

## Emitter Controlled Diode Rapid 1 Advanced Isolation

### Rapid switching emitter controlled diode in fully isolated package

#### Features:

- 650V Emitter Controlled technology
- Temperature stable behavior of key parameters
- Low forward voltage ( $V_F$ )
- Low reverse recovery charge ( $Q_{rr}$ )
- Low reverse recovery current ( $I_{rrm}$ )
- Softness factor  $>1$
- Maximum junction temperature  $175^\circ\text{C}$
- $2500\text{ V}_{\text{RMS}}$  electrical isolation, 50/60 Hz,  $t=1\text{ min}$
- 100 % tested isolated mounting surface
- Pb-free lead plating; RoHS compliant

#### Potential Applications:

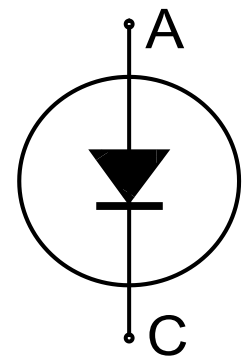
- Air Conditioning PFC
- General Purpose Drives (GPD)

#### Package pin definition:

- Pin 1 - not connected
- Pin 2 - cathode
- Pin 3 - anode

#### Product Validation:

Qualified for industrial applications according to the relevant tests of JEDEC 47/20/22



Fully isolated package TO-247



#### Key Performance and Package Parameters

Type	$V_{rrm}$	$I_f$	$V_f, T_{vj}=25^\circ\text{C}$	$T_{vjmax}$	Marking	Package
IDFW40E65D1E	650V	40A	1.7V	$175^\circ\text{C}$	D40E65D1E	PG-TO247-3-AI

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## Emitter Controlled Diode Rapid 1 Advanced Isolation

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## Emitter Controlled Diode Rapid 1 Advanced Isolation

### 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
Repetitive peak reverse voltage, $T_{vj} \geq 25^{\circ}\text{C}$	$V_{RRM}$	650	V
Diode forward current, limited by $T_{vjmax}$ $T_h = 25^{\circ}\text{C}$ $T_h = 65^{\circ}\text{C}$	$I_F$	42.0 35.0	A
Diode pulsed current, $t_p$ limited by $T_{vjmax}$	$I_{Fpuls}$	120.0	A
Power dissipation $T_h = 25^{\circ}\text{C}$ Power dissipation $T_h = 65^{\circ}\text{C}$	$P_{tot}$	78.0 57.0	W
Operating junction temperature	$T_{vj}$	-40...+175	$^{\circ}\text{C}$
Storage temperature	$T_{stg}$	-55...+150	$^{\circ}\text{C}$
Soldering temperature, wave soldering 1.6mm (0.063in.) from case for 10s		260	$^{\circ}\text{C}$
Mounting torque, M3 screw Maximum of mounting processes: 3	$M$	0.6	Nm
Isolation voltage RMS, $f = 50/60\text{Hz}$ , $t = 1\text{min}^{(1)}$	$V_{isol}$	2500	V

### Thermal Resistance

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b><math>R_{th}</math> Characteristics</b>						
Diode thermal resistance, <sup>2)</sup> junction - heatsink	$R_{th(j-h)}$		-	1.75	1.92	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		-	-	65	K/W

### Electrical Characteristic, at $T_{vj} = 25^{\circ}\text{C}$ , unless otherwise specified

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>Static Characteristic</b>						
Diode forward voltage	$V_F$	$I_F = 40.0\text{A}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	- -	1.70 1.75	2.10 -	V
Reverse leakage current	$I_R$	$V_R = 650\text{V}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	- -	- 350	40 -	$\mu\text{A}$

### Electrical Characteristic, at $T_{vj} = 25^{\circ}\text{C}$ , unless otherwise specified

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>Dynamic Characteristic</b>						
Internal emitter inductance measured 5mm (0.197 in.) from case	$L_E$		-	13.0	-	nH

<sup>1)</sup> For a proper handling and assembly of the advanced isolation device in the application refer to the note at the package drawing.

<sup>2)</sup> At force on body  $F = 500\text{N}$ ,  $T_a = 25^{\circ}\text{C}$

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## Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	

Diode Characteristic, at  $T_{vj} = 25^{\circ}\text{C}$ 

Diode reverse recovery time	$t_{rr}$	$T_{vj} = 25^{\circ}\text{C}$ , $V_R = 400\text{V}$ , $I_F = 40.0\text{A}$ , $di_F/dt = 1000\text{A}/\mu\text{s}$ , $L\sigma = 75\text{nH}$ , $C\sigma = 30\text{pF}$ , Switch IKFW50N60DH3	-	76	-	ns
Diode reverse recovery charge	$Q_{rr}$		-	0.57	-	$\mu\text{C}$
Diode peak reverse recovery current	$I_{rrm}$		-	11.0	-	A
Diode peak rate of fall of reverse recovery current during $t_b$	$di_{rr}/dt$		-	-885	-	$\text{A}/\mu\text{s}$
Diode reverse recovery time	$t_{rr}$	$T_{vj} = 25^{\circ}\text{C}$ , $V_R = 400\text{V}$ , $I_F = 40.0\text{A}$ , $di_F/dt = 300\text{A}/\mu\text{s}$ , $L\sigma = 75\text{nH}$ , $C\sigma = 30\text{pF}$ , Switch IKFW50N60DH3	-	232	-	ns
Diode reverse recovery charge	$Q_{rr}$		-	0.52	-	$\mu\text{C}$
Diode peak reverse recovery current	$I_{rrm}$		-	6.0	-	A
Diode peak rate of fall of reverse recovery current during $t_b$	$di_{rr}/dt$		-	-130	-	$\text{A}/\mu\text{s}$

## Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	

Diode Characteristic, at  $T_{vj} = 175^{\circ}\text{C}$ 

Diode reverse recovery time	$t_{rr}$	$T_{vj} = 175^{\circ}\text{C}$ , $V_R = 400\text{V}$ , $I_F = 40.0\text{A}$ , $di_F/dt = 1000\text{A}/\mu\text{s}$ , $L\sigma = 75\text{nH}$ , $C\sigma = 30\text{pF}$ , Switch IKFW50N60DH3	-	106	-	ns
Diode reverse recovery charge	$Q_{rr}$		-	1.51	-	$\mu\text{C}$
Diode peak reverse recovery current	$I_{rrm}$		-	20.0	-	A
Diode peak rate of fall of reverse recovery current during $t_b$	$di_{rr}/dt$		-	-760	-	$\text{A}/\mu\text{s}$
Diode reverse recovery time	$t_{rr}$	$T_{vj} = 175^{\circ}\text{C}$ , $V_R = 400\text{V}$ , $I_F = 40.0\text{A}$ , $di_F/dt = 300\text{A}/\mu\text{s}$ , $L\sigma = 75\text{nH}$ , $C\sigma = 30\text{pF}$ , Switch IKFW50N60DH3	-	228	-	ns
Diode reverse recovery charge	$Q_{rr}$		-	1.33	-	$\mu\text{C}$
Diode peak reverse recovery current	$I_{rrm}$		-	9.8	-	A
Diode peak rate of fall of reverse recovery current during $t_b$	$di_{rr}/dt$		-	-160	-	$\text{A}/\mu\text{s}$

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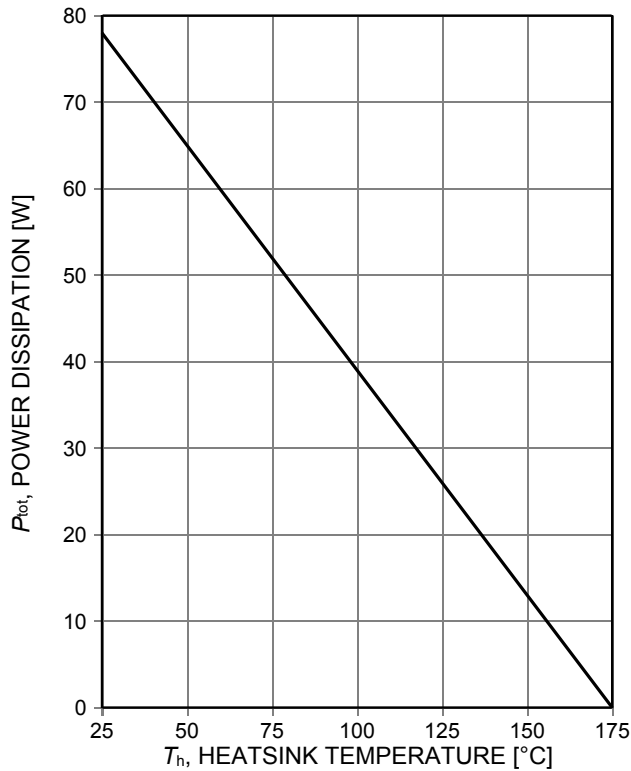


Figure 1. Power dissipation as a function of heatsink temperature ( $T_j \leq 175^\circ\text{C}$ )

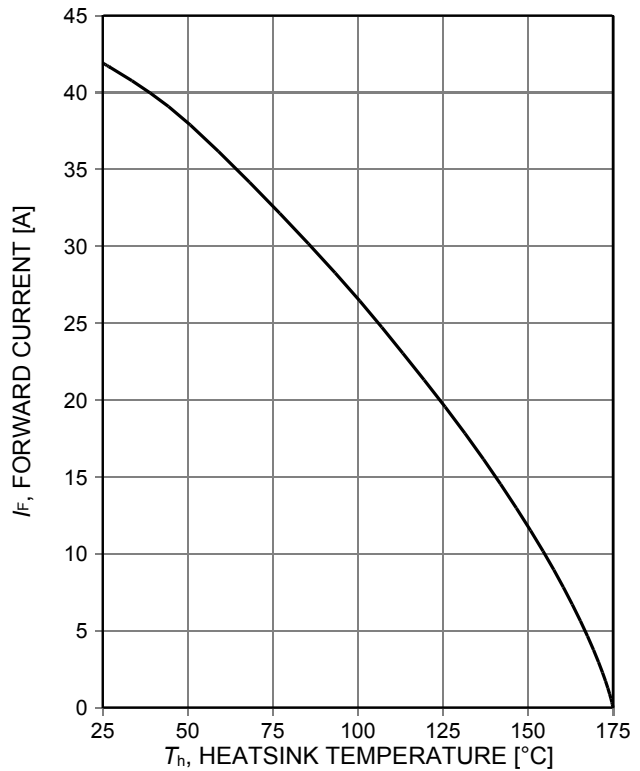


Figure 2. Diode forward current as a function of heatsink temperature

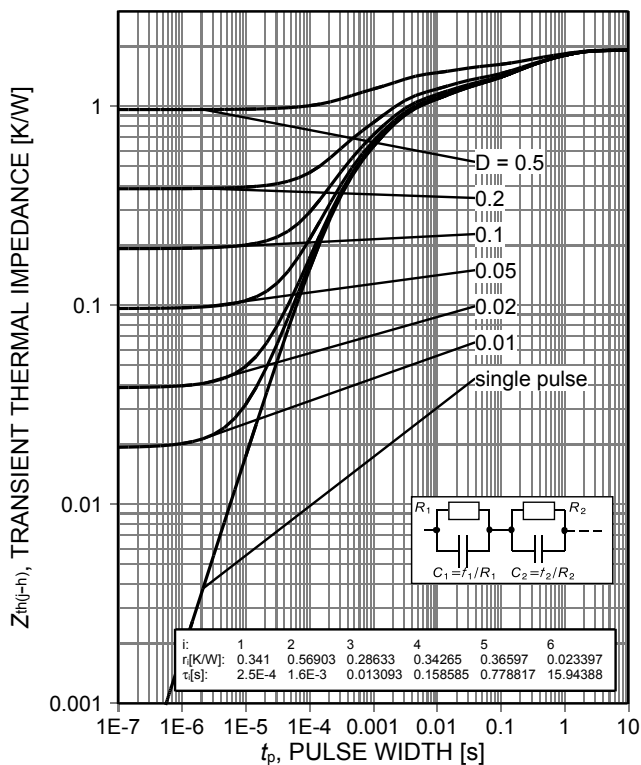


Figure 3. Diode transient thermal impedance as a function of pulse width ( $D = t_p/T$ )

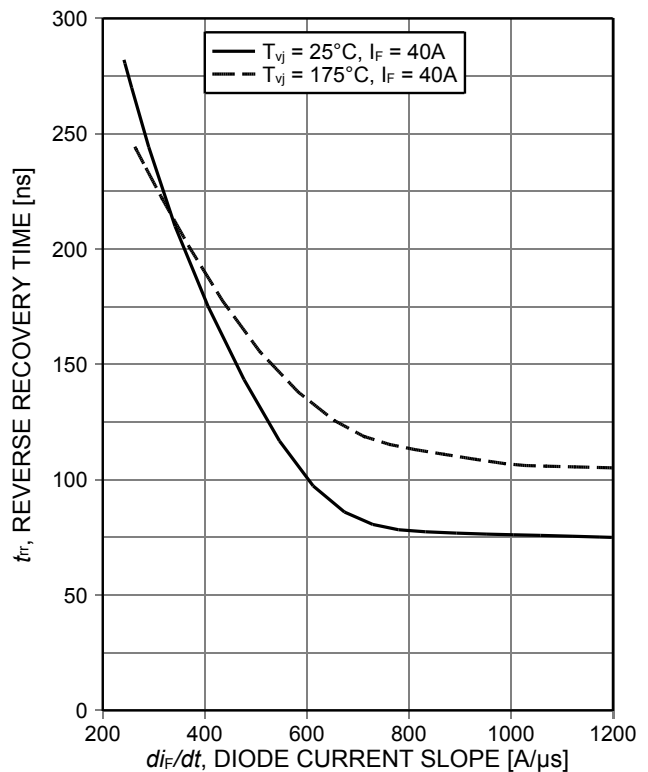


Figure 4. Typical reverse recovery time as a function of diode current slope ( $V_R = 400\text{V}$ )

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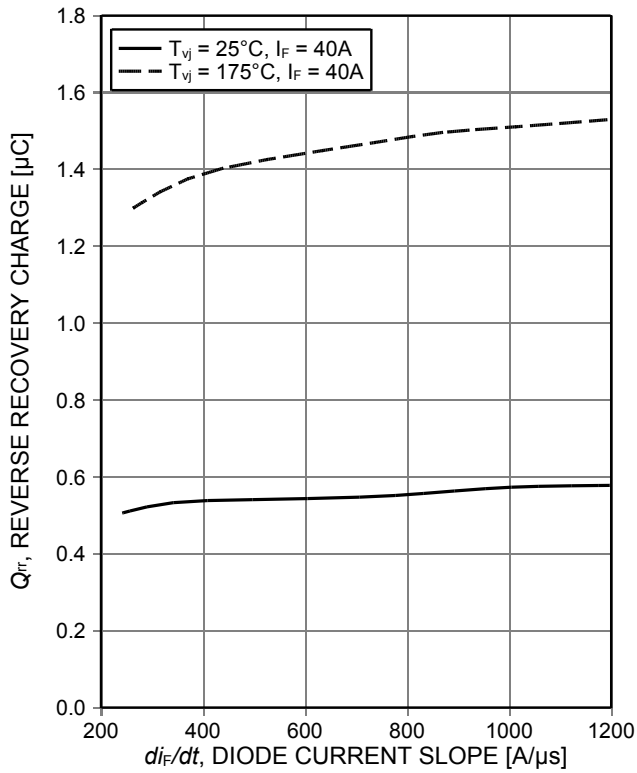


Figure 5. Typical reverse recovery charge as a function of diode current slope (VR=400V)

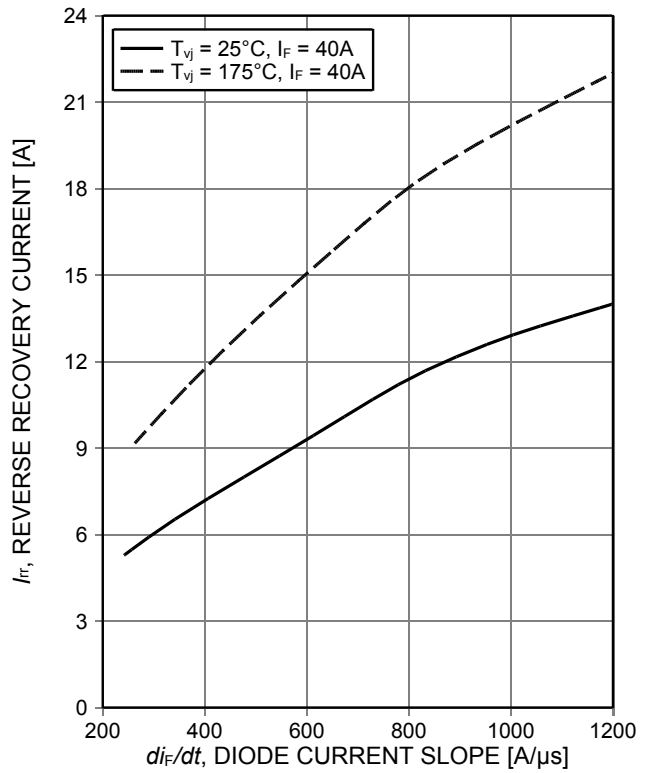


Figure 6. Typical reverse recovery current as a function of diode current slope (VR=400V)

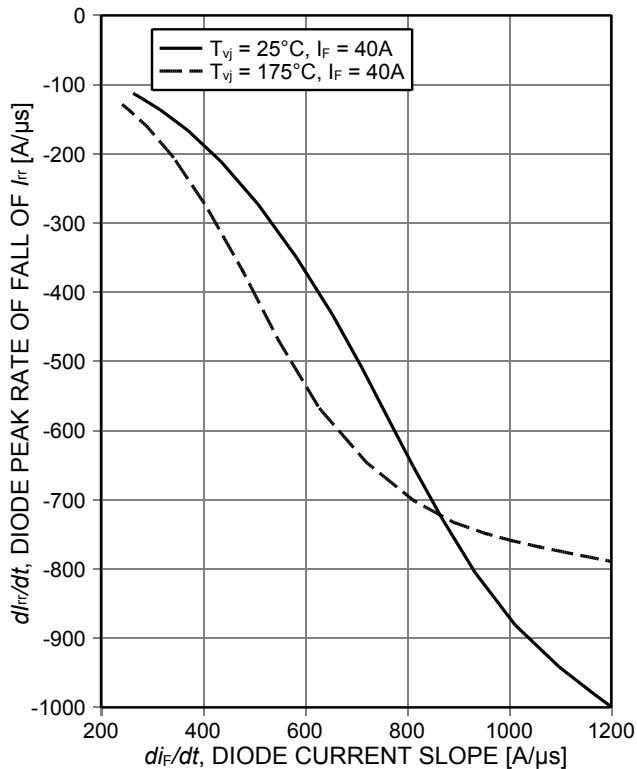


Figure 7. Typical peak reverse recovery current as a function of diode current slope (VR=400V)

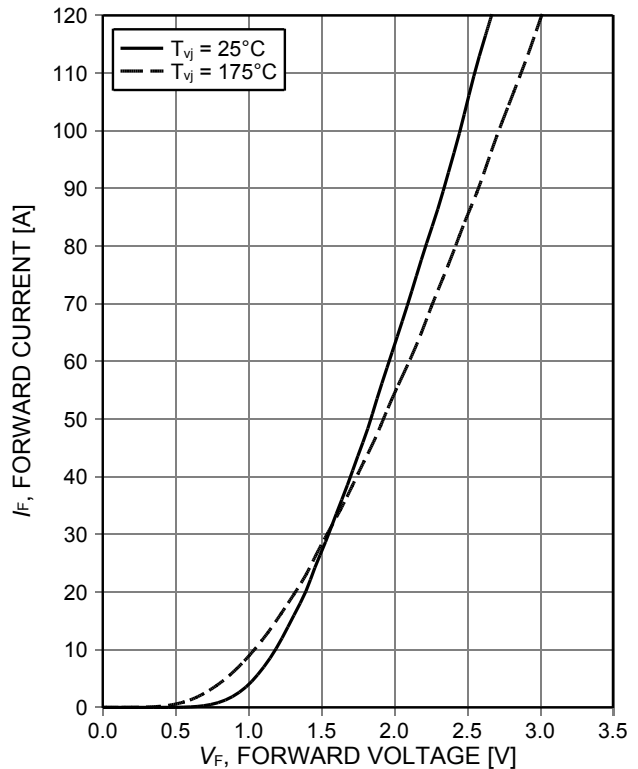


Figure 8. Typical diode forward current as a function of forward voltage

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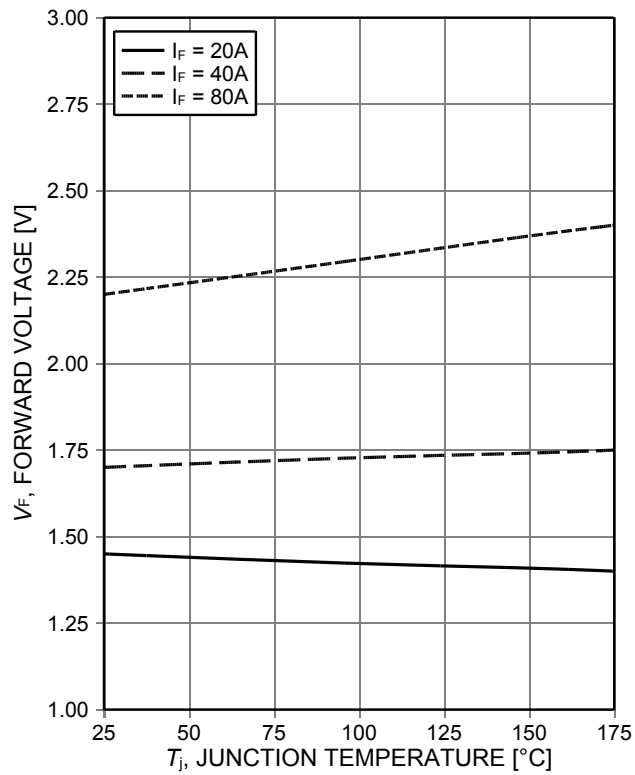
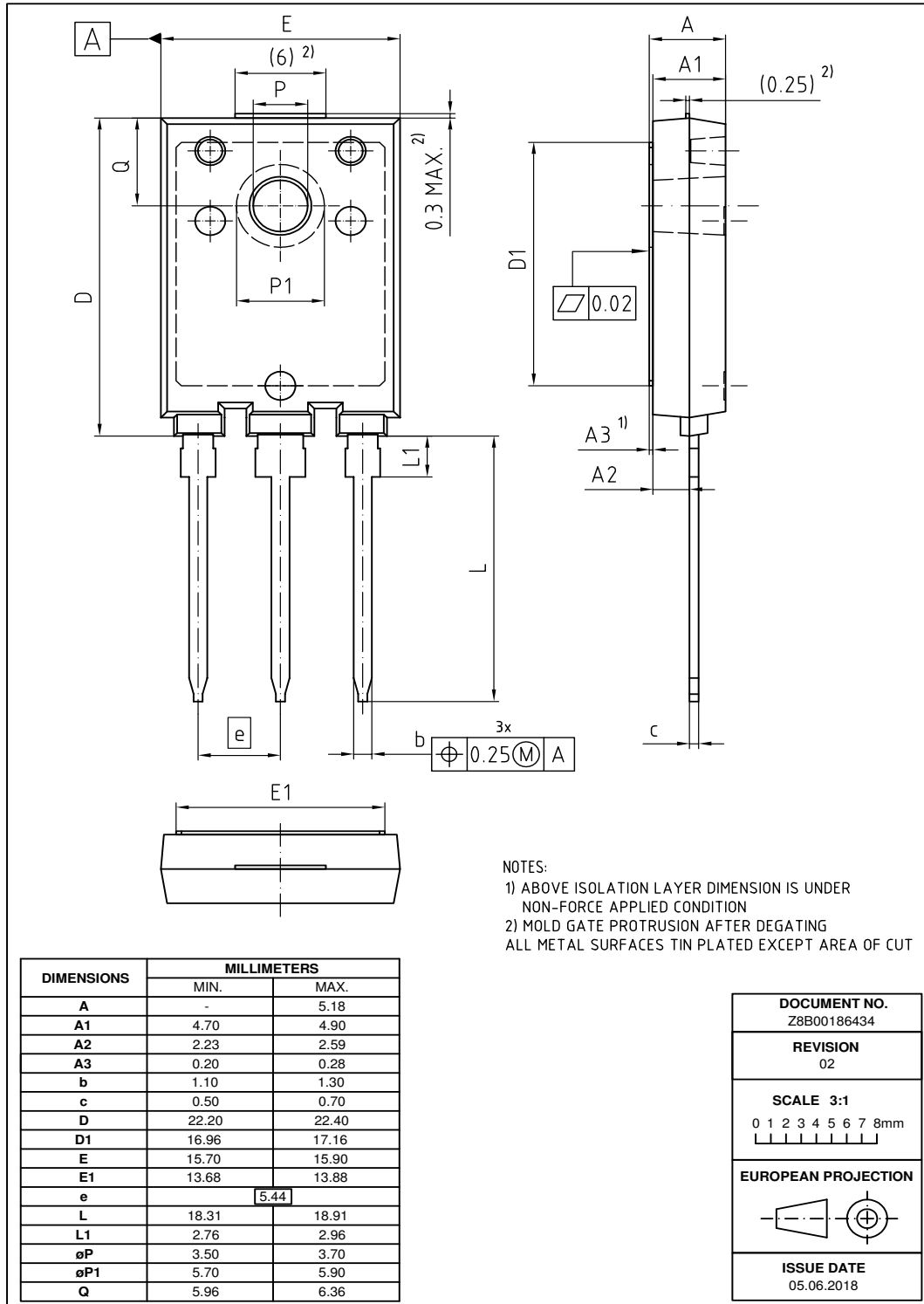


Figure 9. Typical diode forward voltage as a function of junction temperature

**PG-TO247-3-AI (PG-HSIP247-3)**



Note: For a proper handling and assembly of the advanced isolation device in the application the isolation layer must not be exposed to potential penetration via sharp implements or mechanical impacts/shocks, which exceed levels indicated in International Standard (IEC60068-2-6 and IEC60068-2-27). The advanced isolation device is intended only to be used assembled on an appropriate heatsink with recommended flatness of <20µm per 100mm and roughness of <10µm.



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Testing Conditions

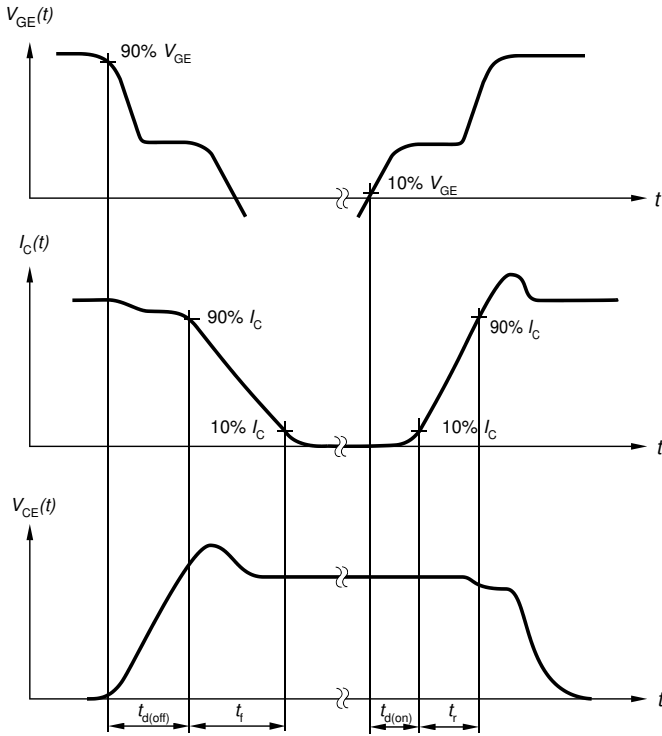


Figure A. Definition of switching times

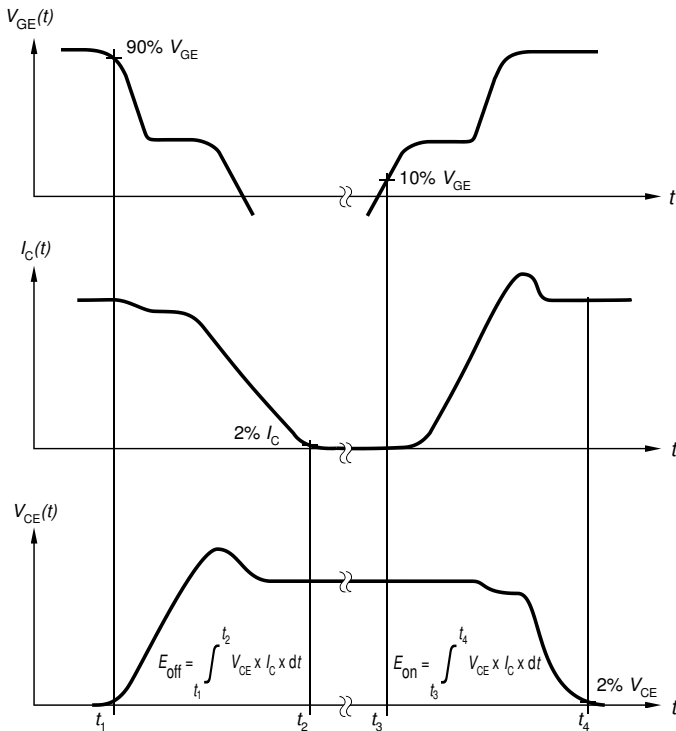


Figure B. Definition of switching losses

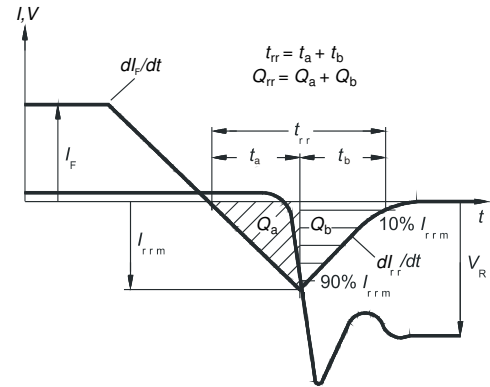


Figure C. Definition of diode switching characteristics

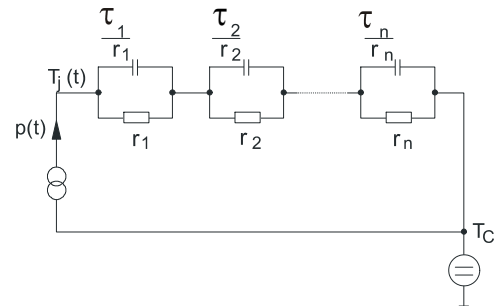


Figure D. Thermal equivalent circuit

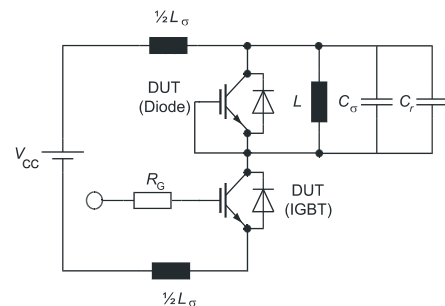


Figure E. Dynamic test circuit  
Parasitic inductance  $L_{\sigma}$ ,  
parasitic capacitor  $C_{\sigma}$ ,  
relief capacitor  $C_r$ ,  
(only for ZVT switching)

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## Emitter Controlled Diode Rapid 1 Advanced Isolation

### Revision History

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IDFW40E65D1E

**Revision: 2017-10-27, Rev. 2.2**

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Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2017-09-21	Final data sheet
2.2	2017-10-27	Update condition Fig.2

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**Infineon Technologies AG**  
**81726 München, Germany**  
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