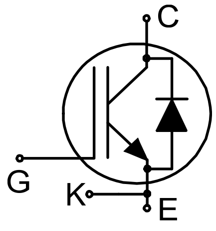
Hybrid CoolSiC™ IGBT

TRENCHSTOP™ 5 H5 IGBT co-packed with half-rated 6th generation CoolSiC™ Schottky barrier diode

Features and Benefits:



- Ultra-low switching losses due to the combination of TRENCHSTOP™ 5 and CoolSiC™ technology as well as the Kelvin emitter pin
- Benchmark efficiency in hard switching topologies
- Plug-and-play replacement of pure silicon devices
- Simplified PCB design due to the optimized pin-out of the four-pin package
- Improved wave soldering quality due to the increased clearance of the Kelvin emitter and gate pins
- Maximum junction temperature 175°C
- Qualified according to JEDEC for target applications
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice models: http://www.infineon.com/igbt/

Potential Applications:

- Industrial Power Supplies
  - Industrial SMPS
  - Industrial UPS
- Energy Generation
  - Solar String Inverter
- Energy Distribution
  - Energy Storage
- Infrastructure – Charge
  - Charger

Product Validation:

Qualified for applications listed above based on the test conditions in the relevant tests of JEDEC20/22

Package pin definition:

- Pin C & backside - collector
- Pin E - emitter
- Pin K - Kelvin emitter
- Pin G - gate

Green

Halogen-Free

RoHS

Key Performance and Package Parameters

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
IKZA40N65RH5	650V	40A	1.65V	175°C	K40ERH5	PG-TO247-4-3

Please read the Important Notice and Warnings at the end of this document

Table of Contents

Maximum Ratings

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

Parameter	Symbol	Value	Unit
Collector-emitter voltage, $T_{vj} \geq 25°C$	V_{CE}	650	V
DC collector current, limited by T_{vjmax} $T_c = 25°C$ $T_c = 100°C$	I_C	74.0 46.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	160.0	A
Turn off safe operating area $V_{CE} \leq 650V$, $T_{vj} \leq 175°C$, $t_p = 1µs$	-	160.0	A
Diode forward current, limited by T_{vjmax} $T_c = 25°C$ $T_c = 100°C$	I_F	27.5 18.5	A
Diode pulsed current, t_p limited by T_{vjmax}[1)]	I_{Fpuls}	60.0	A
Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 10µs$, $D < 0.010$)	V_{GE}	±20 ±30	V
Power dissipation $T_c = 25°C$ Power dissipation $T_c = 100°C$	P_{tot}	250.0 125.0	W
Operating junction temperature	T_{vj}	-40...+175	°C
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 processes: 3	M	0.6	Nm

Thermal Resistance

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
R_{th} Characteristics						
IGBT thermal resistance, junction - case	$R_{th(j-c)}$		-	-	0.60	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		-	-	1.80	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		-	-	40	K/W

1) Pulse current level depends on T_{vj} of diode chip, see also Fig. "Maximum pulse current as a function of junction temperature"

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

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Static Characteristic						
Collector-emitter saturation voltage	V_{CEsat}	V_{GE} = 15.0V, I_C = 40.0A T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	- - -	1.65 1.85 1.95	2.10 - -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 16.0A T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	- - -	1.35 1.55 1.65	1.50 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.40mA, V_{CE} = V_{GE}	3.2	4.0	4.8	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 650V, V_{GE} = 0V T_{vj} = 25°C T_{vj} = 175°C	- -	- 2000	600 -	µA
Zero gate voltage collector current	I_{CES}	V_{CE} = 480V, V_{GE} = 0V T_{vj} = 25°C	-	-	16	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 40.0A	-	50.0	-	S

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

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Dynamic Characteristic						
Input capacitance	C_{ies}	V_{CE} = 25V, V_{GE} = 0V f = 250kHz	-	2190	-	pF
Output capacitance	C_{oes}		-	265	-	
Reverse transfer capacitance	C_{res}		-	8	-	
Gate charge	Q_G	V_{CC} = 520V, I_C = 40.0A, V_{GE} = 15V	-	95.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	13.0	-	nH

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at T_{vj} = 25°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 25°C, V_{CC} = 400V, I_C = 20.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 15.0Ω, $R_{G(off)}$ = 15.0Ω, $L\sigma$ = 30nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	17	-	ns
Rise time	t_r		-	7	-	ns
Turn-off delay time	$t_{d(off)}$		-	165	-	ns
Fall time	t_f		-	13	-	ns
Turn-on energy	E_{on}		-	0.14	-	mJ
Turn-off energy	E_{off}		-	0.12	-	mJ
Total switching energy	E_{ts}		-	0.26	-	mJ

Turn-on delay time	$t_{d(on)}$	T_{vj} = 25°C, V_{CC} = 400V, I_C = 5.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 15.0Ω, $R_{G(off)}$ = 15.0Ω, $L\sigma$ = 30nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	17	-	ns
Rise time	t_r		-	4	-	ns
Turn-off delay time	$t_{d(off)}$		-	190	-	ns
Fall time	t_f		-	25	-	ns
Turn-on energy	E_{on}		-	0.03	-	mJ
Turn-off energy	E_{off}		-	0.05	-	mJ
Total switching energy	E_{ts}		-	0.08	-	mJ

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at T_{vj} = 150°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 150°C, V_{CC} = 400V, I_C = 20.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 15.0Ω, $R_{G(off)}$ = 15.0Ω, $L\sigma$ = 30nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	18	-	ns
Rise time	t_r		-	7	-	ns
Turn-off delay time	$t_{d(off)}$		-	195	-	ns
Fall time	t_f		-	22	-	ns
Turn-on energy	E_{on}		-	0.16	-	mJ
Turn-off energy	E_{off}		-	0.22	-	mJ
Total switching energy	E_{ts}		-	0.38	-	mJ

Turn-on delay time	$t_{d(on)}$	T_{vj} = 150°C, V_{CC} = 400V, I_C = 5.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 15.0Ω, $R_{G(off)}$ = 15.0Ω, $L\sigma$ = 30nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	16	-	ns
Rise time	t_r		-	3	-	ns
Turn-off delay time	$t_{d(off)}$		-	240	-	ns
Fall time	t_f		-	35	-	ns
Turn-on energy	E_{on}		-	0.04	-	mJ
Turn-off energy	E_{off}		-	0.07	-	mJ
Total switching energy	E_{ts}		-	0.11	-	mJ

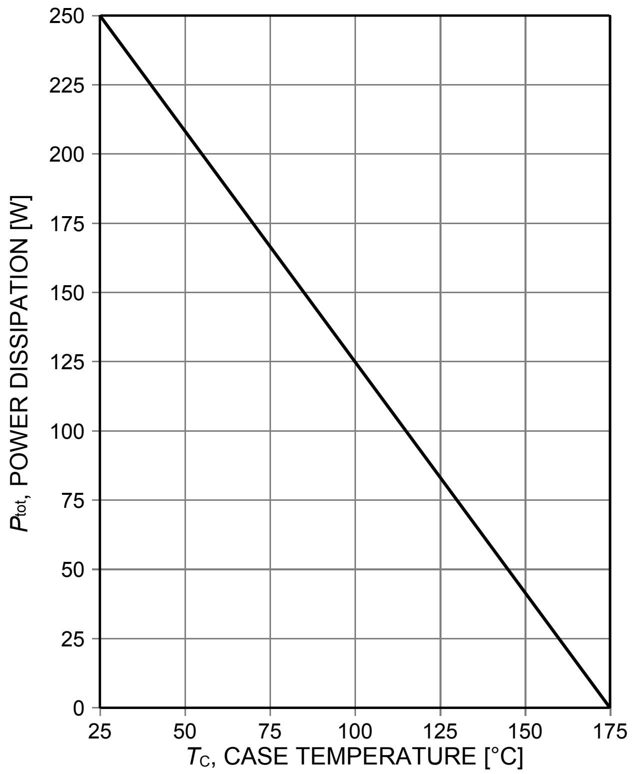


Figure 1. **Power dissipation as a function of case temperature**
(T_{vj}≤175°C)

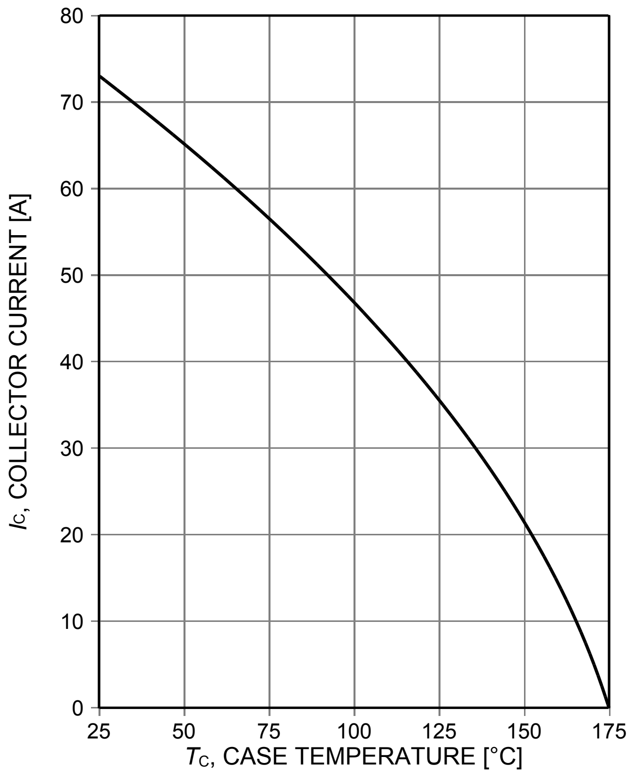


Figure 2. **Collector current as a function of case temperature**
(V_{GE}≥15V, T_{vj}≤175°C)

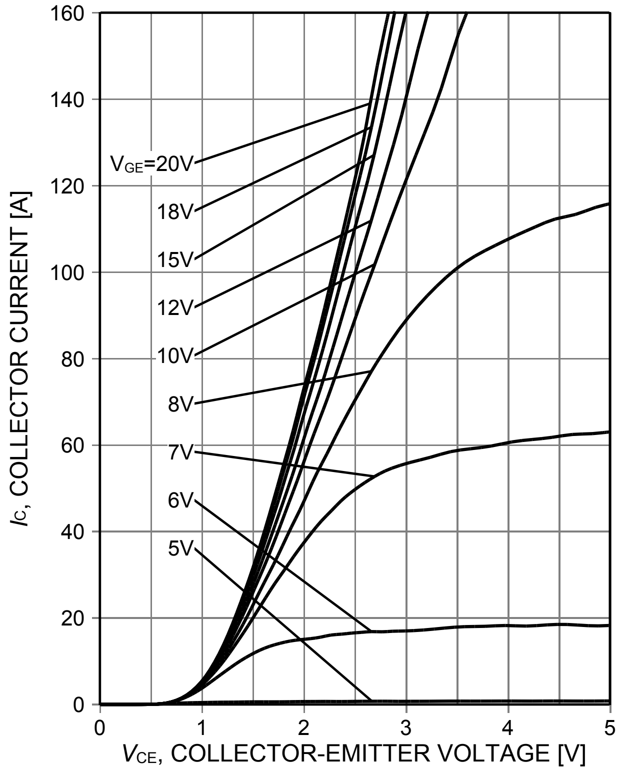


Figure 3. **Typical output characteristic**
(T_{vj}=25°C)

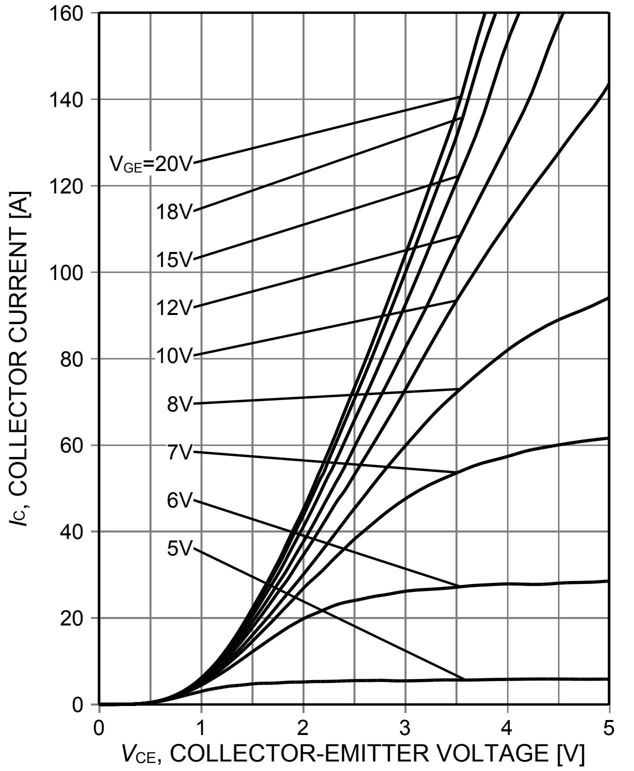


Figure 4. **Typical output characteristic**
(T_{vj}=150°C)

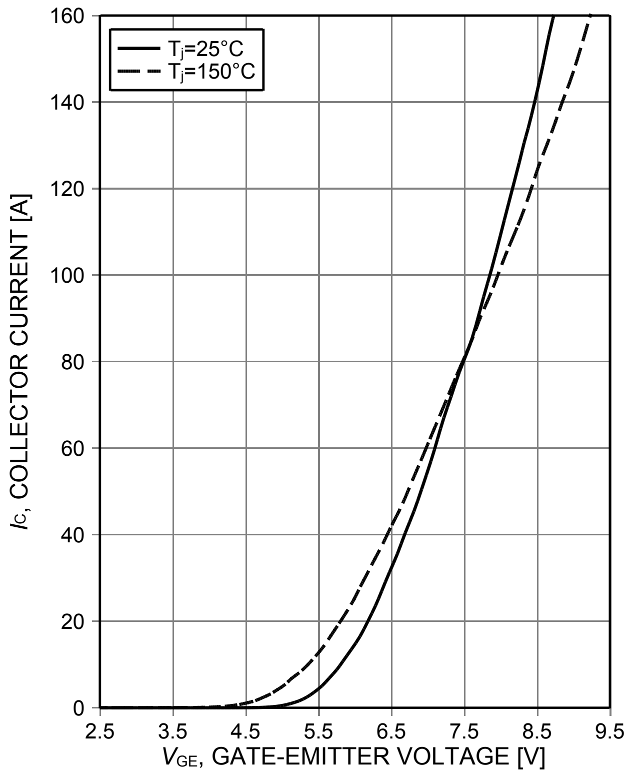


Figure 5. **Typical transfer characteristic**
(V_{CE}=20V)

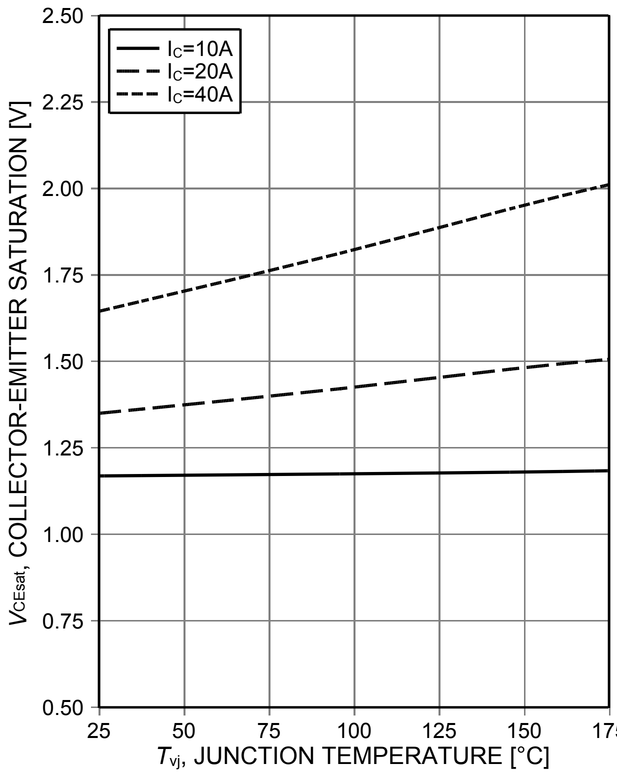


Figure 6. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)

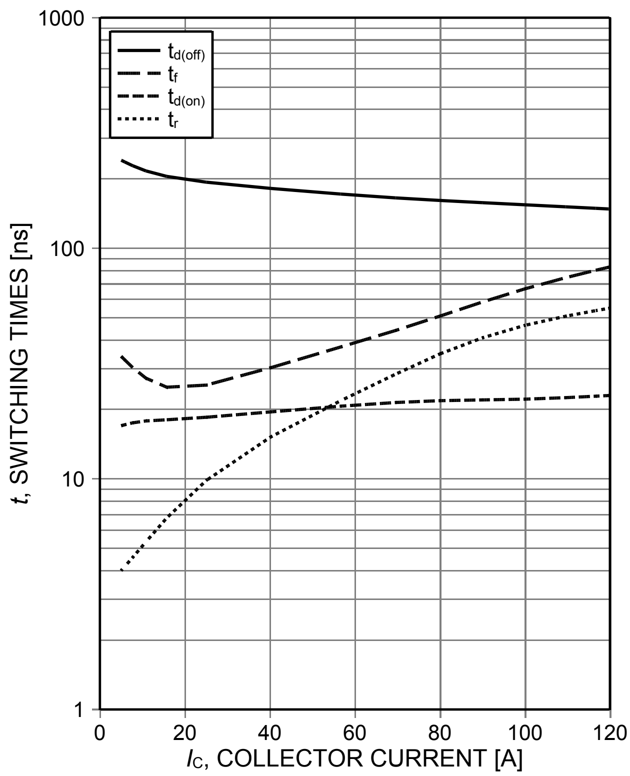


Figure 7. **Typical switching times as a function of collector current**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=15/0V, R_G=15Ω, Dynamic test circuit in Figure E)

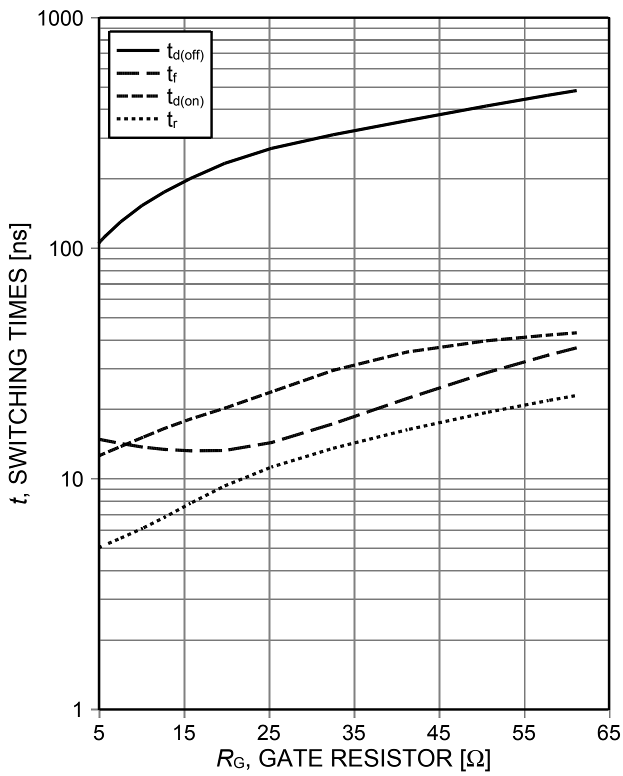


Figure 8. **Typical switching times as a function of gate resistor**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=15/0V, I_C=20A,Dynamic test circuit in Figure E)

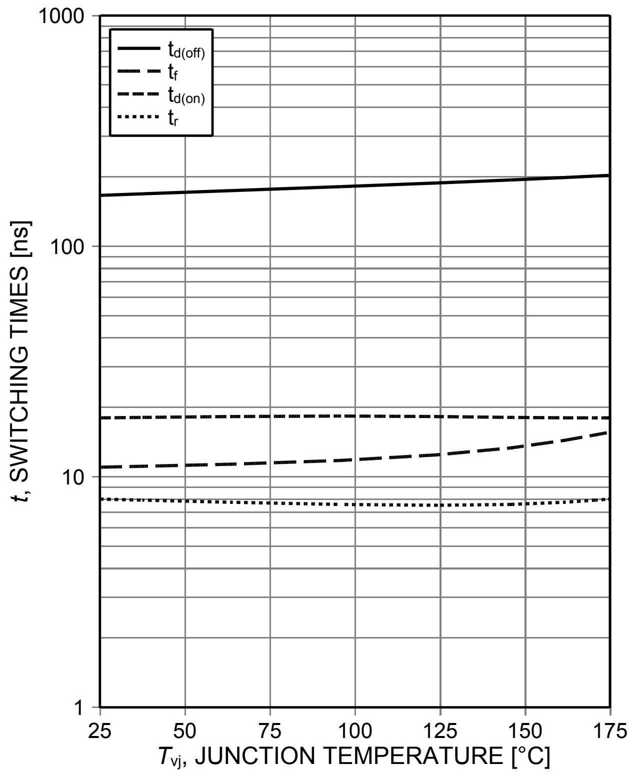


Figure 9. **Typical switching times as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=20A, R_G=15Ω,Dynamic test circuit in Figure E)

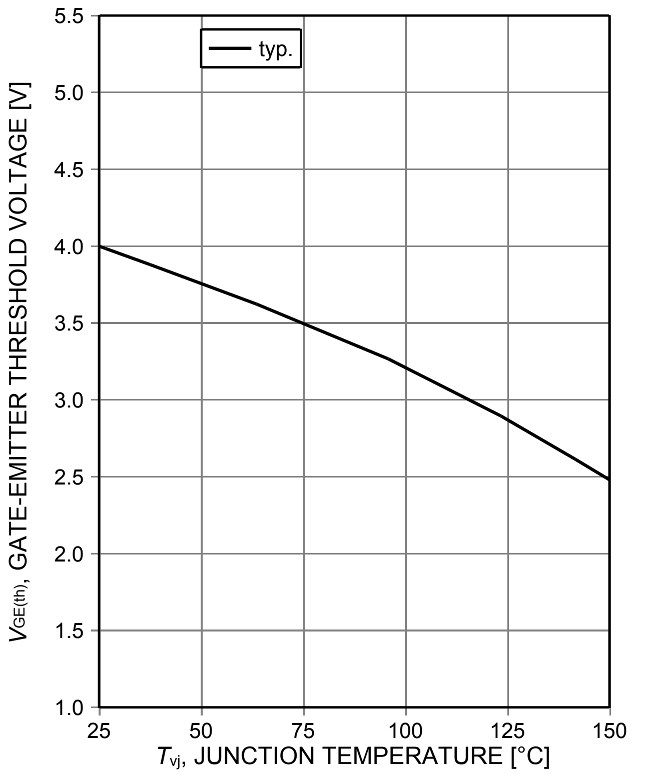


Figure 10. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=0.4mA)

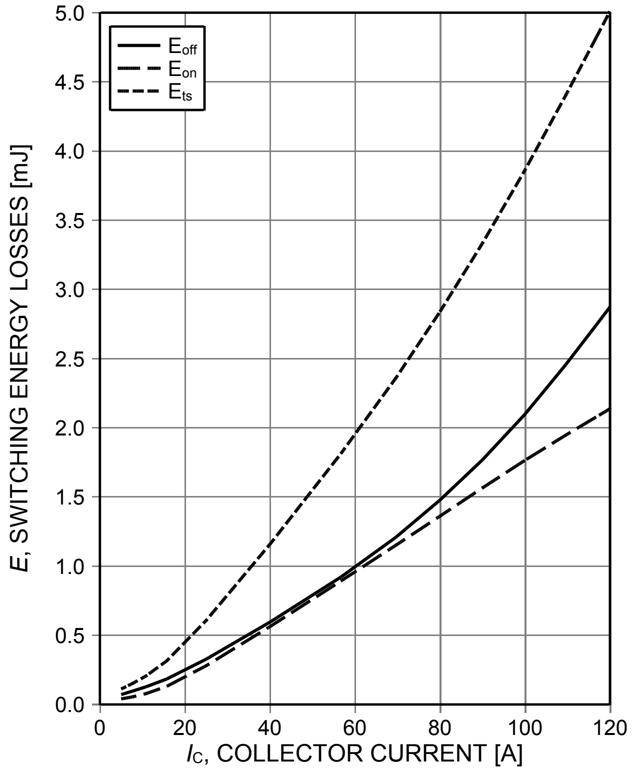


Figure 11. **Typical switching energy losses as a function of collector current**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=15/0V, R_G=15Ω,Dynamic test circuit in Figure E)

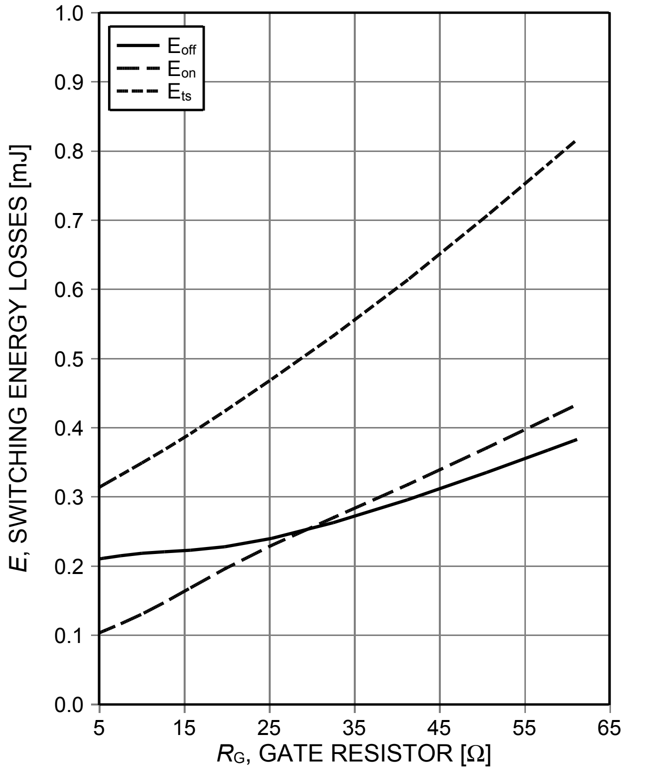


Figure 12. **Typical switching energy losses as a function of gate resistor**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=15/0V, I_C=20A, Dynamic test circuit in Figure E)

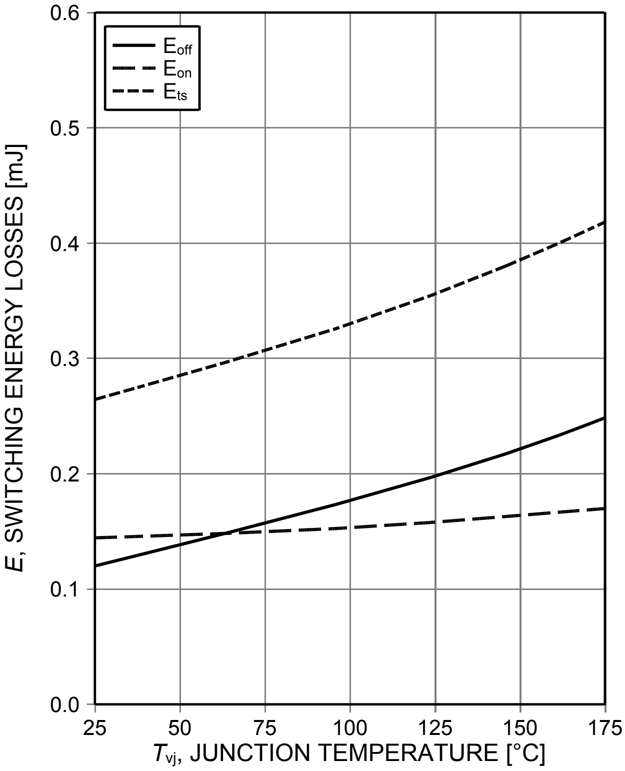


Figure 13. **Typical switching energy losses as a function of junction temperature** (inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=20A, R_G=15Ω,Dynamic test circuit in Figure E)

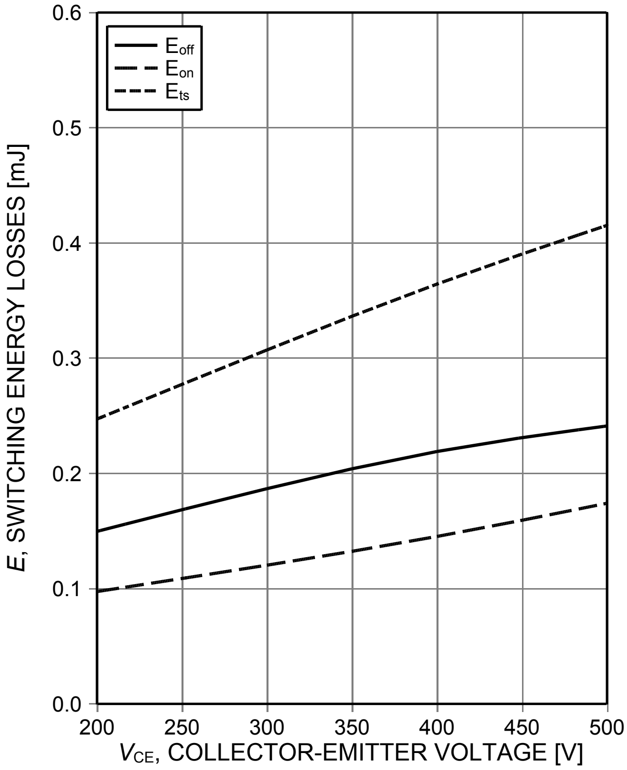


Figure 14. **Typical switching energy losses as a function of collector emitter voltage** (inductive load, T_{vj}=150°C, V_{GE}=15/0V, I_C=20A, R_G=15Ω,Dynamic test circuit in Figure E)

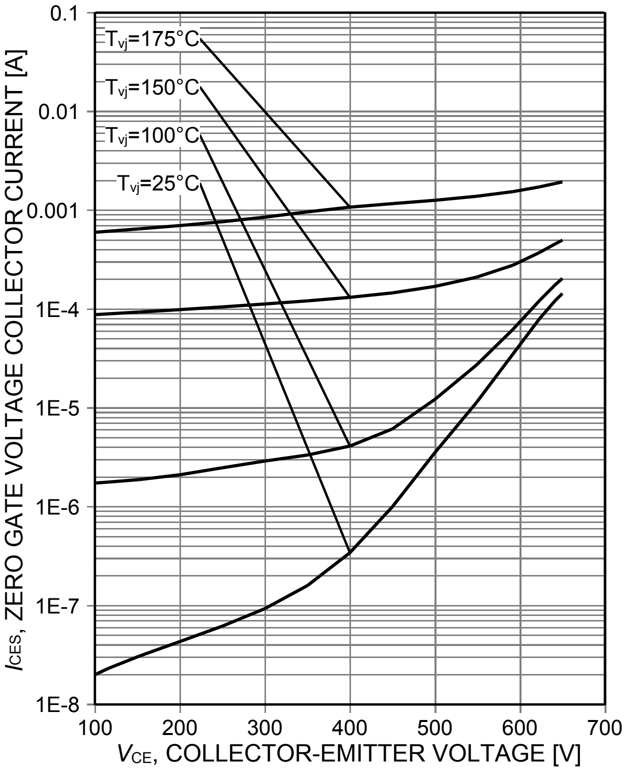


Figure 15. **Typ. reverse current vs. reverse voltage as a function of Tvj**

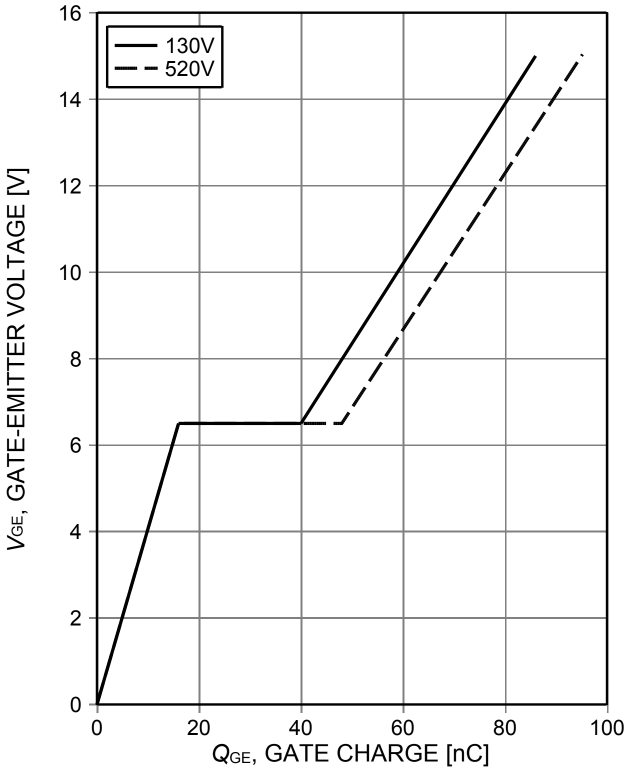


Figure 16. **Typical gate charge** (I_C=40A)

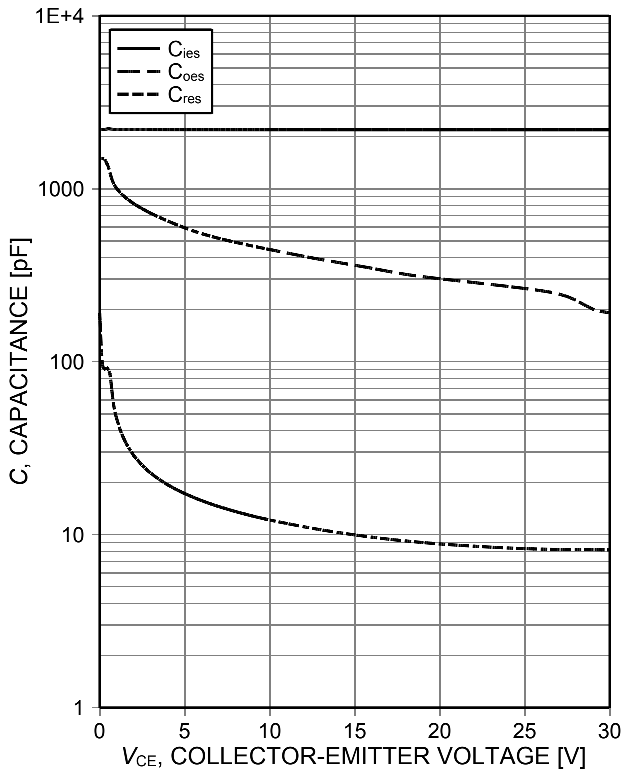


Figure 17. **Typical capacitance as a function of collector-emitter voltage**
(V_{GE}=0V, f=250kHz)

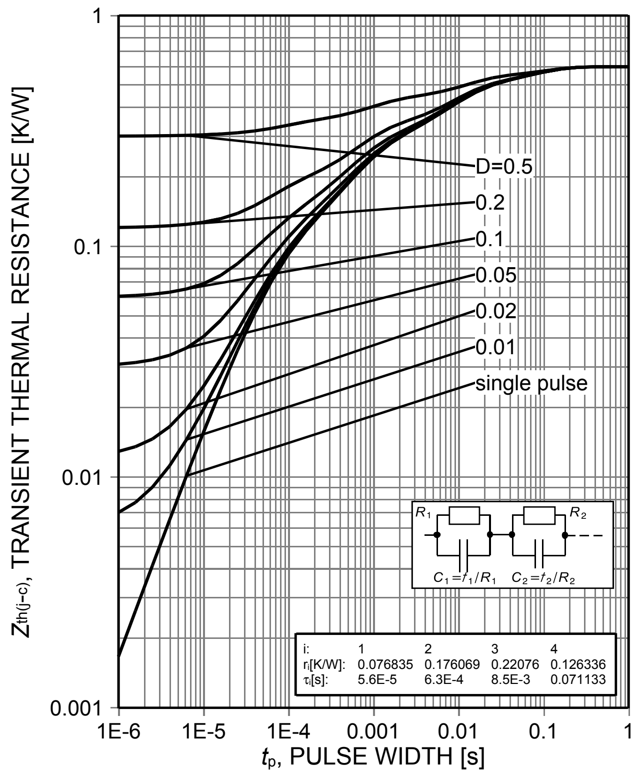


Figure 18. **IGBT transient thermal resistance**
(D=t_p/T)

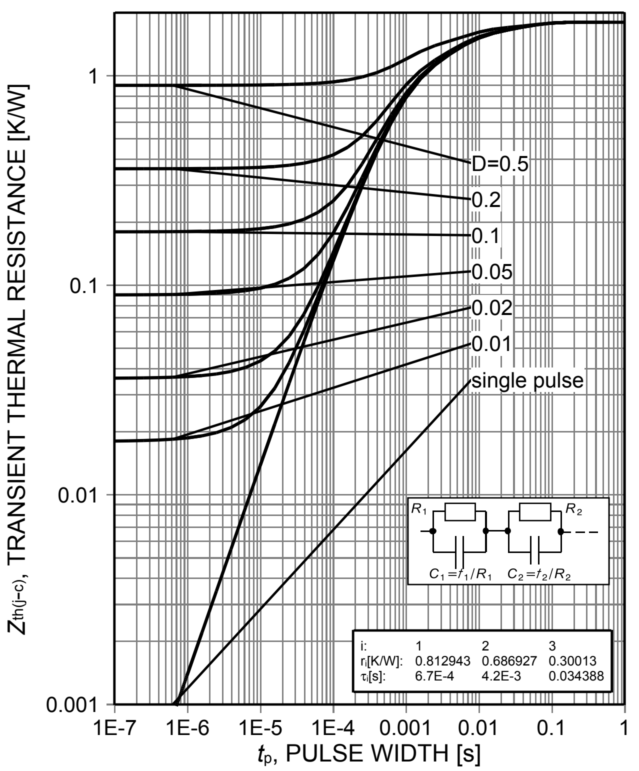


Figure 19. **Diode transient thermal impedance as a function of pulse width**
(D=t_p/T)

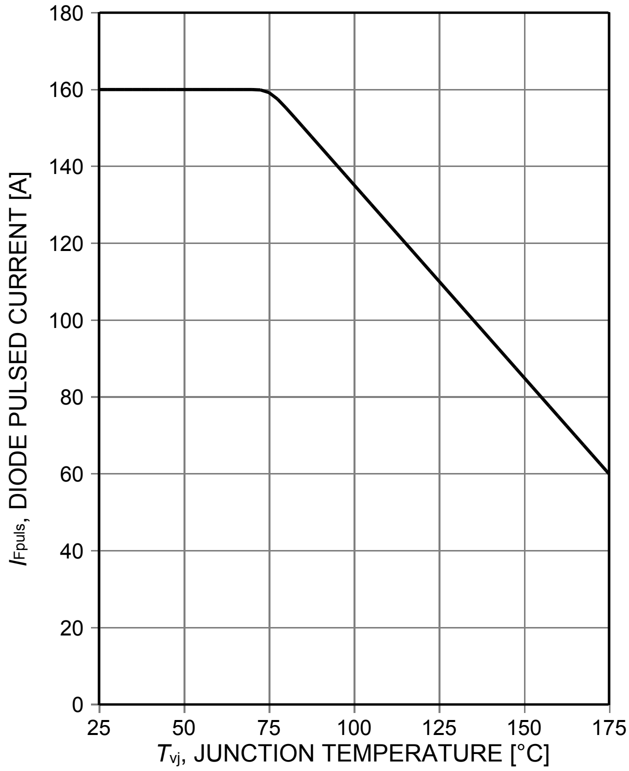


Figure 20. **Maximum pulse current as a function of junction temperature**

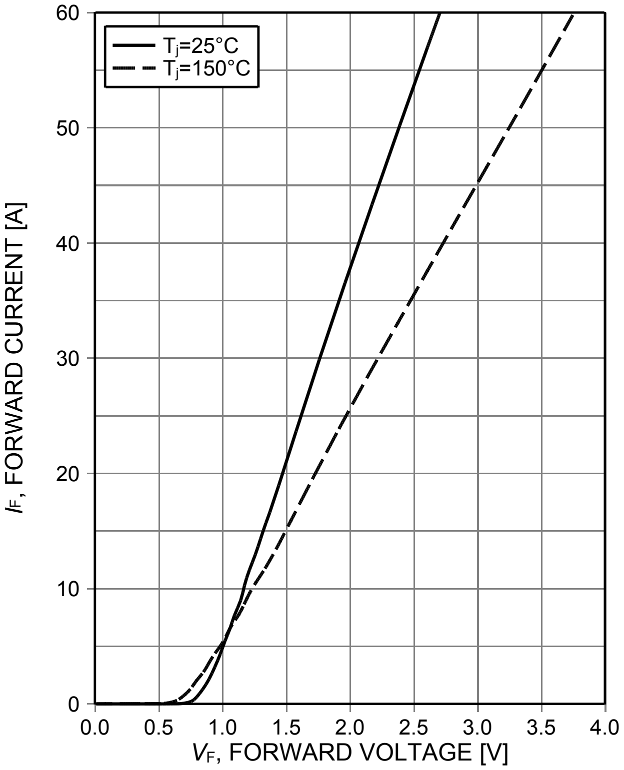


Figure 21. **Typical diode forward current as a function of forward voltage**

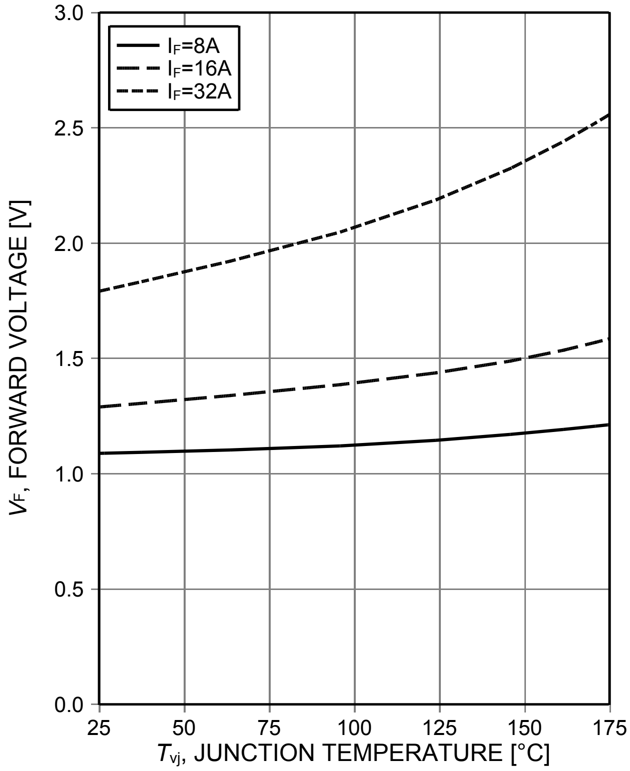


Figure 22. **Typical diode forward voltage as a function of junction temperature**

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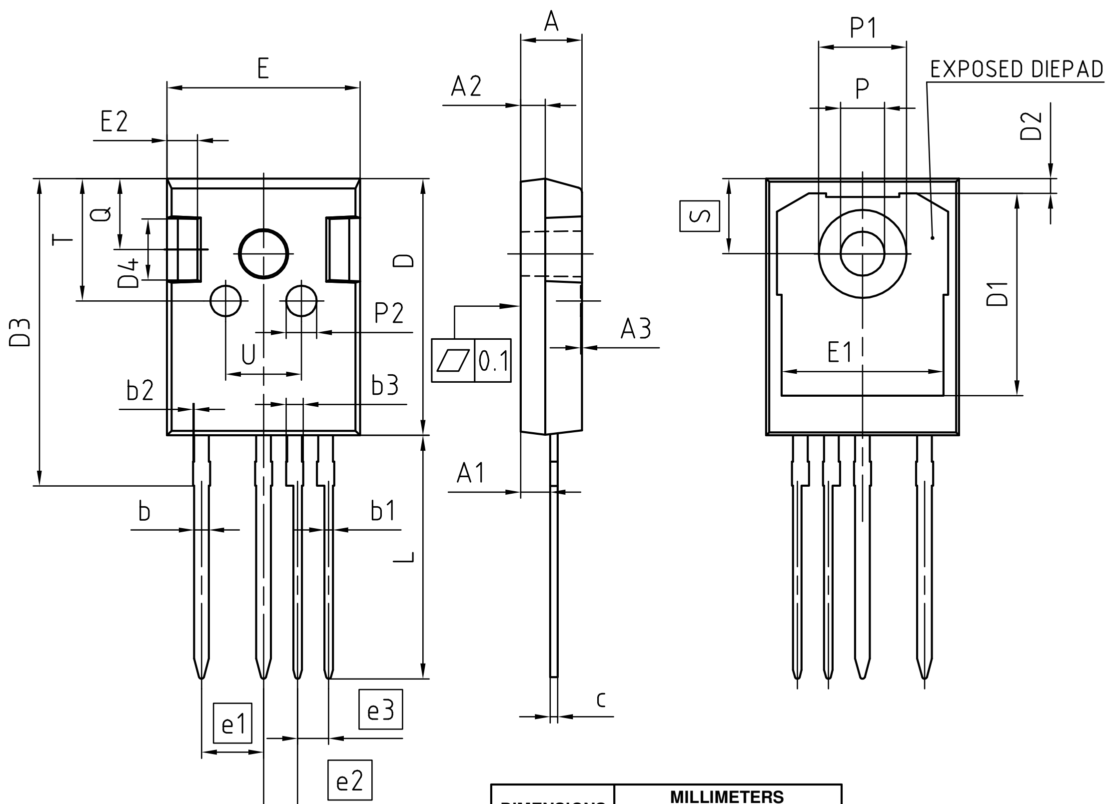

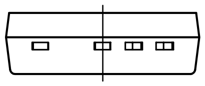

NOTES:
ALL DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.

DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.90	5.10
A1	2.31	2.51
A2	1.90	2.10
A3	0.05	0.25
b	1.10	1.30
b1	0.65	0.79
b2	-	0.20
b3	1.34	1.44
c	0.58	0.66
D	20.90	21.10
D1	16.25	16.85
D2	1.05	1.35
D3	24.97	25.27
D4	4.90	5.10
E	15.70	15.90
E1	13.10	13.50
E2	2.40	2.60
e1	5.08	
e2	2.79	
e3	2.54	
L	19.80	20.10
L1	-	4.30
øP	3.50	3.70
øP1	7.00	7.40
øP2	2.40	2.60
Q	5.60	6.00
S	6.15	
T	9.80	10.20
U	6.00	6.40

DOCUMENT NO.
Z8B00184785

REVISION
03

SCALE 2:1
0 5 10mm

EUROPEAN PROJECTION

ISSUE DATE
21.08.2017

Testing Conditions

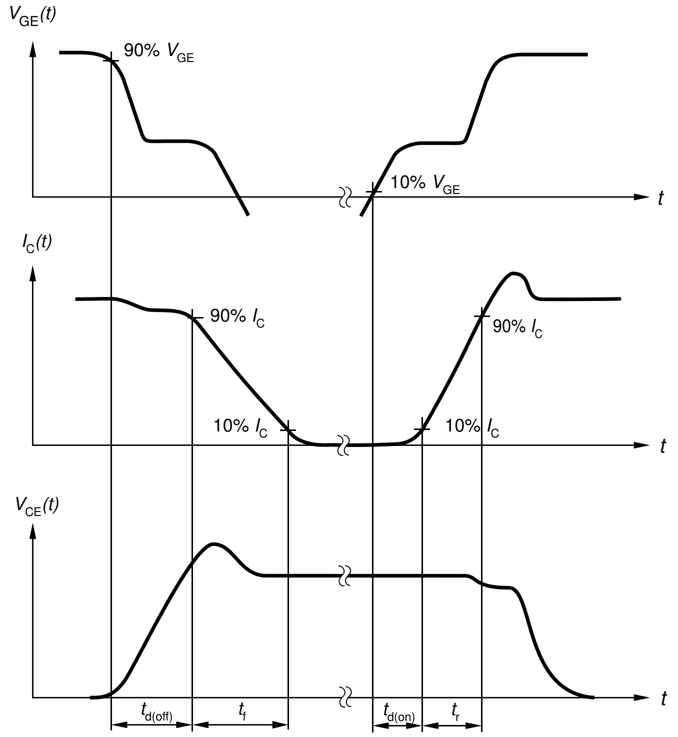

Figure A. **Definition of switching times**

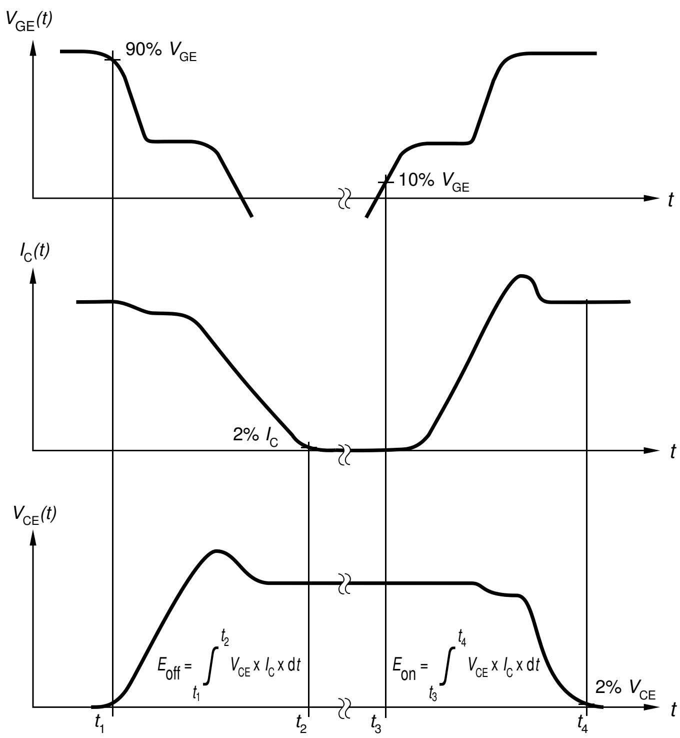

Figure B. **Definition of switching losses**

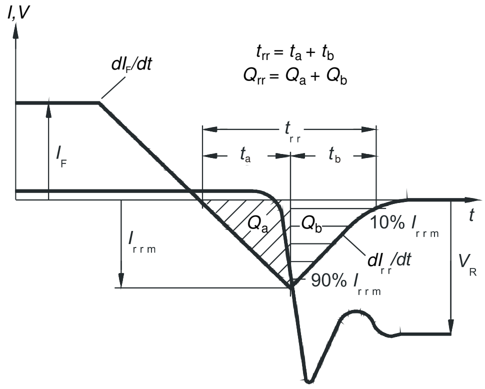

Figure C. **Definition of diode switching characteristics**

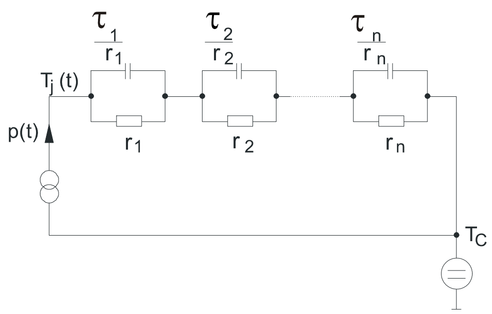

Figure D. **Thermal equivalent circuit**

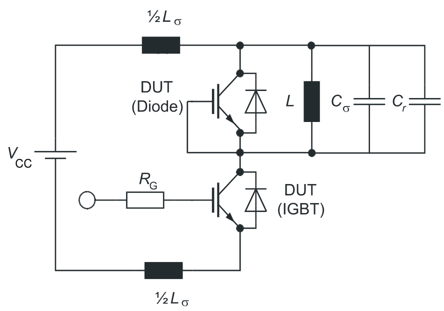

Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Revision History

IKZA40N65RH5

Revision: 2020-07-27, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
1.1	2020-03-20	Preliminary Data Sheet
2.1	2020-07-27	Final Data Sheet

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