Reverse-Conducting IGBT with monolithic body diode

Features

- V_{CE} = 650 V
- I_C = 30 A
- Powerful monolithic diode optimized for ZCS applications
- High ruggedness, temperature stable behavior
- Very low V_{CEsat} and low E_{off}
- Easy paralleling capability due to positive temperature coefficient in V_{CEsat}
- Low EMI
- Low electrical parameters depending (dependence) on temperature
- Qualified according to JESD-022 for target applications
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models: http://www.infineon.com/igbt/

Lead-Free

Green

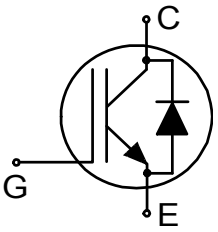
Halogen-Free

RoHS

Potential applications

- Welding
- PFC
- ZCS - converters

Description



Type	Package	Marking
IKW30N65WR5	PG-TO247-3	K30EWR5

Table of contents

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			13.0		nH
Storage temperature	T_{stg}		-55		150	°C
Soldering temperature		wave soldering 1.6 mm (0.063 in.) from case for 10 s			260	°C
Mounting torque	M	M3 screw Maximum of mounting process: 3			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		650	V
DC collector current, limited by T_{vjmax}	I_C		$T_c = 25$ °C	60	A
			$T_c = 117$ °C	30	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			90	A
Turn-off safe operating area		$V_{CE} \leq 650$ V, $T_{vj} \leq 175$ °C		90	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	185	W
			$T_c = 117$ °C	75	

Table 3 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter breakdown voltage	V_{BRCES}	$I_C = 0.2$ mA, $V_{GE} = 0$ V		650			V
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 30$ A, $V_{GE} = 15$ V	$T_{vj} = 25$ °C		1.4	1.8	V
			$T_{vj} = 175$ °C		1.65		
Gate-emitter threshold voltage	V_{GEth}	$I_C = 0.3$ mA, $V_{CE} = V_{GE}$		3.2	4	4.8	V

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Zero gate-voltage collector current	I_{CES}	V_{CE} = 650 V, V_{GE} = 0 V	T_{vj} = 25 °C			40	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V				100	nA
Transconductance	g_{fs}	I_C = 30 A, V_{CE} = 20 V			35		S
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			3700		pF
Output capacitance	C_{oes}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			35		pF
Reverse transfer capacitance	C_{res}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			16		pF
Gate charge	Q_G	I_C = 30 A, V_{GE} = 15 V, V_{CC} = 520 V			155		nC
Turn-on delay time	$t_{d(on)}$	V_{CC} = 400 V, V_{GE} = 0/15 V, R_{Gon} = 26 Ω, R_{Goff} = 26 Ω, L_σ = 45 nH, C_σ = 32 pF	T_{vj} = 25 °C, I_C = 15 A		39		ns
			T_{vj} = 175 °C, I_C = 15 A		35		
Rise time (inductive load)	t_r	V_{CC} = 400 V, V_{GE} = 0/15 V, R_{Gon} = 26 Ω, R_{Goff} = 26 Ω, L_σ = 45 nH, C_σ = 32 pF	T_{vj} = 25 °C, I_C = 15 A		12		ns
			T_{vj} = 175 °C, I_C = 15 A		14		
Turn-off delay time	$t_{d(off)}$	V_{CC} = 400 V, V_{GE} = 0/15 V, R_{Gon} = 26 Ω, R_{Goff} = 26 Ω, L_σ = 45 nH, C_σ = 32 pF	T_{vj} = 25 °C, I_C = 15 A		367		ns
			T_{vj} = 175 °C, I_C = 15 A		484		
Fall time (inductive load)	t_f	V_{CC} = 400 V, V_{GE} = 0/15 V, R_{Gon} = 26 Ω, R_{Goff} = 26 Ω, L_σ = 45 nH, C_σ = 32 pF	T_{vj} = 25 °C, I_C = 15 A		9		ns
			T_{vj} = 175 °C, I_C = 15 A		9		
Turn-on energy	E_{on}	V_{CC} = 400 V, V_{GE} = 0/15 V, R_{Gon} = 26 Ω, R_{Goff} = 26 Ω, L_σ = 45 nH, C_σ = 32 pF	T_{vj} = 25 °C, I_C = 15 A		0.47		mJ
			T_{vj} = 175 °C, I_C = 15 A		0.53		
Turn-off energy	E_{off}	V_{CC} = 400 V, V_{GE} = 0/15 V, R_{Gon} = 26 Ω, R_{Goff} = 26 Ω, L_σ = 45 nH, C_σ = 32 pF	T_{vj} = 25 °C, I_C = 15 A		0.1		mJ
			T_{vj} = 175 °C, I_C = 15 A		0.22		
Total switching energy	E_{ts}	V_{CC} = 400 V, V_{GE} = 0/15 V, R_{Gon} = 26 Ω, R_{Goff} = 26 Ω, L_σ = 45 nH, C_σ = 32 pF	T_{vj} = 25 °C, I_C = 15 A		0.57		mJ
			T_{vj} = 175 °C, I_C = 15 A		0.75		

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
IGBT thermal resistance, junction to case	$R_{th(j-c)}$				0.81	K/W
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		650	V
Diode forward current, limited by T_{vjmax}	I_F		T_c = 25 °C	24	A
			T_c = 100 °C	15	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			45	A

Table 5 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 15 A	T_{vj} = 25 °C		1.4	1.9	V
			T_{vj} = 175 °C		1.5		
Diode reverse recovery time	t_{rr}	V_R = 400 V	T_{vj} = 25 °C, I_F = 15 A, $-di_F/dt$ = 900 A/µs		95		ns
			T_{vj} = 175 °C, I_F = 15 A, $-di_F/dt$ = 900 A/µs		121		
Diode reverse recovery charge	Q_{rr}	V_R = 400 V	T_{vj} = 25 °C, I_F = 15 A, $-di_F/dt$ = 900 A/µs		1.25		µC
			T_{vj} = 175 °C, I_F = 15 A, $-di_F/dt$ = 900 A/µs		2.15		

(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	T_{vj} = 25 °C, I_F = 15 A, $-di_F/dt$ = 900 A/µs		22		A
			T_{vj} = 175 °C, I_F = 15 A, $-di_F/dt$ = 900 A/µs		28		
Diode peak rate of fall of reverse recovery current	di_{rr}/dt	V_R = 400 V	T_{vj} = 25 °C, I_F = 15 A, $-di_F/dt$ = 900 A/µs		590		A/µs
			T_{vj} = 175 °C, I_F = 15 A, $-di_F/dt$ = 900 A/µs		1100		
Diode thermal resistance, junction to case	$R_{th(j-c)}$					3.4	K/W
Operating junction temperature	T_{vj}			-40		175	°C

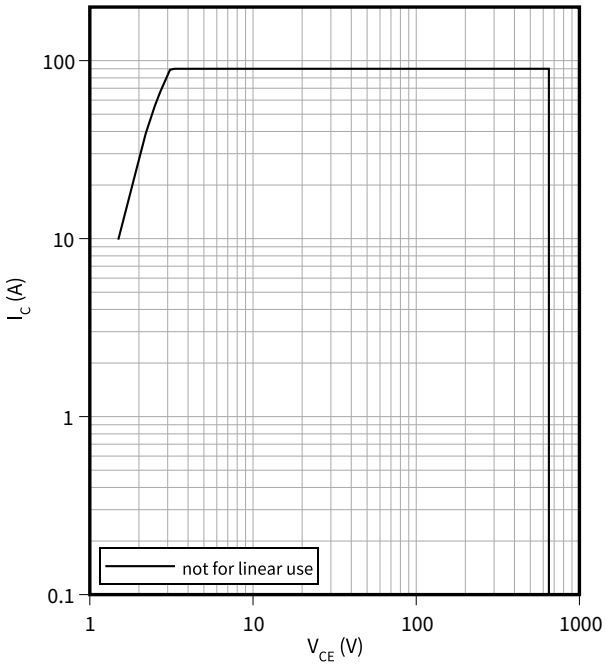
Note: For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

4 Characteristics diagrams

Reverse bias safe operating area

$I_C = f(V_{CE})$

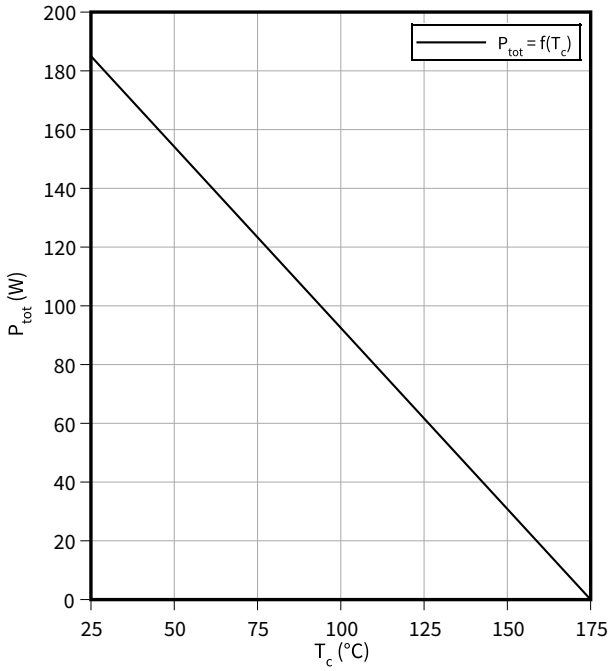
$T_{vj} \leq 175$ °C, $V_{GE} = 15$ V, $T_c = 25$ °C



Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$

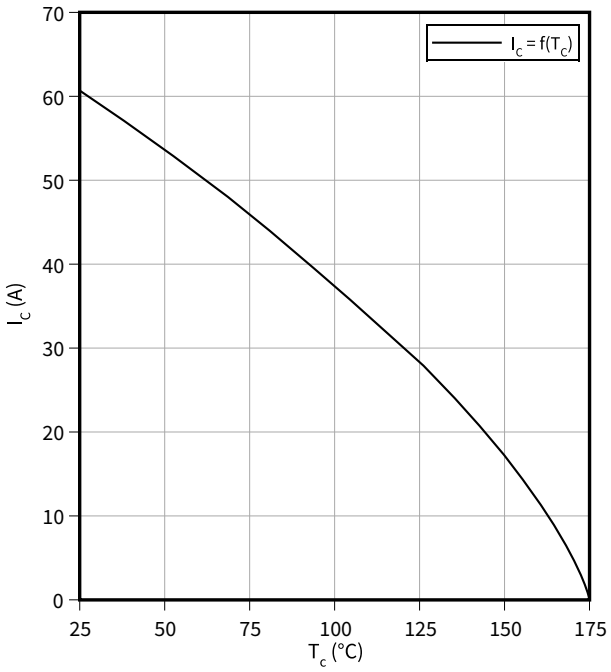
$T_{vj} \leq 175$ °C



Collector current as a function of case temperature

$I_C = f(T_c)$

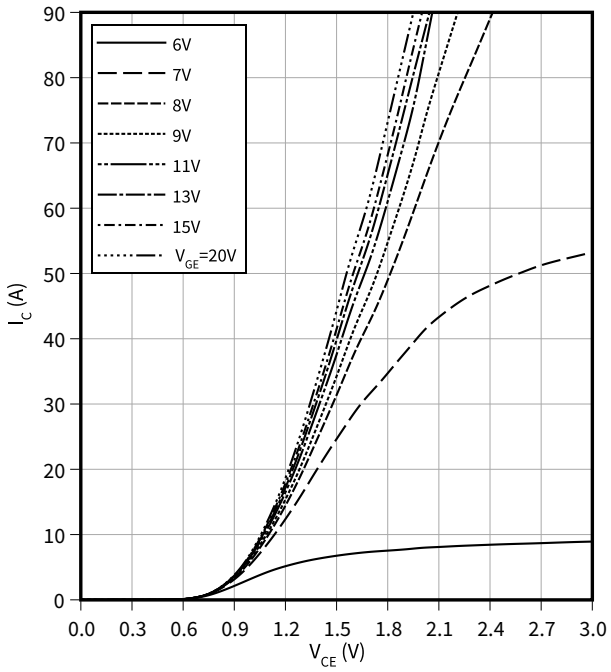
$T_{vj} \leq 175$ °C, $V_{GE} \geq 15$ V



Typical output characteristic

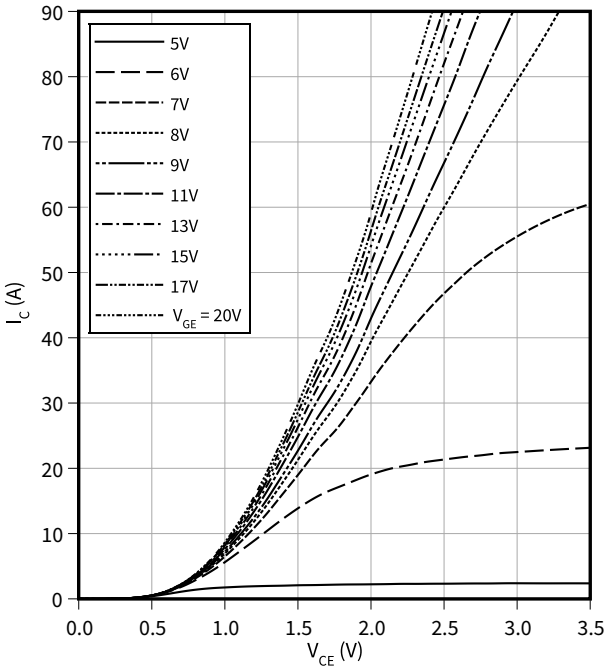
$I_C = f(V_{CE})$

$T_{vj} = 25$ °C



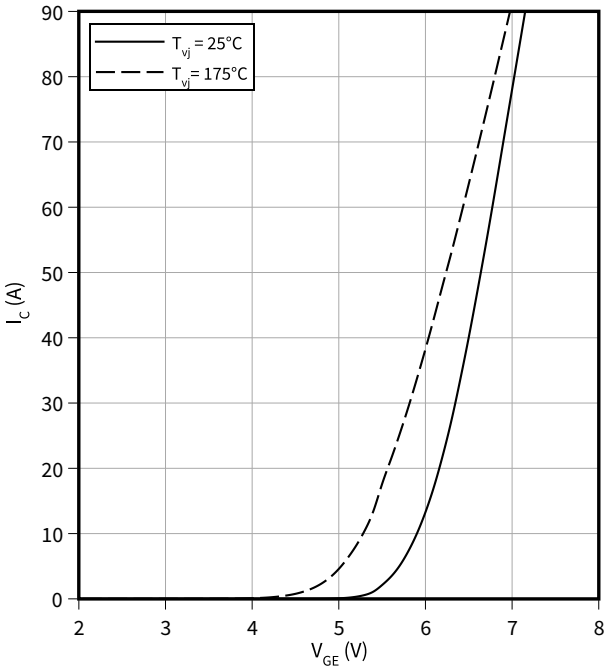
Typical output characteristic

$I_C = f(V_{CE})$
$T_{vj} = 175\ °C$



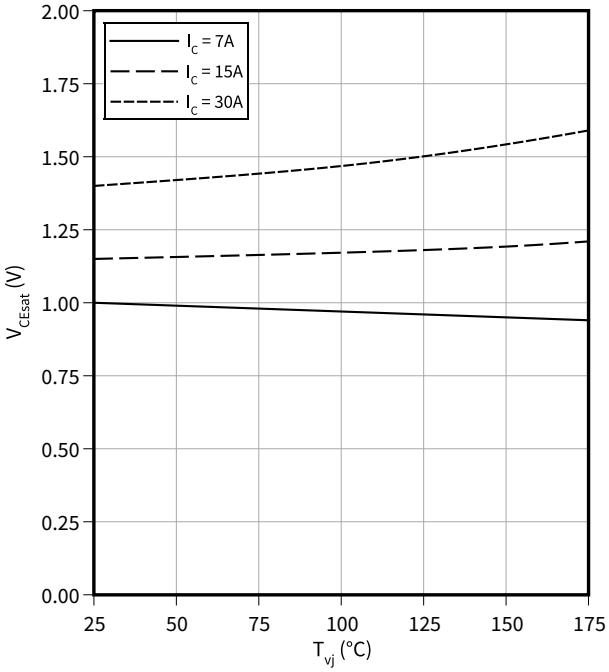
Typical transfer characteristic

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



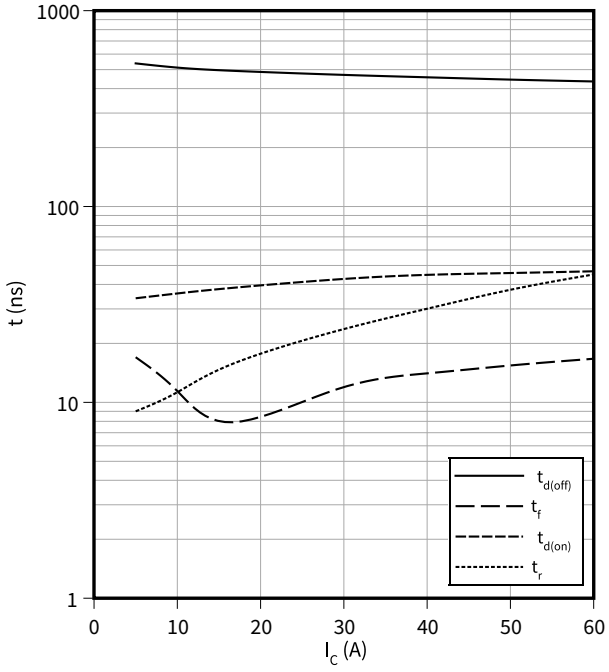
Typical collector-emitter saturation voltage as a function of junction temperature

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



Typical switching times as a function of collector current

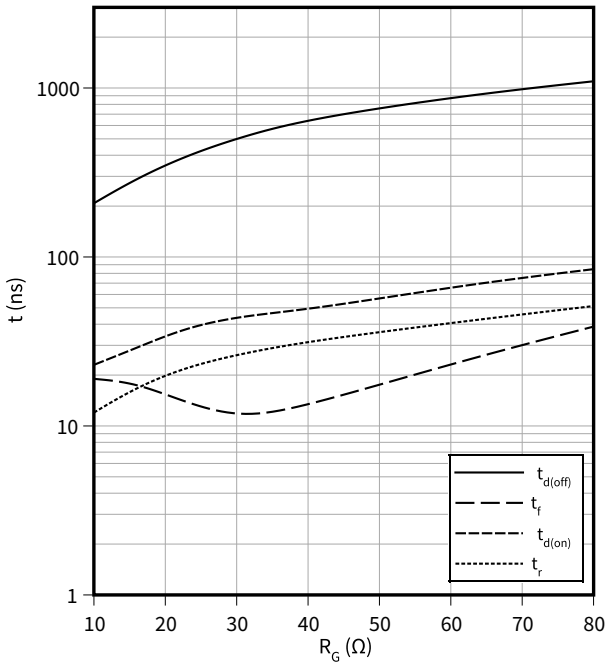
$t = f(I_C)$
$V_{CC} = 400\ V,\ T_{vj} = 175\ °C,\ V_{GE} = 0/15\ V,\ R_G = 26\ \Omega$



Typical switching times as a function of gate resistor

$t = f(R_G)$

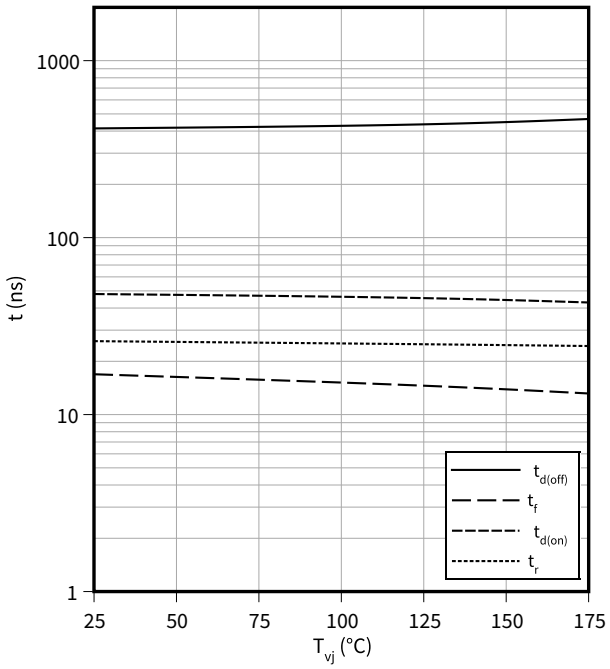
$I_C = 30\ A$, $V_{CC} = 400\ V$, $T_{vj} = 175\ °C$, $V_{GE} = 0/15\ V$



Typical switching times as a function of junction temperature

$t = f(T_{vj})$

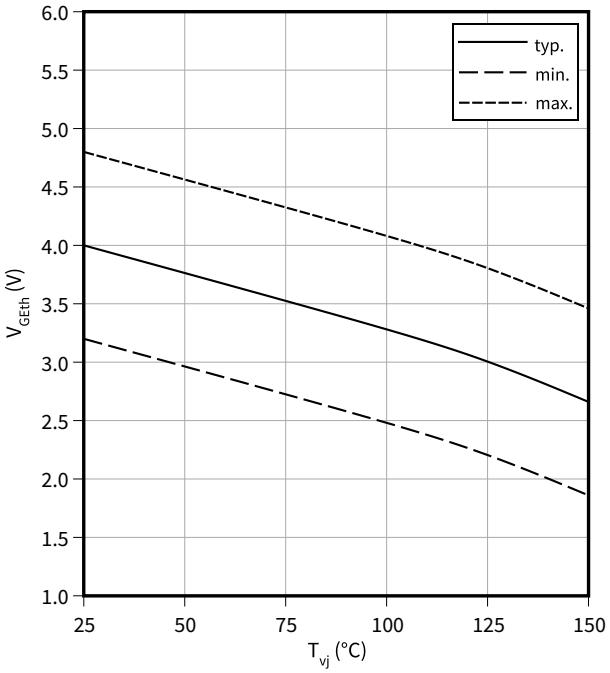
$I_C = 30\ A$, $V_{CC} = 400\ V$, $V_{GE} = 0/15\ V$, $R_G = 26\ Ω$



Gate-emitter threshold voltage as a function of junction temperature

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

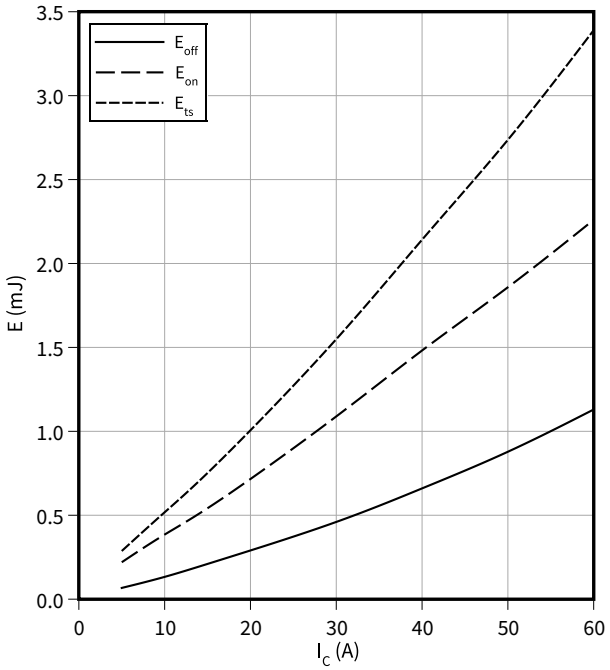
$I_C = 0.3\ mA$



Typical switching energy losses as a function of collector current

$E = f(I_C)$

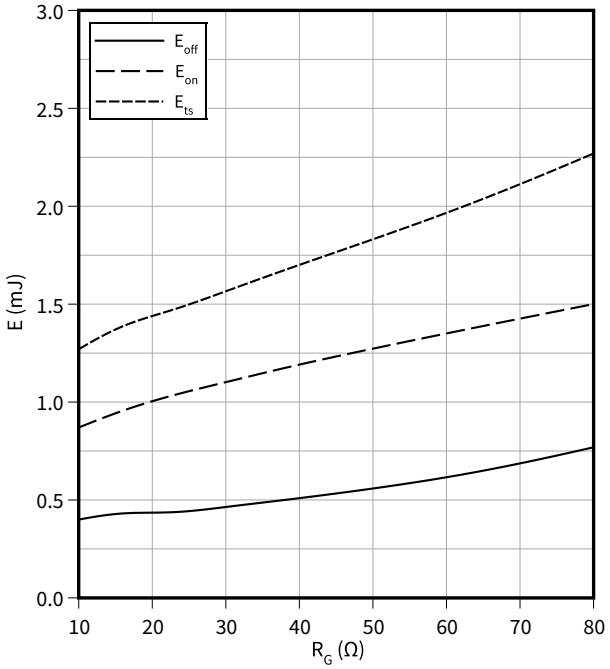
$V_{CC} = 400\ V$, $T_{vj} = 175\ °C$, $V_{GE} = 0/15\ V$, $R_G = 26\ Ω$



Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

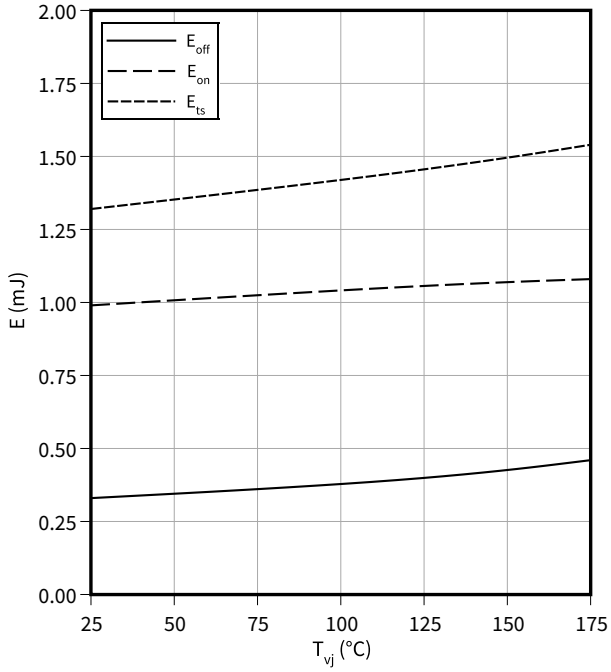
$I_C = 30\ A$, $V_{CC} = 400\ V$, $T_{vj} = 175\ °C$, $V_{GE} = 0/15\ V$



Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

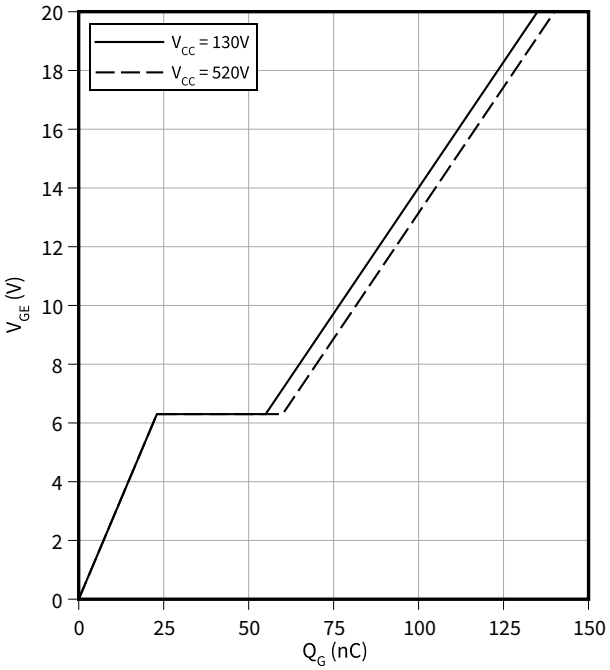
$I_C = 30\ A$, $V_{CC} = 400\ V$, $V_{GE} = 0/15\ V$, $R_G = 26\ Ω$



Typical gate charge

$V_{GE} = f(Q_G)$

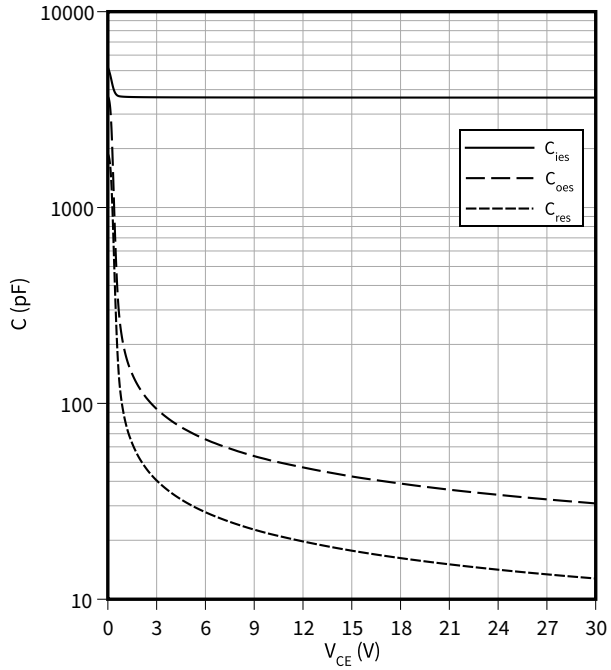
$I_C = 30\ A$



Typical capacitance as a function of collector-emitter voltage

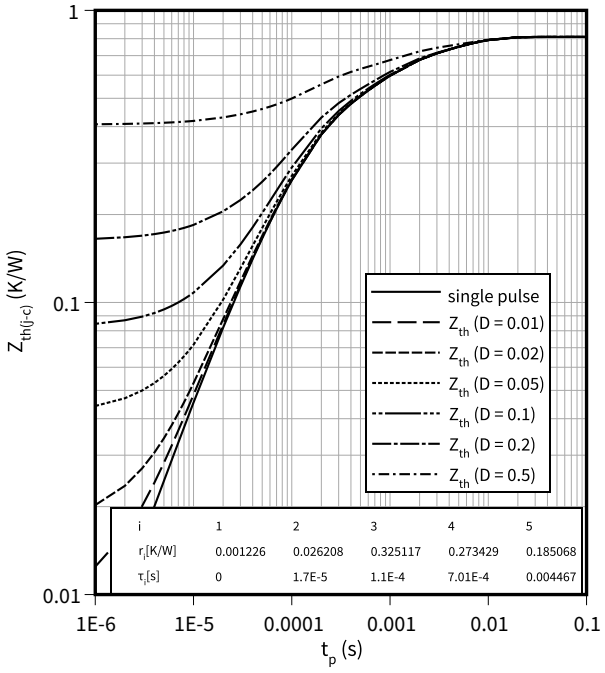
$C = f(V_{CE})$

$f = 1000\ kHz$, $V_{GE} = 0\ V$



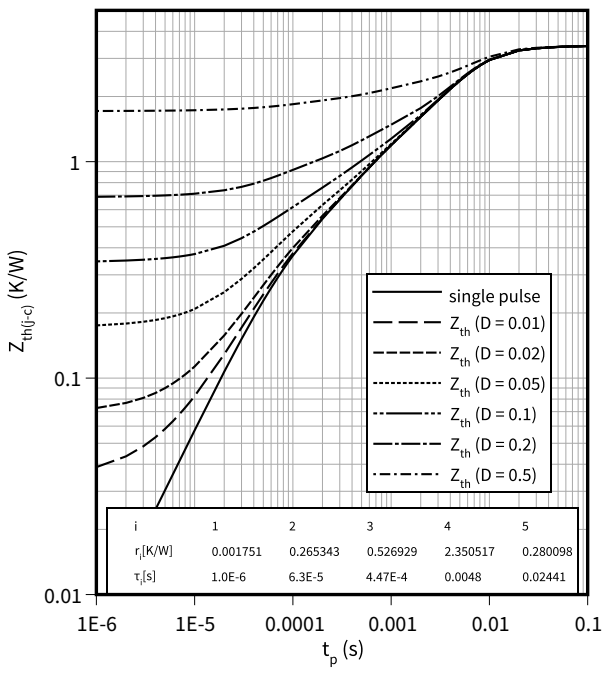
IGBT transient thermal impedance as a function of pulse width

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



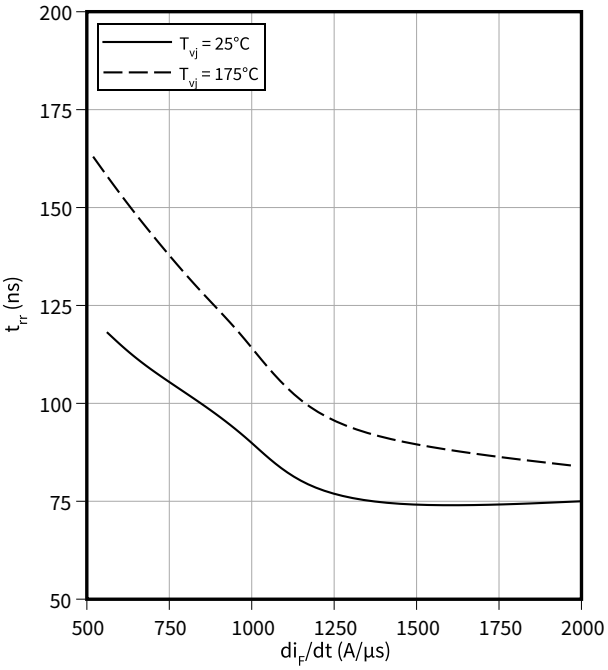
Diode transient thermal impedance as a function of pulse width

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



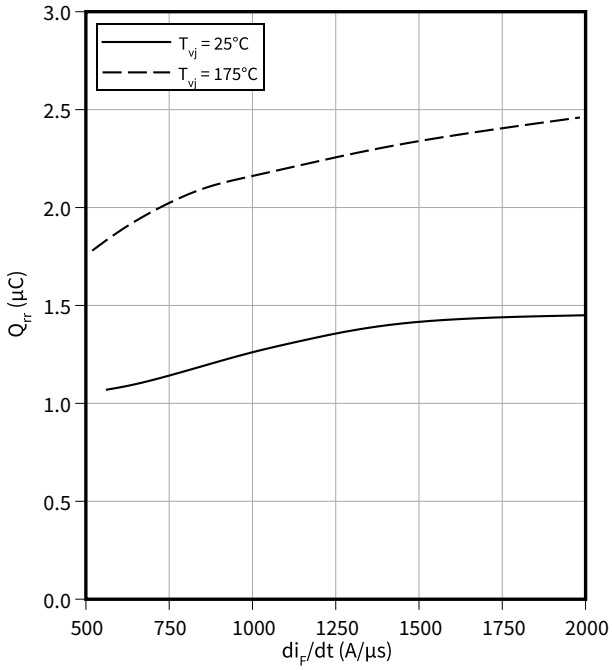
Typical reverse recovery time as a function of diode current slope

$t_{rr} = f(di_F/dt)$
$V_R = 400$ V, $I_F = 15$ A



Typical reverse recovery charge as a function of diode current slope

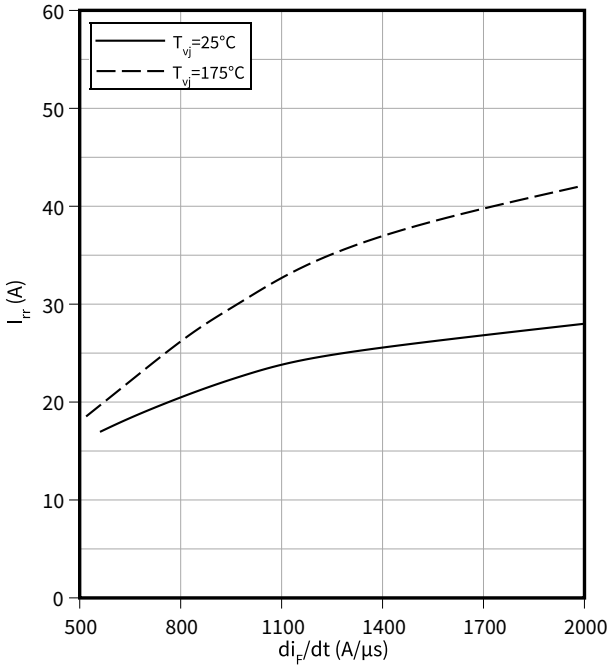
$Q_{rr} = f(di_F/dt)$
$V_R = 400$ V, $I_F = 15$ A



Typical reverse recovery current as a function of diode current slope

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

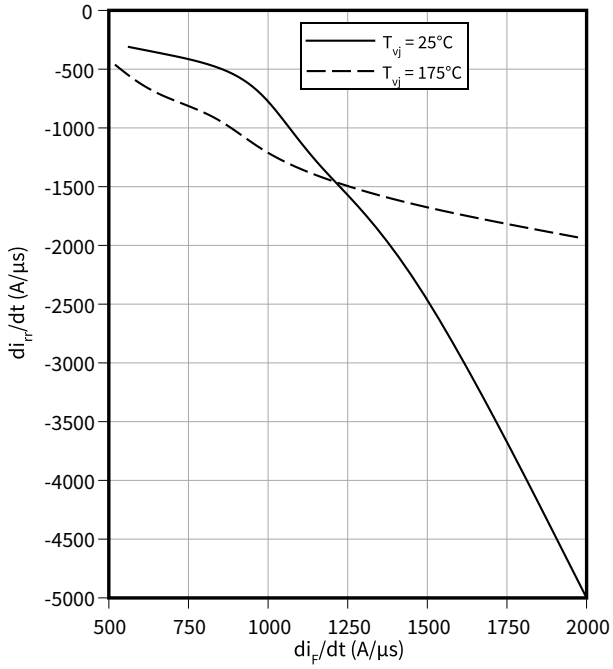
$V_R = 400\ V$, $I_F = 15\ A$



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

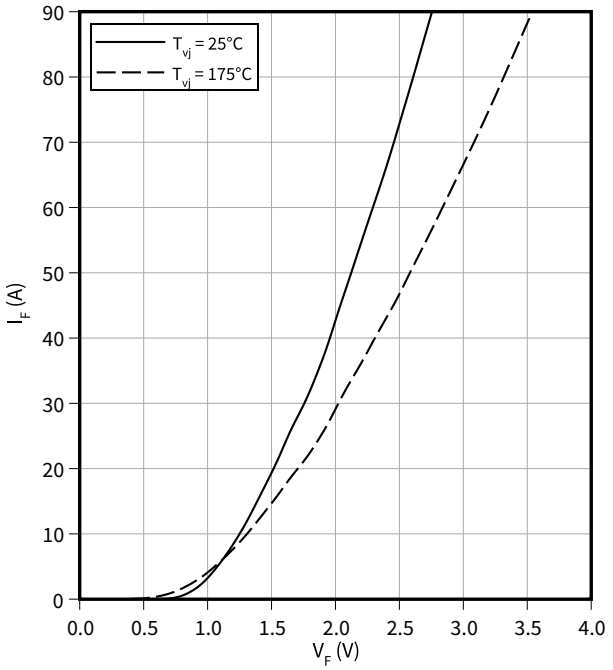
$di_{rr}/dt = f(di_F/dt)$

$V_R = 400\ V$, $I_F = 15\ A$



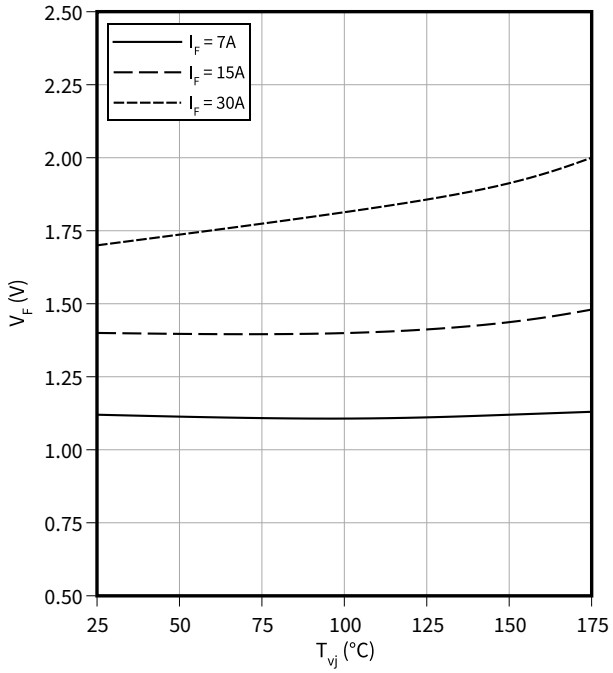
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



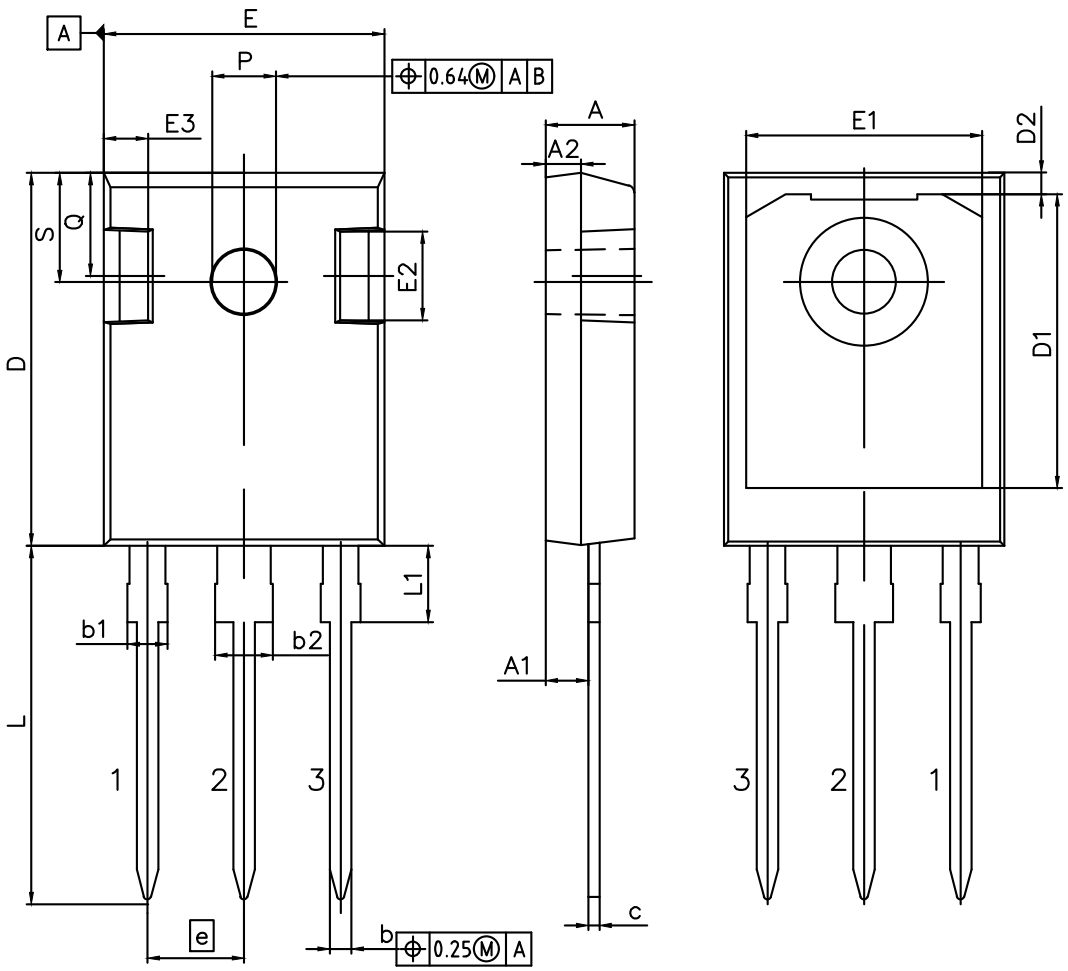
Typical diode forward voltage as a function of junction temperature

$V_F = f(T_{vj})$



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 1

6 Testing conditions

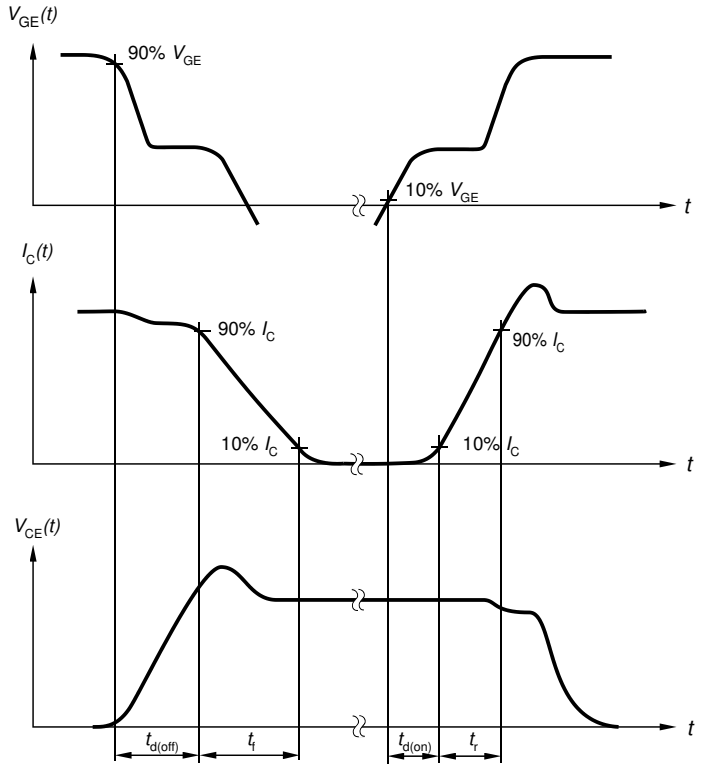


Figure A. **Definition of switching times**

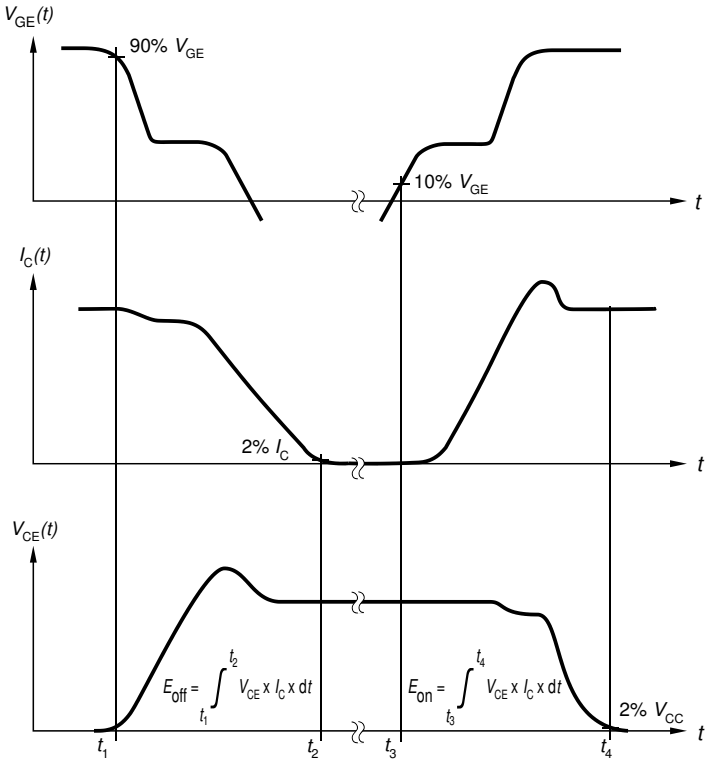


Figure B. **Definition of switching losses**

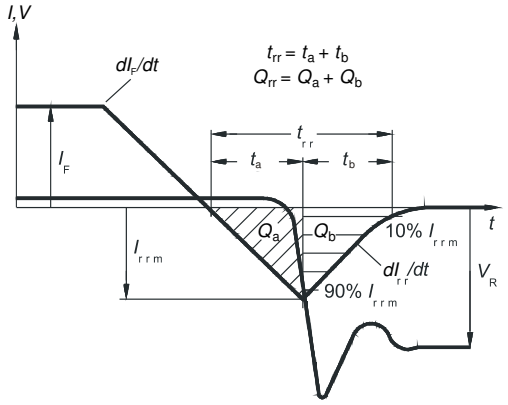


Figure C. **Definition of diode switching characteristics**

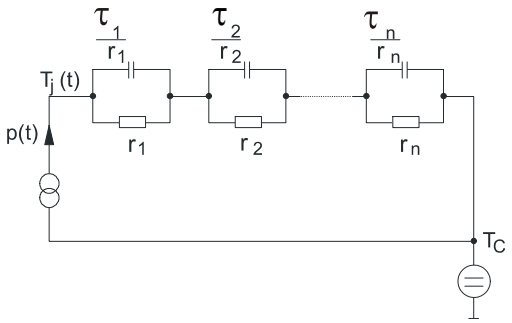


Figure D. **Thermal equivalent circuit**

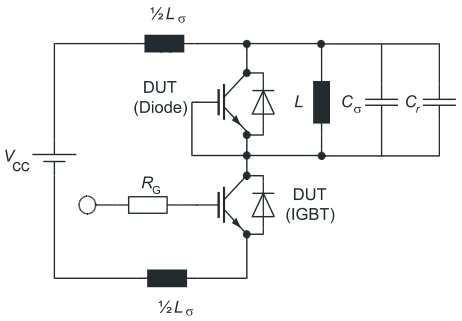


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Figure 2

Revision history

Document revision	Date of release	Description of changes
V1.1	2015-04-23	Preliminary data sheet
V1.2	2015-05-12	Minor change Figure 3
V1.3	2015-06-01	Update Figure 14 E(T)
V2.1	2015-12-10	Final data sheet
V2.2	2016-10-14	New switching parameters for IGBT at Ic=15A
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
1.10	2022-03-08	Added transient gate-emitter voltage
1.20	2022-05-06	Transient gate-emitter voltage V_{GE} added in table “Maximum rated values” of IGBT Update of switching energy values in table “Characteristic values” “Forward bias safe operating area” diagram renamed to “Reverse bias safe operating area”

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