

## 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:

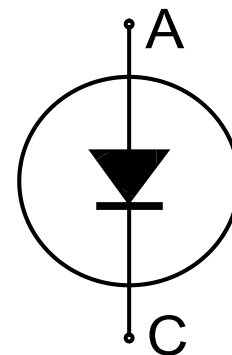
- Air Conditioning PFC
- General Purpose Drives (GPD)

#### 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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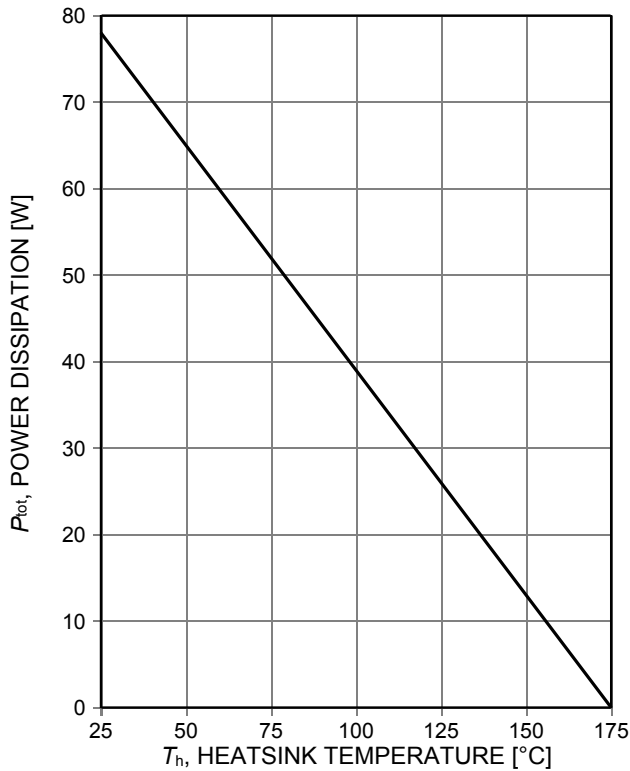


Figure 1. Power dissipation as a function of heatsink temperature ( $T_j \leq 175^\circ\text{C}$ )

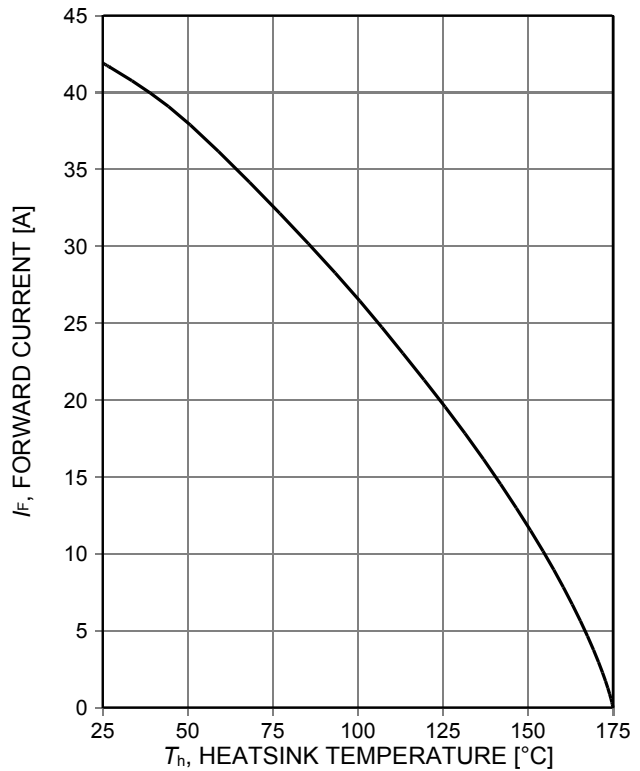


Figure 2. Diode forward current as a function of heatsink temperature

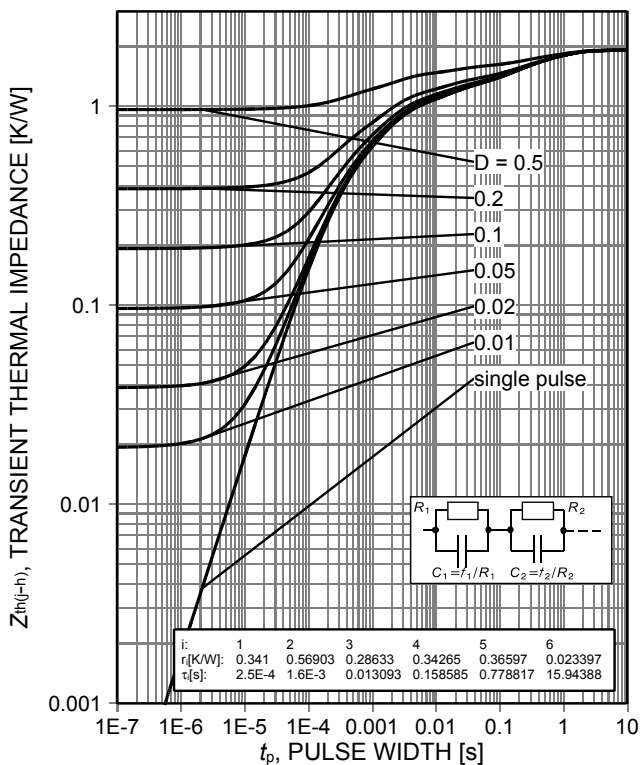


Figure 3. Diode transient thermal impedance as a function of pulse width ( $D = t_p/T$ )

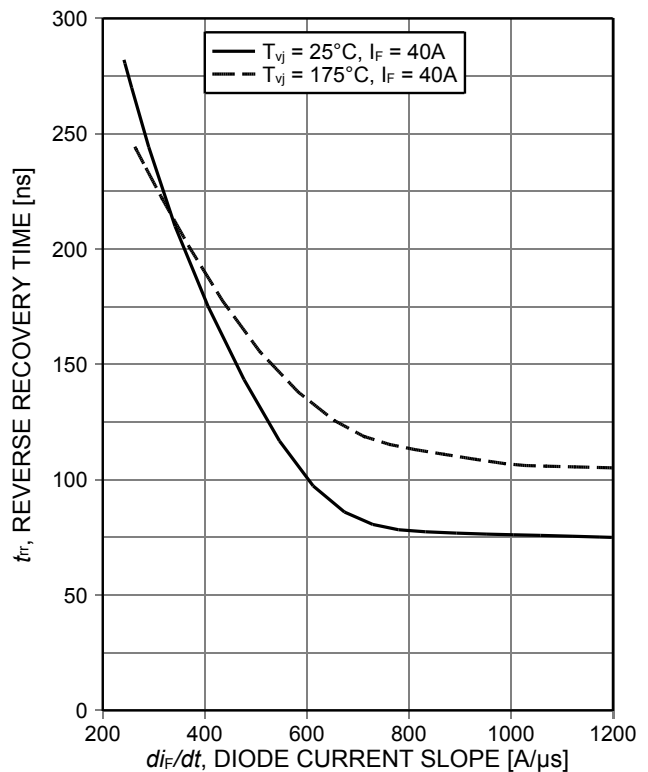


Figure 4. Typical reverse recovery time as a function of diode current slope ( $V_R = 400\text{V}$ )

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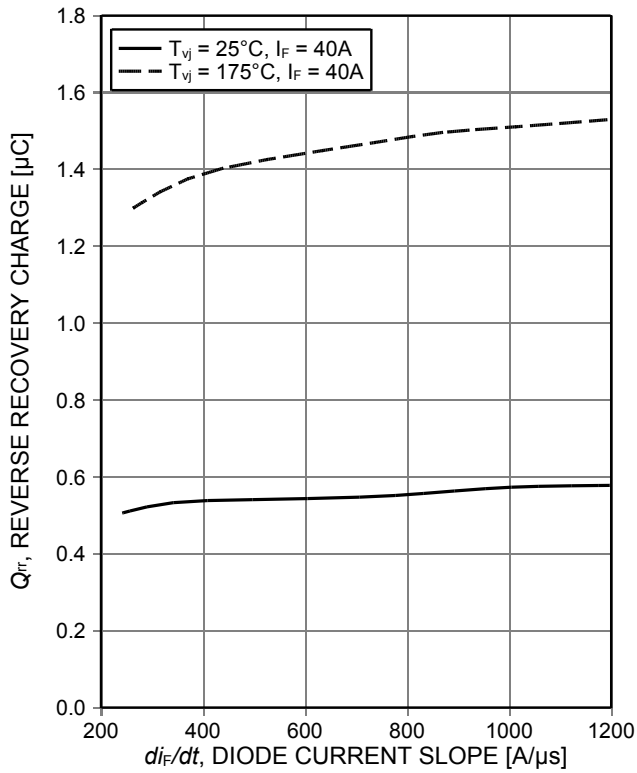


Figure 5. Typical reverse recovery charge as a function of diode current slope ( $V_R=400V$ )

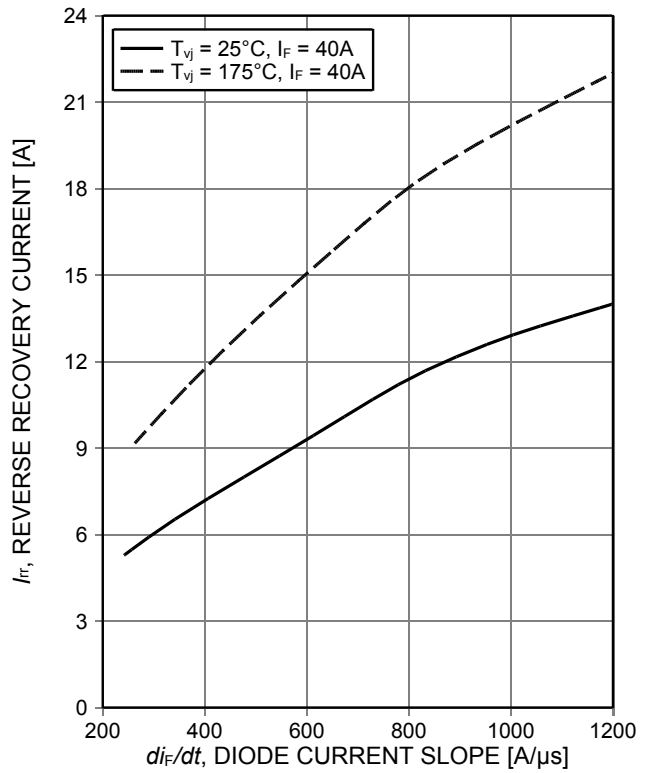


Figure 6. Typical reverse recovery current as a function of diode current slope ( $V_R=400V$ )

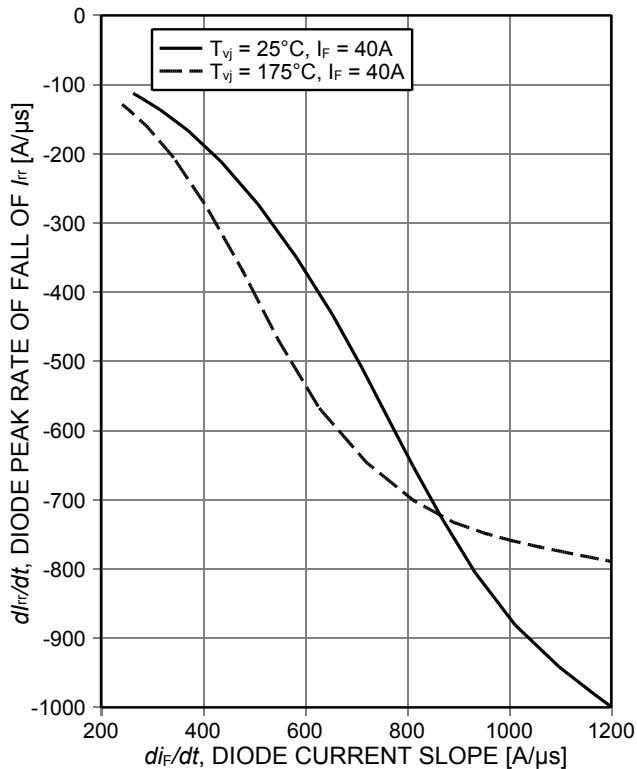


Figure 7. Typical peak reverse recovery current as a function of diode current slope ( $V_R=400V$ )

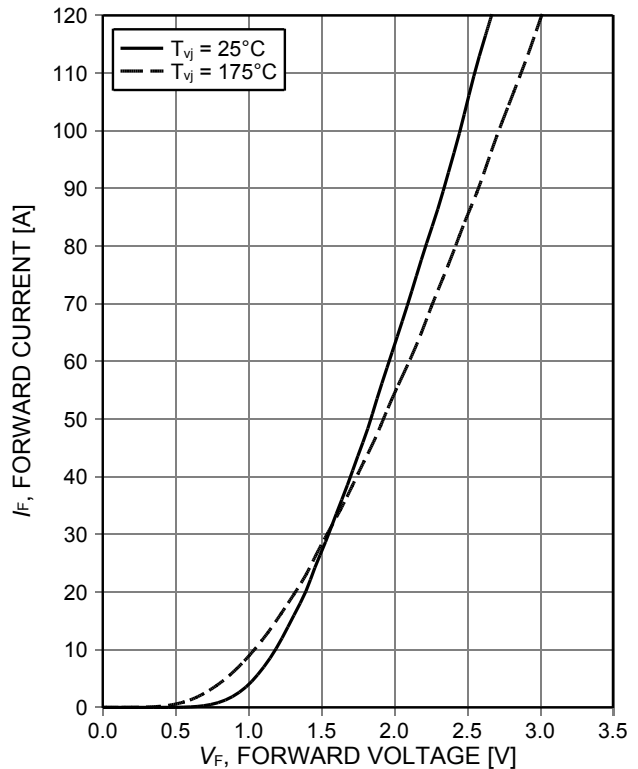


Figure 8. Typical diode forward current as a function of forward voltage

## Emitter Controlled Diode Rapid 1 Advanced Isolation

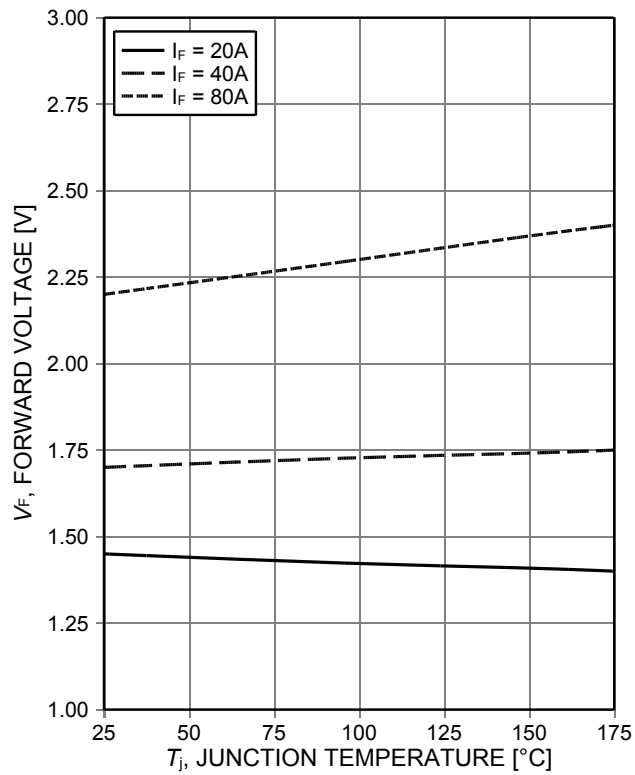
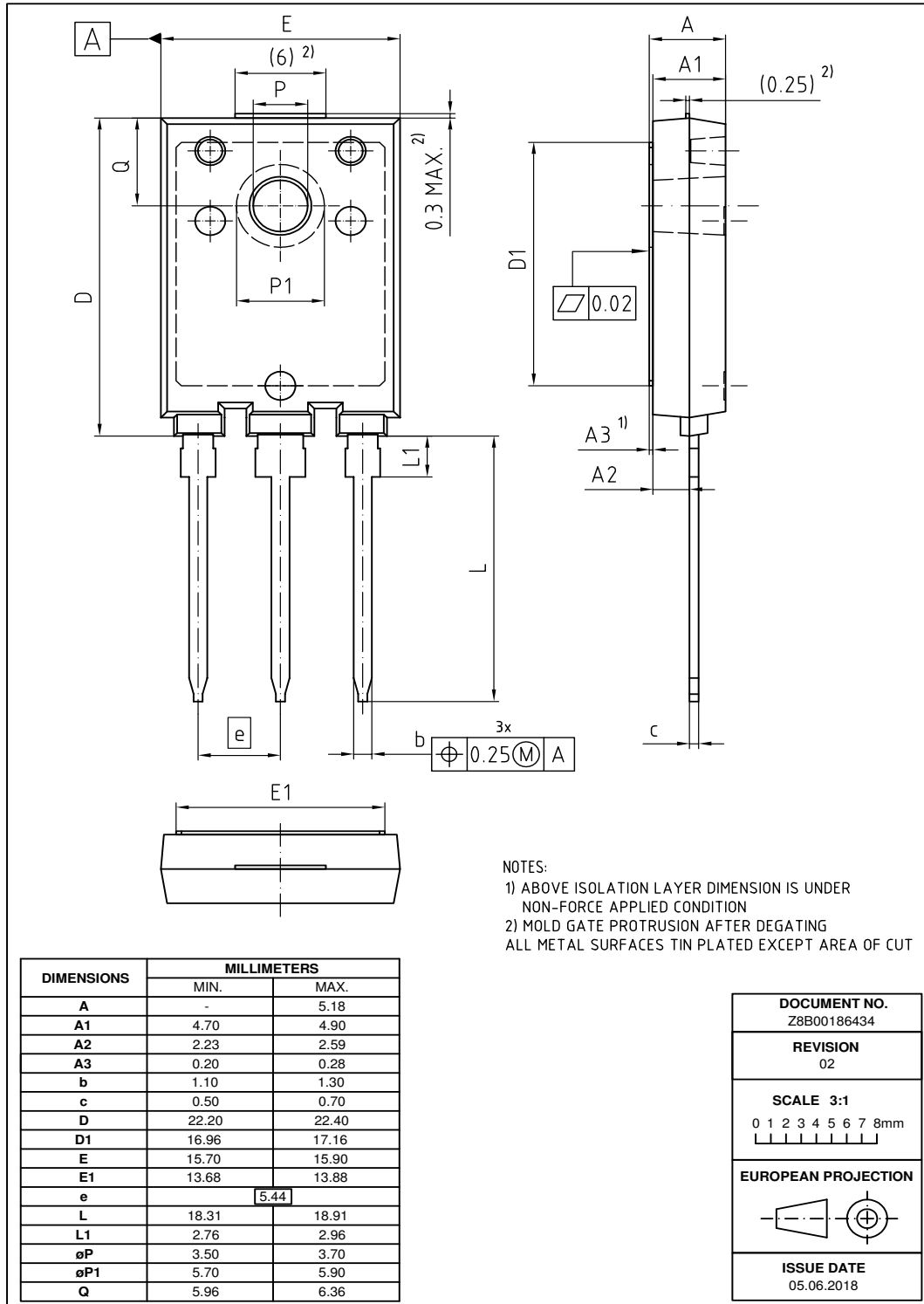


Figure 9. Typical diode forward voltage as a function of junction temperature

**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

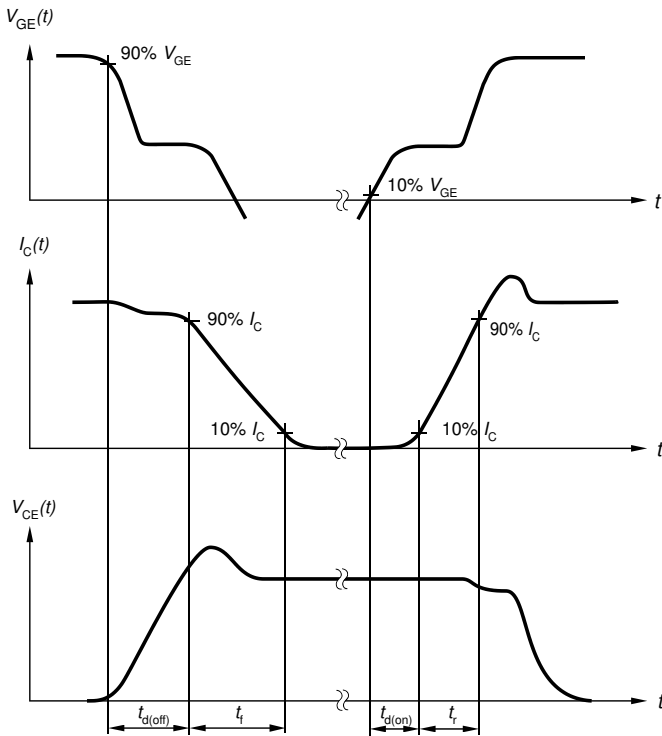


Figure A. Definition of switching times

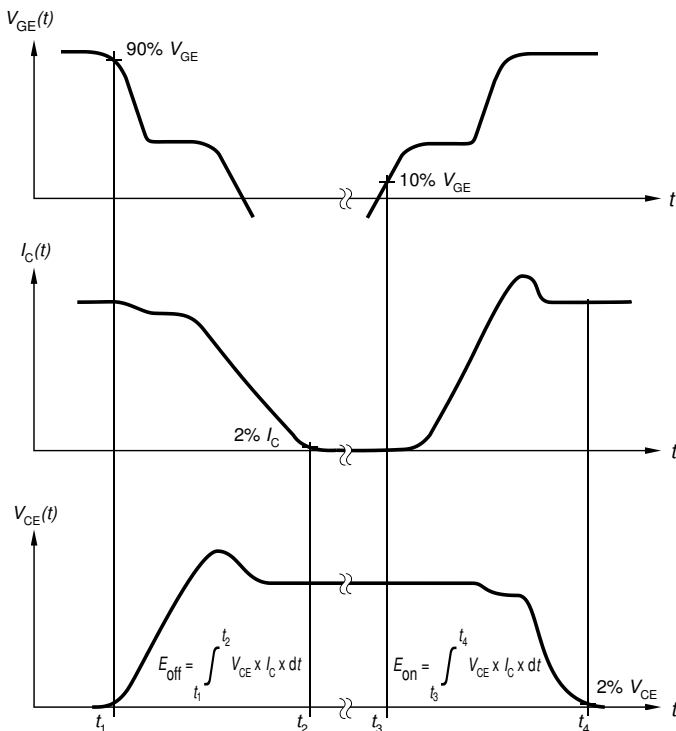


Figure B. Definition of switching losses

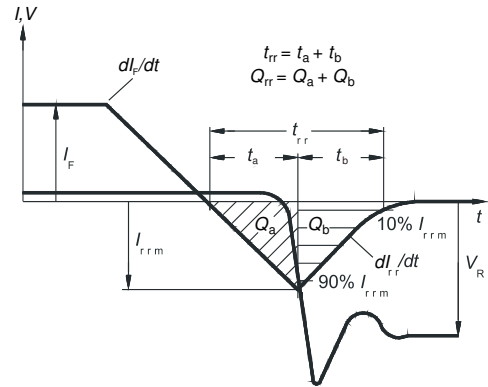


Figure C. Definition of diode switching characteristics

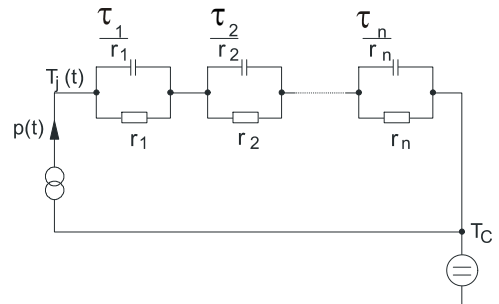


Figure D. Thermal equivalent circuit

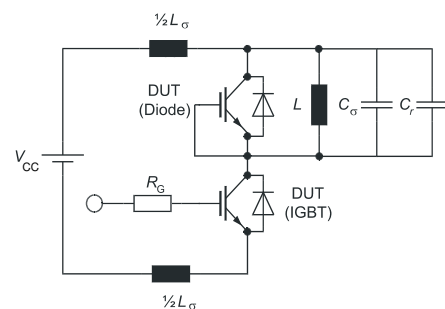


Figure E. **Dynamic test circuit**  
Parasitic inductance  $L_{\sigma}$ ,  
parasitic capacitor  $C_{\sigma}$ ,  
relief capacitor  $C_r$ ,  
(only for ZVT switching)

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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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