

## High speed 1200 V TRENCHSTOP™ IGBT 7 Technology co-packed with full rated current, soft-commutating, ultra-fast recovery and low $Q_{rr}$ emitter controlled 7 Rapid diode

### Features

- $V_{CE} = 1200\text{ V}$
- $I_C = 40\text{ A}$
- Maximum junction temperature  $T_{vjmax} = 175^\circ\text{C}$
- Best-in-class high speed IGBT co-packed with full rated current, low  $Q_{rr}$  and soft-commutating high speed diode
- Low saturation voltage  $V_{CEsat} = 1.7\text{ V}$  at  $T_{vj} = 25^\circ\text{C}$
- Optimized for high efficiency in high speed hard switching topologies (2-L inverter, 3-L NPC T-type, ...)
- Easy paralleling capability due to positive temperature coefficient in  $V_{CEsat}$
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models: <http://www.infineon.com/igbt/>

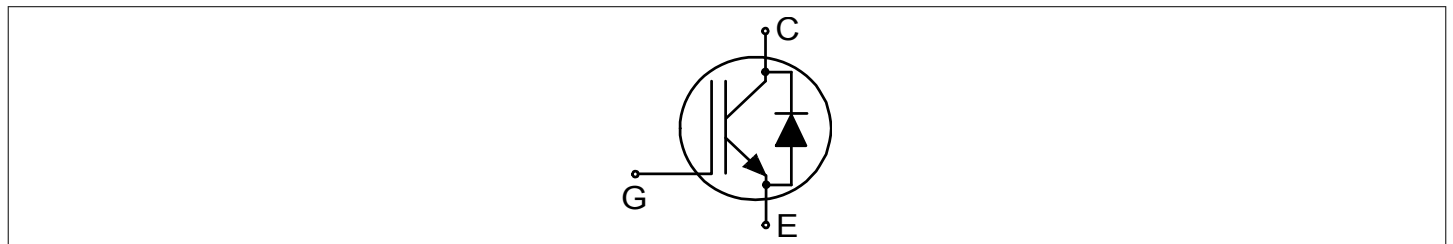
### Potential applications

- Industrial UPS
- EV-Charging
- String inverter
- Welding

### Product validation

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

### Description



Type	Package	Marking
IKW40N120CH7	PG-TO247-3-STD-NN2.5	K40MCH7

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## 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 process: 3			0.6	Nm
Thermal resistance, junction-ambient	$R_{th(j-a)}$				40	K/W
IGBT thermal resistance, junction-case	$R_{th(j-c)}$			0.35	0.46	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$			0.6	0.78	K/W

## 2 IGBT

**Table 2** Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Collector-emitter voltage	$V_{CE}$	$T_{vj} \geq 25\text{ °C}$	1200	V	
DC collector current, limited by $T_{vjmax}$	$I_C$	limited by bondwire	$T_c = 25\text{ °C}$	82	A
			$T_c = 100\text{ °C}$	67	
Pulsed collector current, $t_p$ limited by $T_{vjmax}$	$I_{Cpulse}$		160	A	
Turn-off safe operating area		$V_{CC} \leq 800\text{ V}$ , $V_{CE,peak} < 1200\text{ V}$ , $V_{GE} = 0/15\text{ V}$ , $R_{Goff} \geq 10\ \Omega$ , $T_{vj} \leq 175\text{ °C}$	160	A	
Gate-emitter voltage	$V_{GE}$		$\pm 20$	V	
Transient gate-emitter voltage	$V_{GE}$	$t_p \leq 0.5\ \mu\text{s}$ , $D < 0.001$	$\pm 25$	V	
Power dissipation	$P_{tot}$		$T_c = 25\text{ °C}$	330	W
			$T_c = 100\text{ °C}$	165	

**Table 3** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CEsat}$	$I_C = 40\text{ A}$ , $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$	1.7	2.15	V
			$T_{vj} = 175\text{ °C}$	2		

(table continues...)  
 Datasheet

**Table 3 (continued) Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Gate-emitter threshold voltage	$V_{GEth}$	$I_C = 0.64 \text{ mA}, V_{CE} = V_{GE}$	4.7	5.5	6.2	V
Zero gate-voltage collector current	$I_{CES}$	$V_{CE} = 1200 \text{ V}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		40	$\mu\text{A}$
			$T_{vj} = 175 \text{ }^\circ\text{C}$		2600	
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0 \text{ V}, V_{GE} = 20 \text{ V}$			100	nA
Transconductance	$g_{fs}$	$I_C = 40 \text{ A}, V_{CE} = 20 \text{ V}$		79		S
Input capacitance	$C_{ies}$	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		5		nF
Output capacitance	$C_{oes}$	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		108		pF
Reverse transfer capacitance	$C_{res}$	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		29		pF
Gate charge	$Q_G$	$I_C = 40 \text{ A}, V_{GE} = 15 \text{ V}, V_{CC} = 960 \text{ V}$		290		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 600 \text{ V}, V_{GE} = 0/15 \text{ V},$ $R_{G(on)} = 10 \text{ } \Omega,$ $R_{G(off)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$		36	ns
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$		32	
Rise time (inductive load)	$t_r$	$V_{CC} = 600 \text{ V}, V_{GE} = 0/15 \text{ V},$ $R_{G(on)} = 10 \text{ } \Omega,$ $R_{G(off)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$		22	ns
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$		21	
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 600 \text{ V}, V_{GE} = 0/15 \text{ V},$ $R_{G(on)} = 10 \text{ } \Omega,$ $R_{G(off)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$		336	ns
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$		420	
Fall time (inductive load)	$t_f$	$V_{CC} = 600 \text{ V}, V_{GE} = 0/15 \text{ V},$ $R_{G(on)} = 10 \text{ } \Omega,$ $R_{G(off)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$		45	ns
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$		114	
Turn-on energy	$E_{on}$	$V_{CC} = 600 \text{ V}, V_{GE} = 0/15 \text{ V},$ $R_{G(on)} = 10 \text{ } \Omega,$ $R_{G(off)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$		1.69	mJ
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$		2.44	
Turn-off energy	$E_{off}$	$V_{CC} = 600 \text{ V}, V_{GE} = 0/15 \text{ V},$ $R_{G(on)} = 10 \text{ } \Omega,$ $R_{G(off)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$		0.92	mJ
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$		2.13	

(table continues...)

**Table 3 (continued) Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Total switching energy	$E_{ts}$	$V_{CC} = 600\text{ V}, V_{GE} = 0/15\text{ V},$ $R_{G(on)} = 10\ \Omega,$ $R_{G(off)} = 10\ \Omega$	$T_{vj} = 25\text{ }^\circ\text{C},$ $I_C = 40\text{ A}$		2.61		mJ
			$T_{vj} = 175\text{ }^\circ\text{C},$ $I_C = 40\text{ A}$		4.57		
Operating junction temperature	$T_{vj}$		-40		175	$^\circ\text{C}$	

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

### 3 Diode

**Table 4 Maximum rated values**

Parameter	Symbol	Note or test condition	Values	Unit	
Diode forward current, limited by $T_{vjmax}$	$I_F$		$T_c = 25\text{ }^\circ\text{C}$	66	A
			$T_c = 100\text{ }^\circ\text{C}$	42	
Diode pulsed current, $t_p$ limited by $T_{vjmax}$	$I_{Fpulse}$		160	A	
Power dissipation	$P_{tot}$		$T_c = 25\text{ }^\circ\text{C}$	192	W
			$T_c = 100\text{ }^\circ\text{C}$	96	

**Table 5 Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Diode forward voltage	$V_F$	$I_F = 40\text{ A}$	$T_{vj} = 25\text{ }^\circ\text{C}$		2.5	3	V
			$T_{vj} = 175\text{ }^\circ\text{C}$		2.3		
Diode reverse recovery time	$t_{rr}$	$V_R = 600\text{ V}, R_{G(on)} = 10\ \Omega$	$T_{vj} = 25\text{ }^\circ\text{C},$ $I_F = 40\text{ A}$		120		ns
			$T_{vj} = 175\text{ }^\circ\text{C},$ $I_F = 40\text{ A}$		185		
Diode reverse recovery charge	$Q_{rr}$	$V_R = 600\text{ V}, R_{G(on)} = 10\ \Omega$	$T_{vj} = 25\text{ }^\circ\text{C},$ $I_F = 40\text{ A}$		1.27		$\mu\text{C}$
			$T_{vj} = 175\text{ }^\circ\text{C},$ $I_F = 40\text{ A}$		3.25		
Diode peak reverse recovery current	$I_{rrm}$	$V_R = 600\text{ V}, R_{G(on)} = 10\ \Omega$	$T_{vj} = 25\text{ }^\circ\text{C},$ $I_F = 40\text{ A}$		27		A
			$T_{vj} = 175\text{ }^\circ\text{C},$ $I_F = 40\text{ A}$		43		

(table continues...)

**Table 5 (continued) Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Diode peak rate of fall of reverse recovery current	$di_{rr}/dt$	$V_R = 600 \text{ V}, R_{G(on)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C},$ $I_F = 40 \text{ A}$		-348		A/ $\mu\text{s}$
			$T_{vj} = 175 \text{ } ^\circ\text{C},$ $I_F = 40 \text{ A}$		-405		
Reverse recovery energy	$E_{rec}$	$V_R = 600 \text{ V}, R_{G(on)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C},$ $I_F = 40 \text{ A}$		0.37		mJ
			$T_{vj} = 175 \text{ } ^\circ\text{C},$ $I_F = 40 \text{ A}$		1.09		
Operating junction temperature	$T_{vj}$			-40		175	$^\circ\text{C}$

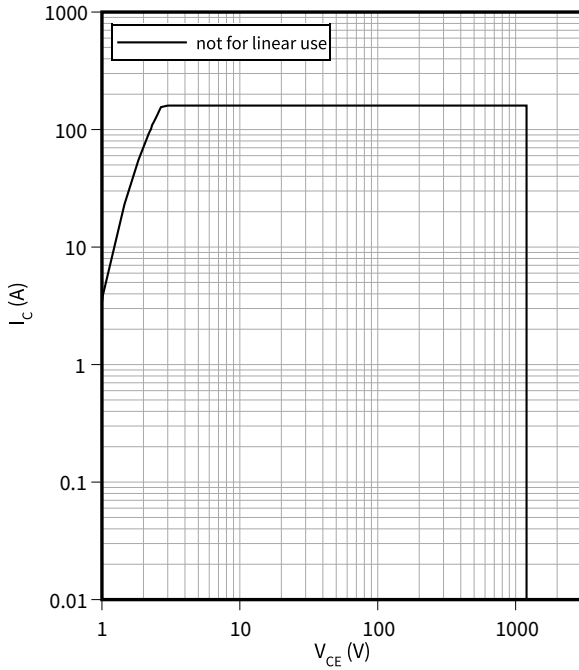
*Note: For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.*

*Dynamic test circuit, parasitic inductance  $L_\sigma = 30 \text{ nH}$ ,  $C_\sigma = 18 \text{ pF}$*

## 4 Characteristics diagrams

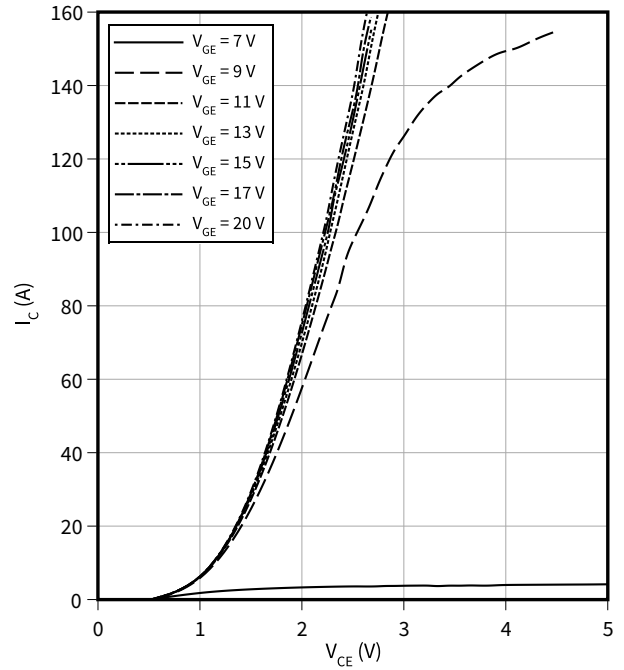
### Reverse bias safe operating area

$I_C = f(V_{CE})$   
 $T_{vj} \leq 175\text{ °C}, V_{GE} = 0/15\text{ V}$



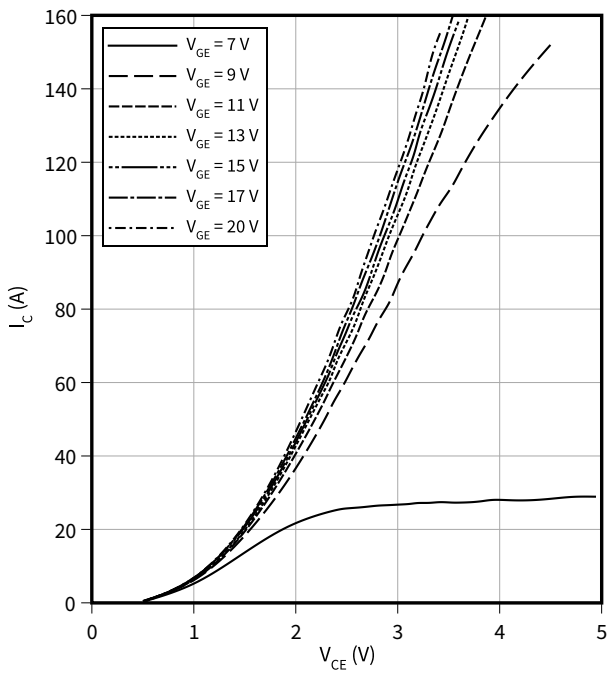
### Typical output characteristic

$I_C = f(V_{CE})$   
 $T_{vj} = 25\text{ °C}$



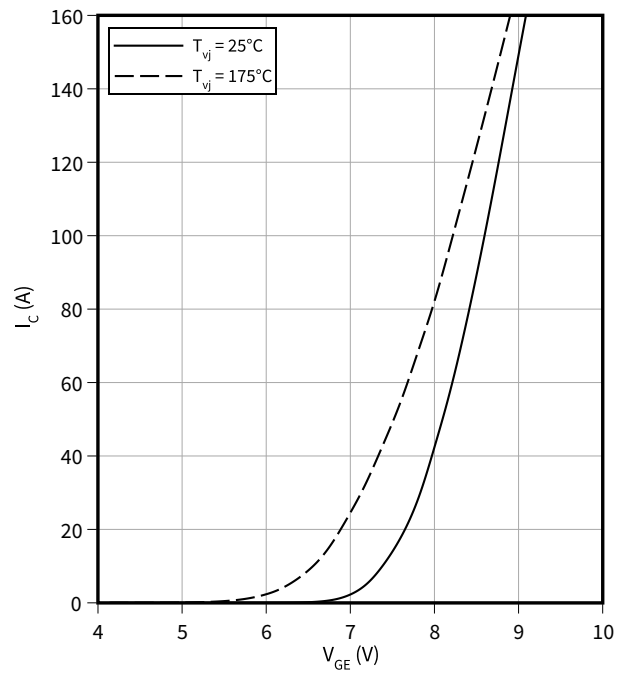
### Typical output characteristic

$I_C = f(V_{CE})$   
 $T_{vj} = 175\text{ °C}$



### Typical transfer characteristic

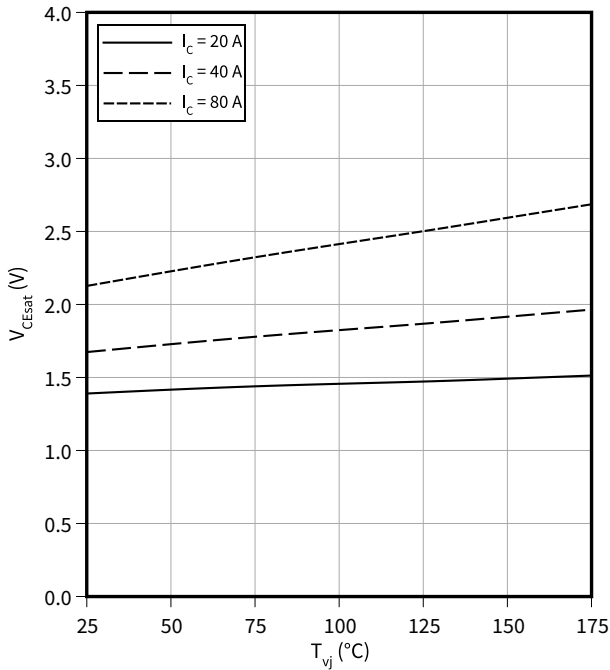
$I_C = f(V_{GE})$   
 $V_{CE} = 20\text{ V}$



4 Characteristics diagrams

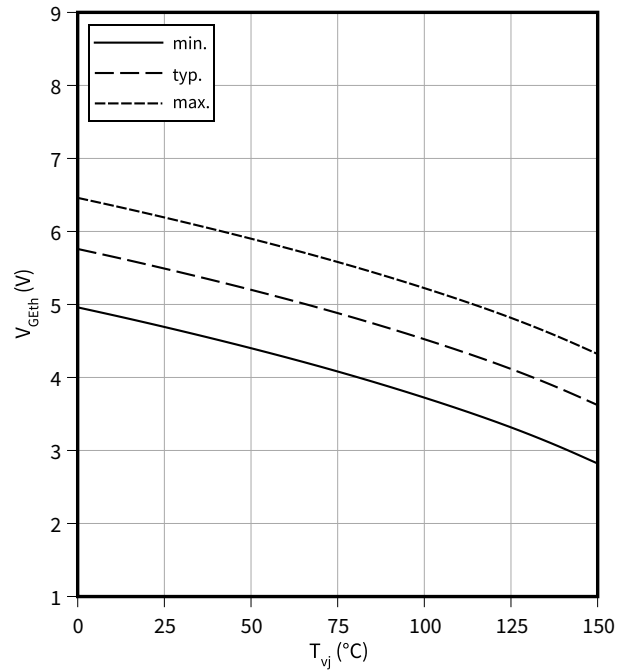
**Typical collector-emitter saturation voltage as a function of junction temperature**

$V_{CEsat} = f(T_{vj})$   
 $V_{GE} = 15 \text{ V}$



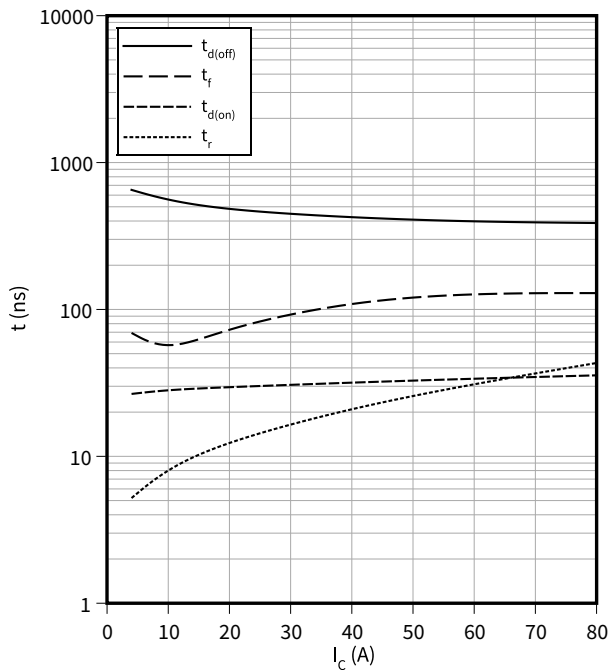
**Gate-emitter threshold voltage as a function of junction temperature**

$V_{GEth} = f(T_{vj})$   
 $I_c = 0.64 \text{ mA}$



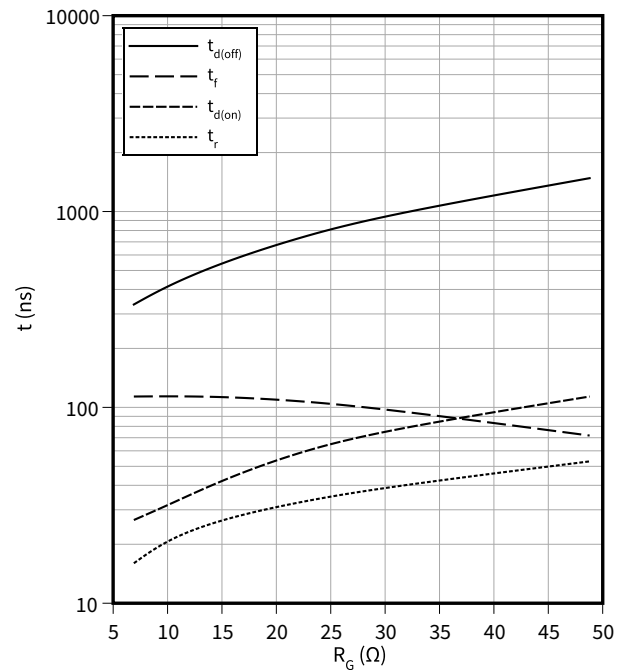
**Typical switching times as a function of collector current**

$t = f(I_c)$   
 $V_{CC} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 10 \text{ } \Omega$



**Typical switching times as a function of gate resistor**

$t = f(R_G)$   
 $I_c = 40 \text{ A}, V_{CC} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}$



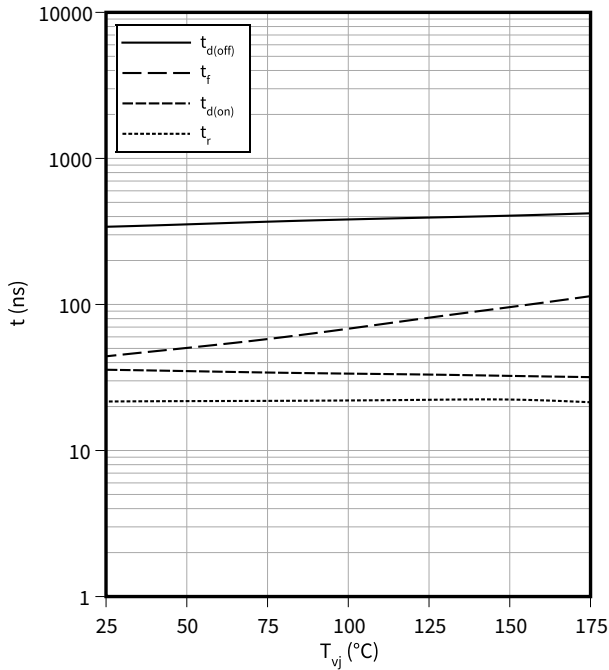


4 Characteristics diagrams

**Typical switching times as a function of junction temperature**

$t = f(T_{vj})$

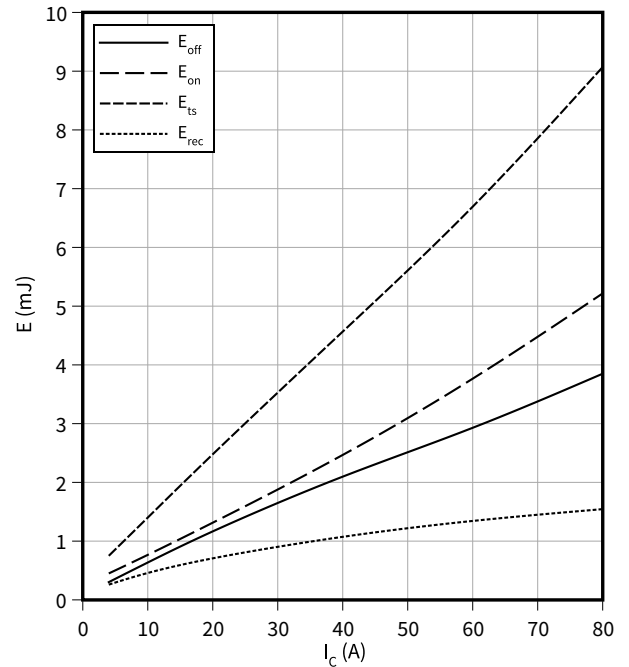
$I_C = 40\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 0/15\text{ V}, R_G = 10\ \Omega$



**Typical switching energy losses as a function of collector current**

$E = f(I_C)$

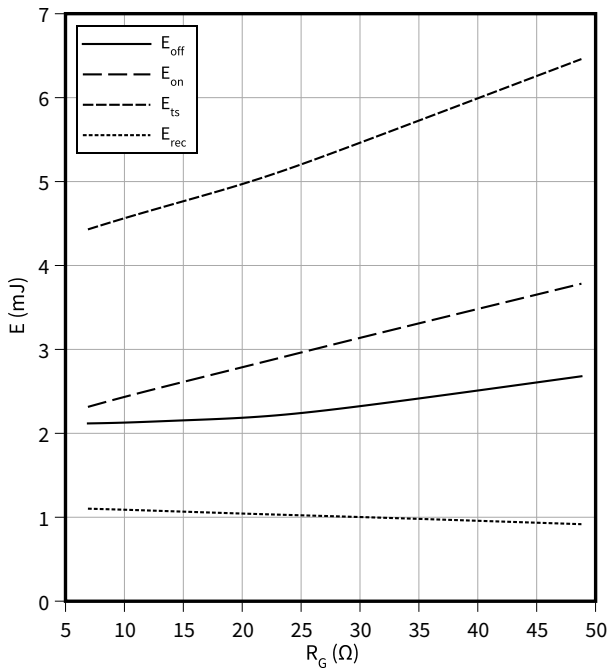
$V_{CC} = 600\text{ V}, T_{vj} = 175\text{ °C}, V_{GE} = 0/15\text{ V}, R_G = 10\ \Omega$



**Typical switching energy losses as a function of gate resistor**

$E = f(R_G)$

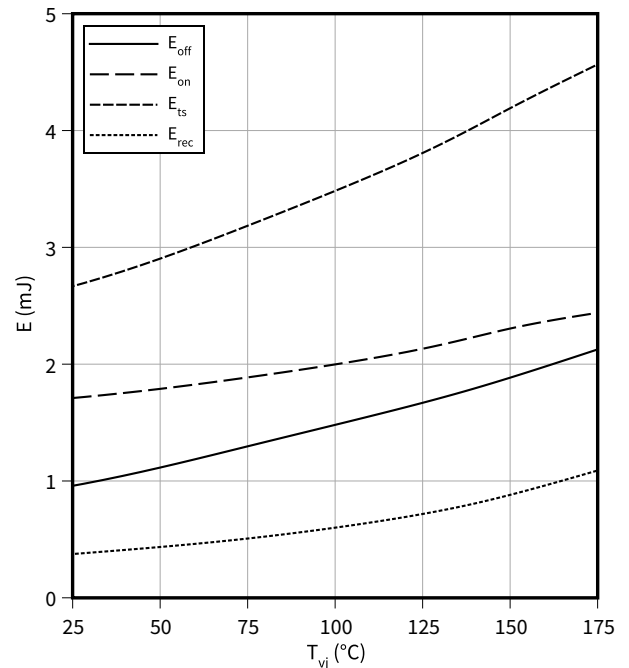
$I_C = 40\text{ A}, V_{CC} = 600\text{ V}, T_{vj} = 175\text{ °C}, V_{GE} = 0/15\text{ V}$



**Typical switching energy losses as a function of junction temperature**

$E = f(T_{vj})$

$I_C = 40\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 0/15\text{ V}, R_G = 10\ \Omega$

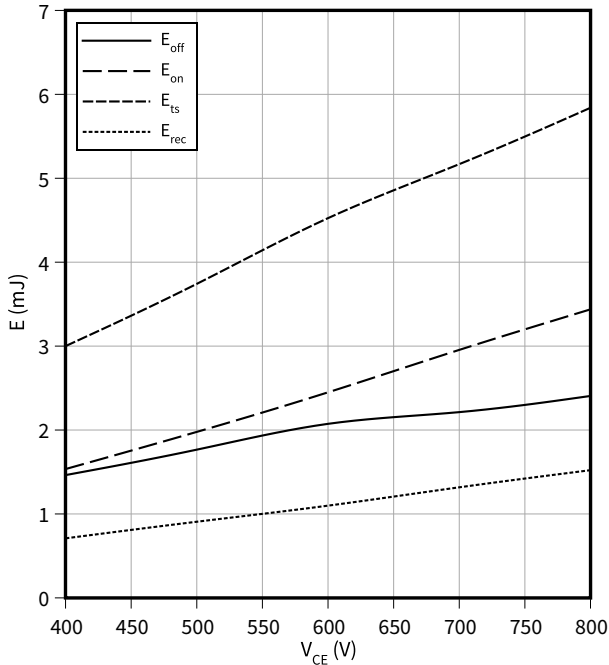


4 Characteristics diagrams

**Typical switching energy losses as a function of collector emitter voltage**

$E = f(V_{CE})$

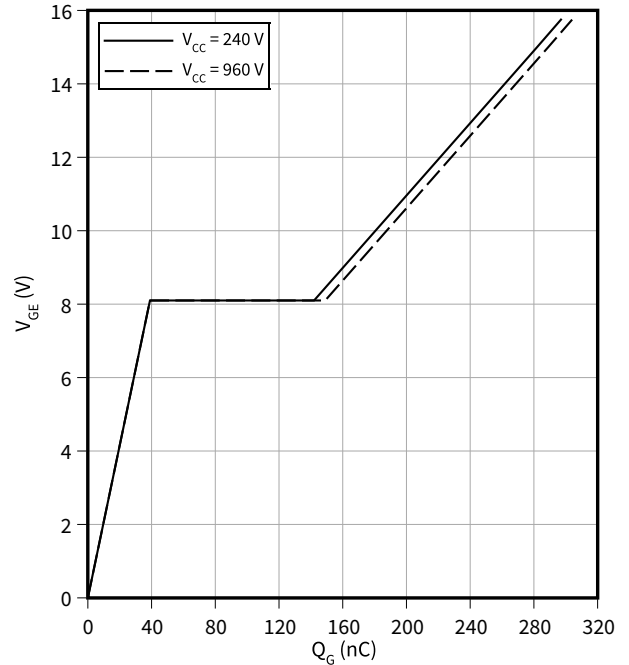
$I_C = 40\text{ A}$ ,  $T_{vj} = 175\text{ °C}$ ,  $V_{GE} = 0/15\text{ V}$ ,  $R_G = 10\text{ }\Omega$



**Typical gate charge**

$V_{GE} = f(Q_G)$

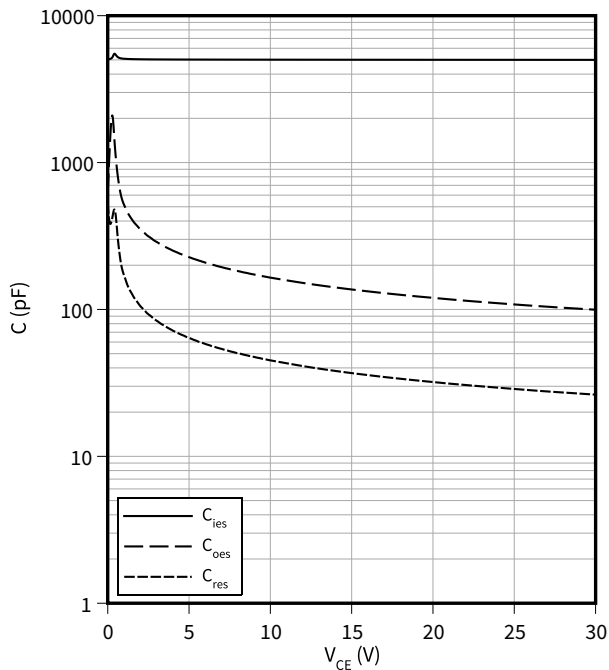
$I_C = 40\text{ A}$



**Typical capacitance as a function of collector-emitter voltage**

$C = f(V_{CE})$

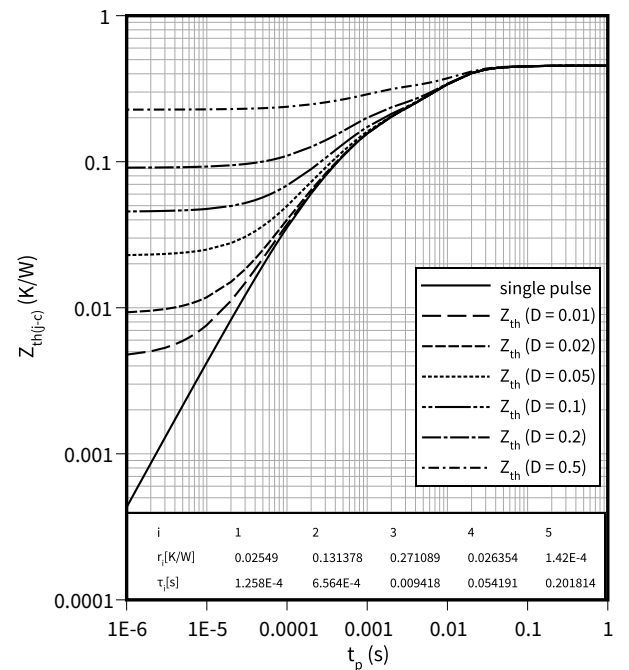
$f = 100\text{ kHz}$ ,  $V_{GE} = 0\text{ V}$



**IGBT transient thermal impedance as a function of pulse width**

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

$D = t_p/T$

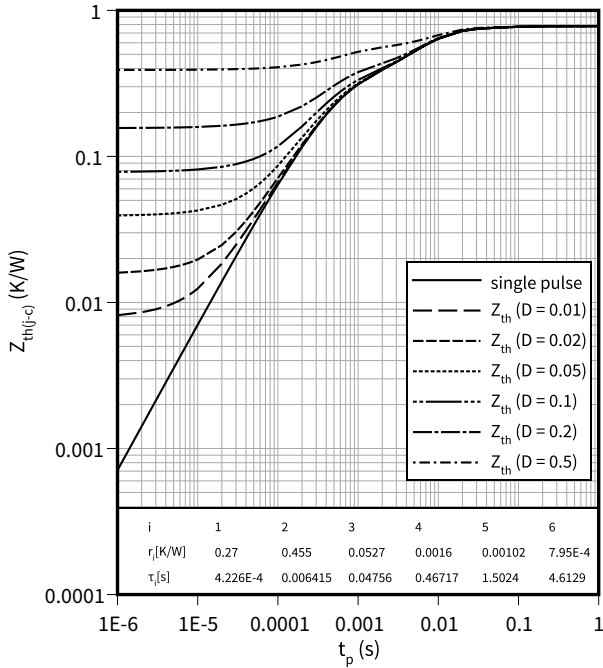


**4 Characteristics diagrams**

**Diode transient thermal impedance as a function of pulse width**

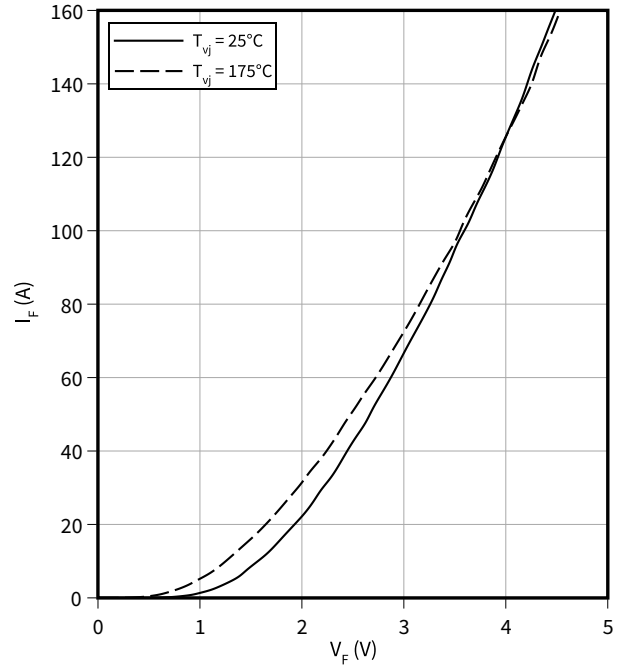
$$Z_{th(j-c)} = f(t_p)$$

$$D = t_p/T$$



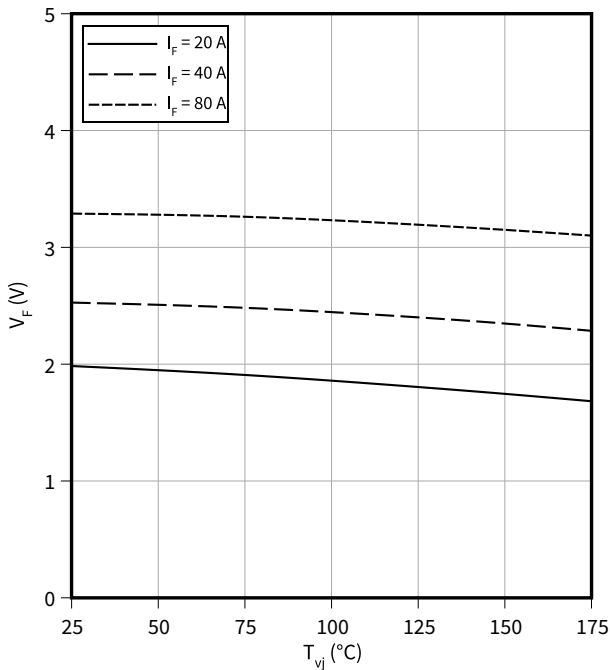
**Typical diode forward current as a function of forward voltage**

$$I_F = f(V_F)$$



**Typical diode forward voltage as a function of junction temperature**

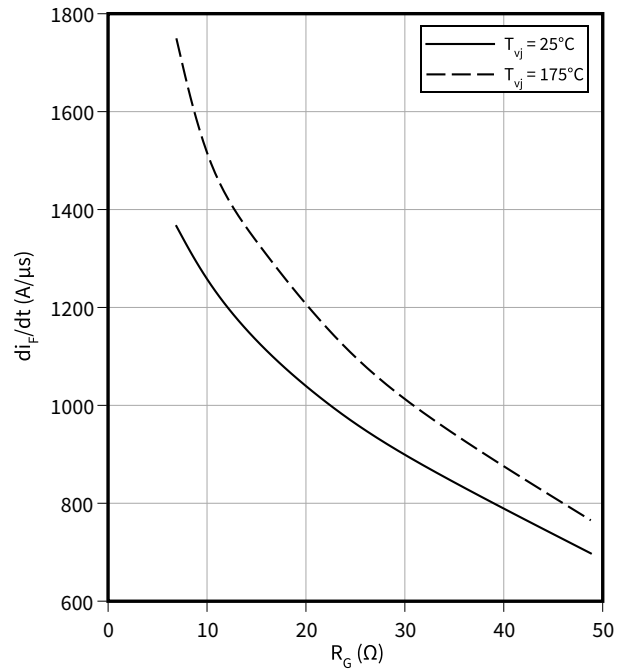
$$V_F = f(T_{vj})$$



**Typical diode current slope as a function of gate resistor**

$$di_F/dt = f(R_G)$$

$$V_R = 600 \text{ V}, I_F = 40 \text{ A}$$

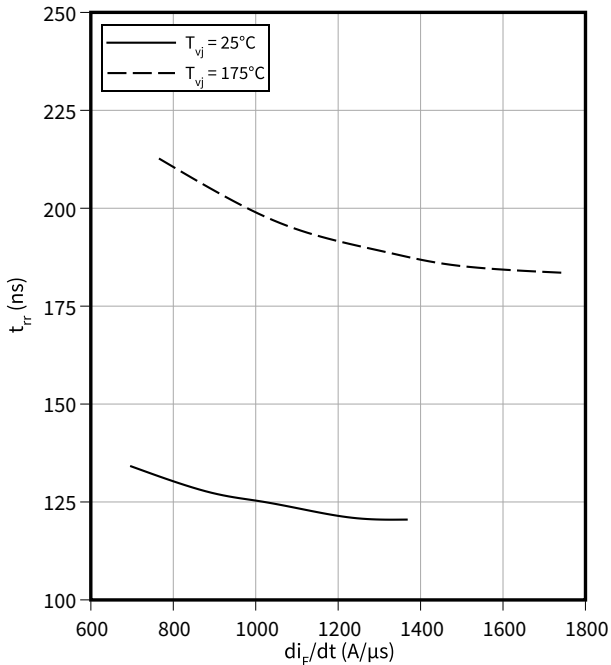


4 Characteristics diagrams

**Typical reverse recovery time as a function of diode current slope**

$t_{rr} = f(di_F/dt)$

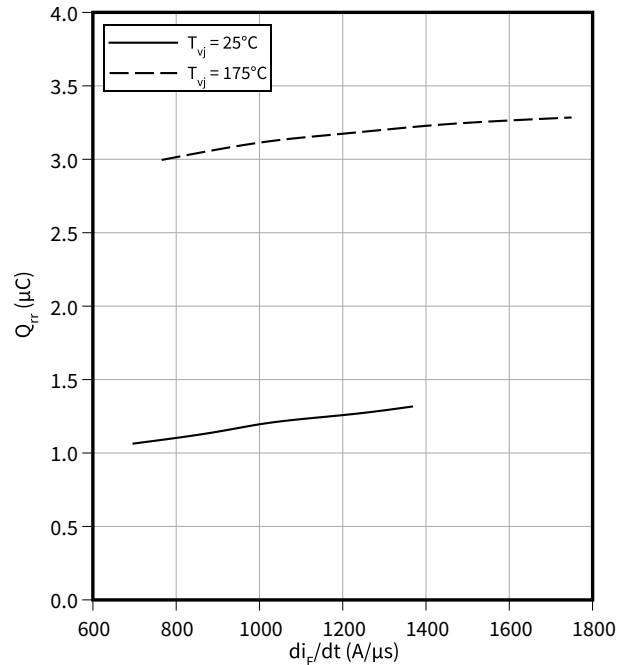
$V_R = 600\text{ V}, I_F = 40\text{ A}$



**Typical reverse recovery charge as a function of diode current slope**

$Q_{rr} = f(di_F/dt)$

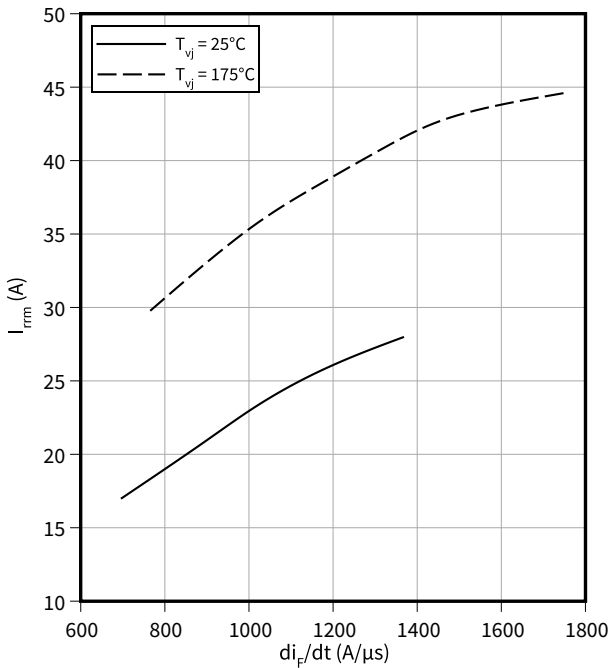
$V_R = 600\text{ V}, I_F = 40\text{ A}$



**Typical reverse recovery current as a function of diode current slope**

$I_{rrm} = f(di_F/dt)$

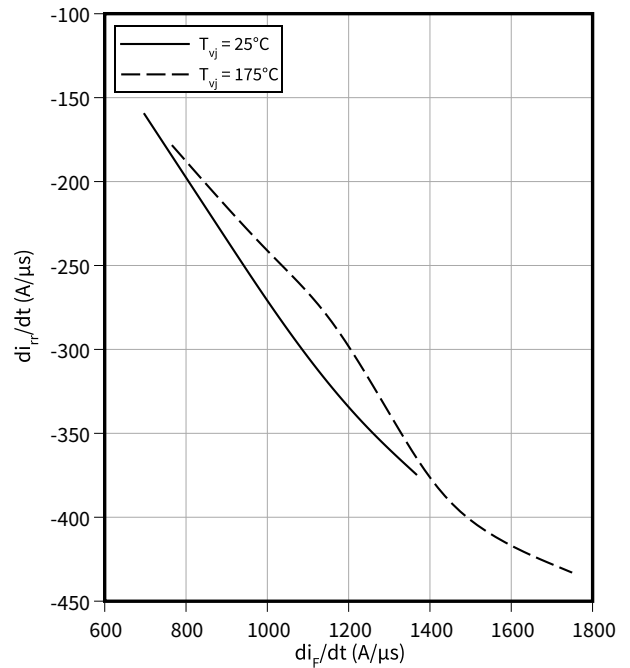
$V_R = 600\text{ V}, I_F = 40\text{ A}$



**Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**

$di_{rr}/dt = f(di_F/dt)$

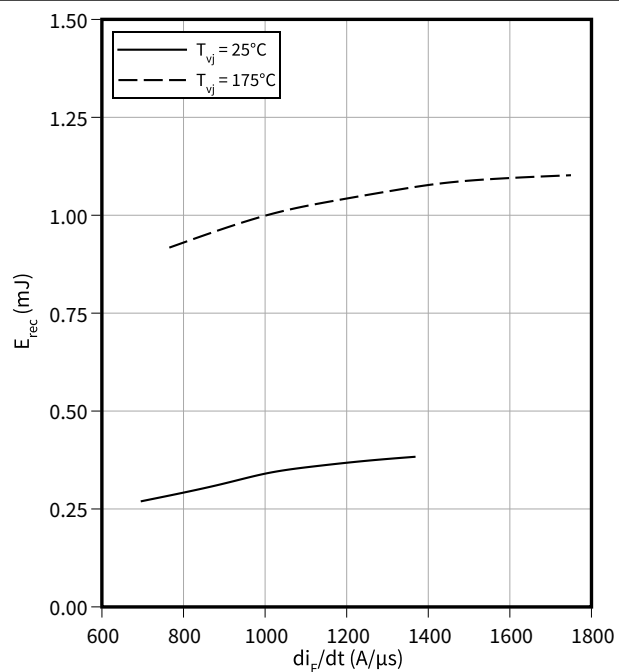
$V_R = 600\text{ V}, I_F = 40\text{ A}$



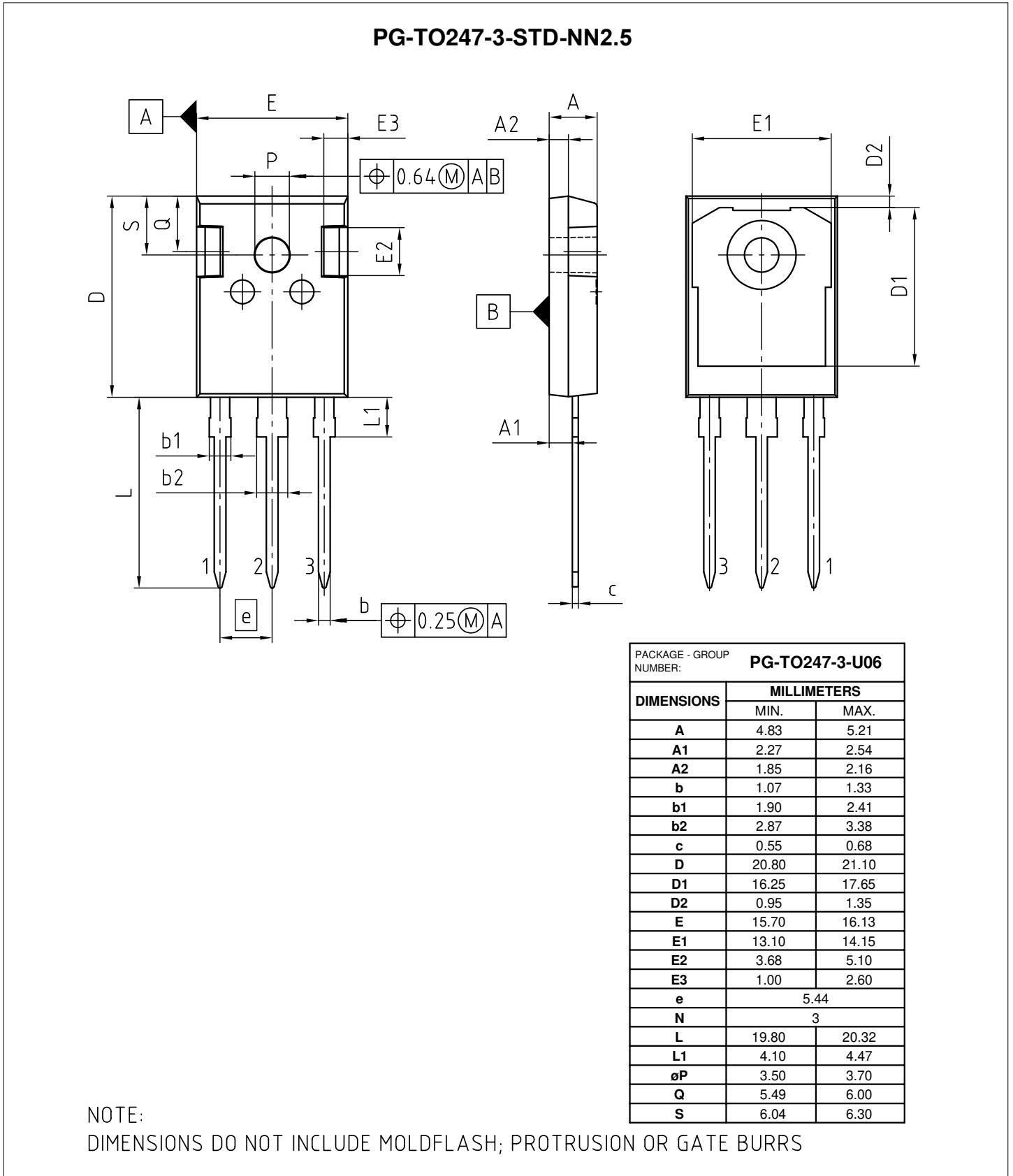
**Typical reverse energy losses as a function of diode current slope**

$$E_{\text{rec}} = f(di_F/dt)$$

$V_R = 600 \text{ V}$ ,  $I_F = 40 \text{ A}$

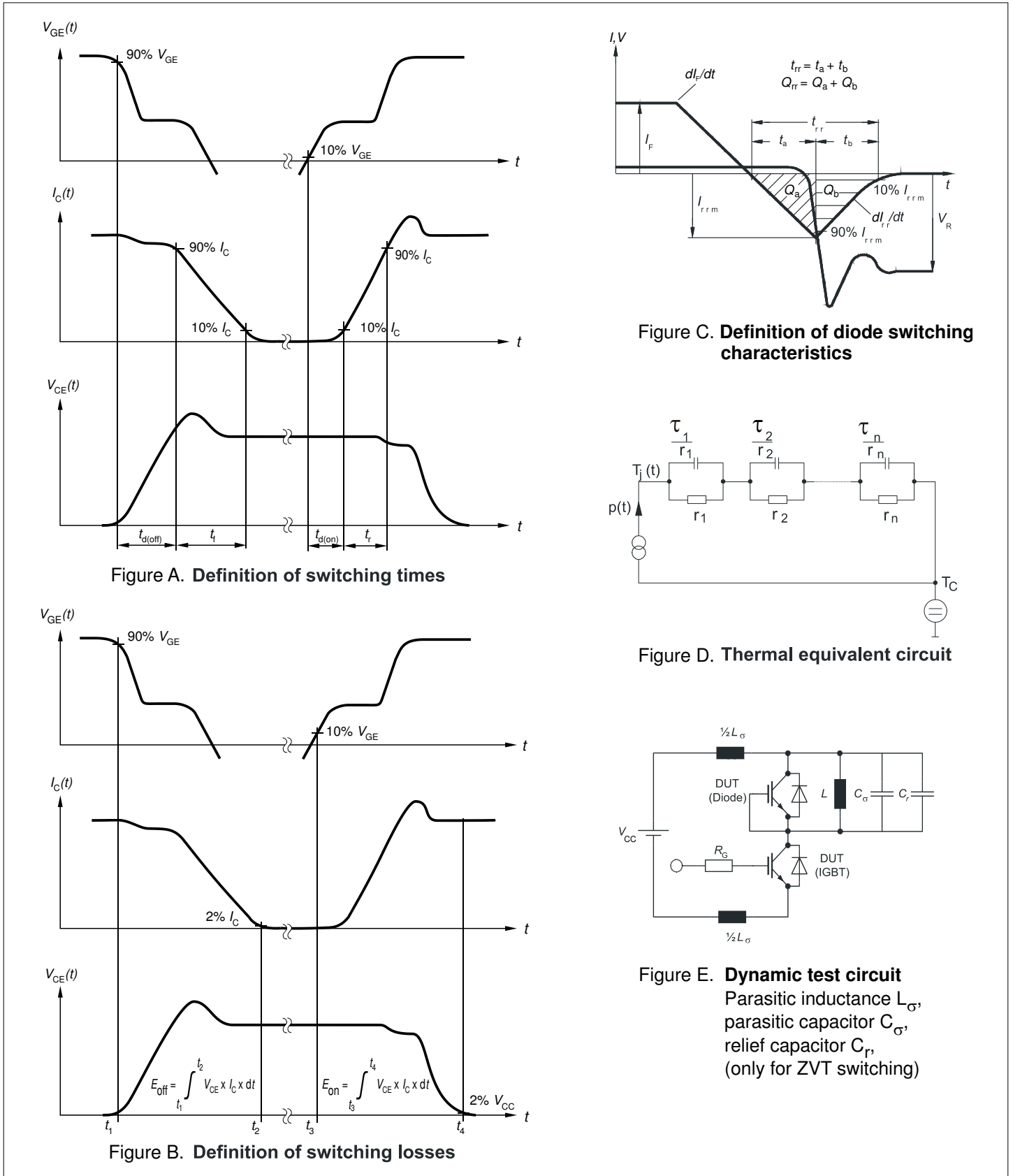


**5 Package outlines**



**Figure 1**

**6 Testing conditions**



**Figure 2**

## Revision history

Document revision	Date of release	Description of changes
0.10	2022-05-02	Target datasheet
0.20	2022-05-31	Editorial changes
1.00	2022-11-02	Final datasheet
1.10	2022-11-25	Update of potential applications



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