

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°C
- 2500 V_{RMS} electrical isolation, 50/60 Hz, $t=1$ min
- 100 % tested isolated mounting surface
- Pb-free lead plating; RoHS compliant

Potential Applications:

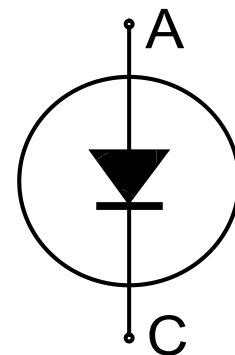
- Air Conditioning PFC
- General Purpose Drives (GPD)

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°C	D40E65D1E	PG-TO247-3-AI

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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.	
R _{th} Characteristics						
Diode thermal resistance, ²⁾ 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.	
Static Characteristic						
Diode forward voltage	V_F	$I_F = 40.0A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$	- -	1.70 1.75	2.10 -	V
Reverse leakage current	I_R	$V_R = 650V$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$	- -	- 350	40 -	μA

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

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Dynamic Characteristic						
Internal emitter inductance measured 5mm (0.197 in.) from case	L _E		-	13.0	-	nH

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

²⁾ 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	-	μC
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	-	μC
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	-	μC
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	-	μC
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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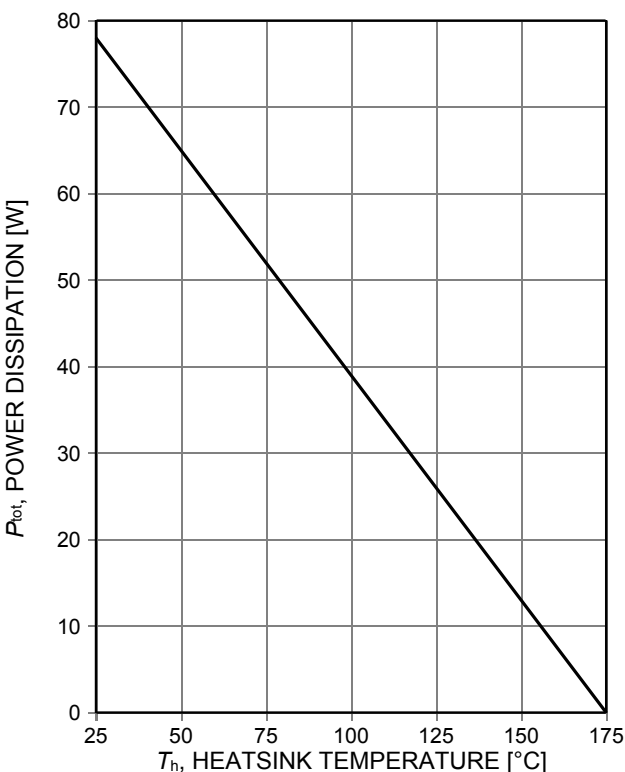


Figure 1. Power dissipation as a function of heatsink temperature ($T_j \leq 175^\circ\text{C}$)

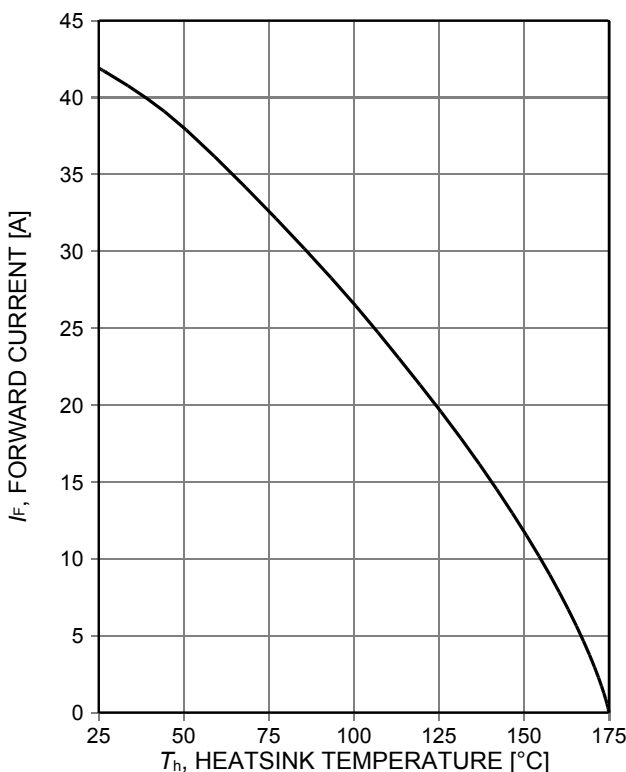


Figure 2. Diode forward current as a function of heatsink temperature

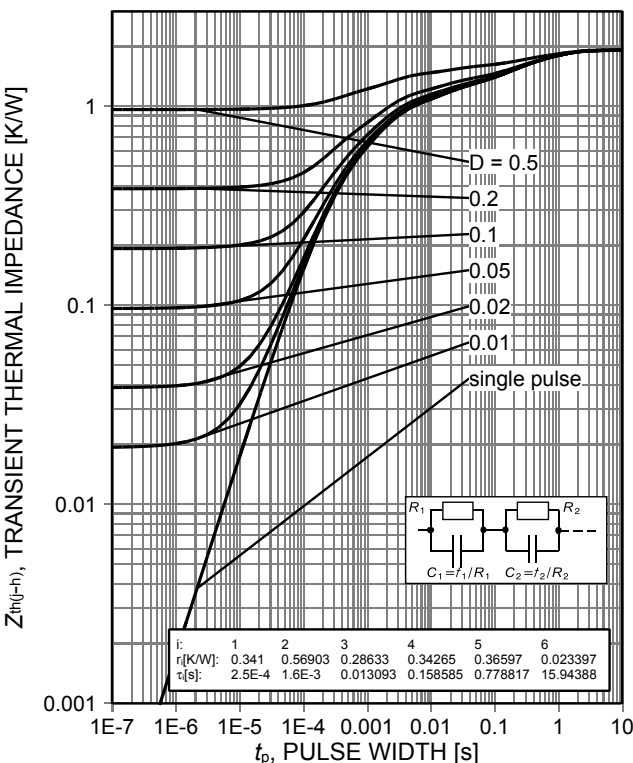


Figure 3. Diode transient thermal impedance as a function of pulse width ($D = t_p/T$)

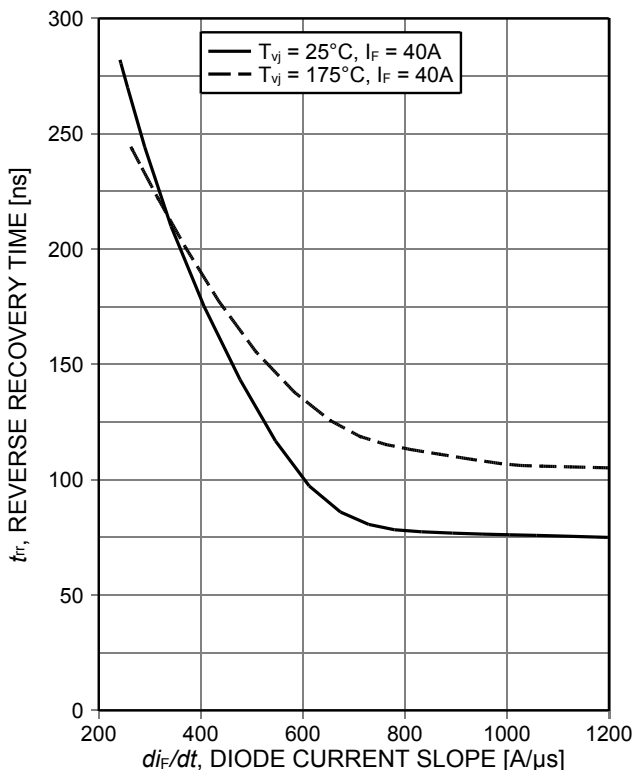


Figure 4. Typical reverse recovery time as a function of diode current slope ($V_R = 400\text{V}$)

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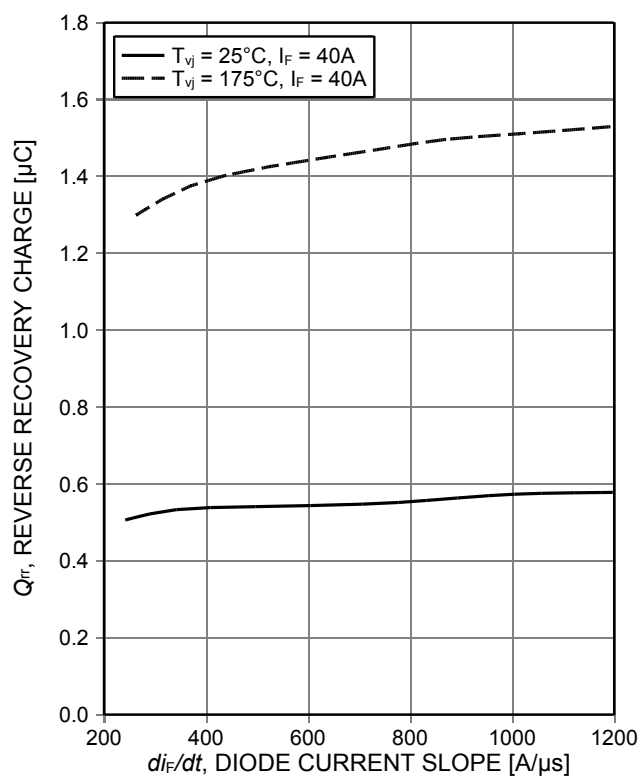


Figure 5. **Typical reverse recovery charge as a function of diode current slope**
($V_R=400V$)

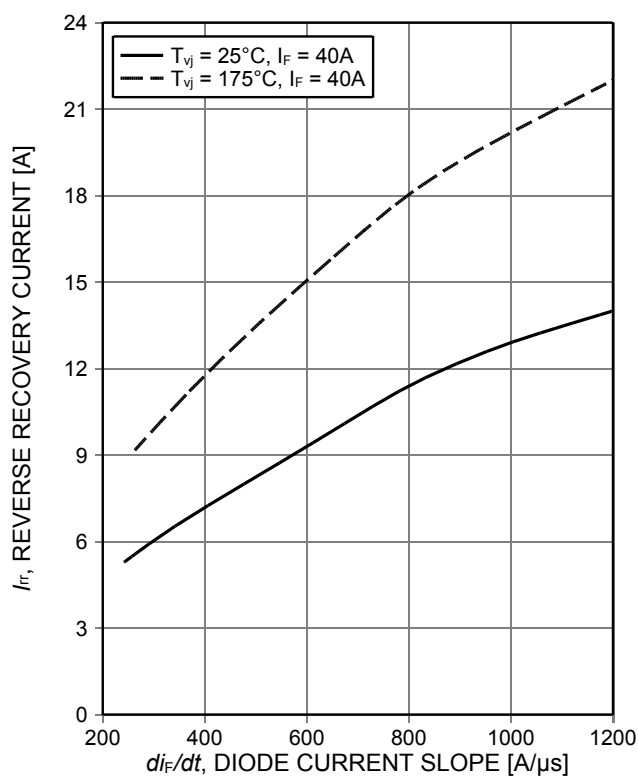


Figure 6. **Typical reverse recovery current as a function of diode current slope**
($V_R=400V$)

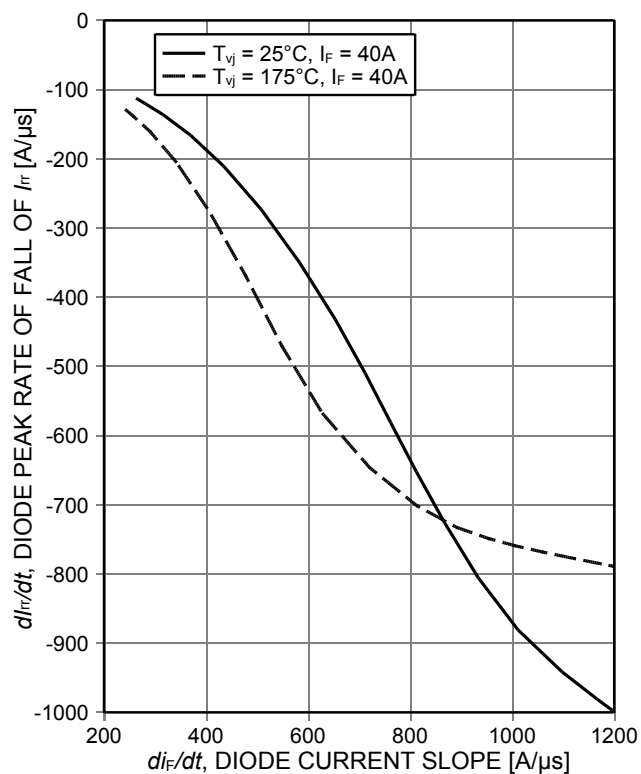


Figure 7. **Typical peak reverse recovery current as a function of diode current slope**
($V_R=400V$)

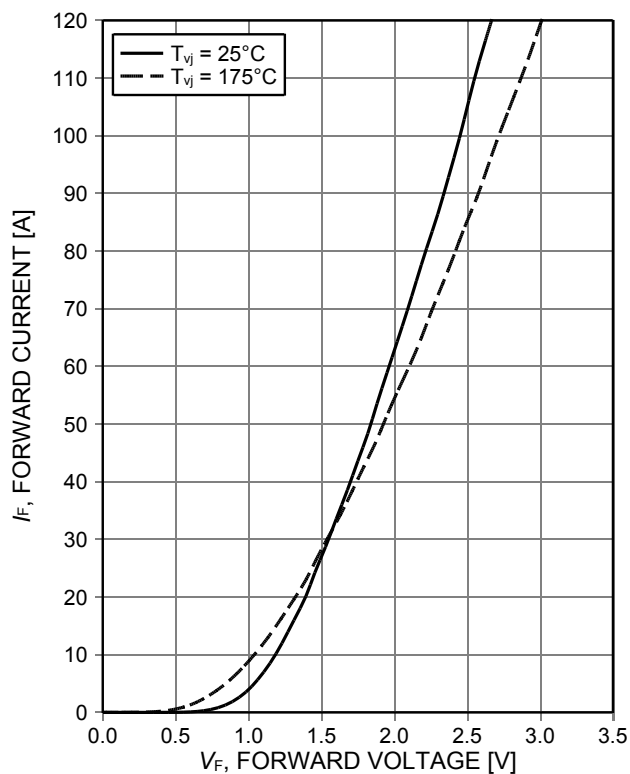


Figure 8. **Typical diode forward current as a function of forward voltage**

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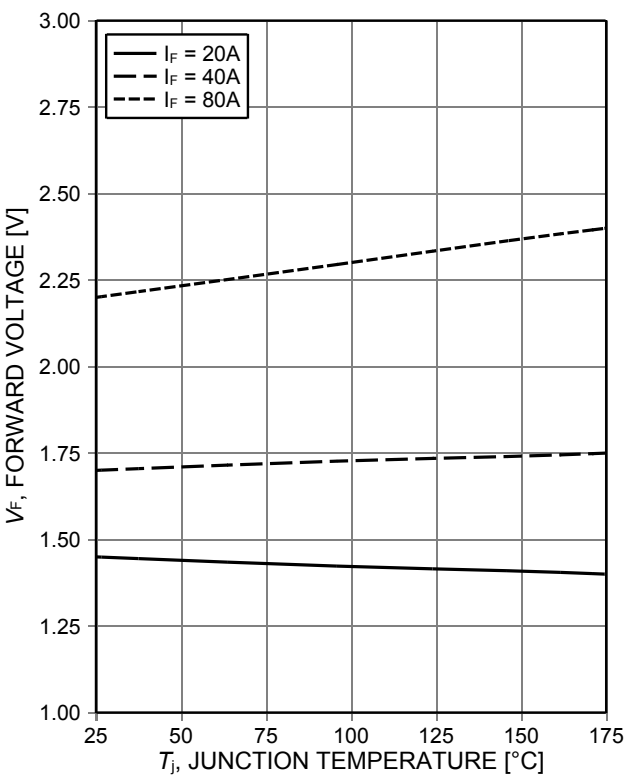
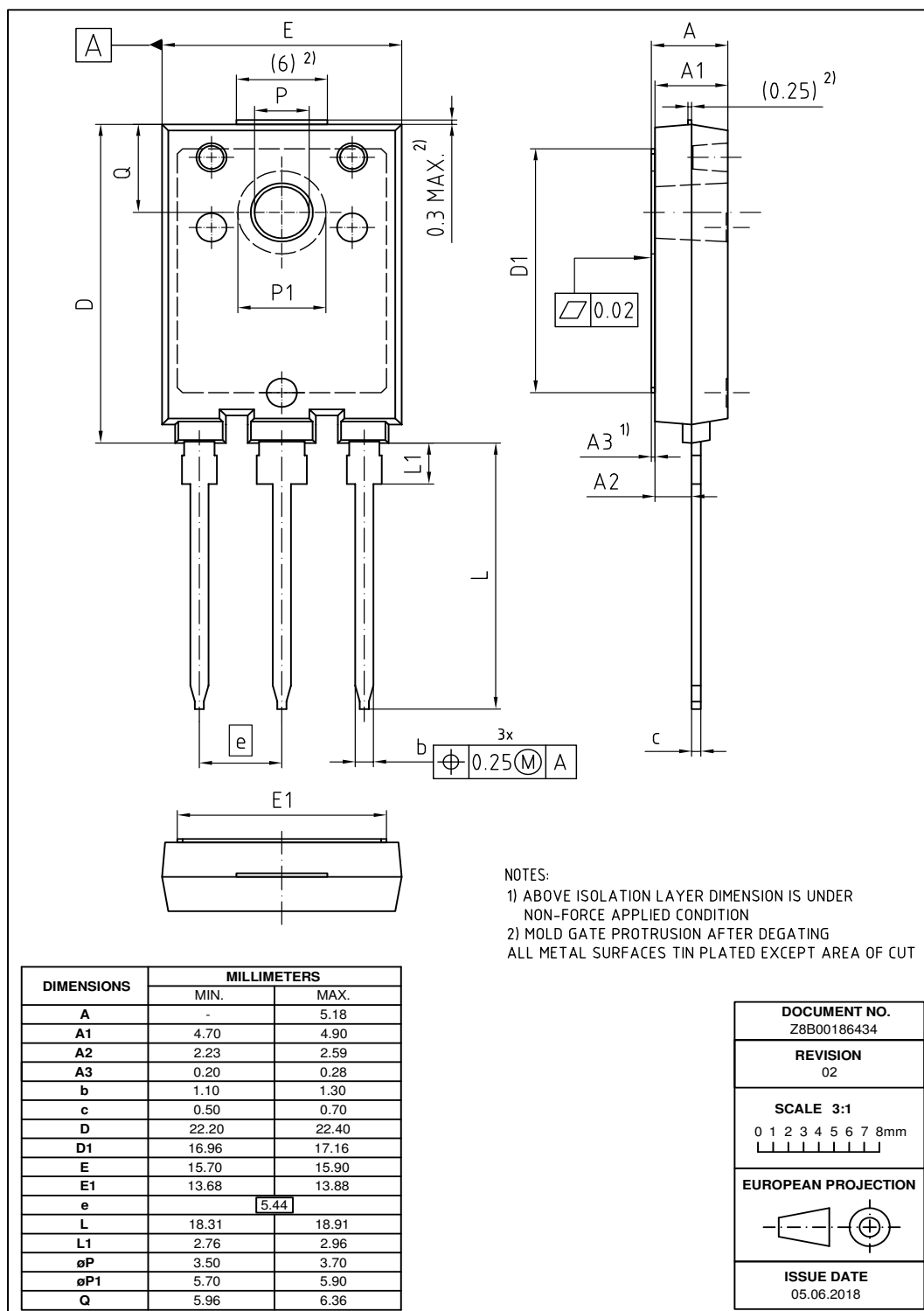


Figure 9. Typical diode forward voltage as a function of junction temperature

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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

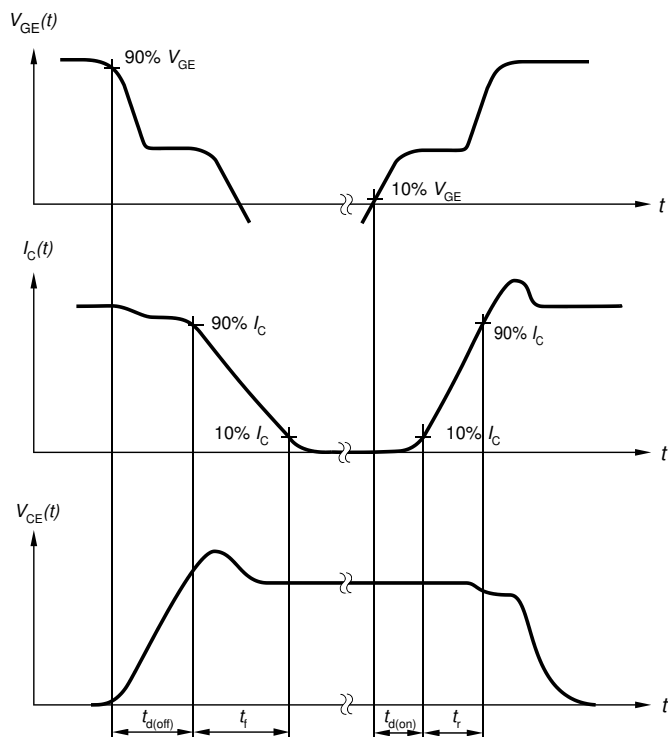


Figure A. Definition of switching times

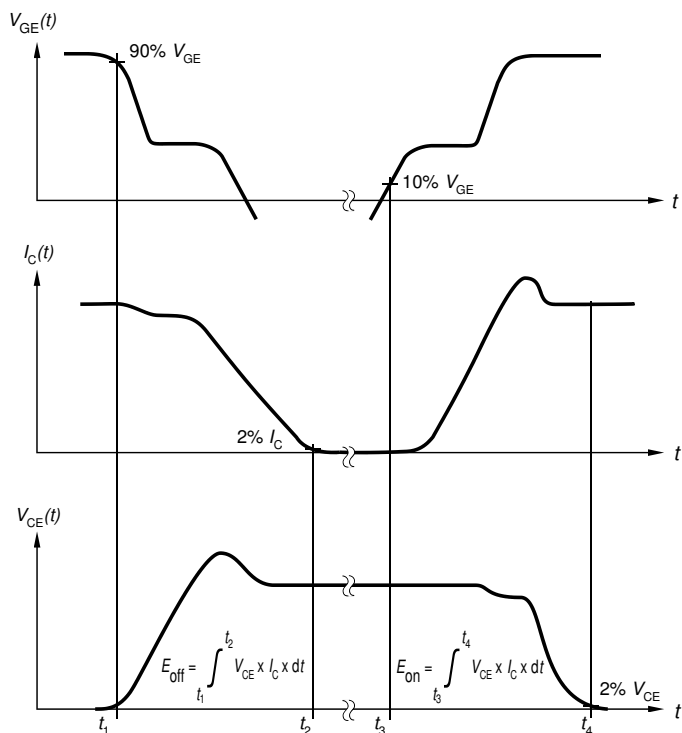


Figure B. Definition of switching losses

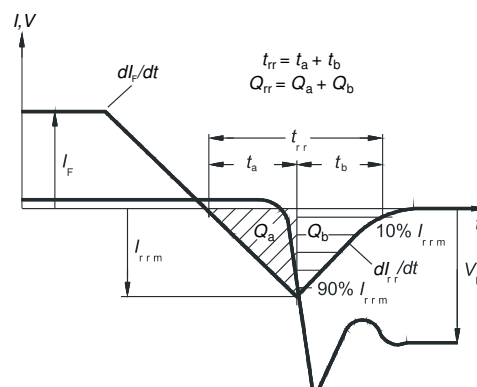


Figure C. Definition of diode switching characteristics

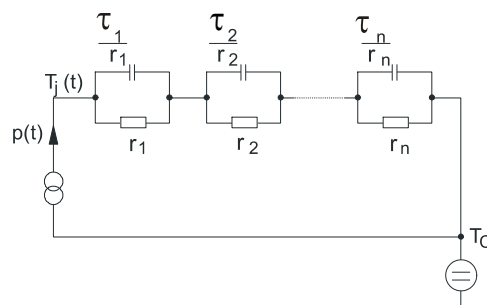


Figure D. Thermal equivalent circuit

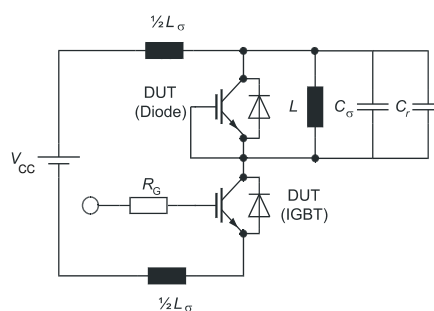


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ ,
parasitic capacitor C_σ ,
relief capacitor C_r ,
(only for ZVT switching)

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Revision History

IDFW40E65D1E

Revision: 2017-10-27, Rev. 2.2

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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