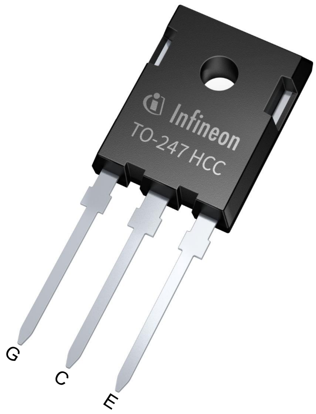
High speed and low saturation voltage 650 V TRENCHSTOP™ IGBT7 technology copacked with soft, fast recovery Emitter Controlled 7 diode



Features

- V_{CE} = 650 V
- I_C = 75 A
- Low switching losses
- Very low collector-emitter saturation voltage V_{CEsat}
- Very soft, fast recovery antiparallel diode
- Smooth switching behavior
- Humidity robustness
- Optimized for hard switching, two- and three-level topologies
- Complete product spectrum and PSpice Models: http://www.infineon.com/igbt/

Potential applications

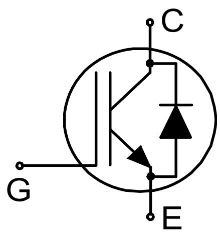
- Industrial UPS
- EV-Charging
- String inverter
- Welding

Product validation

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

Lead-free
Green
Halogen-free
RoHS

Description



Type	Package	Marking
IKWH75N65EH7	PG-TO247-3-STD-NN4.8	K75EEH7

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1 Package

Table 1 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Internal emitter inductance measured 5 mm (0.197 in.) from case	L_E			13		nH
Storage temperature	T_{stg}		-55		150	°C
Soldering temperature	T_{sold}	wave soldering 1.6 mm (0.063 in.) from case for 10 s			260	°C
Mounting torque	M	M3 screw, Maximum of mounting processes: 3			0.6	Nm
Thermal resistance, junction-ambient	$R_{th(j-a)}$				40	K/W
IGBT thermal resistance, junction-case	$R_{th(j-c)}$			0.34	0.44	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$			0.45	0.58	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		650	V
DC collector current, limited by T_{vjmax}	I_C	limited by bondwire	$T_c = 25$ °C	80	A
			$T_c = 100$ °C	80	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			300	A
Turn-off safe operating area		$V_{CE} \leq 650$ V, $t_p \leq 1$ μs, $T_{vj} \leq 175$ °C		300	A
Gate-emitter voltage	V_{GE}			±20	V
Transient gate-emitter voltage	V_{GE}	$t_p \leq 10$ μs, $D < 0.01$		±30	V
Power dissipation	P_{tot}		$T_c = 25$ °C	341	W
			$T_c = 100$ °C	170	

Table 3 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 75$ A, $V_{GE} = 15$ V	$T_{vj} = 25$ °C		1.4	1.65	V
			$T_{vj} = 175$ °C		1.6		
Gate-emitter threshold voltage	V_{GEth}	$I_C = 0.66$ mA, $V_{CE} = V_{GE}$		2.9	3.85	4.8	V
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 650$ V, $V_{GE} = 0$ V	$T_{vj} = 25$ °C			25	µA
			$T_{vj} = 175$ °C		2600		
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0$ V, $V_{GE} = 20$ V				100	nA
Transconductance	g_{fs}	$I_C = 75$ A, $V_{CE} = 20$ V			86		S
Input capacitance	C_{ies}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz			3884		pF
Output capacitance	C_{oes}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz			124		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz			16.8		pF
Gate charge	Q_G	$V_{CC} = 520$ V, $I_C = 75$ A, $V_{GE} = 15$ V			150		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 10\ \Omega$, $R_{G(off)} = 10\ \Omega$	$T_{vj} = 25$ °C, $I_C = 75$ A		25		ns
			$T_{vj} = 175$ °C, $I_C = 75$ A		26		
Rise time (inductive load)	t_r	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 10\ \Omega$, $R_{G(off)} = 10\ \Omega$	$T_{vj} = 25$ °C, $I_C = 75$ A		43		ns
			$T_{vj} = 175$ °C, $I_C = 75$ A		45		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 10\ \Omega$, $R_{G(off)} = 10\ \Omega$	$T_{vj} = 25$ °C, $I_C = 75$ A		195		ns
			$T_{vj} = 175$ °C, $I_C = 75$ A		218		
Fall time (inductive load)	t_f	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 10\ \Omega$, $R_{G(off)} = 10\ \Omega$	$T_{vj} = 25$ °C, $I_C = 75$ A		60		ns
			$T_{vj} = 175$ °C, $I_C = 75$ A		60		
Turn-on energy	E_{on}	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 10\ \Omega$, $R_{G(off)} = 10\ \Omega$	$T_{vj} = 25$ °C, $I_C = 75$ A		2.42		mJ
			$T_{vj} = 175$ °C, $I_C = 75$ A		3.9		

(table continues...)

Table 3 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-off energy	E_{off}	V_{CC} = 400 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 10 Ω, $R_{G(off)}$ = 10 Ω	T_{vj} = 25 °C, I_C = 75 A		1.4		mJ
			T_{vj} = 175 °C, I_C = 75 A		1.6		
Total switching energy	E_{ts}	V_{CC} = 400 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 10 Ω, $R_{G(off)}$ = 10 Ω	T_{vj} = 25 °C, I_C = 75 A		3.8		mJ
			T_{vj} = 175 °C, I_C = 75 A		5.5		
Operating junction temperature	T_{vj}			-40		175	°C

3 Diode

Table 4 **Maximum rated values**

Parameter	Symbol	Note or test condition		Values	Unit
Diode forward current, limited by T_{vjmax}	I_F	limited by bondwire	T_c = 25 °C	80	A
			T_c = 100 °C	80	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			300	A
Power dissipation	P_{tot}		T_c = 25 °C	258	W
			T_c = 100 °C	129	

Table 5 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 75 A	T_{vj} = 25 °C		1.65	2	V
			T_{vj} = 175 °C		1.55		
Diode reverse recovery time	t_{rr}	V_R = 400 V, $R_{G(on)}$ = 10 Ω	T_{vj} = 25 °C, I_F = 75 A		89		ns
			T_{vj} = 175 °C, I_F = 75 A		147		
Diode reverse recovery charge	Q_{rr}	V_R = 400 V, $R_{G(on)}$ = 10 Ω	T_{vj} = 25 °C, I_F = 75 A		1.62		µC
			T_{vj} = 175 °C, I_F = 75 A		4.3		

(table continues...)

Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode peak reverse recovery current	I_{rrm}	V_R = 400 V, $R_{G(on)}$ = 10 Ω	T_{vj} = 25 °C, I_F = 75 A		29.7		A
			T_{vj} = 175 °C, I_F = 75 A		47.2		
Diode peak rate of fall of reverse recovery current	di_{rr}/dt	V_R = 400 V, $R_{G(on)}$ = 10 Ω	T_{vj} = 25 °C, I_F = 75 A		-1510		A/µs
			T_{vj} = 175 °C, I_F = 75 A		-1120		
Reverse recovery energy	E_{rec}	V_R = 400 V, $R_{G(on)}$ = 10 Ω	T_{vj} = 25 °C, I_F = 75 A		0.35		mJ
			T_{vj} = 175 °C, I_F = 75 A		0.7		
Operating junction temperature	T_{vj}			-40		175	°C

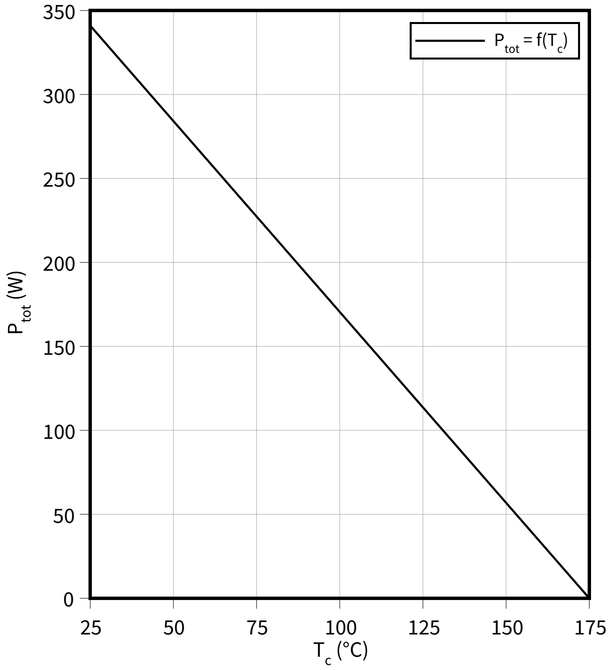
Note: *For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.*

Electrical Characteristic at T_{vj} = 25°C, unless otherwise specified.

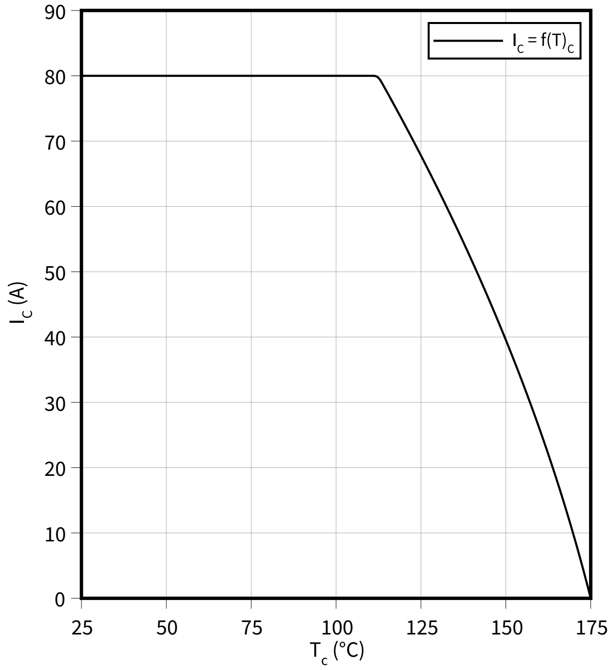
Dynamic test circuit, parasitic inductance L_σ = 8 nH, parasitic capacitor C_σ = 30 pF from Fig. E. Energy losses include “tail” and diode reverse recovery.

4 Characteristics diagrams

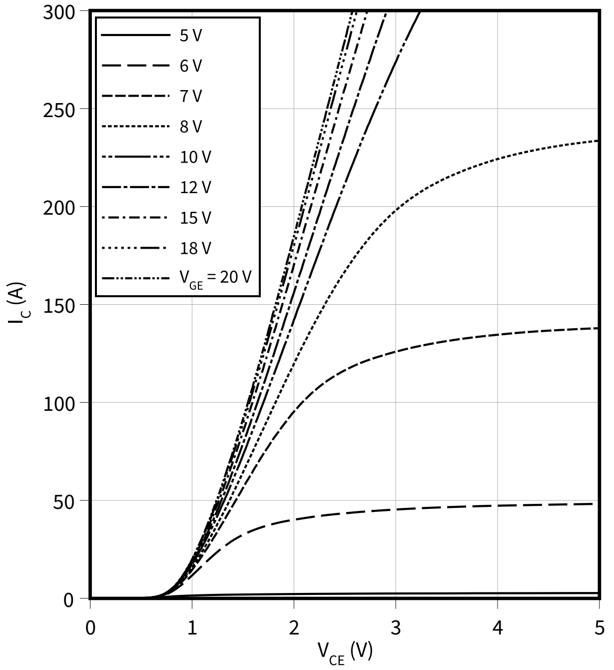
Power dissipation as a function of case temperature
$P_{tot} = f(T_c)$
$T_{vj} \leq 175$ °C



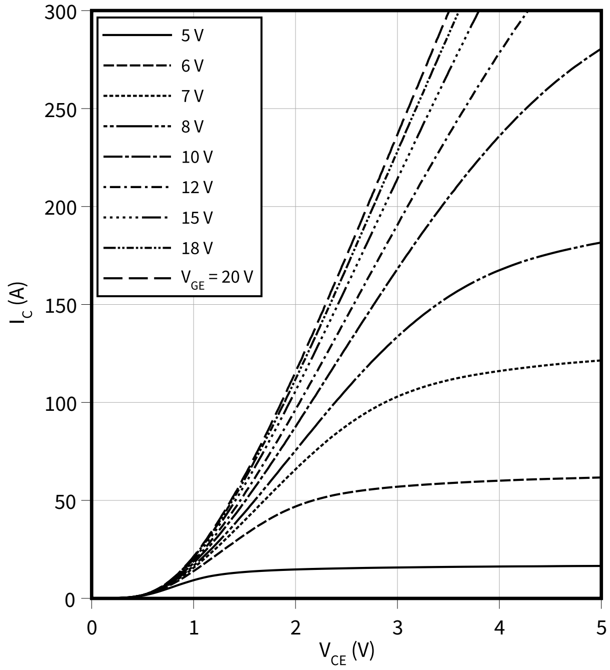
Collector current as a function of case temperature
$I_C = f(T_c)$
$T_{vj} \leq 175$ °C, $V_{GE} \geq 15$ V



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



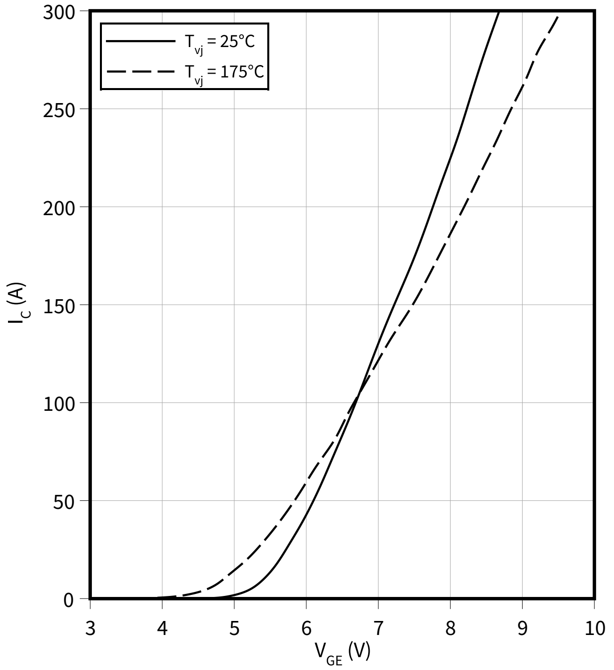
Typical output characteristic
$I_C = f(V_{CE})$
$T_{vj} = 175$ °C



Typical transfer characteristic

$I_C = f(V_{GE})$

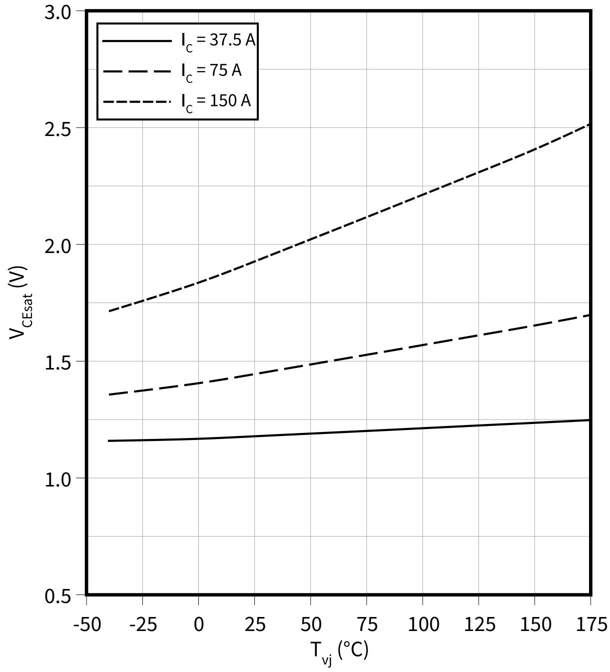
$V_{CE} = 20$ V



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

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

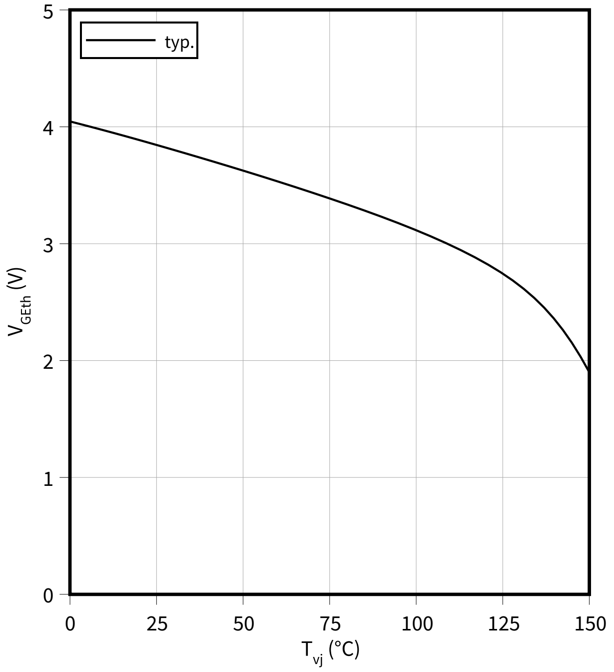
$V_{GE} = 15$ V



Gate-emitter threshold voltage as a function of junction temperature

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

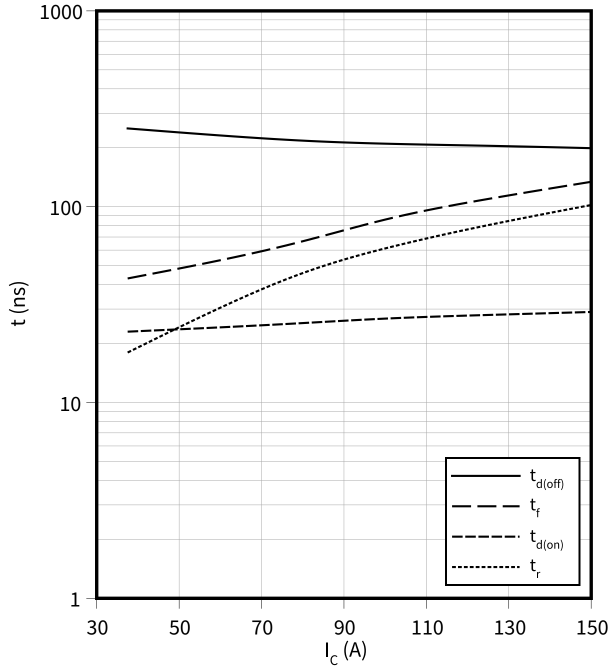
$I_C = 0.66$ mA



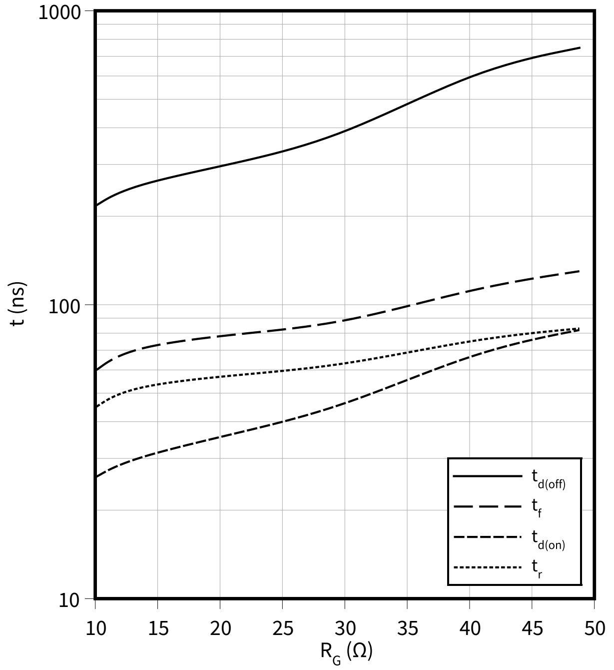
Typical switching times as a function of collector current

$t = f(I_C)$

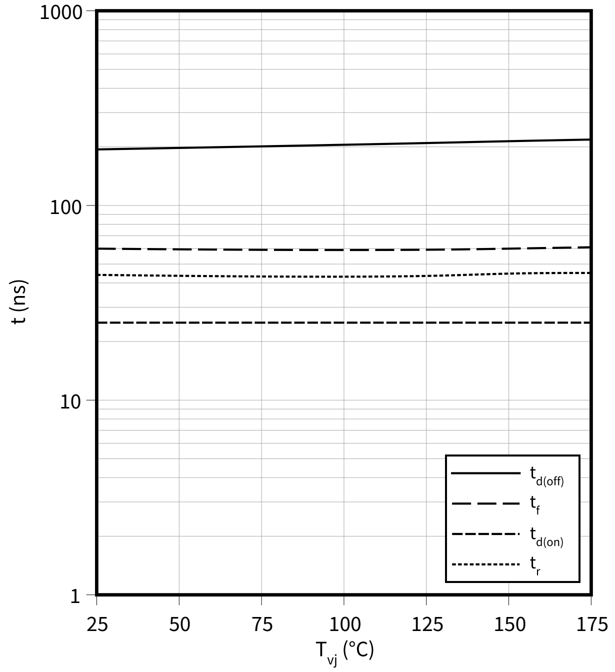
$V_{CC} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 10\ \Omega$



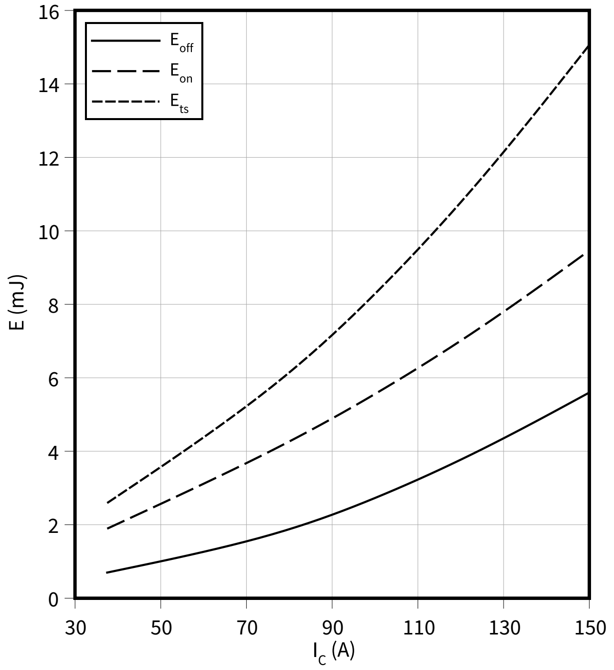
Typical switching times as a function of gate resistor
$t = f(R_G)$
$I_C = 75$ A, $V_{CC} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



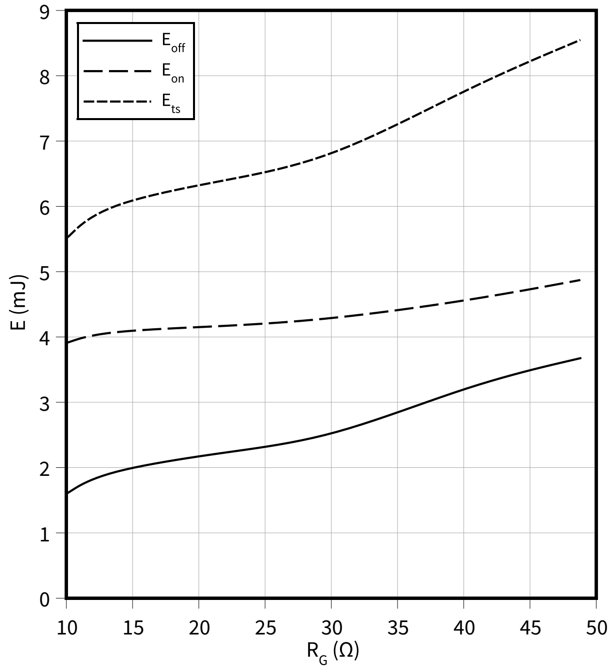
Typical switching times as a function of junction temperature
$t = f(T_{vj})$
$R_G = 10$ Ω, $I_C = 75$ A, $V_{CC} = 400$ V, $V_{GE} = 0/15$ V



Typical switching energy losses as a function of collector current
$E = f(I_C)$
$V_{CC} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 10$ Ω



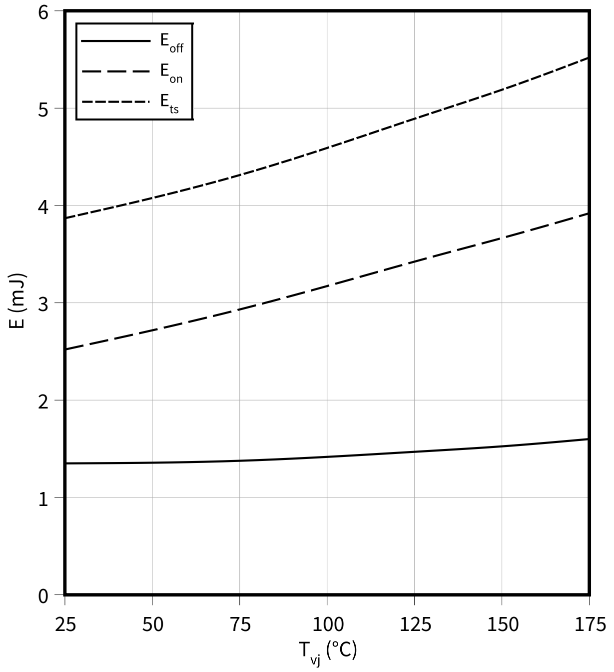
Typical switching energy losses as a function of gate resistor
$E = f(R_G)$
$I_C = 75$ A, $V_{CC} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

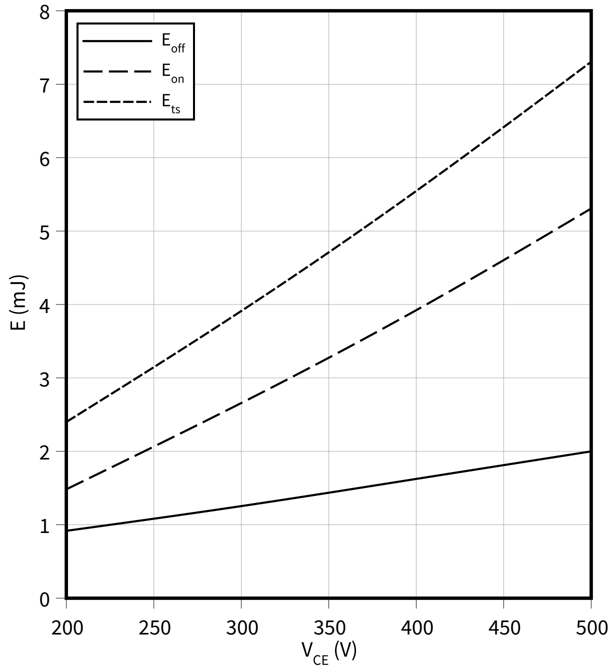
I_C = 75 A, V_{CC} = 400 V, V_{GE} = 0/15 V, R_G = 10 Ω



Typical switching energy losses as a function of collector emitter voltage

$E = f(V_{CE})$

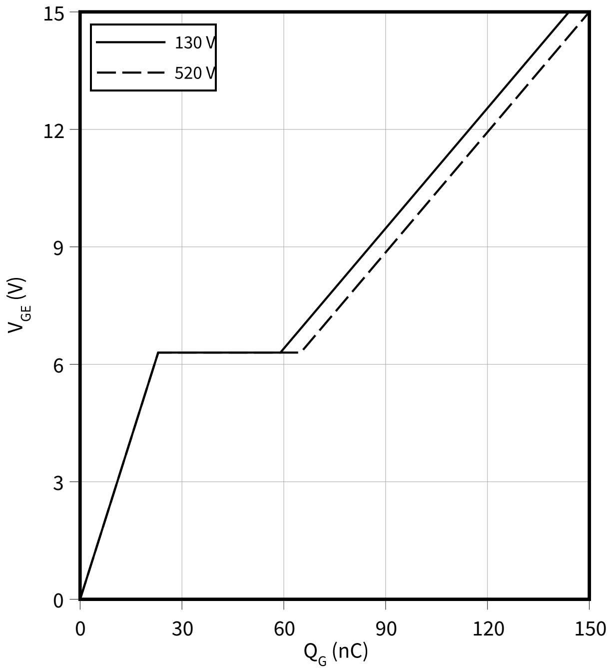
I_C = 75 A, T_{vj} = 175 °C, V_{GE} = 0/15 V, R_G = 10 Ω



Typical gate charge

$V_{GE} = f(Q_G)$

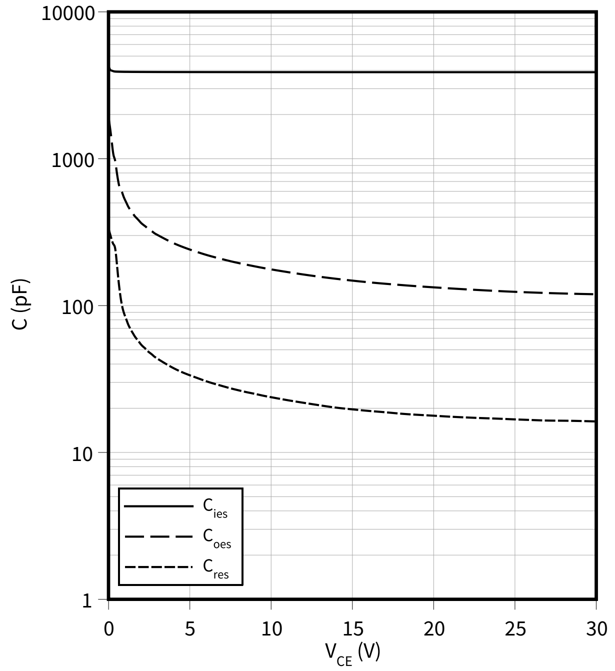
I_C = 75 A



Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$

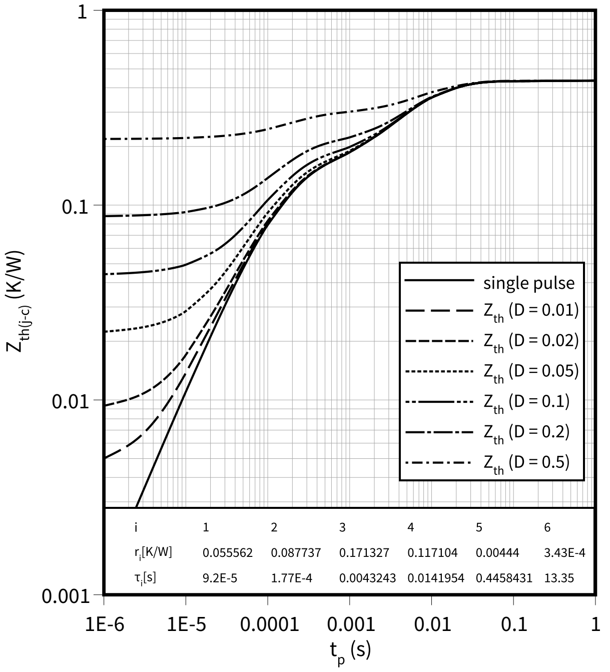
f = 100 kHz, V_{GE} = 0 V



IGBT transient thermal impedance as a function of pulse width

$Z_{th(j-c)} = f(t_p)$

$D = t_p/T$

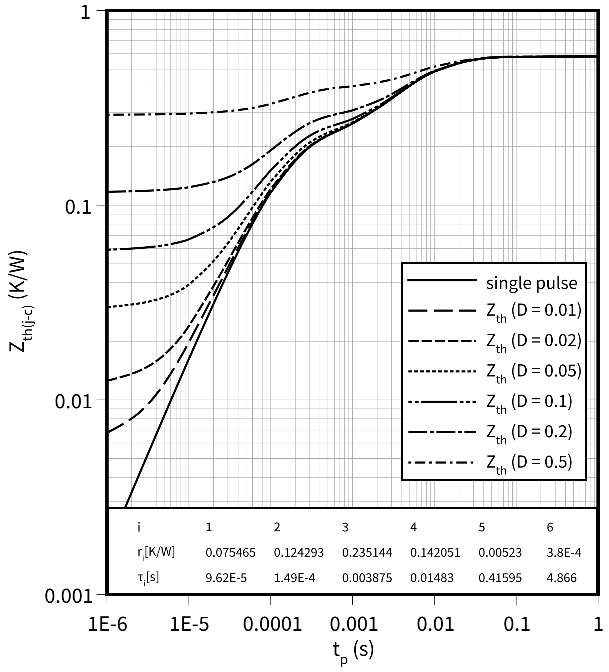


i	1	2	3	4	5	6
r_i[K/W]	0.055562	0.087737	0.171327	0.117104	0.00444	3.43E-4
τ_i[s]	9.2E-5	1.77E-4	0.0043243	0.0141954	0.4458431	13.35

Diode transient thermal impedance as a function of pulse width

$Z_{th(j-c)} = f(t_p)$

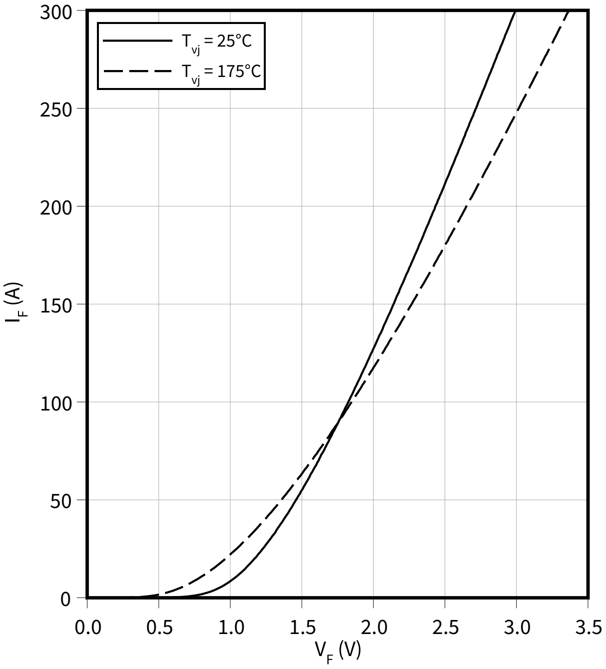
$D = t_p/T$



i	1	2	3	4	5	6
r_i[K/W]	0.075465	0.124293	0.235144	0.142051	0.00523	3.8E-4
τ_i[s]	9.62E-5	1.49E-4	0.003875	0.01483	0.41595	4.866

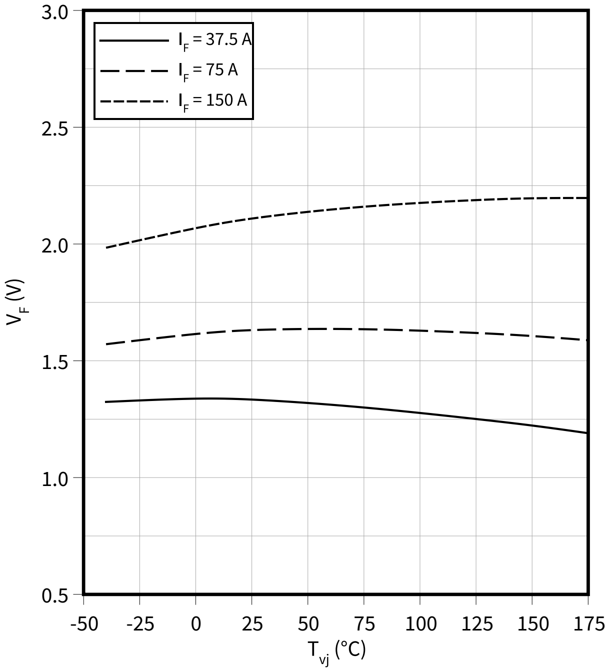
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



Typical diode forward voltage as a function of junction temperature

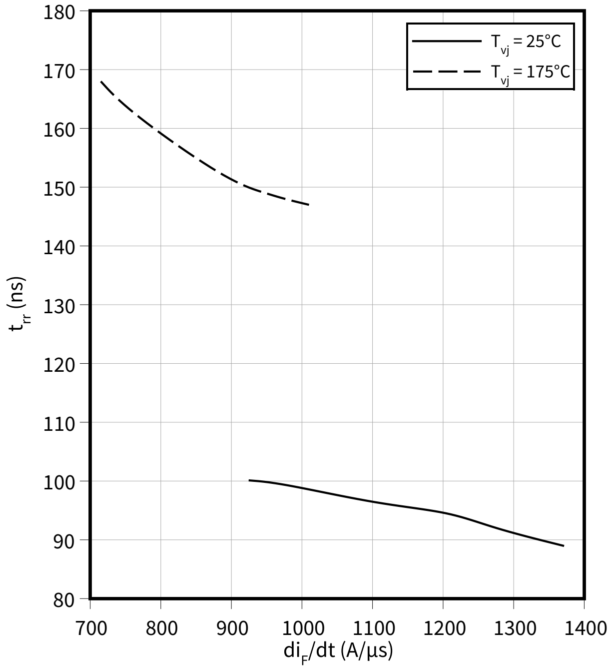
$V_F = f(T_{vj})$



Typical reverse recovery time as a function of diode current slope

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

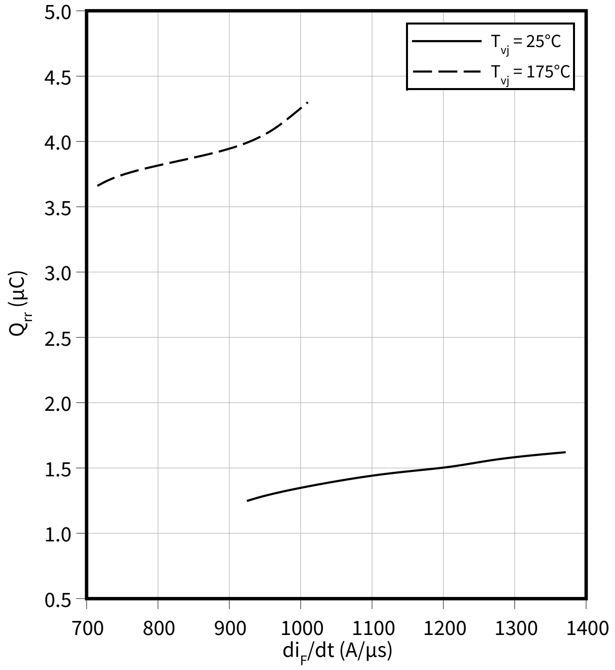
$V_R = 400$ V, $I_F = 75$ A



Typical reverse recovery charge as a function of diode current slope

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

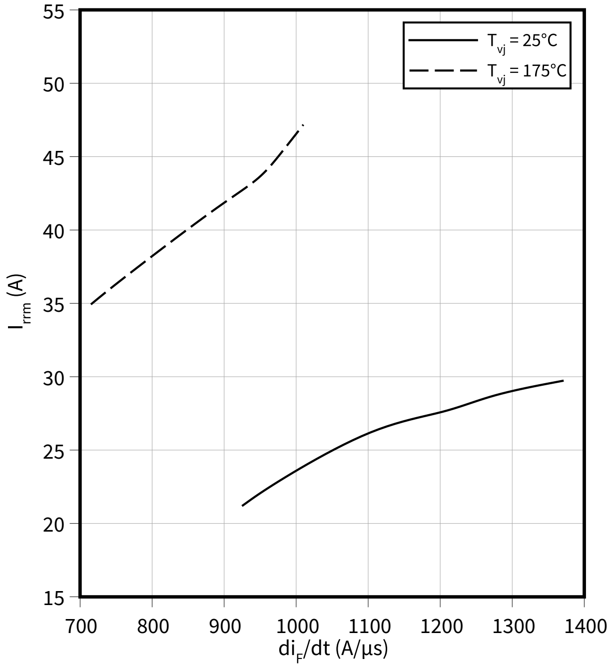
$V_R = 400$ V, $I_F = 75$ A



Typical reverse recovery current as a function of diode current slope

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

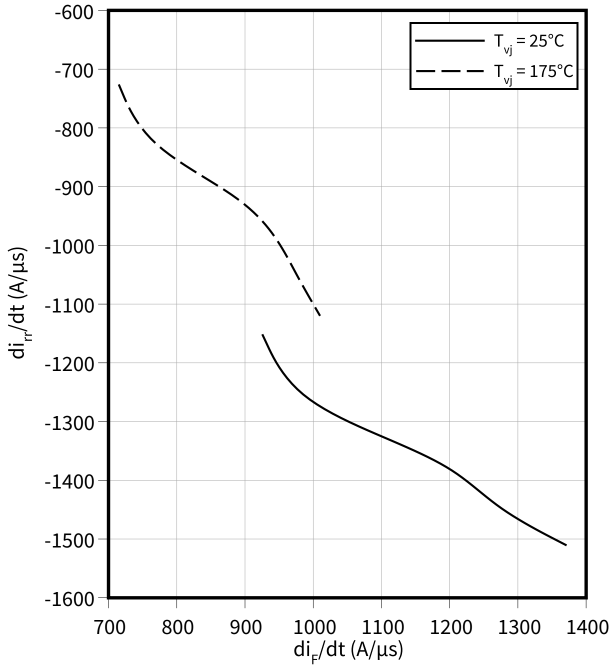
$V_R = 400$ V, $I_F = 75$ A



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

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

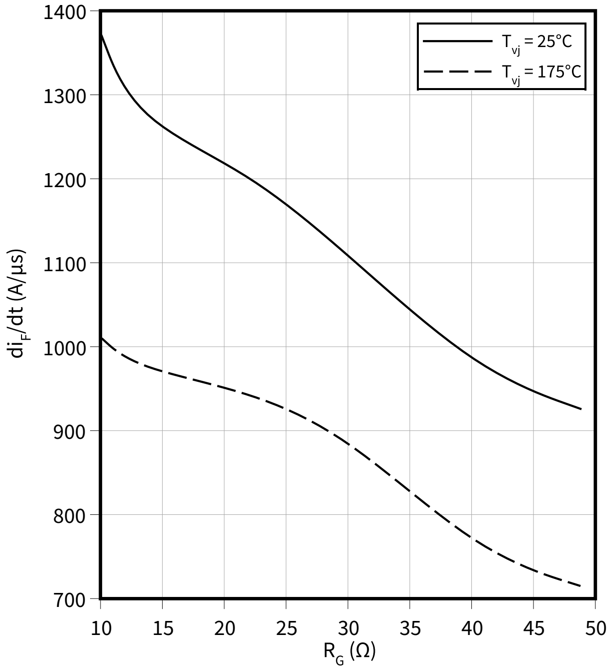
$V_R = 400$ V, $I_F = 75$ A



Typical diode current slope as a function of gate resistor

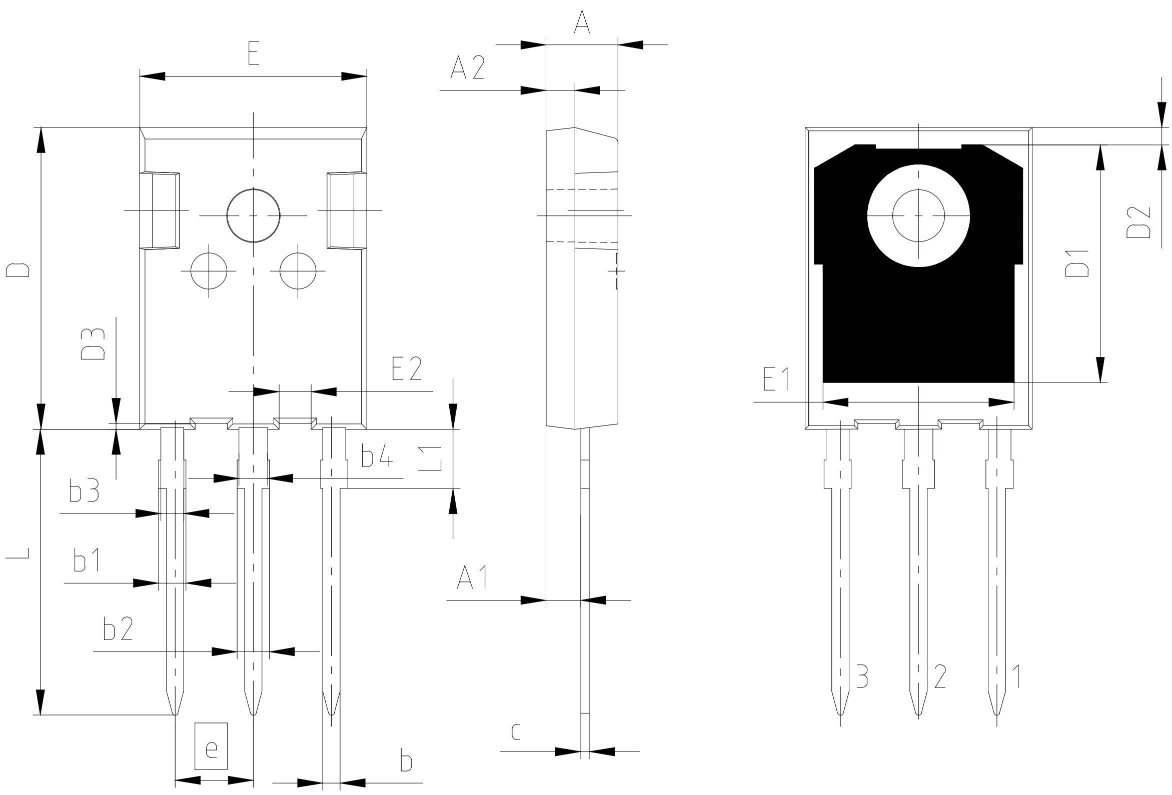
$di_F/dt = f(R_G)$

$V_R = 400$ V, $I_F = 75$ A



5 Package outlines

PG-TO247-3-STD-NN4.8



PACKAGE - GROUP NUMBER:	PG-TO247-3-U04	
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.90	5.10
A1	2.31	2.51
A2	1.90	2.10
b	1.16	1.26
b1		1.90
b2		2.30
b3	1.55	1.65
b4	1.96	2.06
c	0.59	0.66
D	20.90	21.10
D1	16.25	16.85
D2	1.05	1.35
D3	0.55	0.65
E	15.70	15.90
E1	13.10	13.50
E2	2.14	2.34
e	5.44	
N	3	
L	19.80	20.10
L1	3.95	4.30

Figure 1

6 Testing conditions

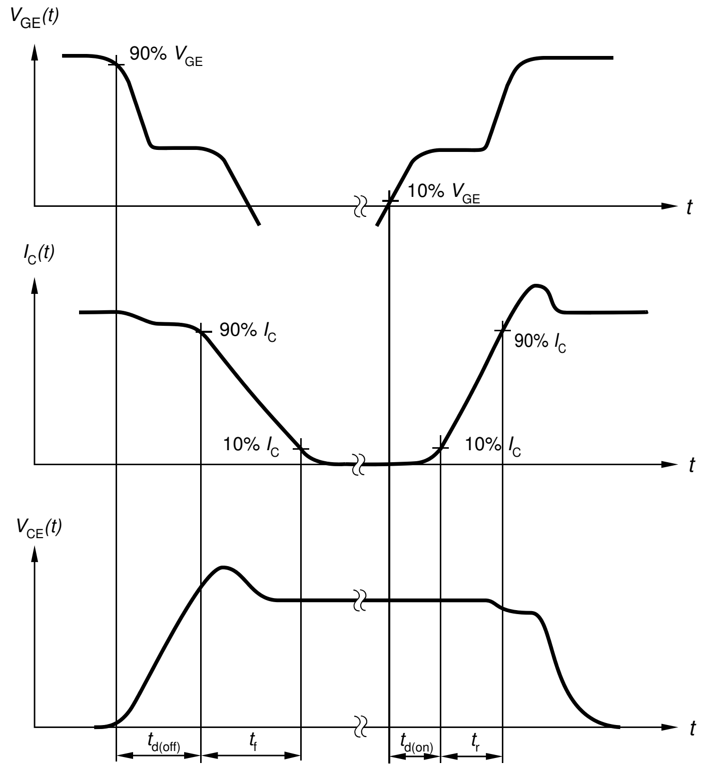


Figure A. **Definition of switching times**

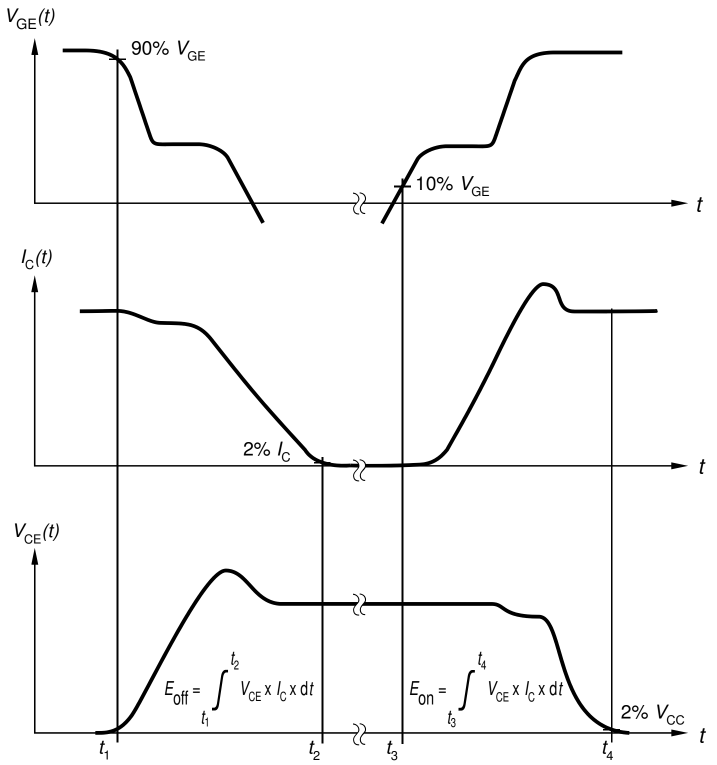


Figure B. **Definition of switching losses**

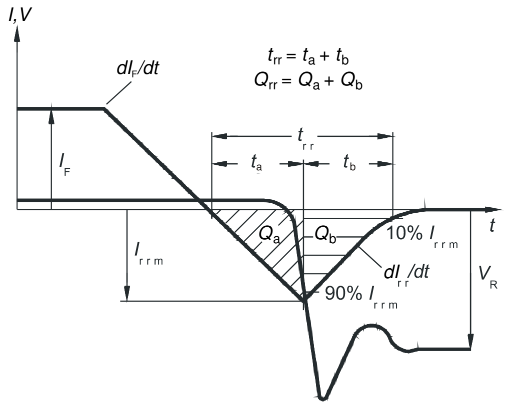


Figure C. **Definition of diode switching characteristics**

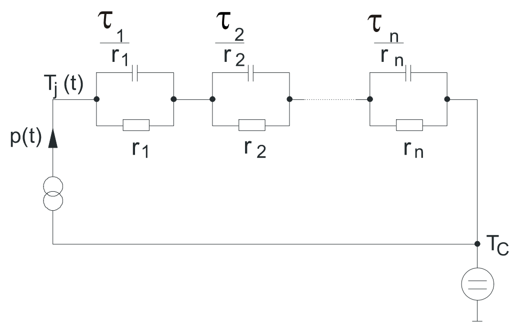


Figure D. **Thermal equivalent circuit**

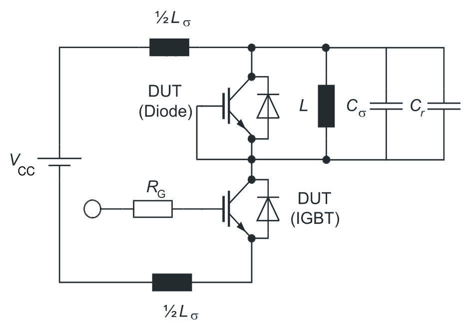


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Figure 2

Revision history

Document revision	Date of release	Description of changes
1.00	2023-01-24	Final datasheet
1.10	2023-04-27	Correction of switching values in Table 3 Update of diagrams t = f(R_G) and E = f(R_G)

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