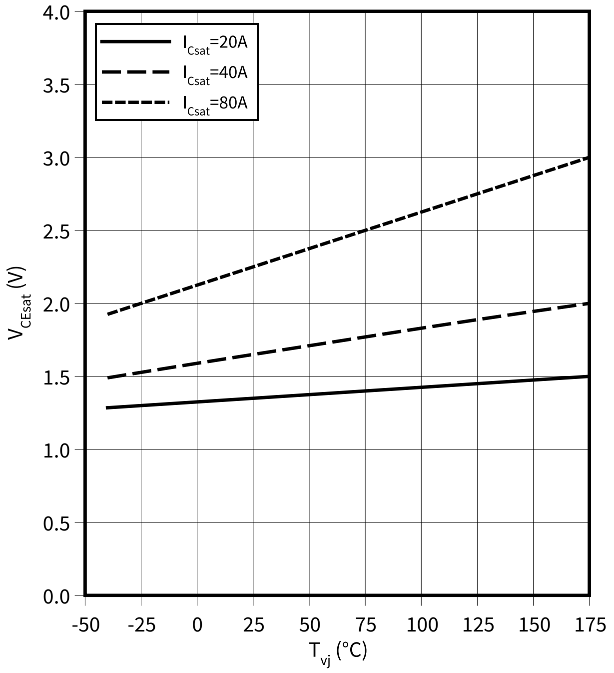
Typical transfer characteristic, IGBT
$I_C = f(V_{GE})$
$V_{CE} = 20\ V$



Typical collector-emitter saturation voltage as a function of junction temperature, IGBT

$V_{CEsat} = f(T_{vj})$

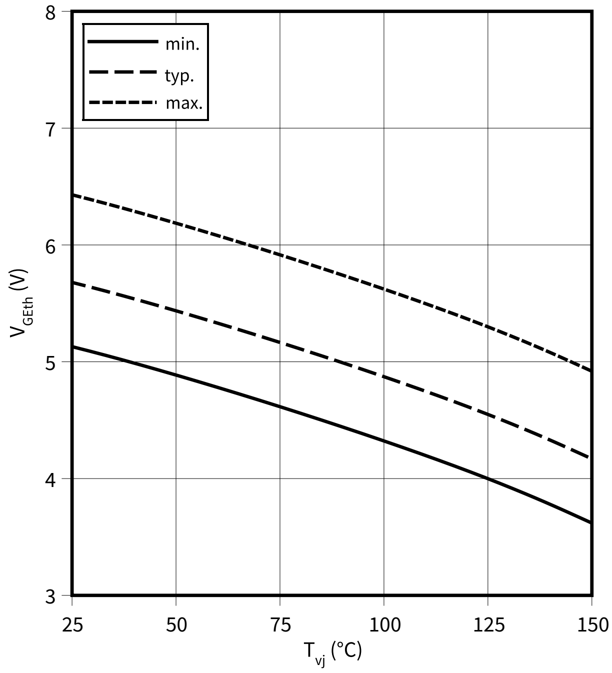
$V_{GE} = 15$ V



Gate-emitter threshold voltage as a function of junction temperature, IGBT

$V_{GEth} = f(T_{vj})$

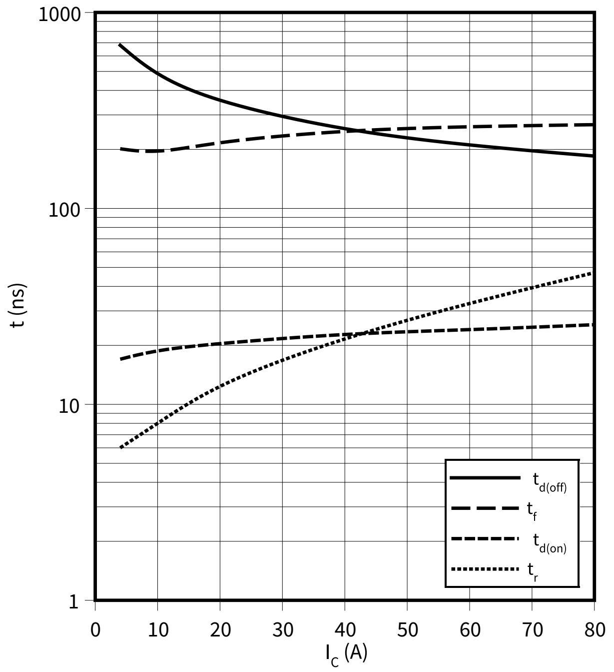
$I_C = 0.85$ mA



Typical switching times as a function of collector current, IGBT

$t = f(I_C)$

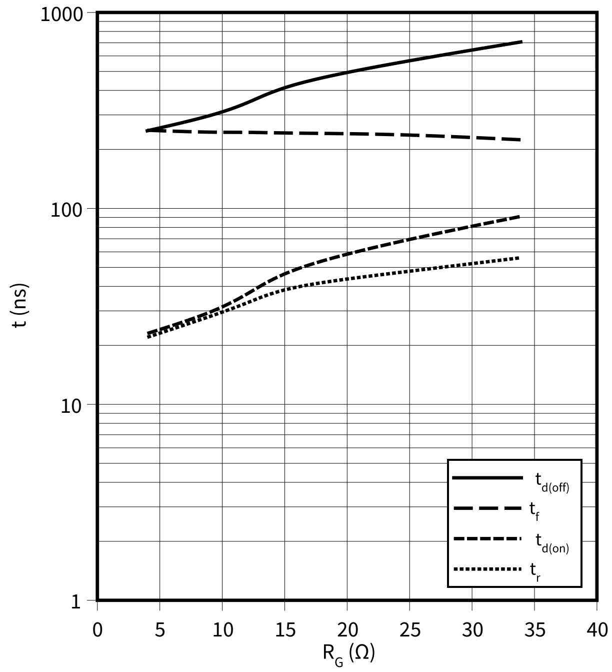
$T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 4.0$ Ω, $V_{CE} = 600$ V



Typical switching times as a function of gate resistor, IGBT

$t = f(R_G)$

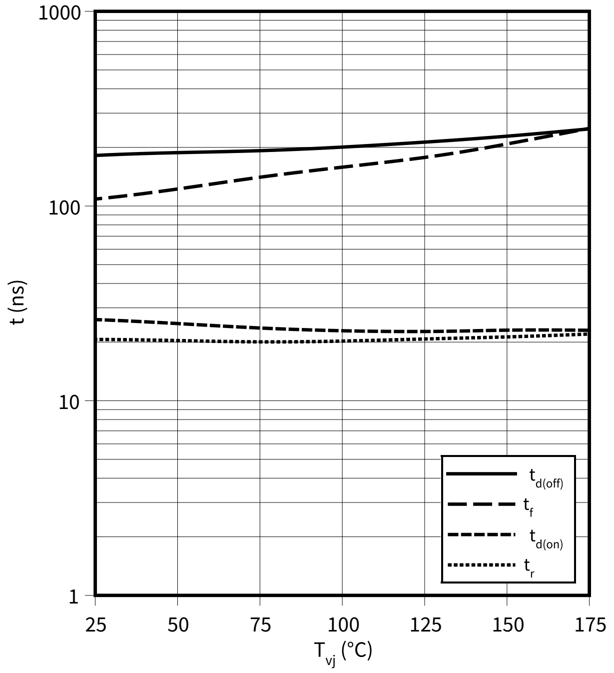
$I_C = 40.0$ A, $V_{CE} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



Typical switching times as a function of junction temperature, IGBT

$t = f(T_{vj})$

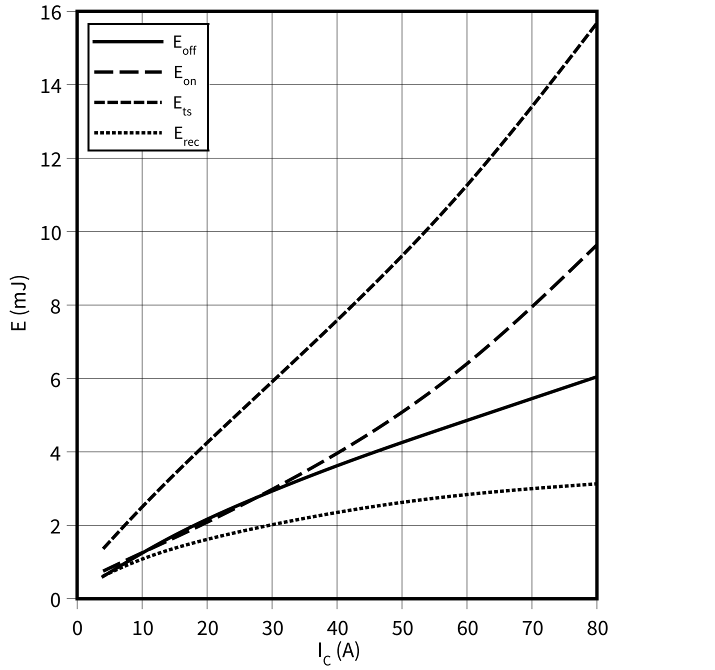
$I_C = 40.0$ A, $V_{CE} = 600$ V, $V_{GE} = 0/15$ V, $R_G = 4.0\ \Omega$



Typical switching energy losses as a function of collector current, IGBT

$E = f(I_C)$

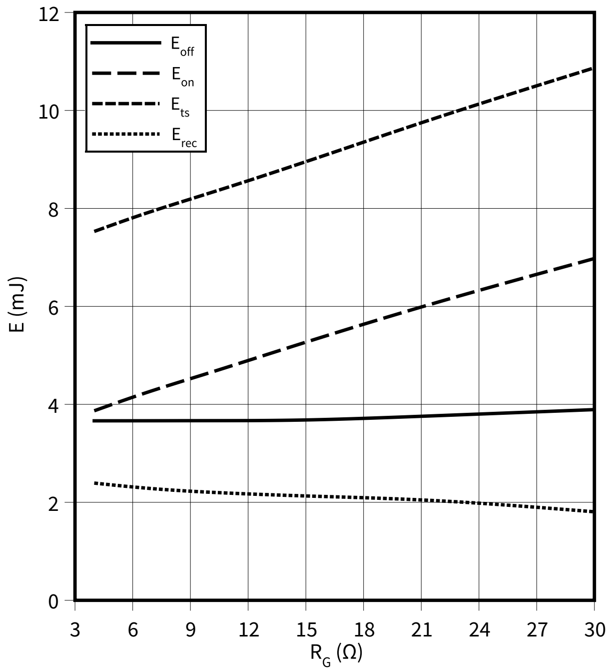
$V_{CE} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 4.0\ \Omega$



Typical switching energy losses as a function of gate resistor, IGBT

$E = f(R_G)$

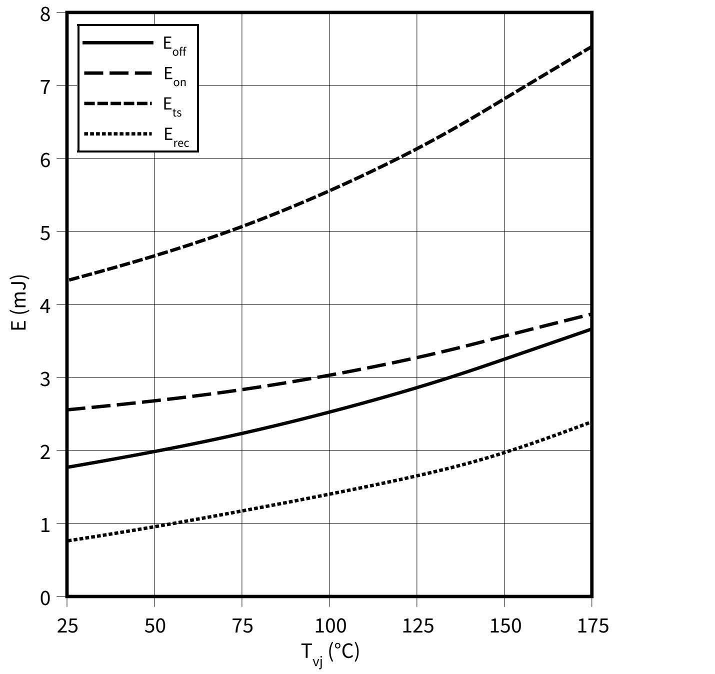
$I_C = 40.0$ A, $V_{CE} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



Typical switching energy losses as a function of junction temperature, IGBT

$E = f(T_{vj})$

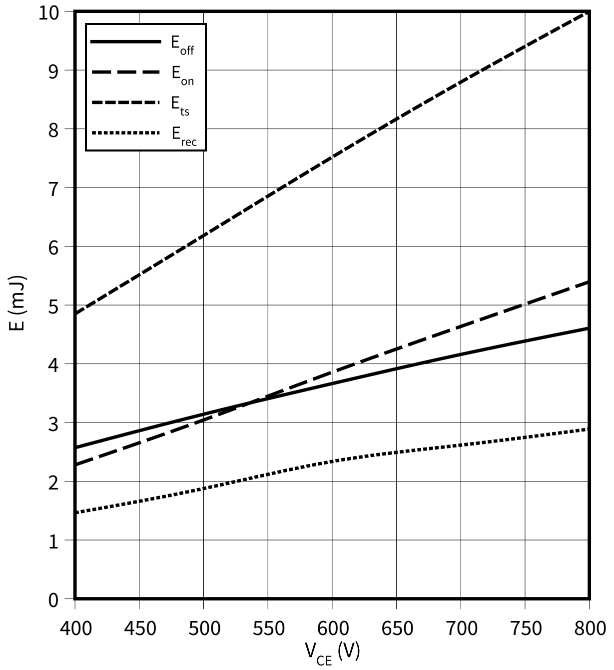
$I_C = 40.0$ A, $V_{CE} = 600$ V, $V_{GE} = 0/15$ V, $R_G = 4.0\ \Omega$



Typical switching energy losses as a function of collector emitter voltage, IGBT

$E = f(V_{CE})$

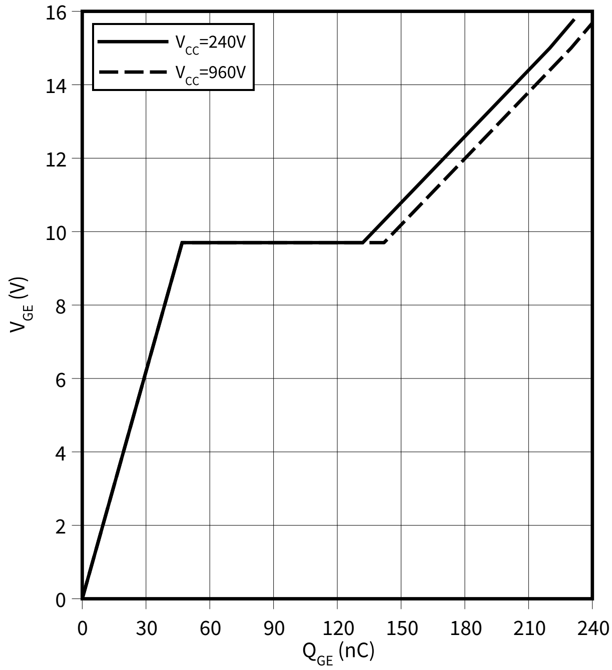
$I_C = 40.0$ A, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 4.0$ Ω



Typical gate charge, IGBT

$V_{GE} = f(Q_{GE})$

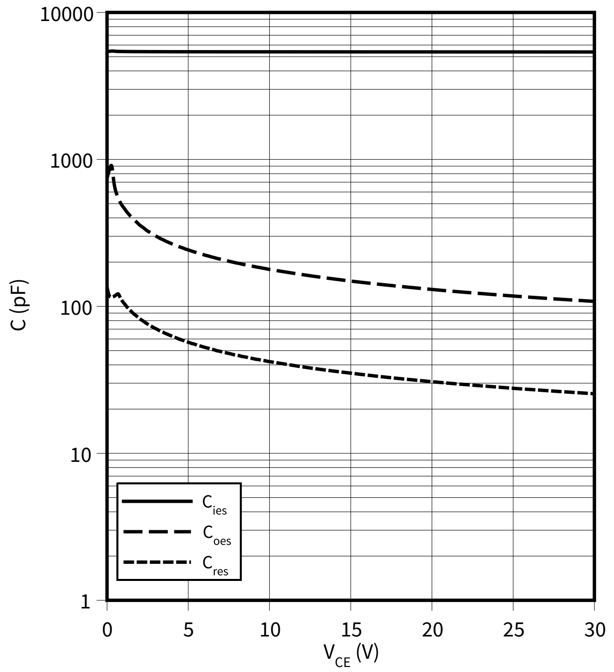
$I_C = 40.0$ A



Typical capacitance as a function of collector-emitter voltage, IGBT

$C = f(V_{CE})$

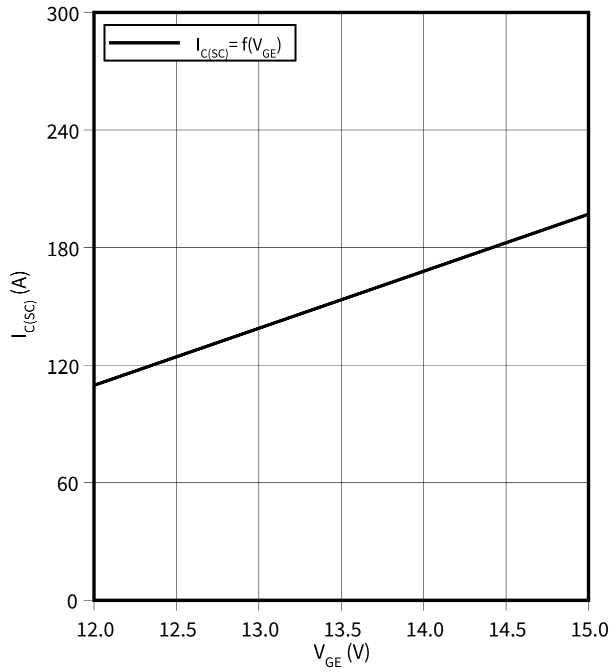
$f = 100$ kHz, $V_{GE} = 0$ V



Typical short circuit collector current as a function of gate-emitter voltage, IGBT

$I_{C(SC)} = f(V_{GE})$

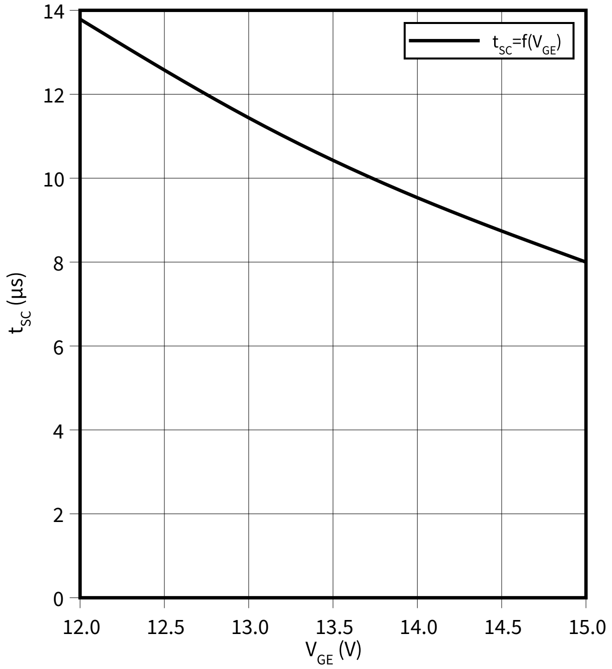
$T_{vj} = 150$ °C, $V_{CC} = 600$ V



Short circuit withstand time as a function of gate-emitter voltage, IGBT

$t_{SC} = f(V_{GE})$

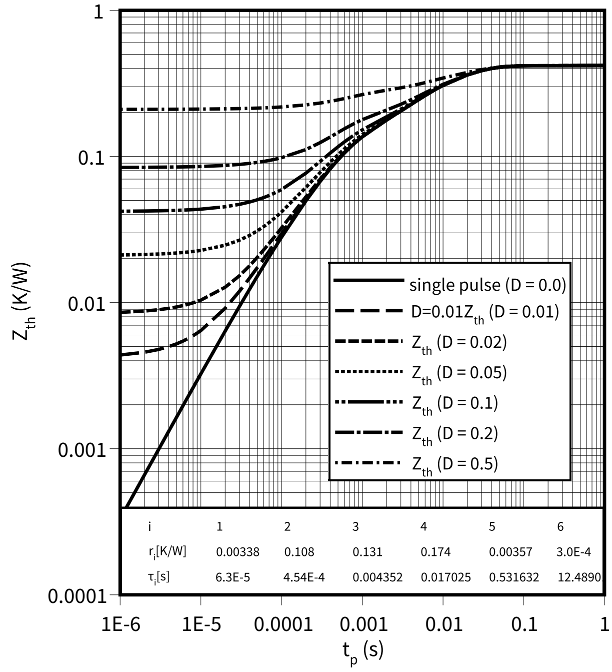
$T_{vj} \leq 150$ °C, $V_{CC} = 600$ V



IGBT transient thermal impedance, IGBT

$Z_{th} = f(t_p)$

$D = t_p/T$

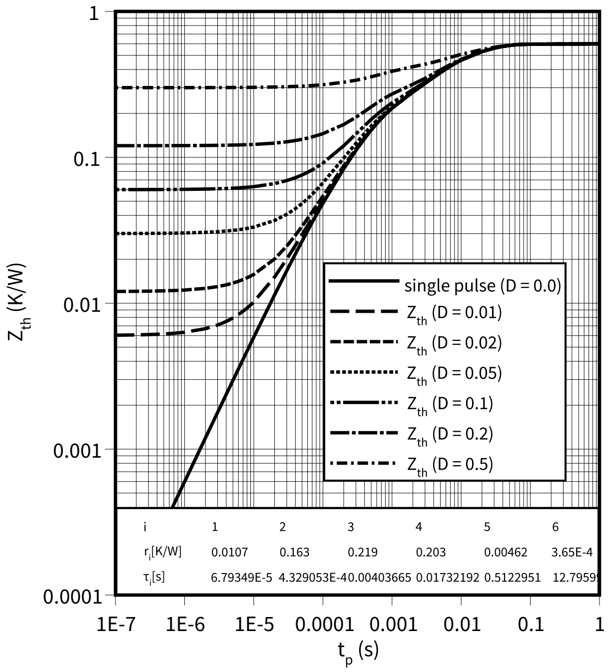


i	1	2	3	4	5	6
r_i[K/W]	0.00338	0.108	0.131	0.174	0.00357	3.0E-4
τ_i[s]	6.3E-5	4.54E-4	0.004352	0.017025	0.531632	12.4890

Diode transient thermal impedance as a function of pulse width, Diode

$Z_{th} = f(t_p)$

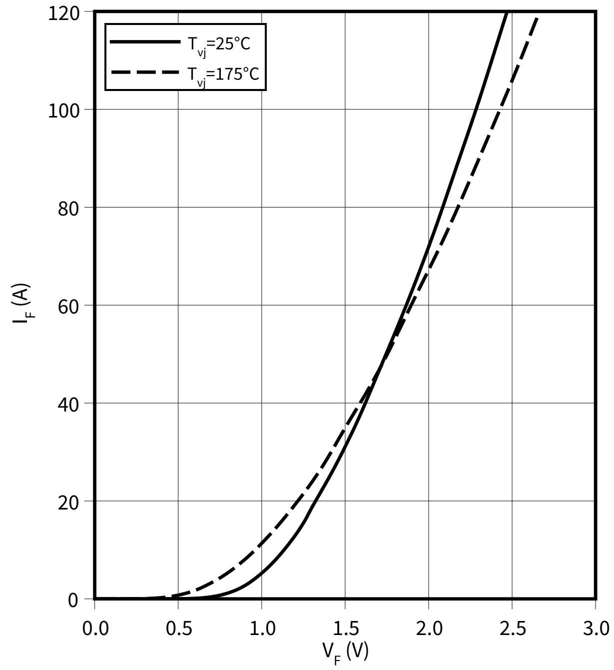
$D = t_p/T$



i	1	2	3	4	5	6
r_i[K/W]	0.0107	0.163	0.219	0.203	0.00462	3.65E-4
τ_i[s]	6.79349E-5	4.329053E-4	0.00403665	0.01732192	0.5122951	12.7959

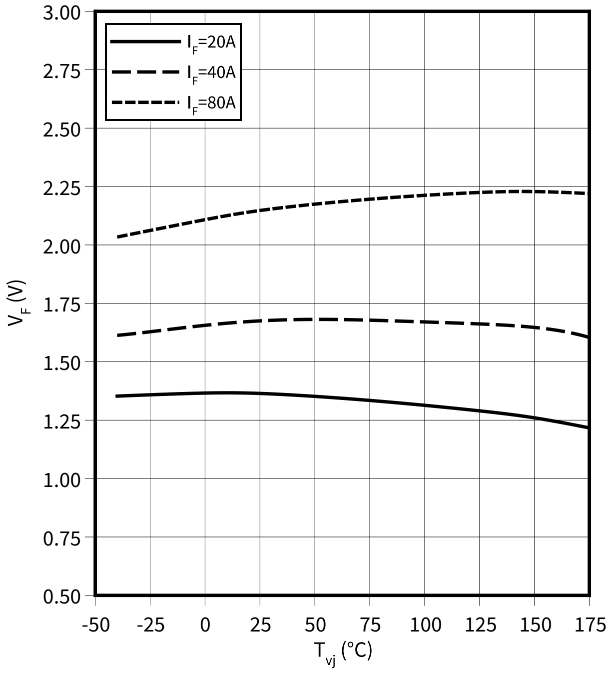
Typical diode forward current as a function of forward voltage, Diode

$I_F = f(V_F)$



Typical diode forward voltage as a function of junction temperature, Diode

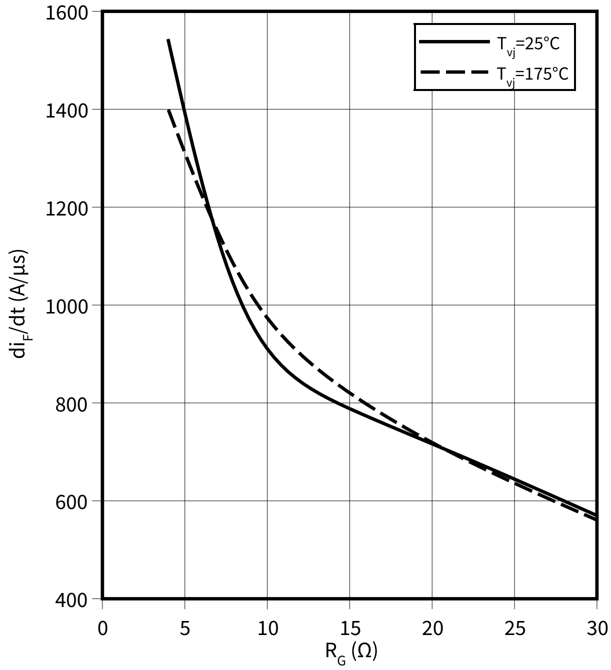
$V_F = f(T_{vj})$



Typical diode current slope as a function of gate resistor, Diode

$di_F/dt = f(R_G)$

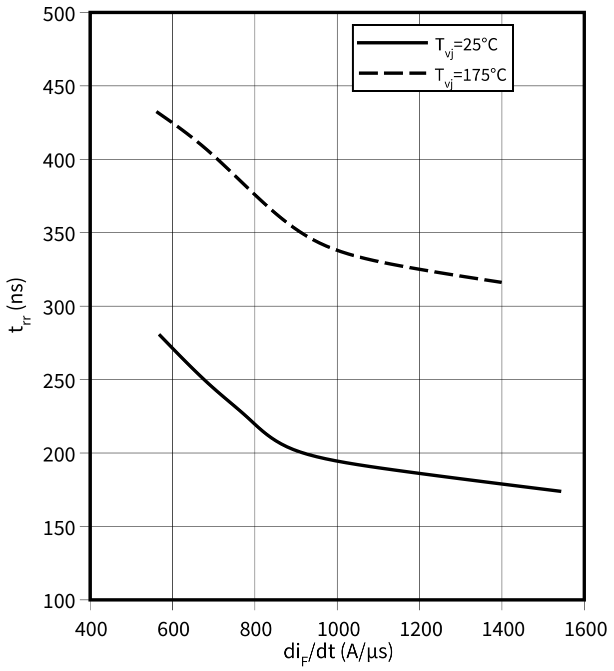
$I_C = 40.0$ A, $V_{CE} = 600$ V, $V_{GE} = 0/15$ V



Typical reverse recovery time as a function of diode current slope, Diode

$t_{rr} = f(di_F/dt)$

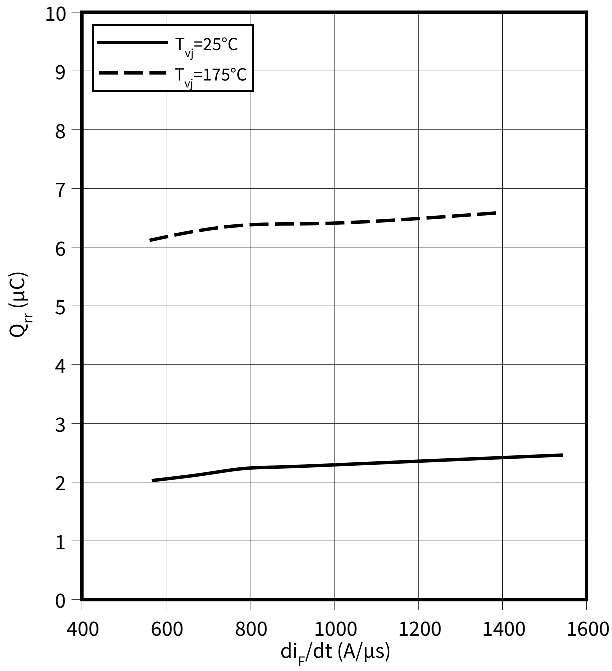
$V_R = 600$ V, $I_F = 40.0$ A



Typical reverse recovery charge as a function of diode current slope, Diode

$Q_{rr} = f(di_F/dt)$

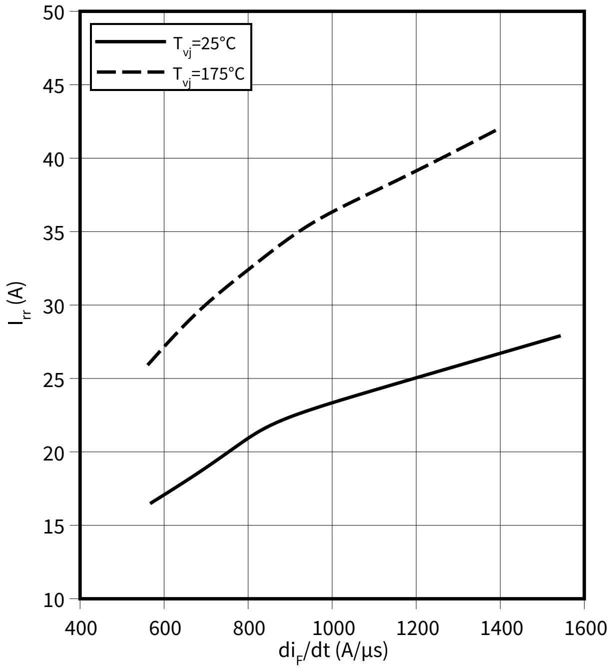
$V_R = 600$ V, $I_F = 40.0$ A



Typical reverse recovery current as a function of diode current slope, Diode

$I_{rr} = f(di_F/dt)$

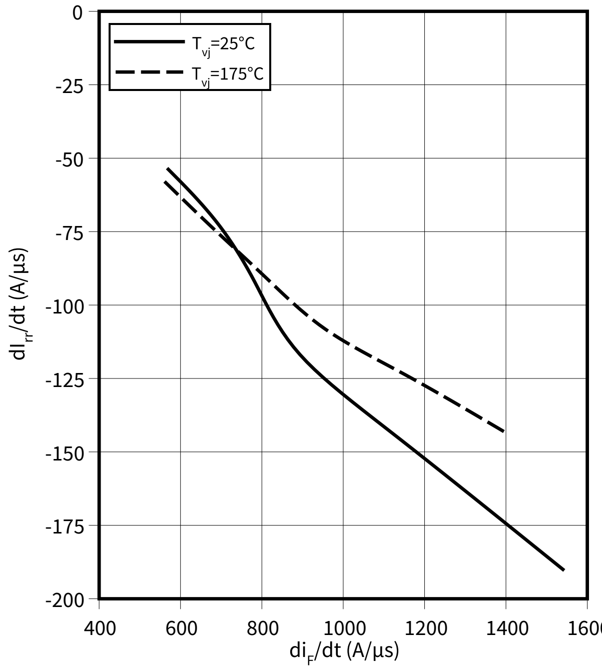
$V_R = 600$ V, $I_F = 40.0$ A



Typical diode peak rate of fall of reverse recovery current as a function of diode current slope, Diode

$dI_{rr}/dt = f(di_F/dt)$

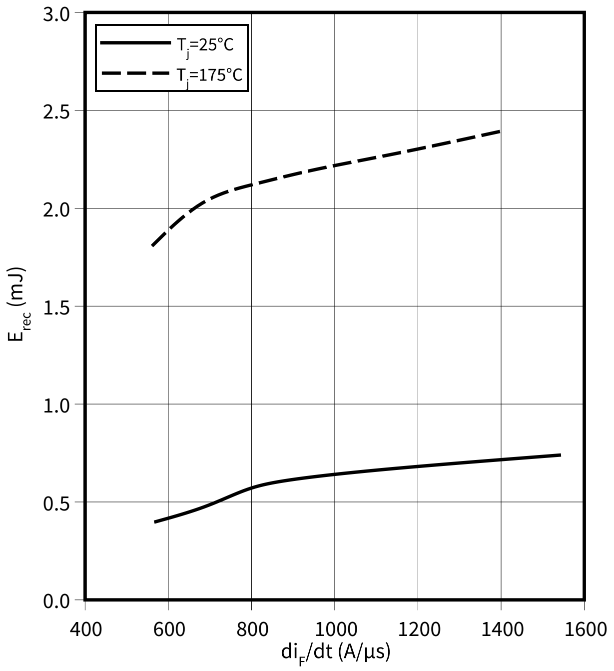
$V_R = 600$ V, $I_F = 40.0$ A



Typical reverse energy losses as a function of diode current slope, Diode

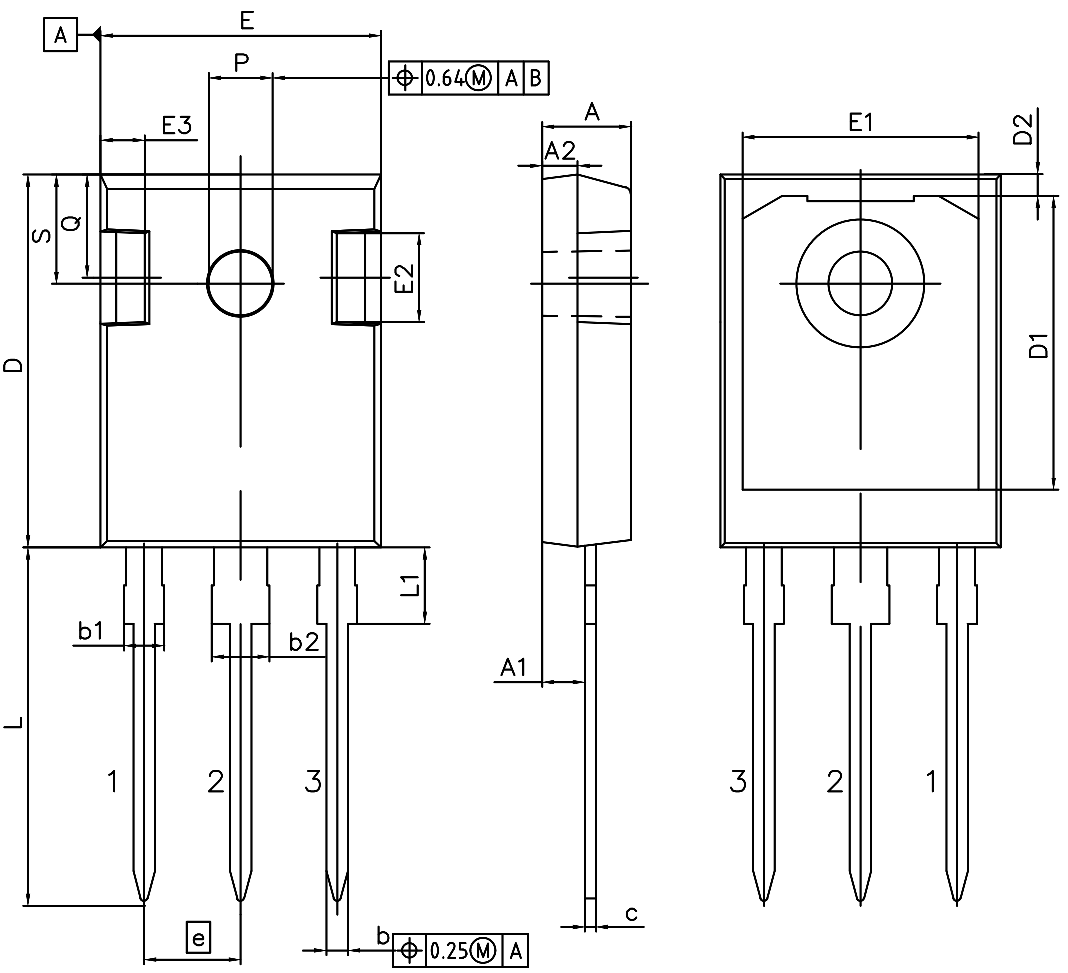
$E_{rec} = f(di_F/dt)$

$V_R = 600$ V, $I_F = 40.0$ A



5 Package outlines

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

Figure 6

6 Testing conditions

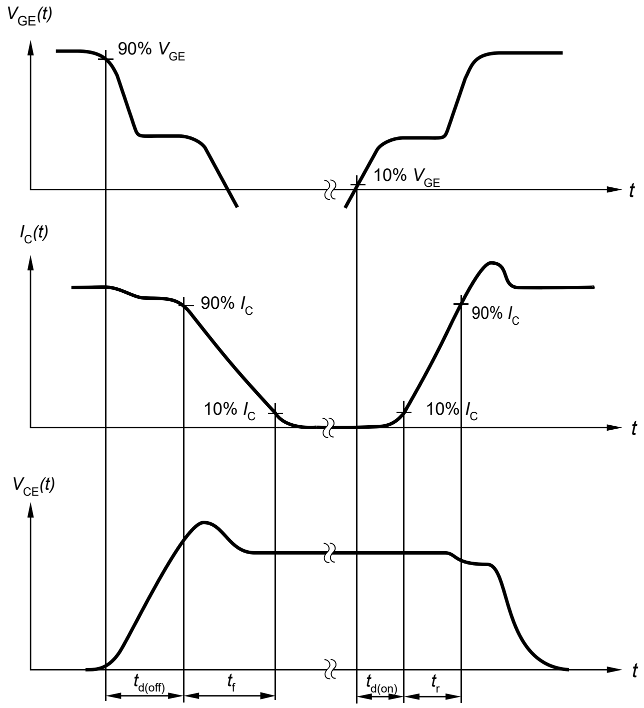


Figure A. **Definition of switching times**

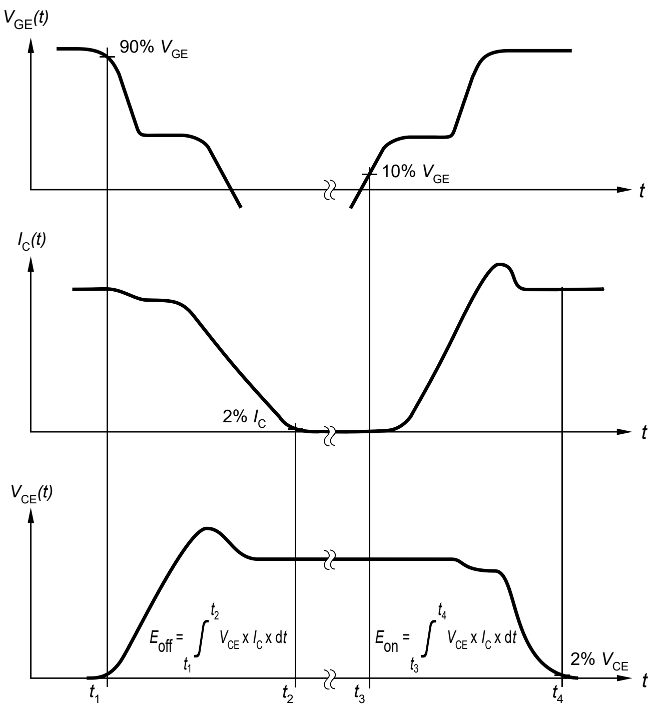


Figure B. **Definition of switching losses**

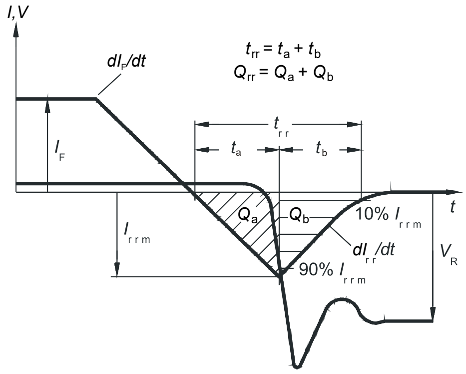


Figure C. **Definition of diode switching characteristics**

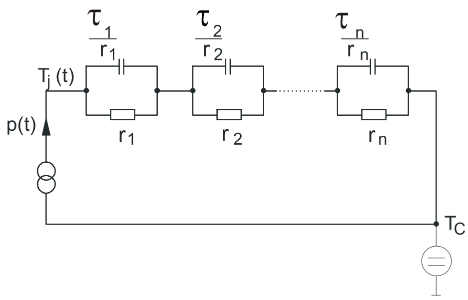


Figure D. **Thermal equivalent circuit**

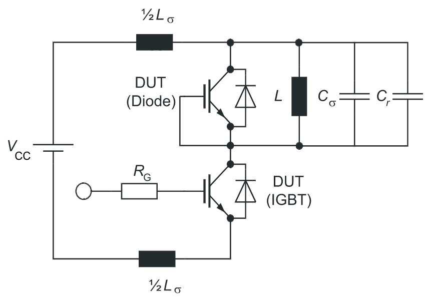


Figure E. **Dynamic test circuit**
Parasitic inductance L_{σ},
parasitic capacitor C_{σ},
relief capacitor C_r,
(only for ZVT switching)

Figure 7

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