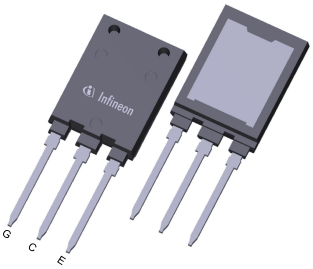
Short circuit rugged 750 V EDT2 IGBT in reflow-solderable package co-packed with soft and fast recovery diode



Green

Halogen-free

RoHS

Features

- V_{CE} = 750 V
- I_C = 160 A
- Low saturation voltage V_{CEsat} = 1.4 V
- Low switching losses
- Short circuit ruggedness 3 µs
- IGBT co-packed with full current, soft and fast recovery diode
- Optimized for hard switching topologies up to 10 kHz
- Package backside suitable for reflow soldering at 245°C, 3 times
- Plating of pins further enable electrical resistance welding
- Complete product spectrum and PSpice Models: http://www.infineon.com/igbt/

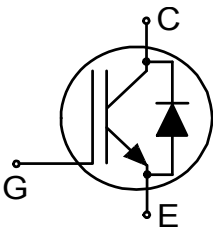
Potential applications

- CAV Powertrain Control Modules
- General purpose drives (GPD)

Product validation

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

Description



Type	Package	Marking
IKQB160N75CP2	PG-TO247-3-PLUS-NN8.5	K160GCP2

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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}	reflow soldering (MSL1 according to JEDEC J-STA-020)			245	°C
Thermal resistance, junction-ambient	$R_{th(j\text{-}a)}$				40	K/W
IGBT thermal resistance, junction-case	$R_{th(j\text{-}c)}$				0.2	K/W
Diode thermal resistance, junction-case	$R_{th(j\text{-}c)}$				0.36	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		750	V
DC collector current, limited by T_{vjmax}	I_C	limited by bondwire	$T_c = 25$ °C	200	A
			$T_c = 125$ °C	160	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			480	A
Turn-off safe operating area		$V_{CE} \leq 750$ V, $T_{vj} \leq 175$ °C		480	A
Gate-emitter voltage	V_{GE}			±20	V
Transient gate-emitter voltage	V_{GE}	$t_p = 10$ µs, $D < 0.01$		±30	V
Short-circuit withstand time	t_{SC}	$V_{CC} \leq 450$ V, $V_{GE} = 15$ V, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, $T_{vj} = 125$ °C		3	µs
Power dissipation	P_{tot}		$T_c = 25$ °C	750	W
			$T_c = 125$ °C	250	

Table 3 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	I_C = 160 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.4	1.65	V
			T_{vj} = 175 °C		1.7		
Gate-emitter threshold voltage	V_{GEth}	I_C = 2.15 mA, V_{CE} = V_{GE}		5	5.8	6.5	V
Zero gate-voltage collector current	I_{CES}	V_{CE} = 750 V, V_{GE} = 0 V	T_{vj} = 25 °C			200	µA
			T_{vj} = 175 °C		6000		
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V				100	nA
Transconductance	g_{fs}	I_C = 160 A, V_{CE} = 20 V			118		S
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			16500		pF
Output capacitance	C_{oes}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			435		pF
Reverse transfer capacitance	C_{res}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			75		pF
Gate charge	Q_G	V_{CC} = 600 V, I_C = 160 A, V_{GE} = 15 V			610		nC
Turn-on delay time	$t_{d(on)}$	V_{CC} = 450 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 4.8 Ω, $R_{G(off)}$ = 4.8 Ω, L_σ = 30 nH, C_σ = 144 pF	T_{vj} = 25 °C, I_C = 160 A		72		ns
			T_{vj} = 175 °C, I_C = 160 A		69		
Rise time (inductive load)	t_r	V_{CC} = 450 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 4.8 Ω, $R_{G(off)}$ = 4.8 Ω, L_σ = 30 nH, C_σ = 144 pF	T_{vj} = 25 °C, I_C = 160 A		73		ns
			T_{vj} = 175 °C, I_C = 160 A		69		
Turn-off delay time	$t_{d(off)}$	V_{CC} = 450 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 4.8 Ω, $R_{G(off)}$ = 4.8 Ω, L_σ = 30 nH, C_σ = 144 pF	T_{vj} = 25 °C, I_C = 160 A		324		ns
			T_{vj} = 175 °C, I_C = 160 A		395		
Fall time (inductive load)	t_f	V_{CC} = 450 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 4.8 Ω, $R_{G(off)}$ = 4.8 Ω, L_σ = 30 nH, C_σ = 144 pF	T_{vj} = 25 °C, I_C = 160 A		40		ns
			T_{vj} = 175 °C, I_C = 160 A		53		
Turn-on energy	E_{on}	V_{CC} = 450 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 4.8 Ω, $R_{G(off)}$ = 4.8 Ω, L_σ = 30 nH, C_σ = 144 pF	T_{vj} = 25 °C, I_C = 160 A		9.7		mJ
			T_{vj} = 175 °C, I_C = 160 A		12.5		

(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} = 450 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 4.8 Ω, $R_{G(off)}$ = 4.8 Ω, L_σ = 30 nH, C_σ = 144 pF	T_{vj} = 25 °C, I_C = 160 A		5.2		mJ
			T_{vj} = 175 °C, I_C = 160 A		7.6		
Total switching energy	E_{ts}	V_{CC} = 450 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 4.8 Ω, $R_{G(off)}$ = 4.8 Ω, L_σ = 30 nH, C_σ = 144 pF	T_{vj} = 25 °C, I_C = 160 A		14.9		mJ
			T_{vj} = 175 °C, I_C = 160 A		20.1		
Operating junction temperature	T_{vj}			-40		175	°C

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

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		750	V
Diode forward current, limited by T_{vjmax}	I_F		T_c = 25 °C	200	A
			T_c = 65 °C	160	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			480	A
Power dissipation	P_{tot}		T_c = 25 °C	417	W
			T_c = 125 °C	139	

Table 5 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 160 A	T_{vj} = 25 °C		1.8	2	V
			T_{vj} = 175 °C		1.9		
Diode reverse recovery time	t_{rr}	V_R = 450 V	T_{vj} = 25 °C, I_F = 160 A, $-di_F/dt$ = 1000 A/µs		255		ns
			T_{vj} = 175 °C, I_F = 160 A, $-di_F/dt$ = 1000 A/µs		373		

(table continues...)

Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode reverse recovery charge	Q_{rr}	V_R = 450 V	T_{vj} = 25 °C, I_F = 160 A, $-di_F/dt$ = 1000 A/µs		4.2		µC
			T_{vj} = 175 °C, I_F = 160 A, $-di_F/dt$ = 1000 A/µs		12.3		
Diode peak reverse recovery current	I_{rrm}	V_R = 450 V	T_{vj} = 25 °C, I_F = 160 A, $-di_F/dt$ = 1000 A/µs		29.6		A
			T_{vj} = 175 °C, I_F = 160 A, $-di_F/dt$ = 1000 A/µs		56.7		
Diode peak rate of fall of reverse recovery current	di_{rr}/dt	V_R = 450 V	T_{vj} = 25 °C, I_F = 160 A, $-di_F/dt$ = 1000 A/µs		265		A/µs
			T_{vj} = 175 °C, I_F = 160 A, $-di_F/dt$ = 1000 A/µs		283		
Operating junction temperature	T_{vj}			-40		175	°C

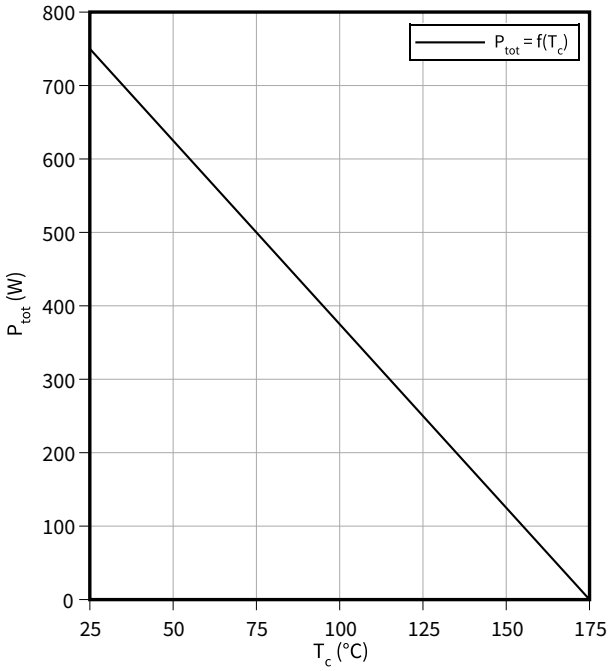
Note: For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

4 Characteristics diagrams

Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$

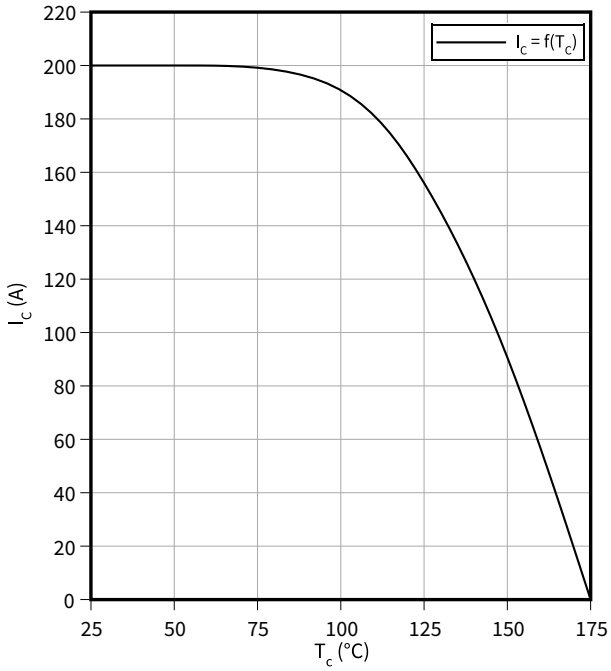
$T_{vj} \leq 175\ °C$



Collector current as a function of case temperature

$I_C = f(T_c)$

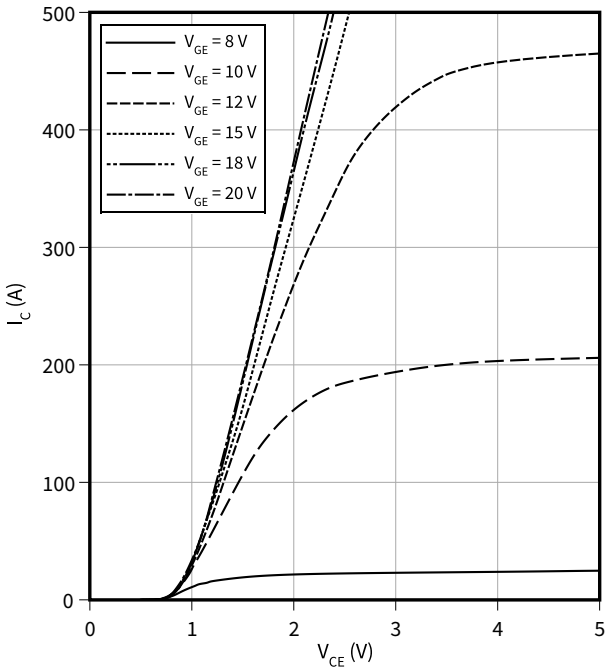
$T_{vj} \leq 175\ °C, V_{GE} \geq 15\ V$



Typical output characteristic

$I_C = f(V_{CE})$

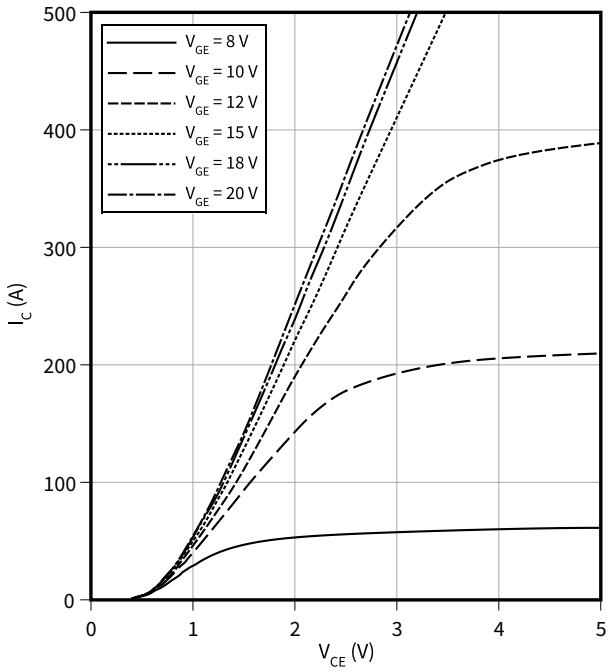
$T_{vj} = 25\ °C$



Typical output characteristic

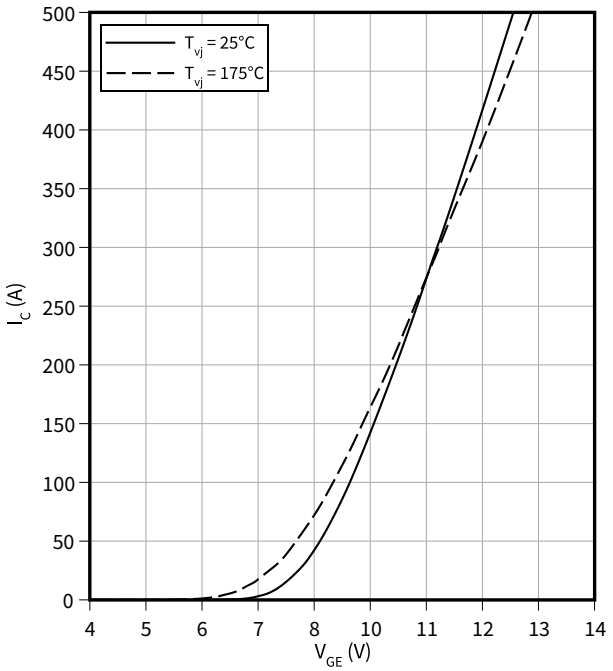
$I_C = f(V_{CE})$

$T_{vj} = 175\ °C$



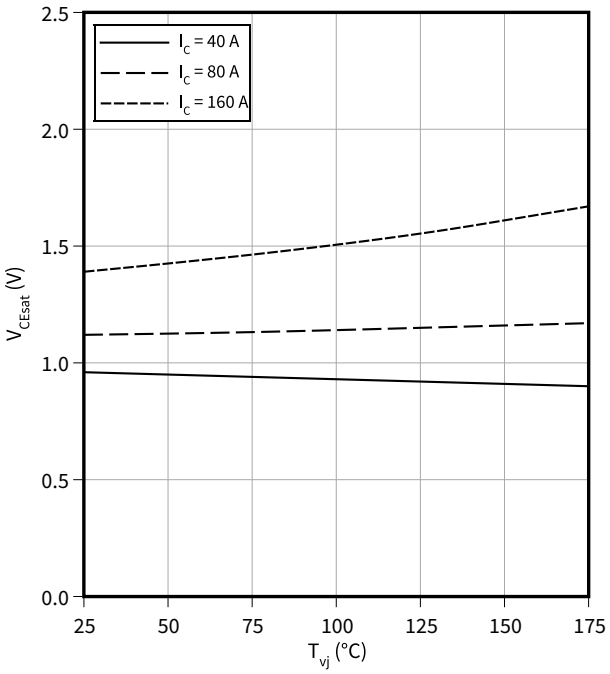
Typical transfer characteristic

$I_C = f(V_{GE})$
$V_{CE} = 20$ V



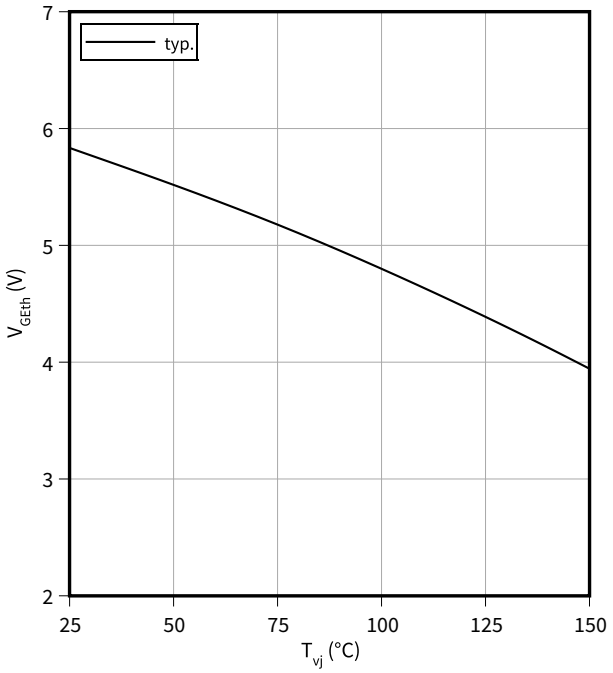
Typical collector-emitter saturation voltage as a function of junction temperature

$V_{CEsat} = f(T_{vj})$
$V_{GE} = 15$ V



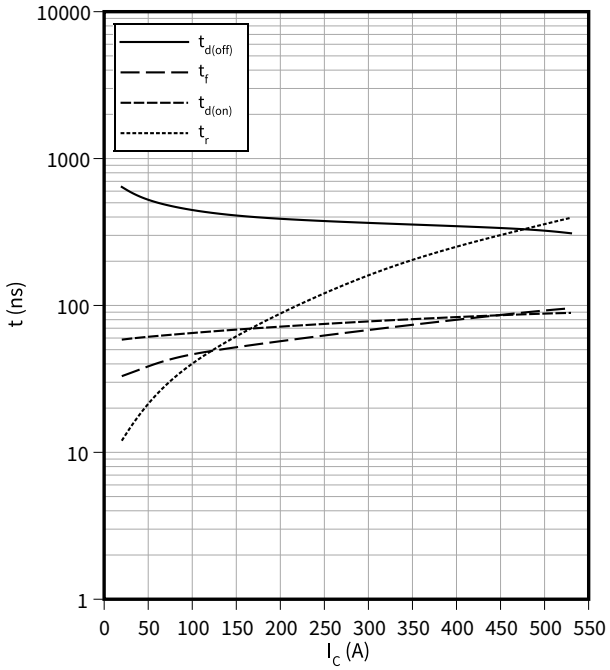
Gate-emitter threshold voltage as a function of junction temperature

$V_{GEth} = f(T_{vj})$
$I_C = 2.15$ mA



Typical switching times as a function of collector current

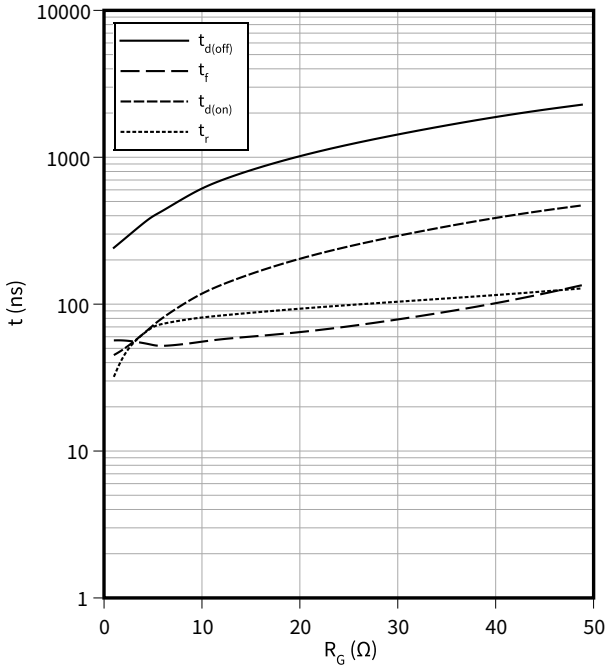
$t = f(I_C)$
$V_{CC} = 450$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 4.8\ \Omega$



Typical switching times as a function of gate resistor

$t = f(R_G)$

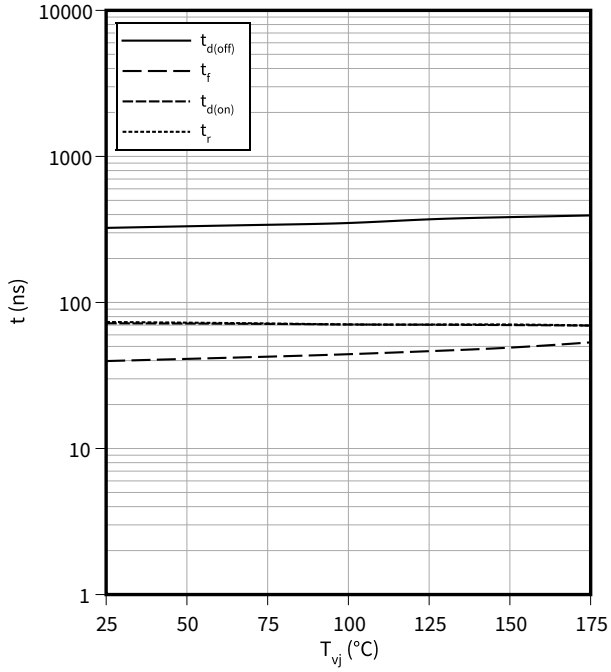
$I_C = 160\ A$, $V_{CC} = 450\ V$, $T_{vj} = 175\ °C$, $V_{GE} = 0/15\ V$



Typical switching times as a function of junction temperature

$t = f(T_{vj})$

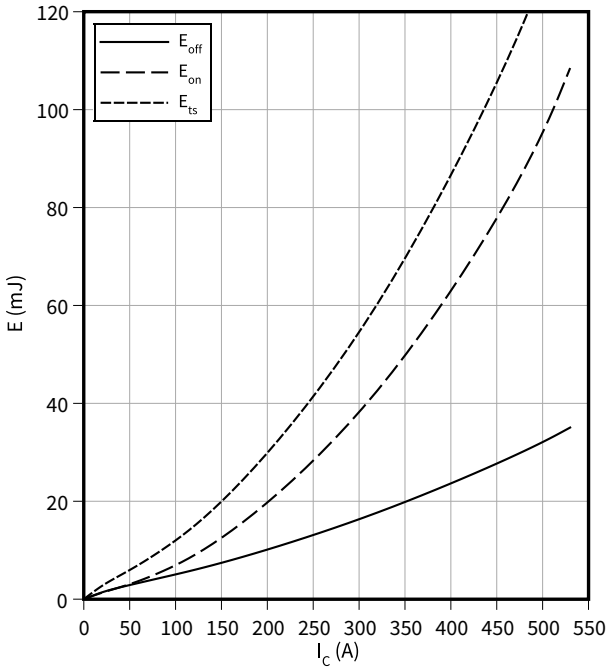
$I_C = 160\ A$, $V_{CC} = 450\ V$, $V_{GE} = 0/15\ V$, $R_G = 4.8\ Ω$



Typical switching energy losses as a function of collector current

$E = f(I_C)$

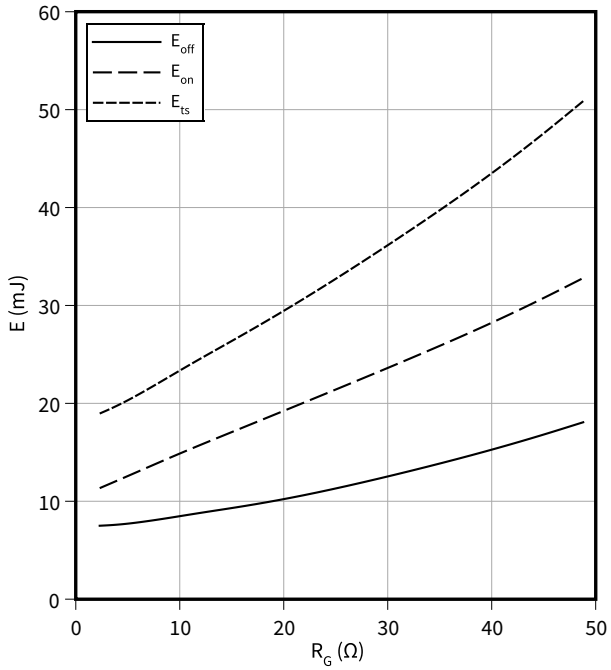
$V_{CC} = 450\ V$, $T_{vj} = 175\ °C$, $V_{GE} = 0/15\ V$, $R_G = 4.8\ Ω$



Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

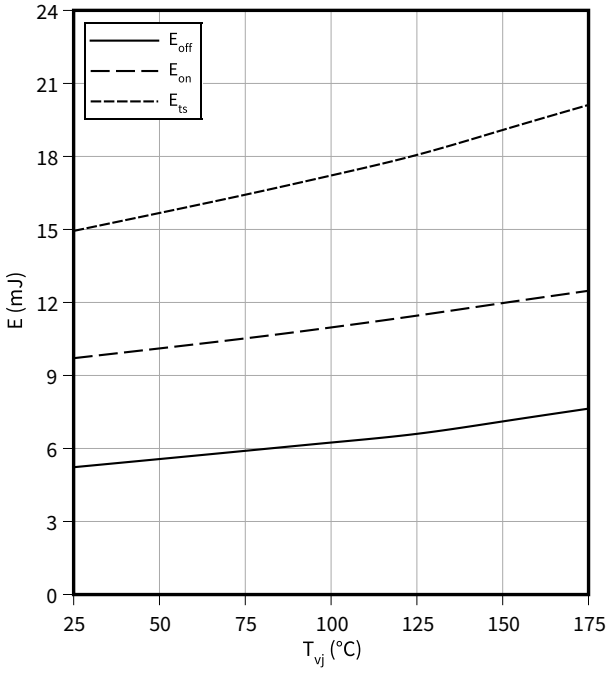
$I_C = 160\ A$, $V_{CC} = 450\ V$, $T_{vj} = 175\ °C$, $V_{GE} = 0/15\ V$



Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

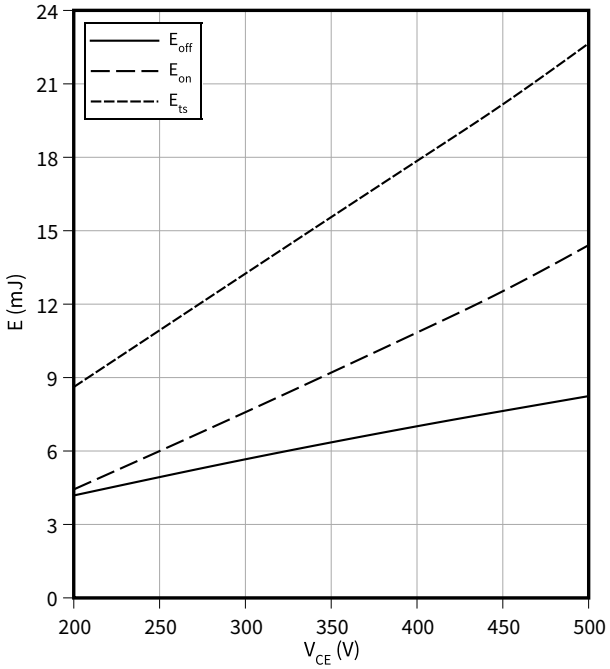
$I_C = 160$ A, $V_{CC} = 450$ V, $V_{GE} = 0/15$ V, $R_G = 4.8\ \Omega$



Typical switching energy losses as a function of collector emitter voltage

$E = f(V_{CE})$

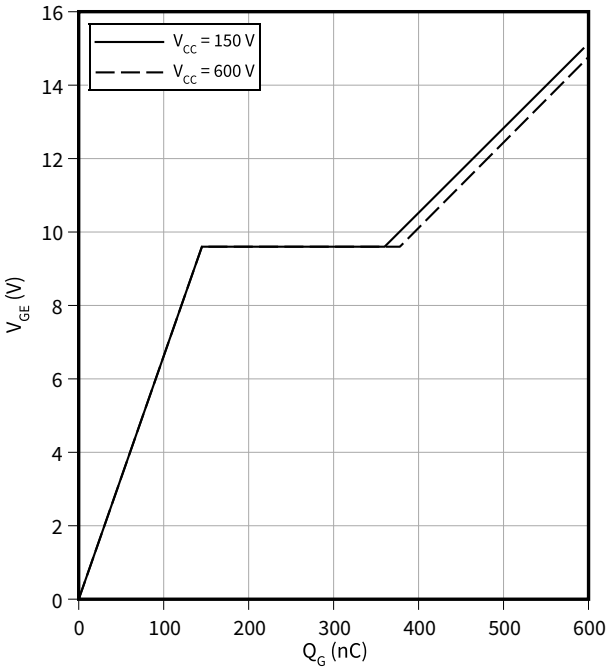
$I_C = 160$ A, $V_{GE} = 0/15$ V, $T_{vj} = 175$ °C, $R_G = 4.8\ \Omega$



Typical gate charge

$V_{GE} = f(Q_G)$

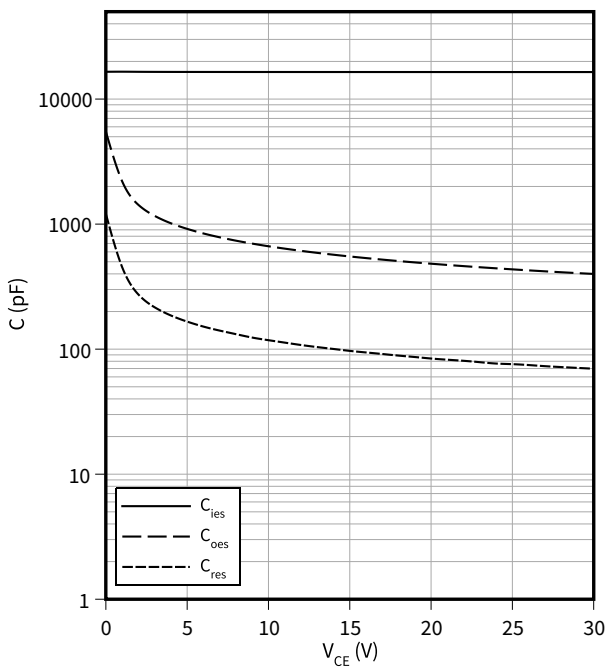
$I_C = 160$ A



Typical capacitance as a function of collector-emitter voltage

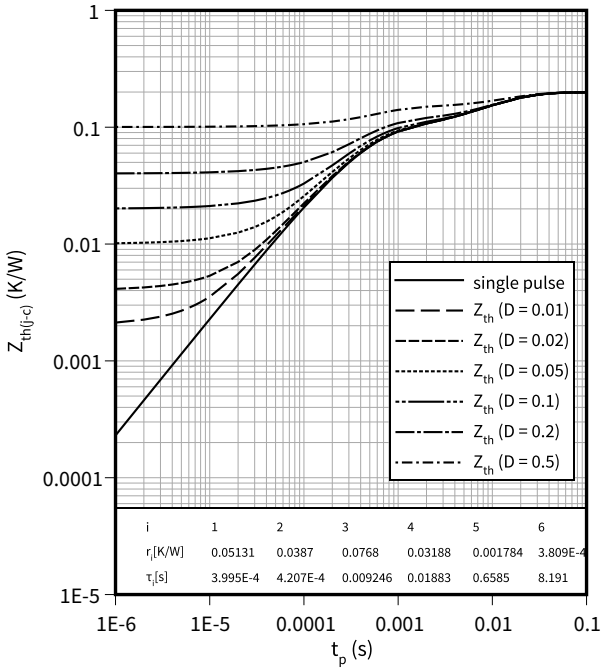
$C = f(V_{CE})$

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



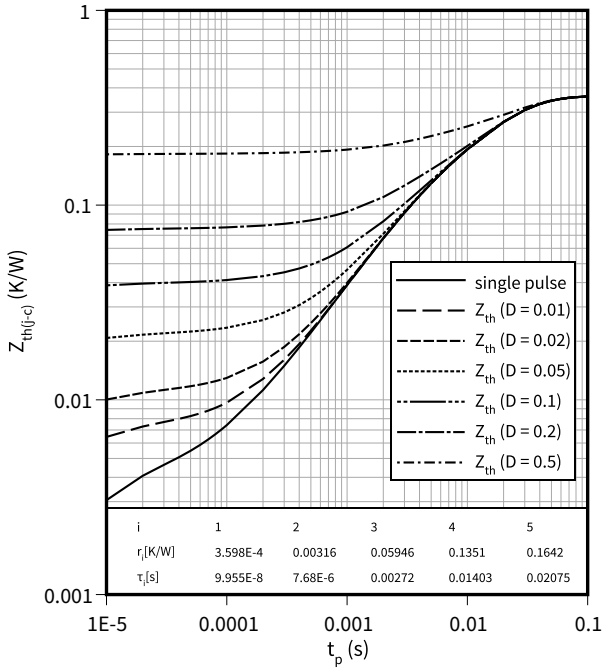
IGBT transient thermal impedance as a function of pulse width

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



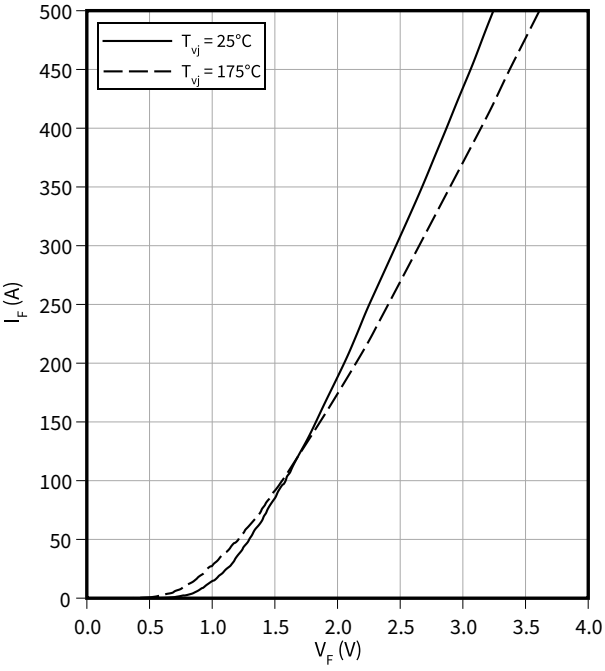
Diode transient thermal impedance as a function of pulse width

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



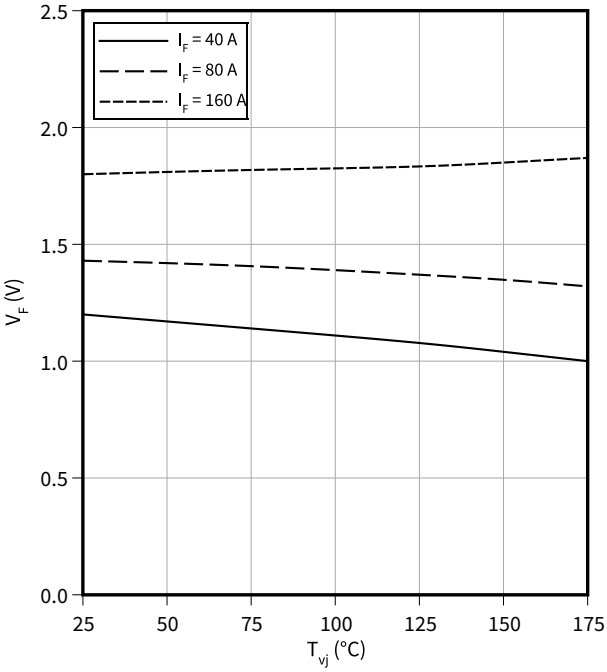
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



Typical diode forward voltage as a function of junction temperature

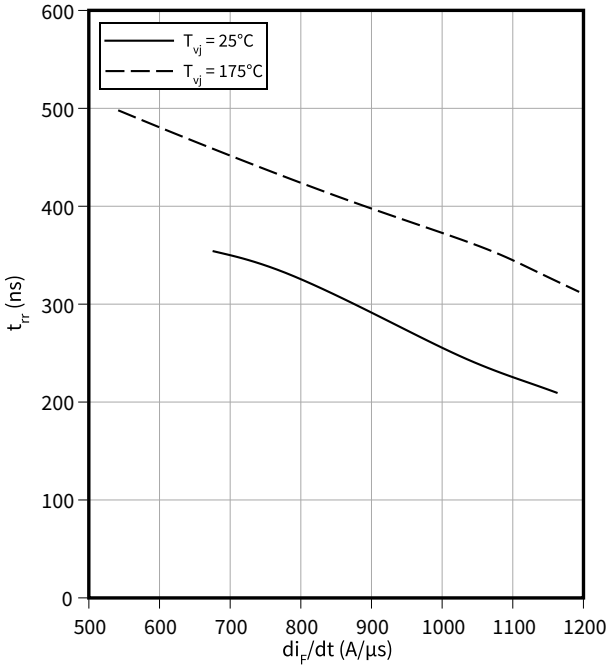
$V_F = f(T_{vj})$



Typical reverse recovery time as a function of diode current slope

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

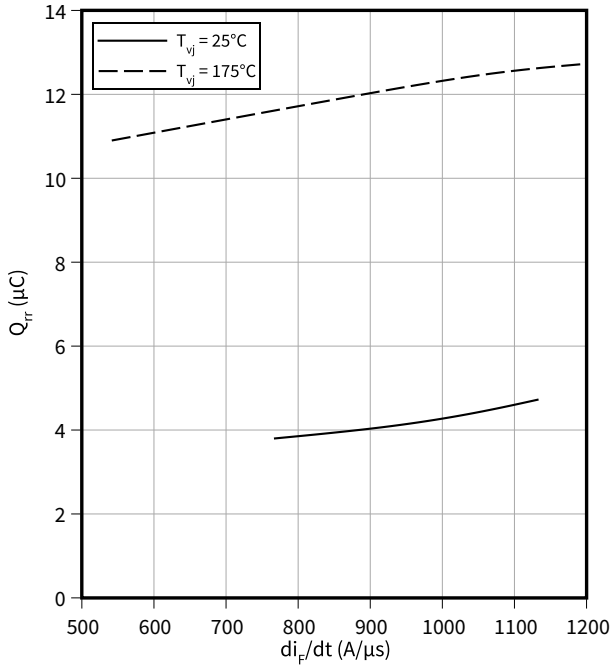
$V_R = 450$ V, $I_F = 160$ A



Typical reverse recovery charge as a function of diode current slope

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

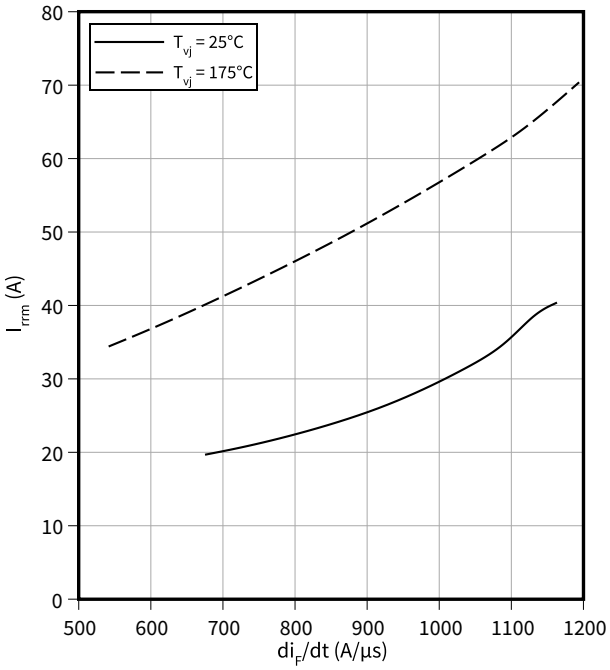
$V_R = 450$ V, $I_F = 160$ A



Typical reverse recovery current as a function of diode current slope

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

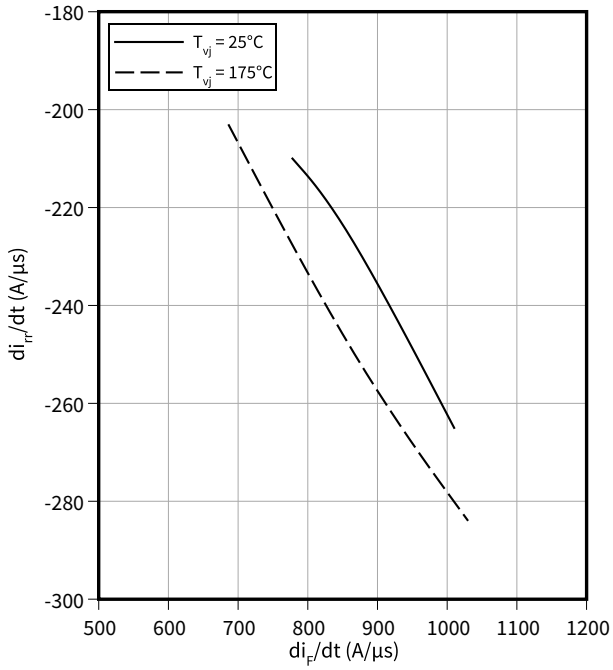
$V_R = 450$ V, $I_F = 160$ A



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

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

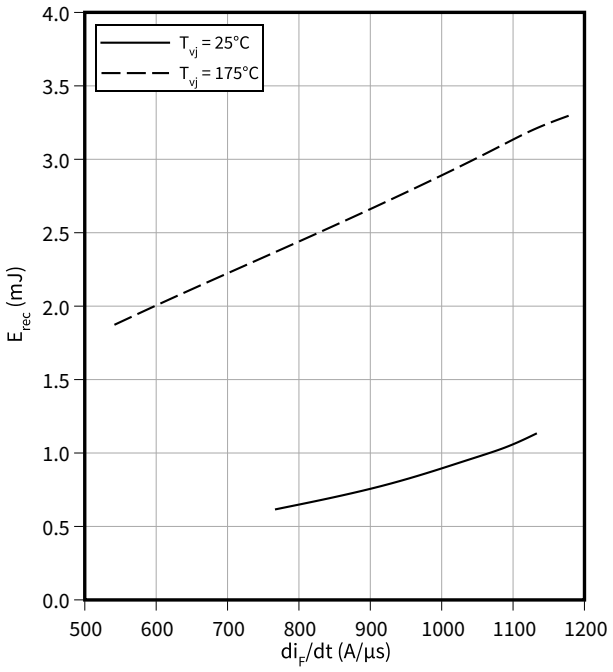
$V_R = 450$ V, $I_F = 160$ A



Typical reverse energy losses as a function of diode current slope

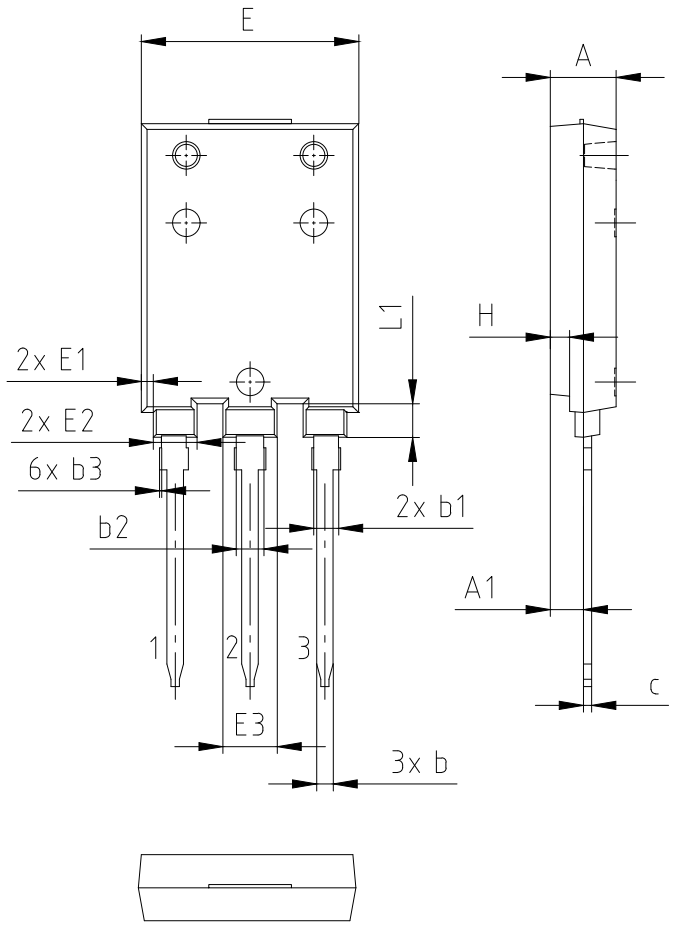
$E_{rec} = f(di_F/dt)$

$V_R = 450$ V, $I_F = 160$ A



5 Package outlines

PG-TO247-3-PLUS-NN8.5



PACKAGE - GROUP NUMBER:	PG-TO247-3-U02	
DIMENSIONS	**MILLIMETERS**	
	MIN.	MAX.
A	4.70	4.90
A1	2.16	2.66
b	1.10	1.30
b1	1.80	
b2	2.00	
b3	0.00	0.15
c	0.50	0.70
D	22.70	22.90
D1	14.69	14.89
E	15.70	15.90
E1	0.76	0.96
E2	3.08	3.28
E3	3.84	4.04
E4	12.28	12.48
e	5.44	
N	3	
H	1.30	1.50
L	18.01	18.21
L1	2.34	2.54
aaa	0.25	

NOTES:

(1) ALL METAL SURFACES TIN PLATED EXCEPT AREA OF CUT
(2) MOLD GATE PROTRUSION AFTER DEGATING.

Figure 1

6 Testing conditions

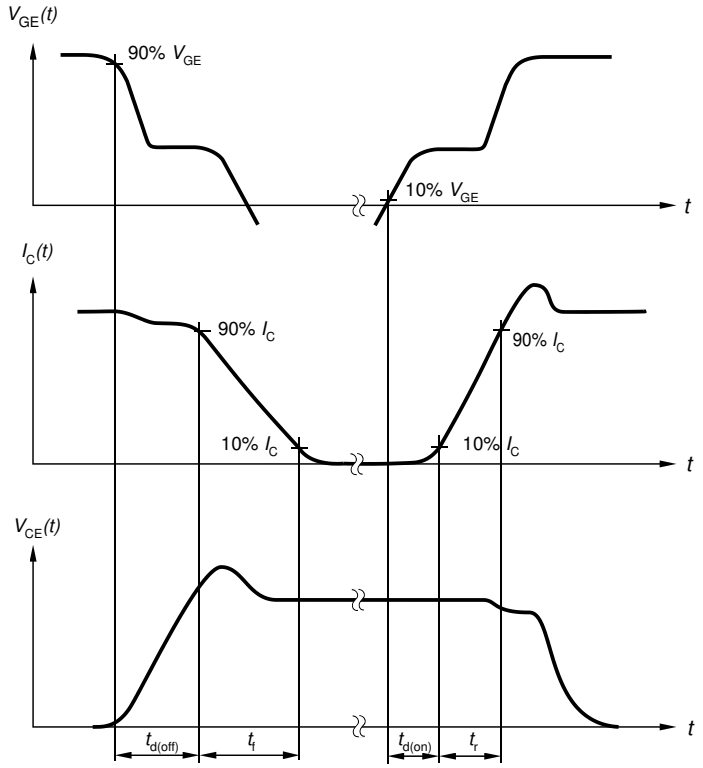


Figure A. **Definition of switching times**

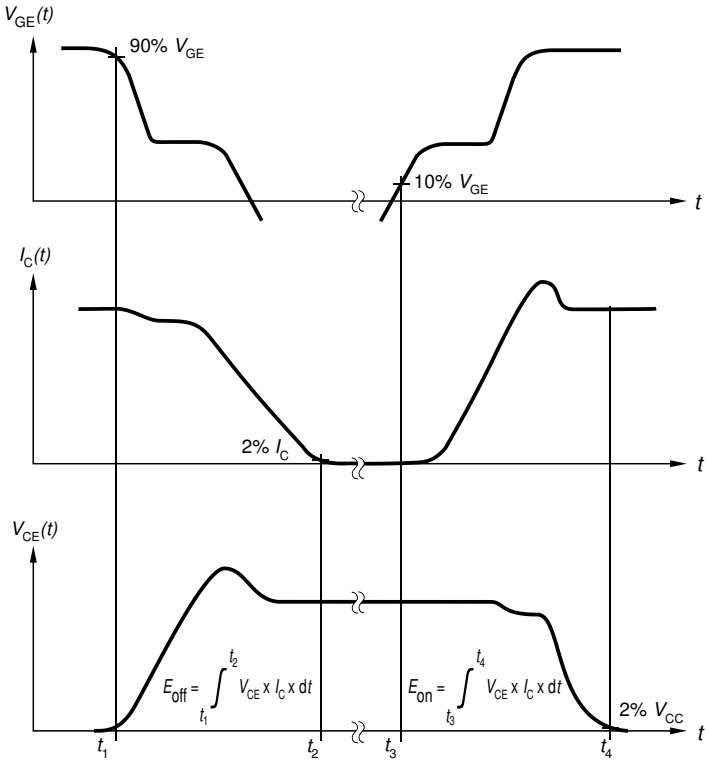


Figure B. **Definition of switching losses**

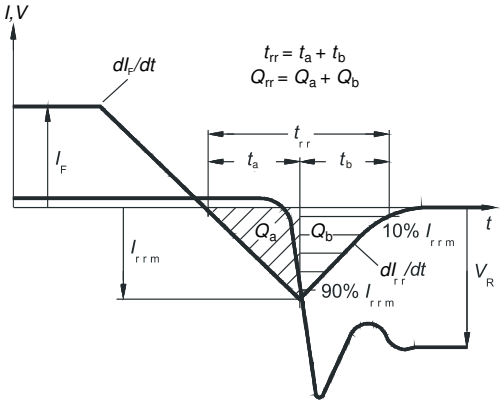


Figure C. **Definition of diode switching characteristics**

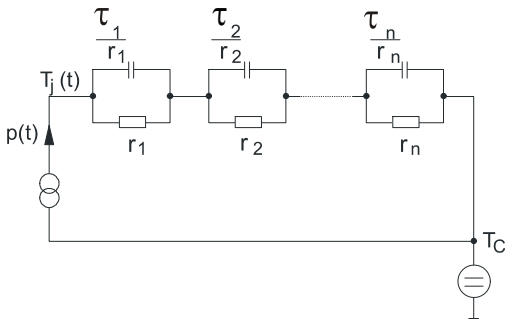


Figure D. **Thermal equivalent circuit**

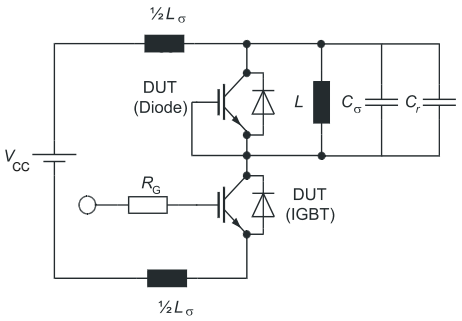


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Figure 2

Revision history

Document revision	Date of release	Description of changes
V0.1		Target Data Sheet
n/a	2020-11-30	Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy
1.00	2022-11-23	Final datasheet
1.10	2023-06-30	Editorial changes on cover page

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Edition 2023-06-30

Published by

Infineon Technologies AG

81726 Munich, Germany

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Document reference
IFX-AAL444-003

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