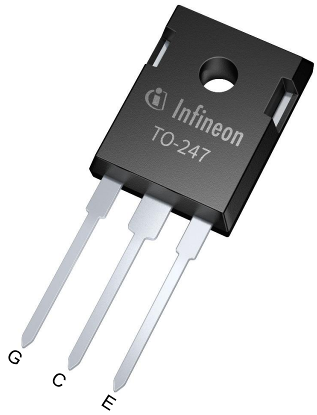
Reverse-Conducting IGBT with monolithic body diode



Features

- V_{CE} = 1400 V
- I_C = 40 A
- Powerful monolithic body diode with low forward voltage designed for soft commutation only
- Very tight parameter distribution
- High ruggedness, temperature stable behavior
- Very low V_{CEsat}
- Easy paralleling capability due to positive temperature coefficient in V_{CEsat}
- Low EMI
- Qualified according to JESD-022 for target applications
- Pb-free lead plating; RoHS compliant
- Halogen free (according to IEC 61249-2-21)
- Complete product spectrum and PSpice Models: http://www.infineon.com/igbt/

Lead-free
Green
Halogen-free
RoHS

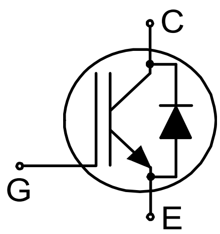
Potential applications

- Induction cooker
- Microwave ovens

Product validation

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

Description



Type	Package	Marking
IHW40N140R5L	PG-TO247-3-STD-NN2.5	H40QR5L

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		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	$R_{th(j-c)}$				0.41	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$				0.41	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		1400	V
DC collector current, limited by T_{vjmax}	I_C	limited by bondwire	$T_c = 25$ °C	80	A
			$T_c = 100$ °C	72	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			120	A
Non repetitive peak collector current[1)]	I_{CSM}			200	A
Turn-off safe operating area[2)]		$V_{CE} \leq 1400$ V, $T_{vj} \leq 175$ °C		120	A
Gate-emitter voltage	V_{GE}			±20	V
Transient gate-emitter voltage	V_{GE}	$t_p \leq 10$ µs, $D < 0.01$		±25	V
Power dissipation	P_{tot}		$T_c = 25$ °C	366	W
			$T_c = 100$ °C	183	

1) capacitor charging saturation current limited by $T_{vjmax} < 175$°C and $t_p < 3$ µs
2) dV/dt < 1 kV/µs

Table 3 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter breakdown voltage	V_{BRCES}	I_C = 0.5 mA, V_{GE} = 0 V		1400			V
Collector-emitter saturation voltage	V_{CEsat}	I_C = 40 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.65	1.95	V
			T_{vj} = 125 °C		1.8		
			T_{vj} = 175 °C		1.9		
Gate-emitter threshold voltage	V_{GEth}	I_C = 0.63 mA, V_{CE} = V_{GE}		4	5.6	6.2	V
Zero gate-voltage collector current	I_{CES}	V_{CE} = 1400 V, V_{GE} = 0 V	T_{vj} = 25 °C			100	µA
			T_{vj} = 175 °C		920		
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V				100	nA
Transconductance	g_{fs}	I_C = 40 A, V_{CE} = 20 V			35.4		S
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			2020		pF
Output capacitance	C_{oes}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			57		pF
Reverse transfer capacitance	C_{res}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			48		pF
Gate charge	Q_G	V_{CC} = 1120 V, I_C = 40 A, V_{GE} = 15 V			260		nC
Turn-off delay time	$t_{d(off)}$	V_{GE} = 0/15 V, $R_{G(off)}$ = 10 Ω, C_r = 270 nF, L = 77 µH, R = 2.2 Ω	T_{vj} = 25 °C, I_C = 40 A		225		ns
			T_{vj} = 175 °C, I_C = 40 A		235		
Fall time (inductive load)	t_f	V_{GE} = 0/15 V, $R_{G(off)}$ = 10 Ω, C_r = 270 nF, L = 77 µH, R = 2.2 Ω	T_{vj} = 25 °C, I_C = 40 A		1005		ns
			T_{vj} = 175 °C, I_C = 40 A		1775		
Soft turn-off energy	E_{off}	V_{GE} = 0/15 V, $R_{G(off)}$ = 10 Ω, C_r = 270 nF, L = 77 µH, R = 2.2 Ω	T_{vj} = 25 °C, I_C = 40 A		0.24		mJ
			T_{vj} = 175 °C, I_C = 40 A		0.64		
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	71	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			120	A

Table 5 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	$I_F = 40$ A	$T_{vj} = 25$ °C		1.7	1.95	V
			$T_{vj} = 125$ °C		1.9		
			$T_{vj} = 175$ °C		2		
Operating junction temperature	T_{vj}			-40		175	°C

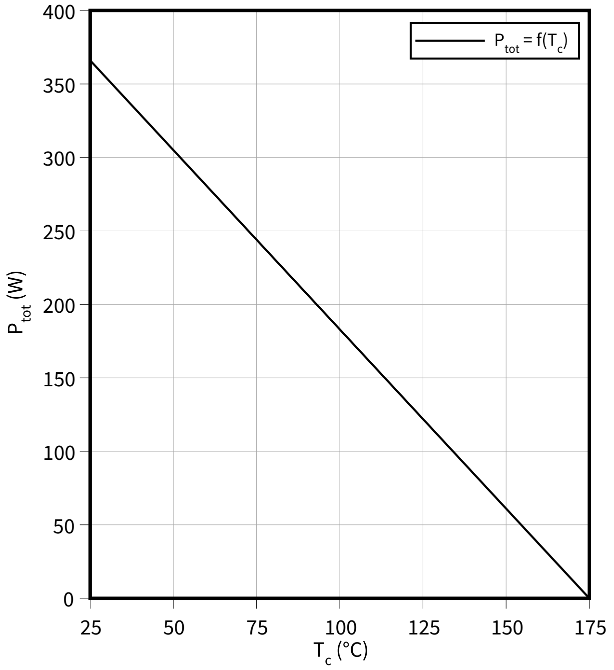
Note: For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

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

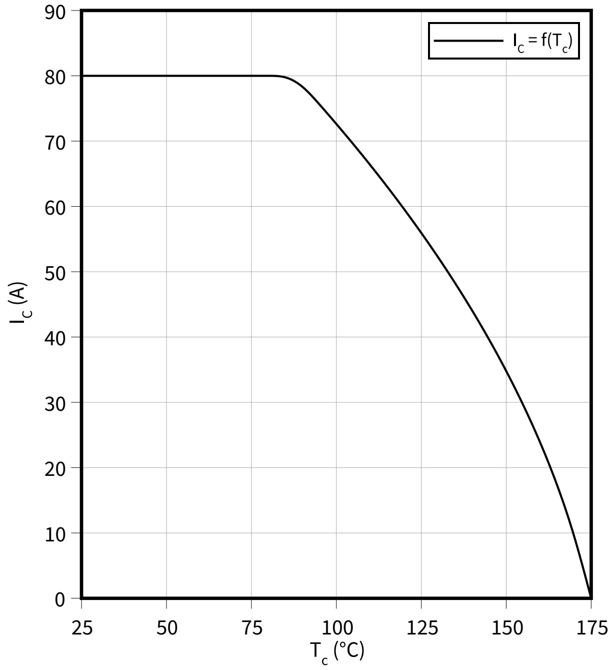
Dynamic test circuit, energy losses include “tail” according to Figure B. (Test circuit Figure E).

4 Characteristics diagrams

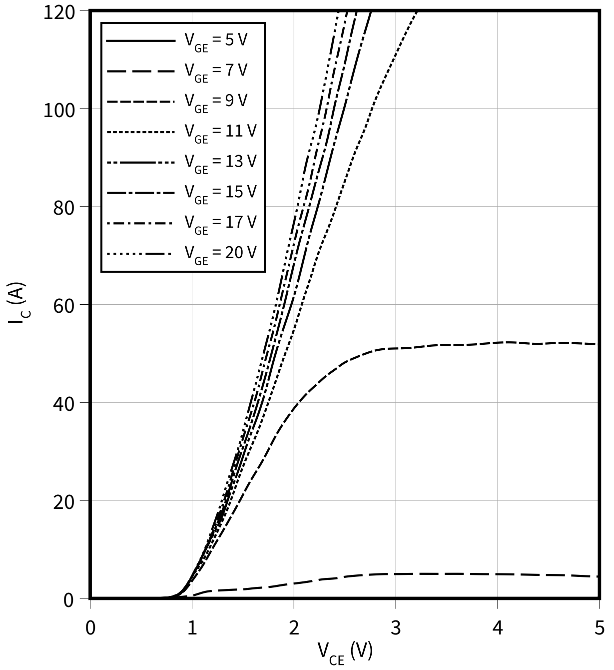
Power dissipation as a function of case temperature
$P_{tot} = f(T_c)$
$T_{vj} \leq 175$ °C



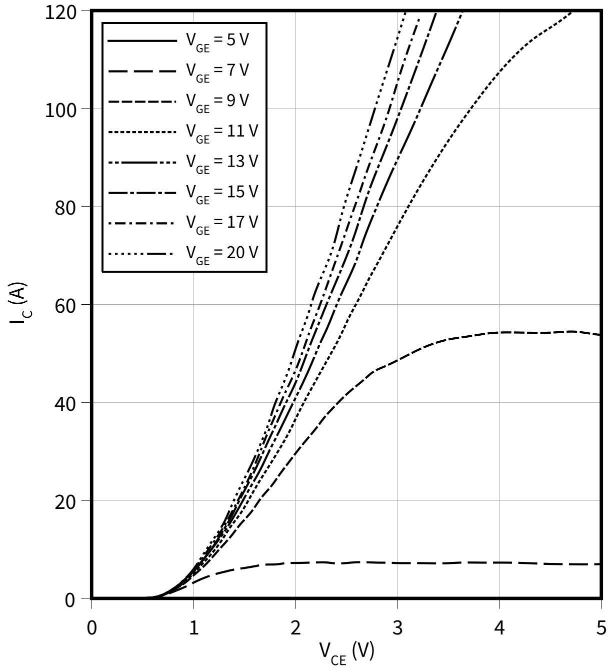
Collector current as a function of case temperature
$I_C = f(T_c)$
$T_{vj} \leq 175$ °C, $V_{GE} \geq 15$ V



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



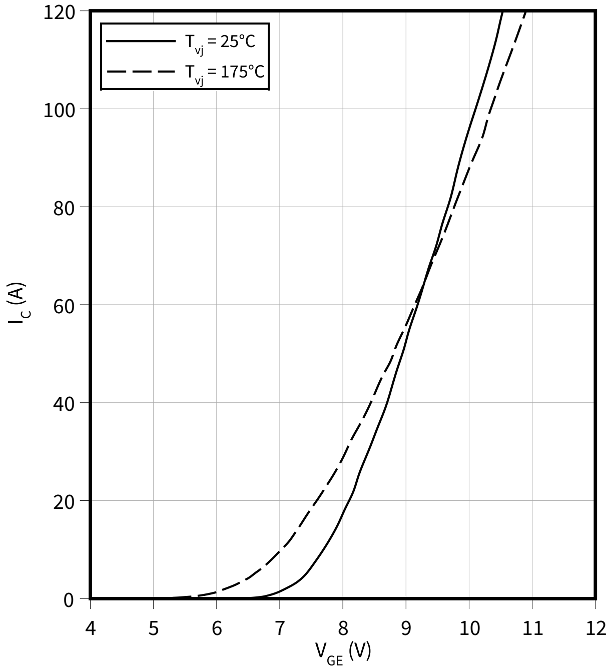
Typical output characteristic
$I_C = f(V_{CE})$
$T_{vj} = 175$ °C



Typical transfer characteristic

$I_C = f(V_{GE})$

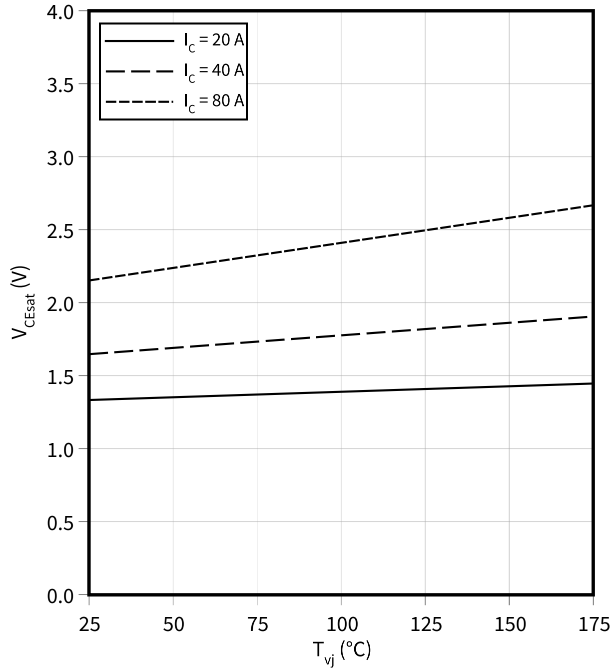
$V_{CE} = 20$ V



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

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

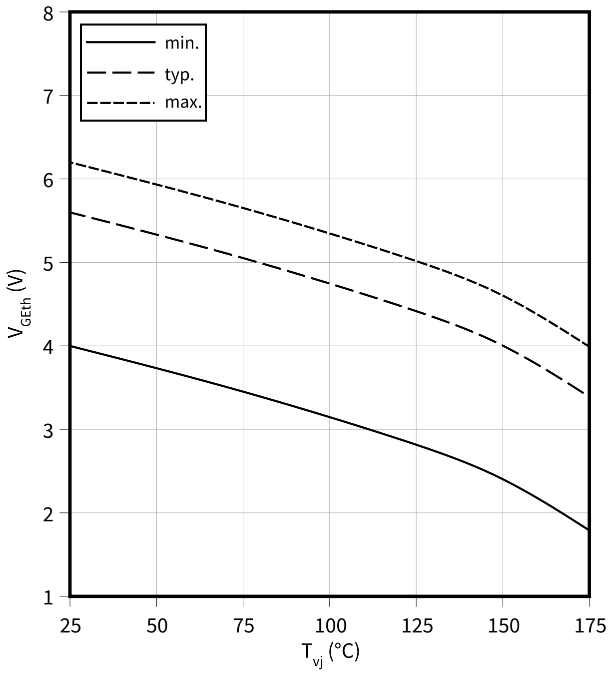
$V_{GE} = 15$ V



Gate-emitter threshold voltage as a function of junction temperature

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

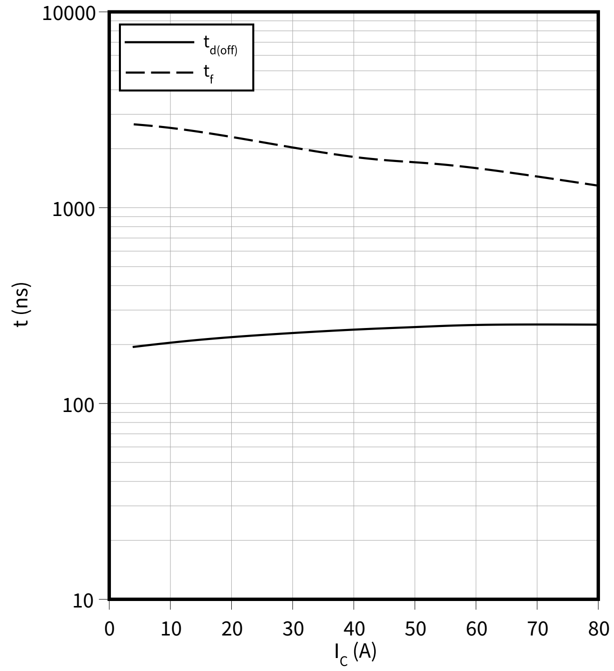
$I_C = 0.63$ mA



Typical switching times as a function of collector current

$t = f(I_C)$

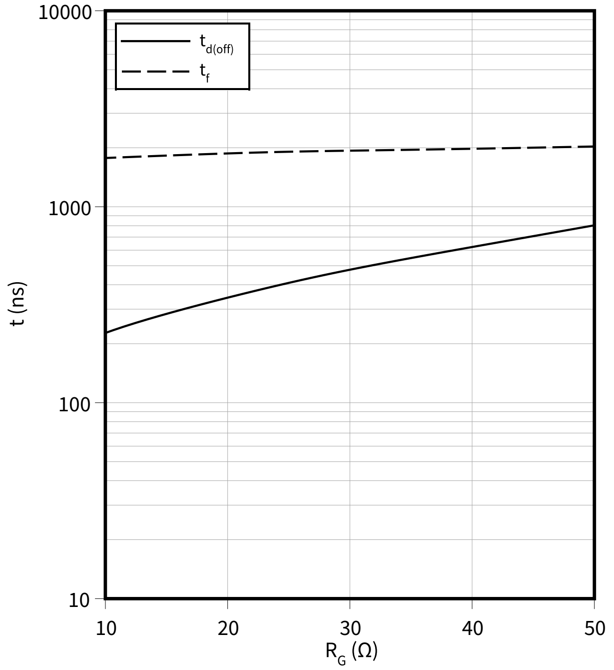
$T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $C_r = 270$ nF, $R_G = 10\ \Omega$



Typical switching times as a function of gate resistor

$t = f(R_G)$

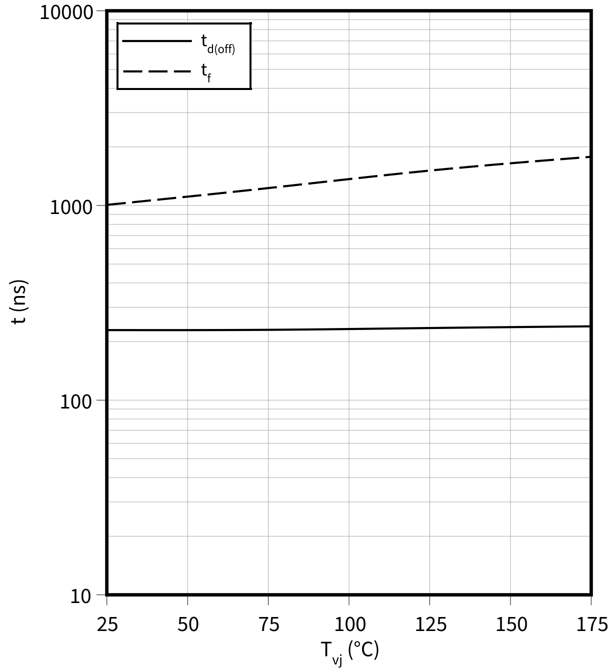
I_C = 40 A, T_{vj} = 175 °C, V_{GE} = 0/15 V, C_r = 270 nF



Typical switching times as a function of junction temperature

$t = f(T_{vj})$

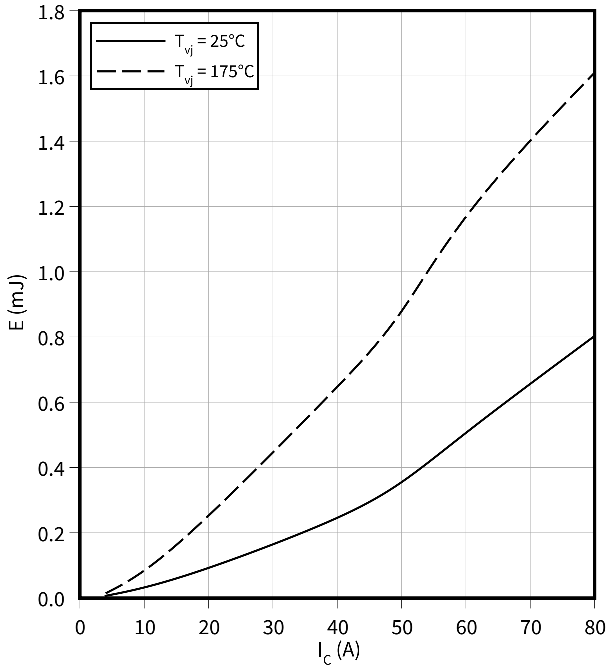
I_C = 40 A, V_{GE} = 0/15 V, C_r = 270 nF, R_G = 10 Ω



Typical switching energy losses as a function of collector current

$E = f(I_C)$

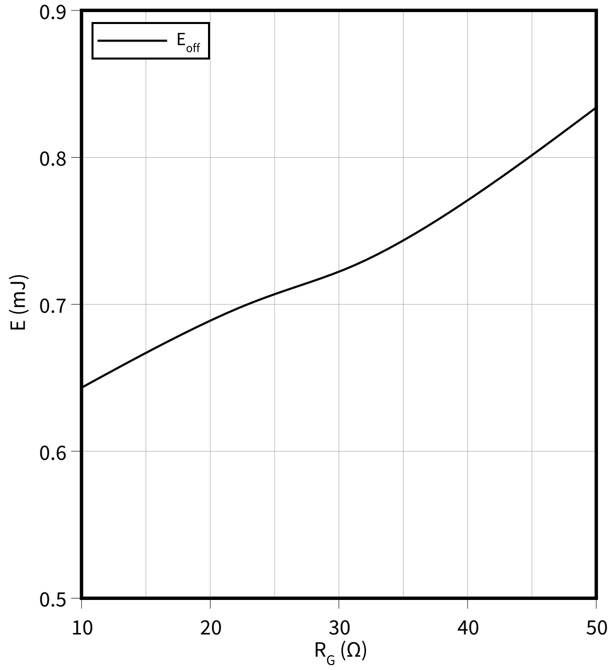
V_{GE} = 0/15 V, C_r = 270 nF, R_G = 10 Ω



Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

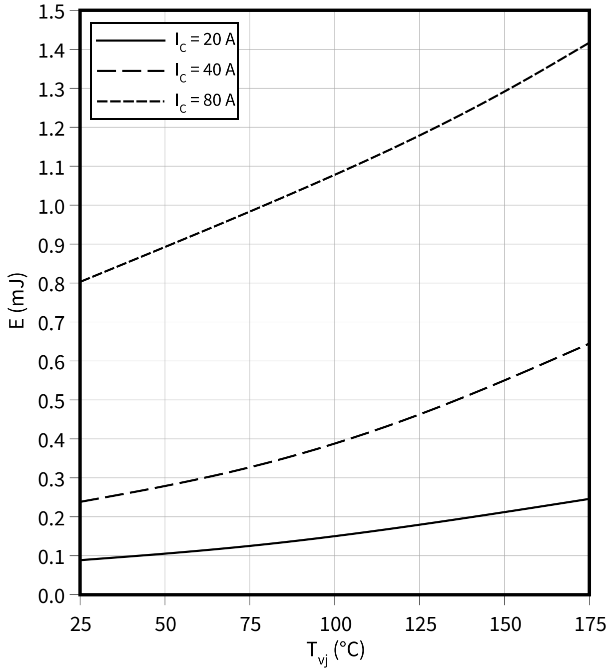
I_C = 40 A, T_{vj} = 175 °C, V_{GE} = 0/15 V, C_r = 270 nF



Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

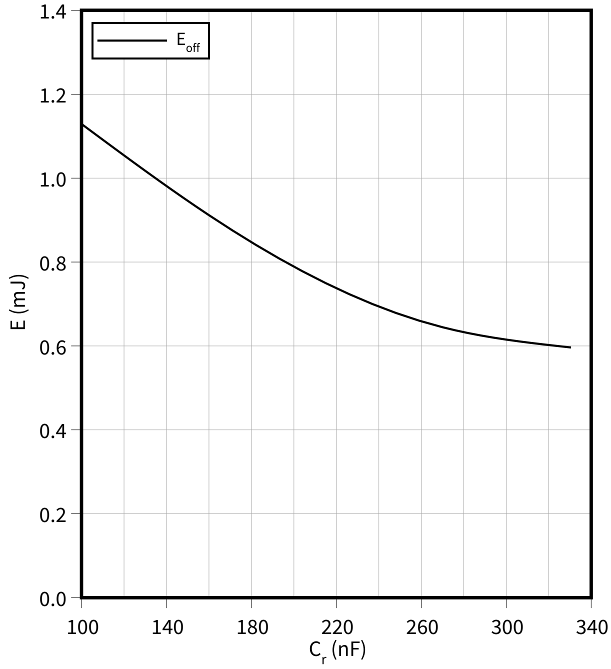
V_{GE} = 0/15 V, C_r = 270 nF, R_G = 10 Ω



Typical switching energy losses as a function of resonant capacitance

$E = f(C_r)$

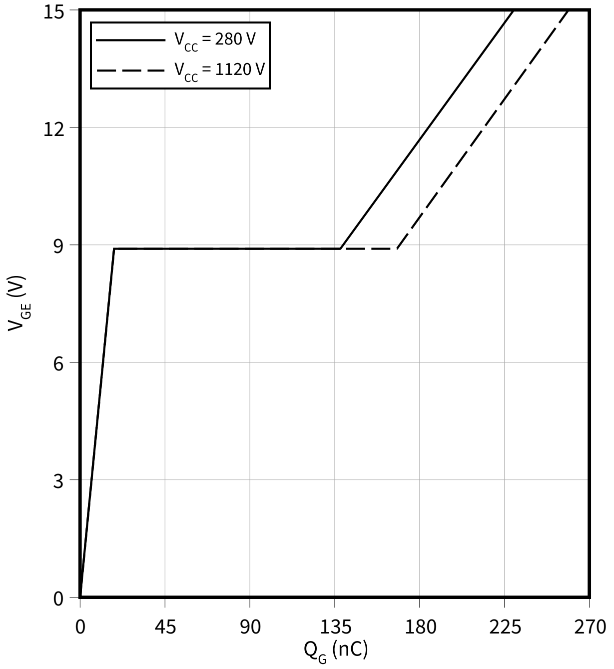
I_C = 40 A, T_{vj} = 175 °C, V_{GE} = 0/15 V, R_G = 10 Ω



Typical gate charge

$V_{GE} = f(Q_G)$

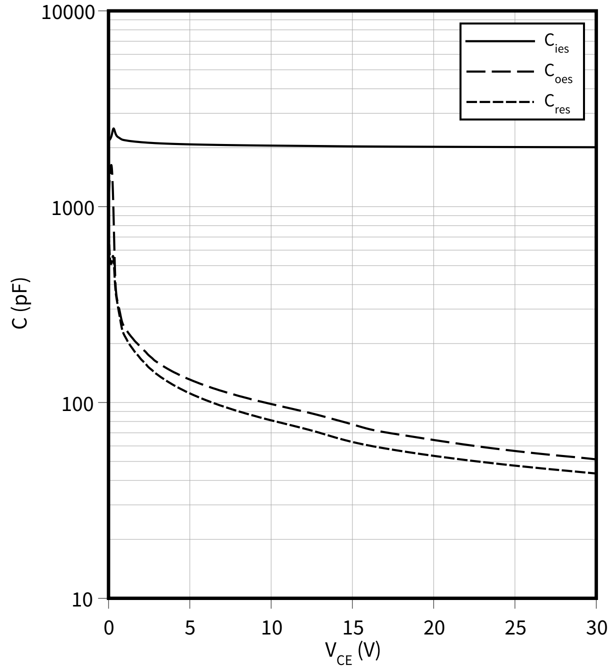
I_C = 40 A



Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$

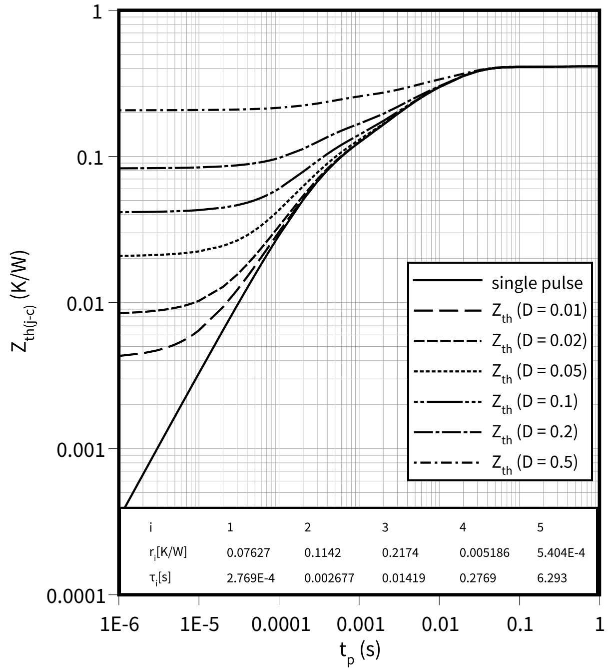
f = 100 kHz, V_{GE} = 0 V



IGBT transient thermal impedance as a function of pulse width

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

$D = t_p/T$

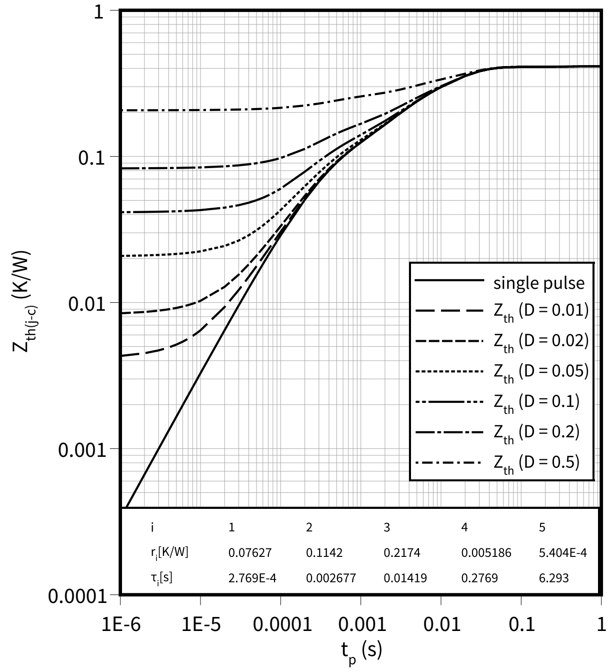


i	1	2	3	4	5
r_i[K/W]	0.07627	0.1142	0.2174	0.005186	5.404E-4
τ_i[s]	2.769E-4	0.002677	0.01419	0.2769	6.293

Diode transient thermal impedance as a function of pulse width

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

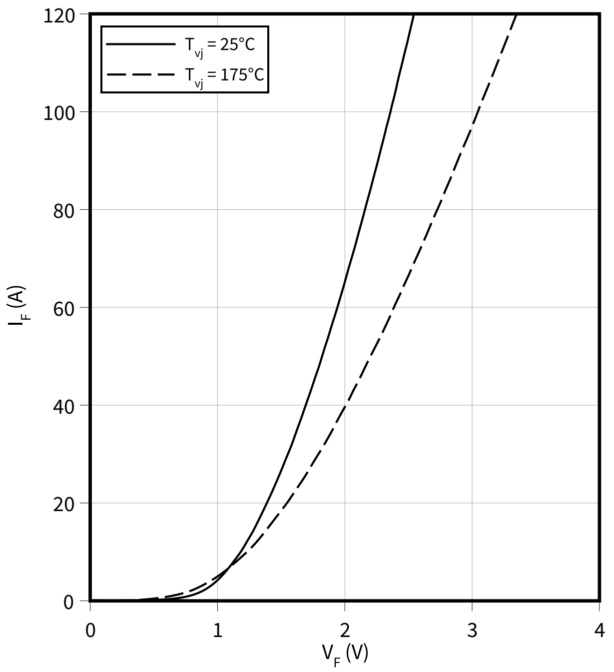
$D = t_p/T$



i	1	2	3	4	5
r_i[K/W]	0.07627	0.1142	0.2174	0.005186	5.404E-4
τ_i[s]	2.769E-4	0.002677	0.01419	0.2769	6.293

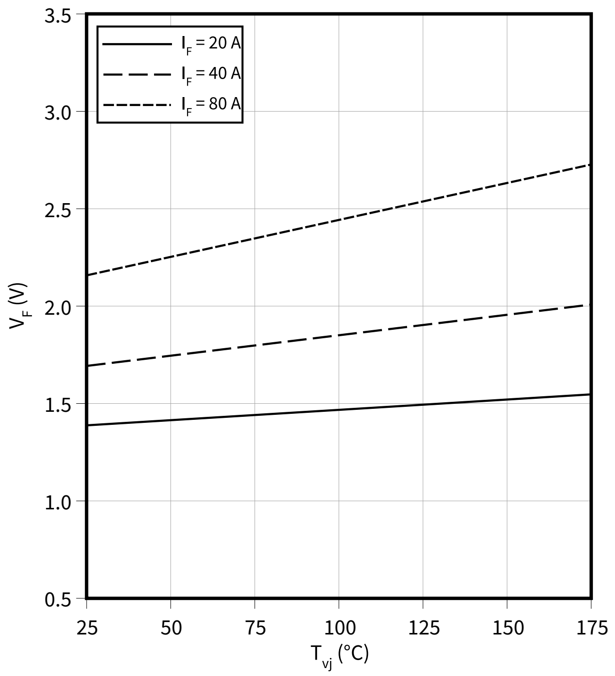
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



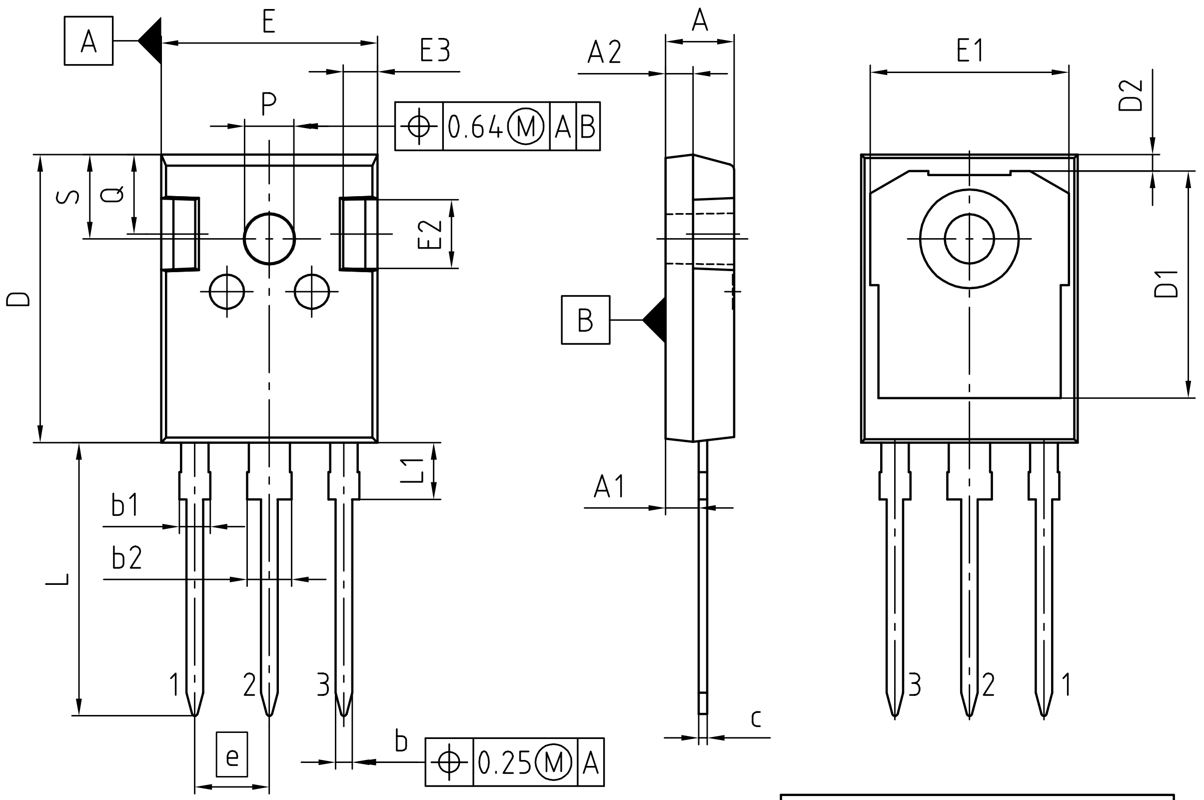
Typical diode forward voltage as a function of junction temperature

$V_F = f(T_{vj})$



5 Package outlines

PG-TO247-3-STD-NN2.5



PACKAGE - GROUP NUMBER:	PG-TO247-3-U06	
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.83	5.21
A1	2.27	2.54
A2	1.85	2.16
b	1.07	1.33
b1	1.90	2.41
b2	2.87	3.38
c	0.55	0.68
D	20.80	21.10
D1	16.25	17.65
D2	0.95	1.35
E	15.70	16.13
E1	13.10	14.15
E2	3.68	5.10
E3	1.00	2.60
e	5.44	
N	3	
L	19.80	20.32
L1	4.10	4.47
øP	3.50	3.70
Q	5.49	6.00
S	6.04	6.30

NOTE:
DIMENSIONS DO NOT INCLUDE MOLDFLASH; PROTRUSION OR GATE BURRS

Figure 1

6 Testing conditions

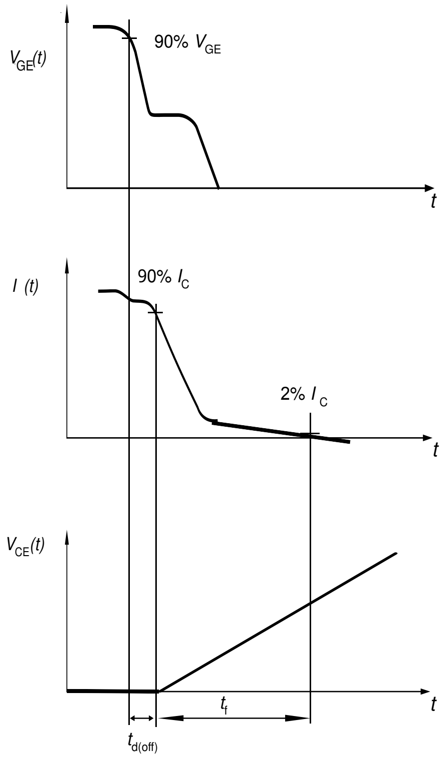


Figure A. **Definition of switching times**

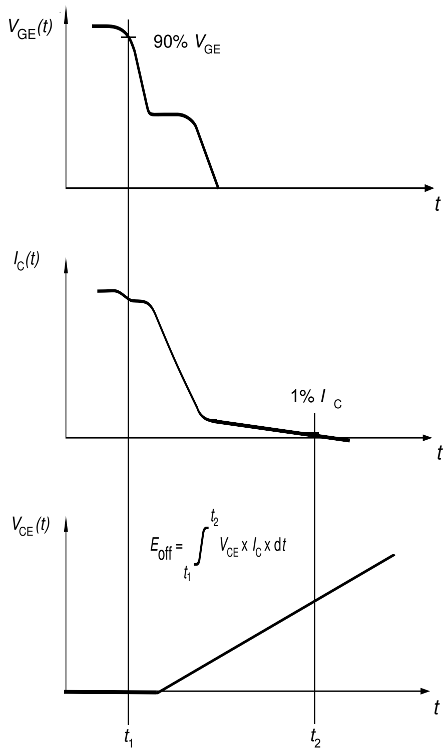


Figure B. **Definition of switching losses**

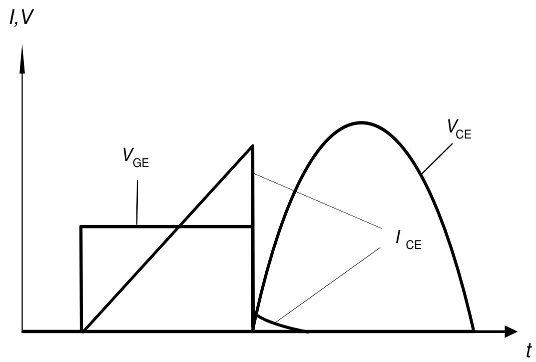


Figure C. **Typical switching behavior in resonant applications**

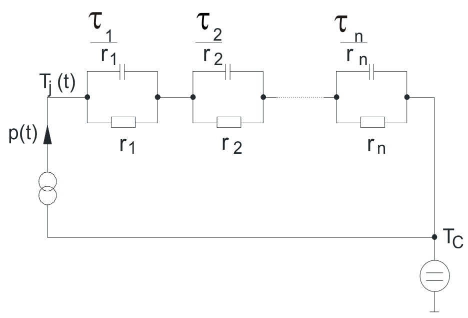


Figure D. **Thermal equivalent circuit**

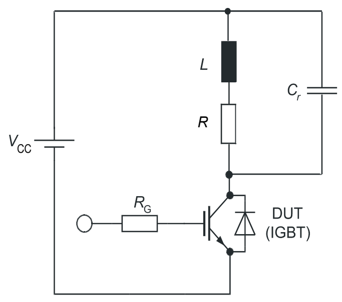


Figure E. **Dynamic test circuit**
Resonant capacitor, C_r
Damping resistor, R

Figure 2

Revision history

Document revision	Date of release	Description of changes
0.10	2022-11-25	Preliminary datasheet
1.00	2023-05-19	Final datasheet

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Edition 2023-05-19

Published by

Infineon Technologies AG

81726 Munich, Germany

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Document reference
IFX-ABC845-002