

High speed and low saturation voltage 650 V TRENCHSTOP™ IGBT7 technology copacked with soft, fast recovery Emitter Controlled 7 diode

Features

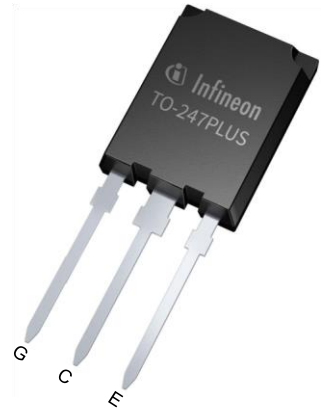
- $V_{CE} = 650\text{ V}$
- $I_C = 120\text{ A}$
- Low switching losses
- Very low collector-emitter saturation voltage V_{CEsat}
- Very soft, fast recovery antiparallel diode
- Smooth switching behavior
- Humidity robustness
- Optimized for hard switching, two- and three-level topologies
- Complete product spectrum and PSpice Models: <http://www.infineon.com/igbt/>

Potential applications

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

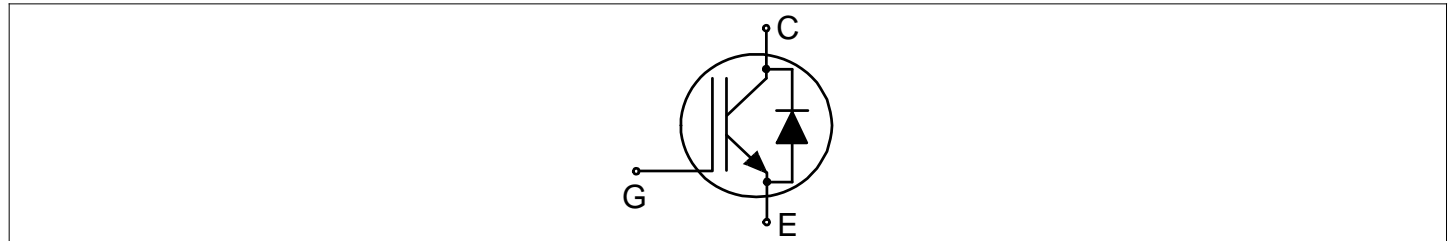
Product validation

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



- Lead-free
- Green
- Halogen-free
- RoHS

Description



Type	Package	Marking
IKQ120N65EH7	PG-TO247-3-PLUS-NN3.7	K120EEH7

Datasheet [Please read the sections "Important notice" and "Warnings" at the end of this document](#) www.infineon.com

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IKQ120N65EH7

High speed and low saturation voltage 650 V TRENCHSTOP™ IGBT7 technology



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1 Package

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
Thermal resistance, junction-ambient	$R_{th(j-a)}$				40	K/W
IGBT thermal resistance, junction-case	$R_{th(j-c)}$			0.23	0.3	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$			0.31	0.4	K/W

2 IGBT

Table 2 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CE}	$T_{vj} \geq 25 \text{ °C}$		650	V
DC collector current, limited by T_{vjmax}	I_C	limited by bondwire	$T_c = 25 \text{ °C}$	160	A
			$T_c = 100 \text{ °C}$	136	
				480	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}				
Turn-off safe operating area		$V_{CE} \leq 650 \text{ V}, t_p \leq 1 \text{ }\mu\text{s}, T_{vj} \leq 175 \text{ °C}$		480	A
Gate-emitter voltage	V_{GE}			± 20	V
Transient gate-emitter voltage	V_{GE}	$t_p \leq 10 \text{ }\mu\text{s}, D < 0.01$		± 30	V
Power dissipation	P_{tot}	$T_c = 25 \text{ °C}$		498	W
		$T_c = 100 \text{ °C}$		249	

Table 3 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
	V_{CEsat}	$I_C = 120 \text{ A}, V_{GE} = 15 \text{ V}$	$T_{vj} = 25 \text{ °C}$		1.4	1.65	V

IKQ120N65EH7

High speed and low saturation voltage 650 V TRENCHSTOP™ IGBT7 technology



Collector-emitter
saturation voltage

$T_{vj} = 175\text{ °C}$

1.6

(table continues...)

(continued) Characteristic values

2 IGBT

Table 3

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Gate-emitter threshold voltage	V_{GEth}	$I_C = 1.05 \text{ mA}, V_{CE} = V_{GE}$	2.9	3.85	4.8	V
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 650 \text{ V}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		35	μA
			$T_{vj} = 175 \text{ }^\circ\text{C}$		5500	
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0 \text{ V}, V_{GE} = 20 \text{ V}$			100	nA
Transconductance	g_{fs}	$I_C = 120 \text{ A}, V_{CE} = 20 \text{ V}$		148		S
Input capacitance	C_{ies}	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		6644		pF
Output capacitance	C_{oes}	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		197		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		27.5		pF
Gate charge	Q_G	$V_{CC} = 520 \text{ V}, I_C = 120 \text{ A}, V_{GE} = 15 \text{ V}$		251		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V},$ $R_{G(on)} = 10 \text{ } \Omega,$ $R_{G(off)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 120 \text{ A}$		38	ns
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 120 \text{ A}$		38	
Rise time (inductive load)	t_r	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V},$ $R_{G(on)} = 10 \text{ } \Omega,$ $R_{G(off)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 120 \text{ A}$		62	ns
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 120 \text{ A}$		62	
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V},$ $R_{G(on)} = 10 \text{ } \Omega,$ $R_{G(off)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 120 \text{ A}$		287	ns
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 120 \text{ A}$		317	
Fall time (inductive load)	t_f	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V},$ $R_{G(on)} = 10 \text{ } \Omega,$ $R_{G(off)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 120 \text{ A}$		98	ns
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 120 \text{ A}$		90	
Turn-on energy	E_{on}	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V},$ $R_{G(on)} = 10 \text{ } \Omega,$ $R_{G(off)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 120 \text{ A}$		4.2	mJ
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 120 \text{ A}$		6.1	

(continued) Characteristic values

Turn-off energy	E_{off}	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V},$ $R_{G(on)} = 10\ \Omega,$ $R_{G(off)} = 10\ \Omega$	$T_{vj} = 25\text{ °C},$ $I_C = 120\text{ A}$		3.7		mJ
			$T_{vj} = 175\text{ °C},$ $I_C = 120\text{ A}$		3.7		

(table continues...)
3 Diode
Table 3

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Total switching energy	E_{ts}	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V},$ $R_{G(on)} = 10\ \Omega,$ $R_{G(off)} = 10\ \Omega$	$T_{vj} = 25\text{ °C},$ $I_C = 120\text{ A}$		7.9		mJ
			$T_{vj} = 175\text{ °C},$ $I_C = 120\text{ A}$		9.8		
Operating junction temperature	T_{vj}		-40		175	°C	

3 Diode
Table 4 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Diode forward current, limited by T_{vjmax}	I_F	limited by bondwire	$T_c = 25\text{ °C}$	160	A
			$T_c = 100\text{ °C}$	125	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}		480	A	
Power dissipation	P_{tot}		$T_c = 25\text{ °C}$	375	W
			$T_c = 100\text{ °C}$	188	

Table 5 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode forward voltage	V_F	$I_F = 120\text{ A}$	$T_{vj} = 25\text{ °C}$	1.65	2	V
			$T_{vj} = 175\text{ °C}$	1.55		
Diode reverse recovery time	t_{rr}	$V_R = 400\text{ V}, R_{G(on)} = 10\ \Omega$	$T_{vj} = 25\text{ °C},$ $I_F = 120\text{ A}$	82		ns
			$T_{vj} = 175\text{ °C},$ $I_F = 120\text{ A}$	154		

(continued) Characteristic values

Diode reverse recovery charge	Q_{rr}	$V_R = 400 \text{ V}, R_{G(on)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C},$ $I_F = 120 \text{ A}$		2.4		μC
			$T_{vj} = 175 \text{ } ^\circ\text{C},$ $I_F = 120 \text{ A}$		6.7		
Diode peak reverse recovery current	I_{rrm}	$V_R = 400 \text{ V}, R_{G(on)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C},$ $I_F = 120 \text{ A}$		44.5		A
			$T_{vj} = 175 \text{ } ^\circ\text{C},$ $I_F = 120 \text{ A}$		67		

(table continues...)
3 Diode
Table 5

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Diode peak rate of fall of reverse recovery current	di_{rr}/dt	$V_R = 400 \text{ V}, R_{G(on)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C},$ $I_F = 120 \text{ A}$		-2320		A/ μs
			$T_{vj} = 175 \text{ } ^\circ\text{C},$ $I_F = 120 \text{ A}$		-2440		
Reverse recovery energy	E_{rec}	$V_R = 400 \text{ V}, R_{G(on)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C},$ $I_F = 120 \text{ A}$		0.46		mJ
			$T_{vj} = 175 \text{ } ^\circ\text{C},$ $I_F = 120 \text{ A}$		1.38		
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.

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

Dynamic test circuit, parasitic inductance $L_\sigma = 8 \text{ nH}$, parasitic capacitor $C_\sigma = 30 \text{ pF}$ from Fig. E. Energy losses include "tail" and diode reverse recovery.

4 Characteristics diagrams

1

0

dissipation as a function of case temperature

T_c

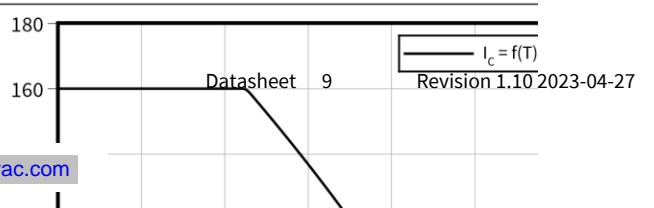
5 °C



Collector current as a function of case temperature

$I_C = f(T_c)$

$T_{vj} \leq 175$ °C, $V_{GE} \geq 15$ V



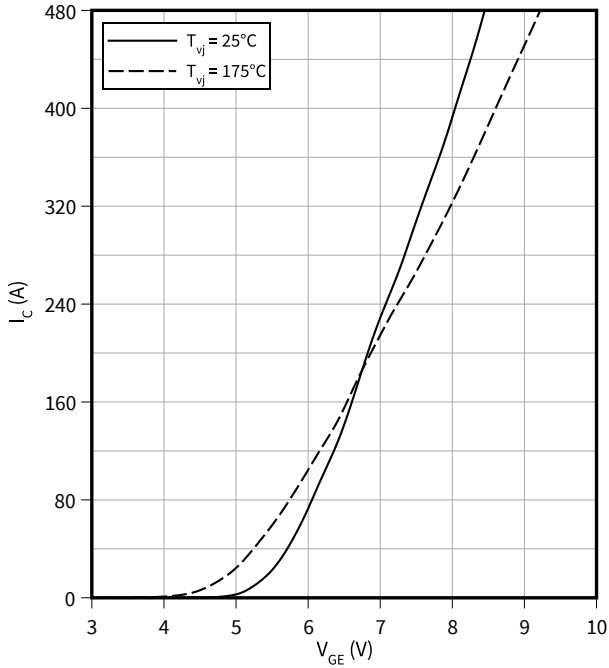
Datasheet 9

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Typical transfer characteristic

$I_C = f(V_{GE})$

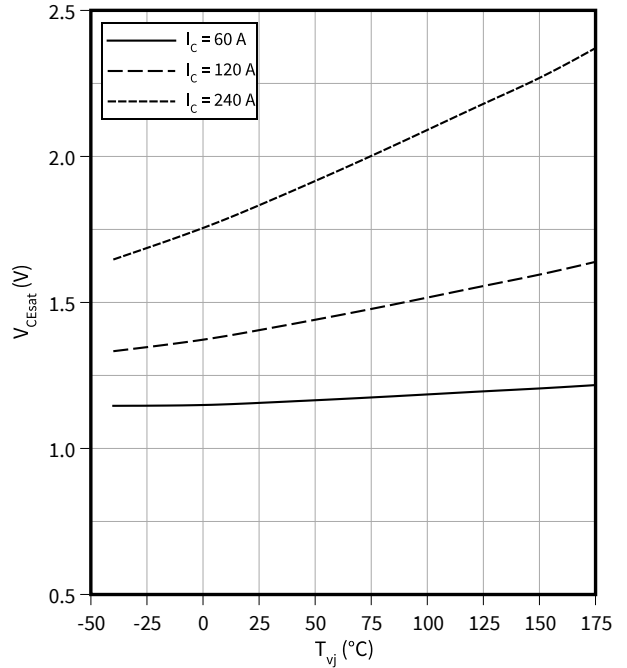
$V_{CE} = 20\text{ V}$



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

$V_{GEth} = f(T_{vj})$

$I_C = 1.05\text{ mA}$

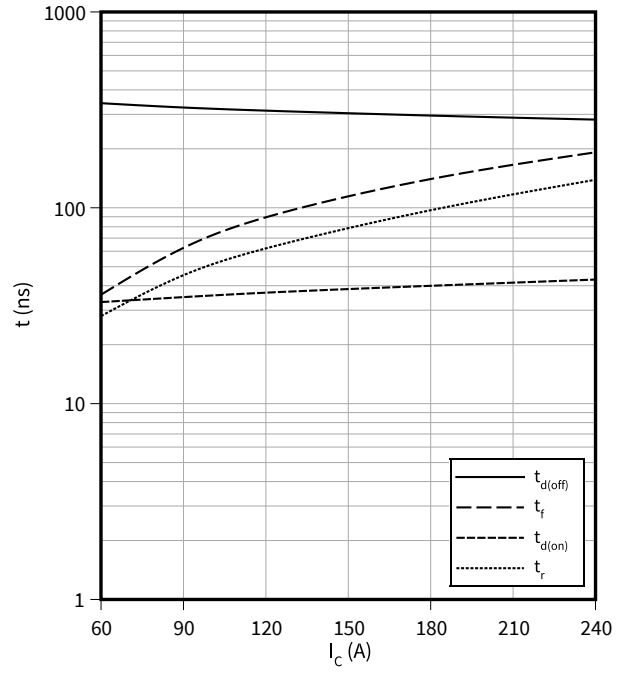
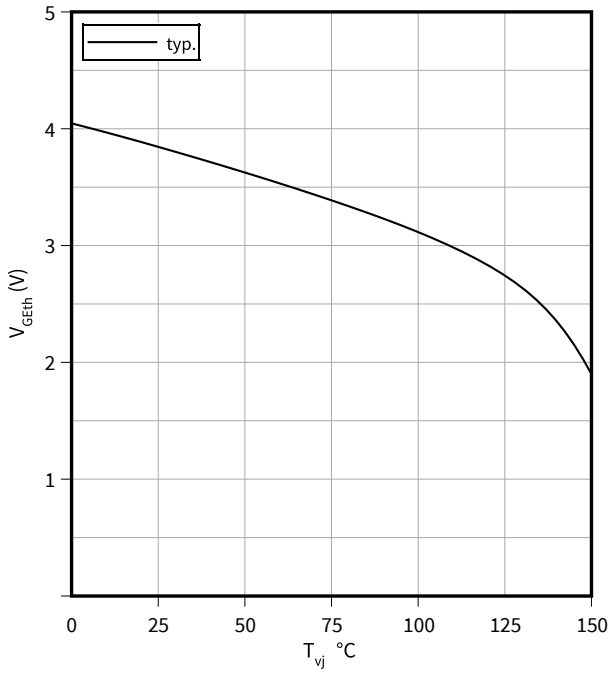
Typical switching times as a function of collector current

$t = f(I_C)$

$V_{CC} = 400\text{ V}, T_{vj} = 175^\circ\text{C}, V_{GE} = 0/15\text{ V}, R_G = 10\ \Omega$

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Typical switching times as a function of gate resistor

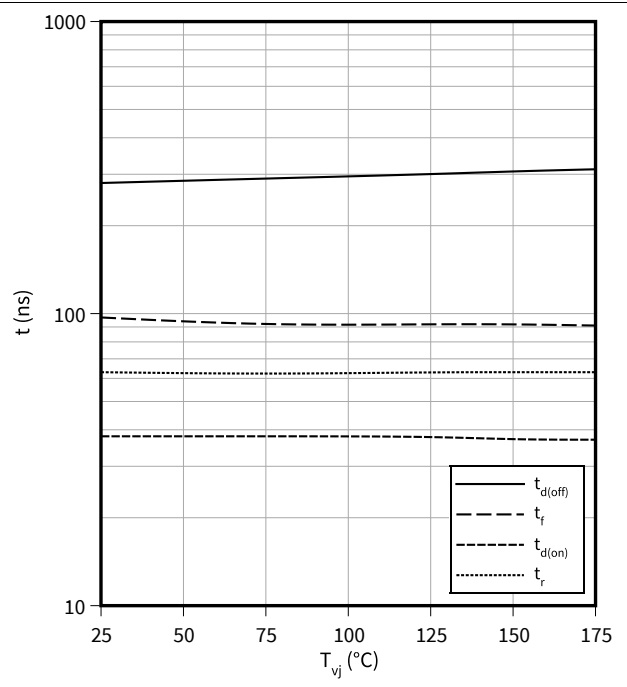
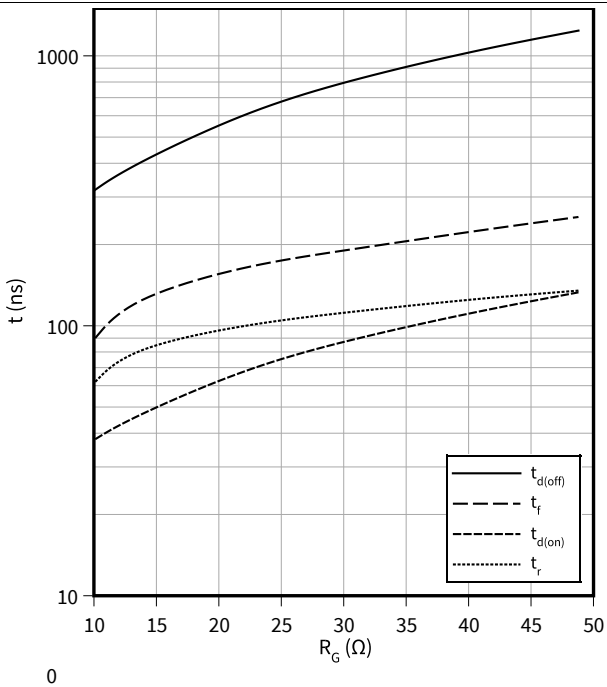
$t = f(R_G)$

$I_C = 120 \text{ A}, V_{CC} = 400 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}$

Typical switching times as a function of junction temperature

$t = f(T_{vj})$

$I_C = 120 \text{ A}, V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_G = 10 \text{ } \Omega$

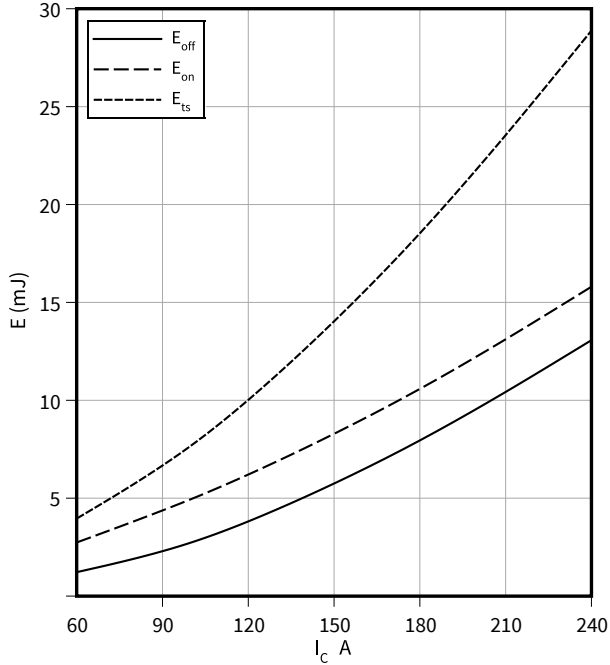


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Typical switching energy losses as a function of collector current

$E = f(I_C)$

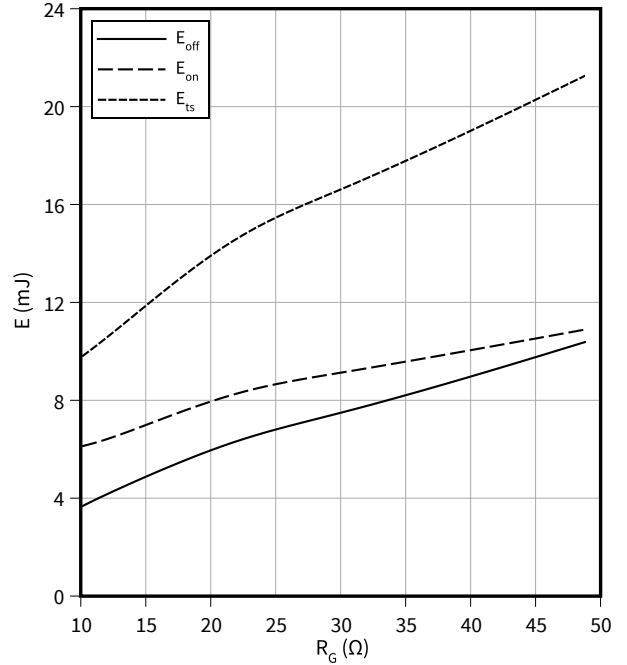
$V_{CC} = 400\text{ V}$, $T_{vj} = 175\text{ °C}$, $V_{GE} = 0/15\text{ V}$, $R_G = 10\text{ }\Omega$



Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

$I_C = 120\text{ A}$, $V_{CC} = 400\text{ V}$, $T_{vj} = 175\text{ °C}$, $V_{GE} = 0/15\text{ V}$



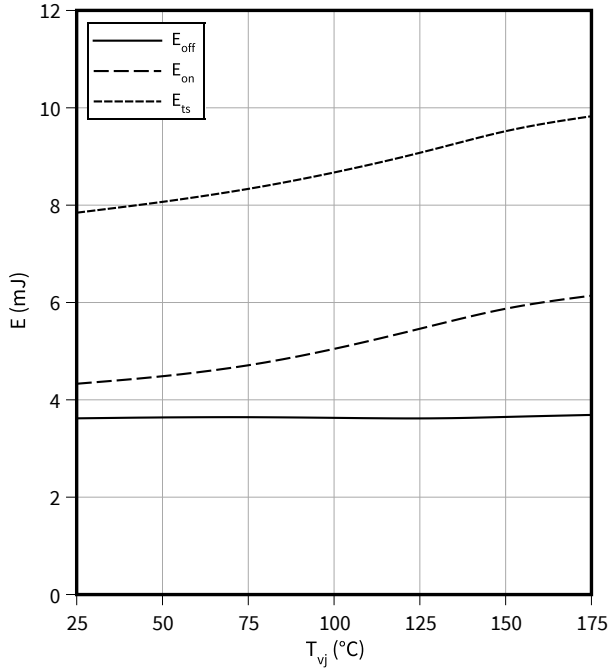
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Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

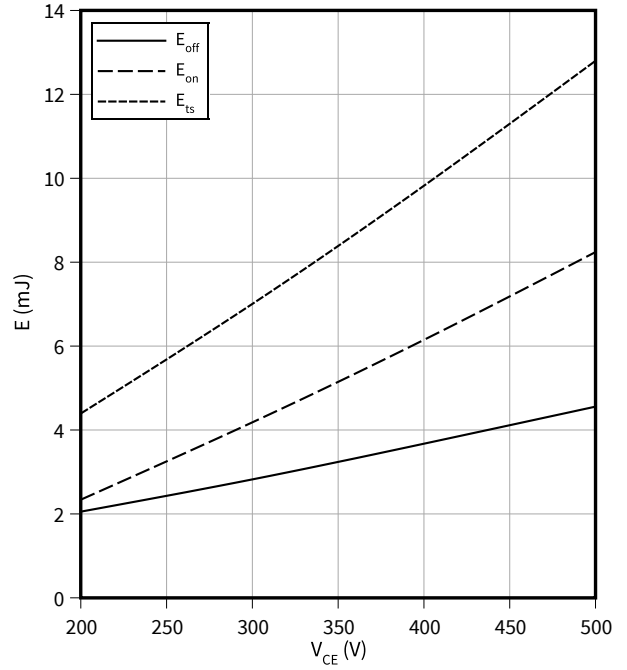
$I_C = 120\text{ A}$, $V_{CC} = 400\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_G = 10\ \Omega$



Typical switching energy losses as a function of collector emitter voltage

$E = f(V_{CE})$

$I_C = 120\text{ A}$, $T_{vj} = 175\text{ °C}$, $V_{GE} = 0/15\text{ V}$, $R_G = 10\ \Omega$



Typical gate charge

$V_{GE} = f(Q_G)$

$I_C = 120\text{ A}$

Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$

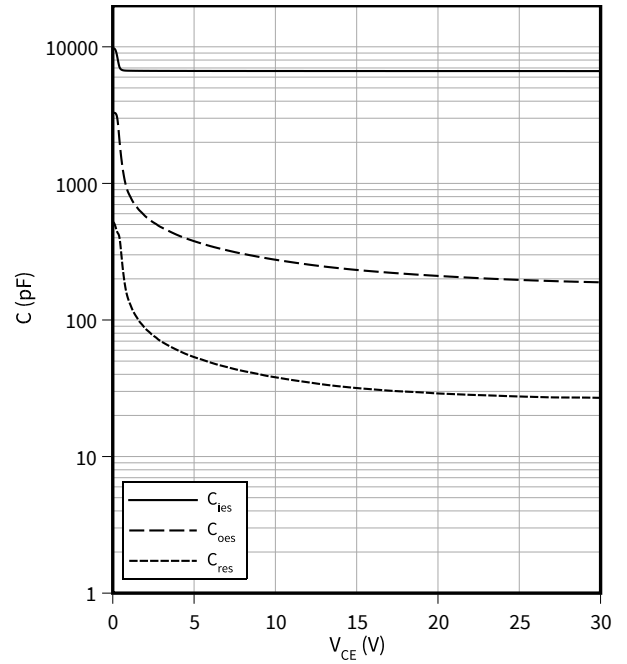
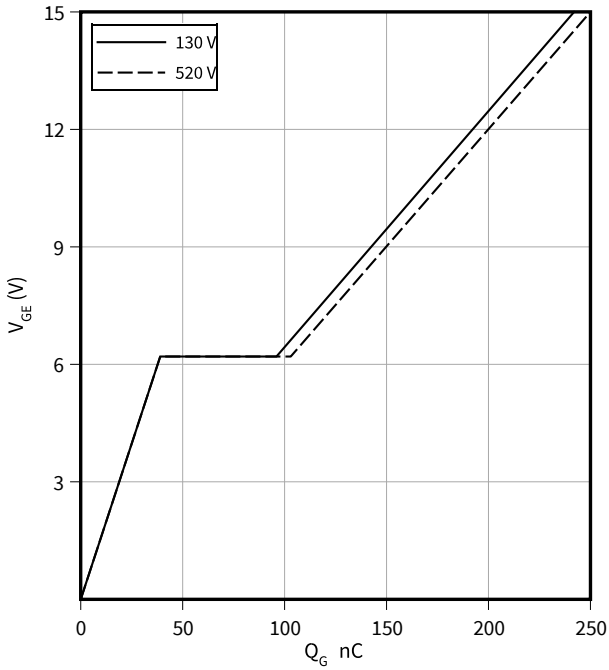
$f = 100\text{ kHz}$, $V_{GE} = 0\text{ V}$

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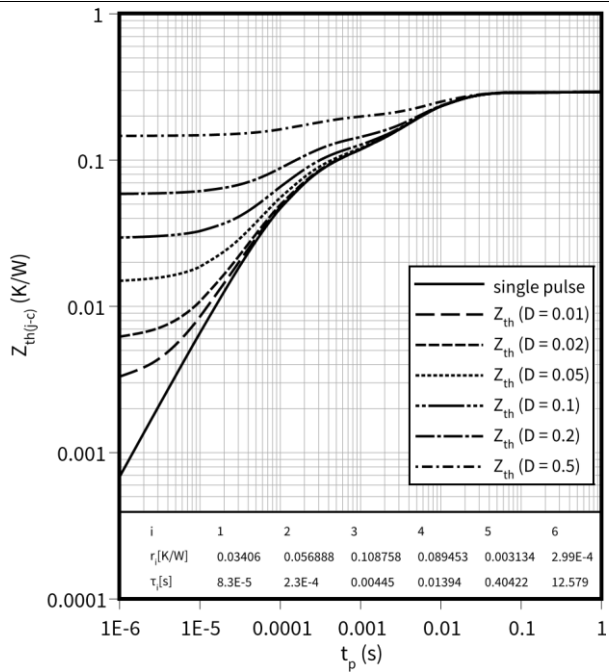
4 Characteristics diagrams



IGBT transient thermal impedance as a function of pulse width

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

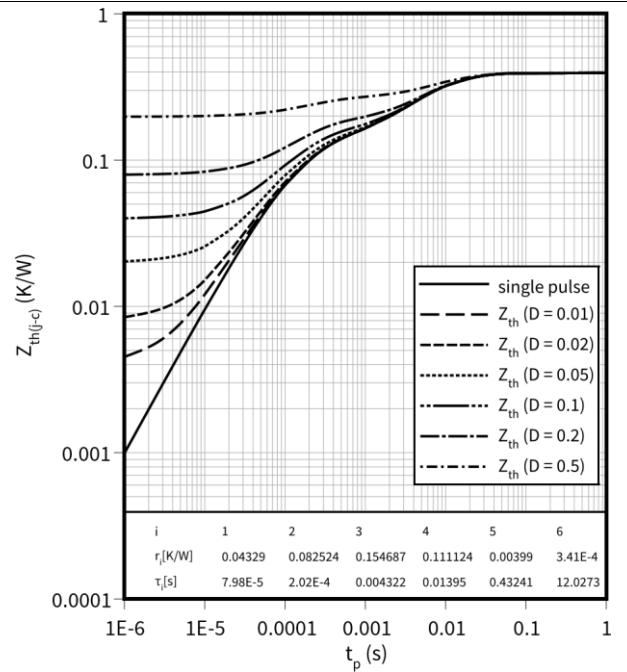
$D = t_p/T$



Diode transient thermal impedance as a function of pulse width

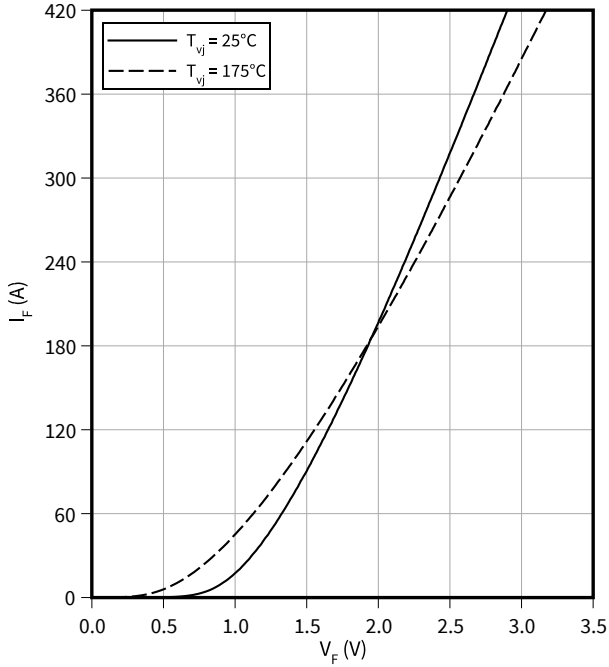
$Z_{th(j-c)} = f(t_p)$

$D = t_p/T$



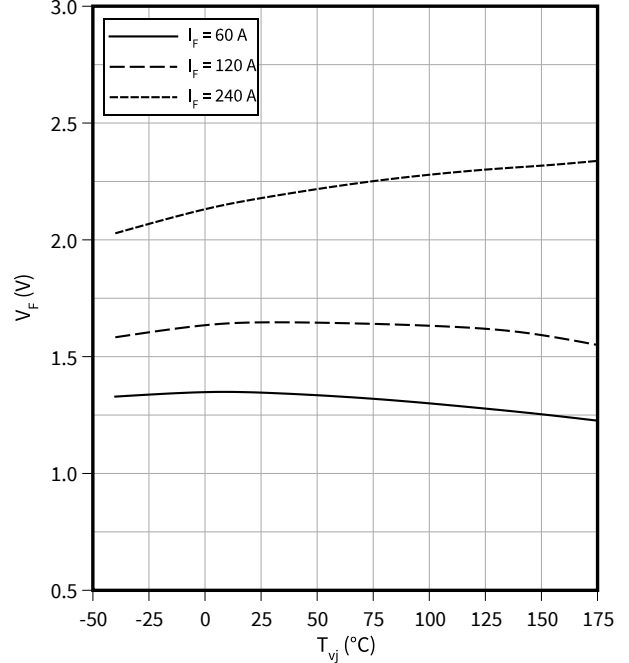
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



Typical diode forward voltage as a function of junction temperature

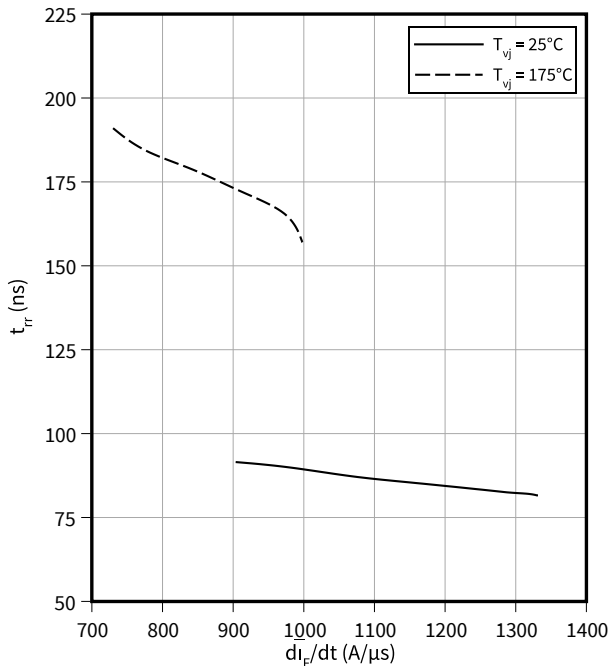
$V_F = f(T_{vj})$



Typical reverse recovery time as a function of diode current slope

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

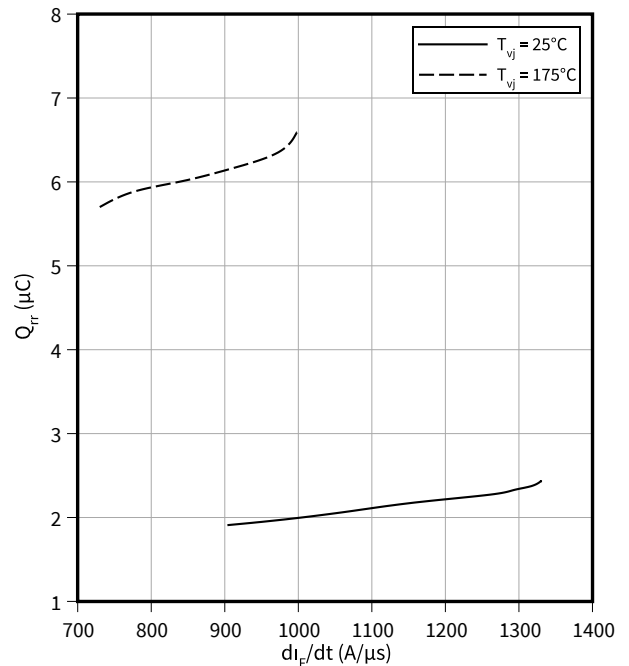
$V_R = 400\text{ V}, I_F = 120\text{ A}$



Typical reverse recovery charge as a function of diode current slope

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

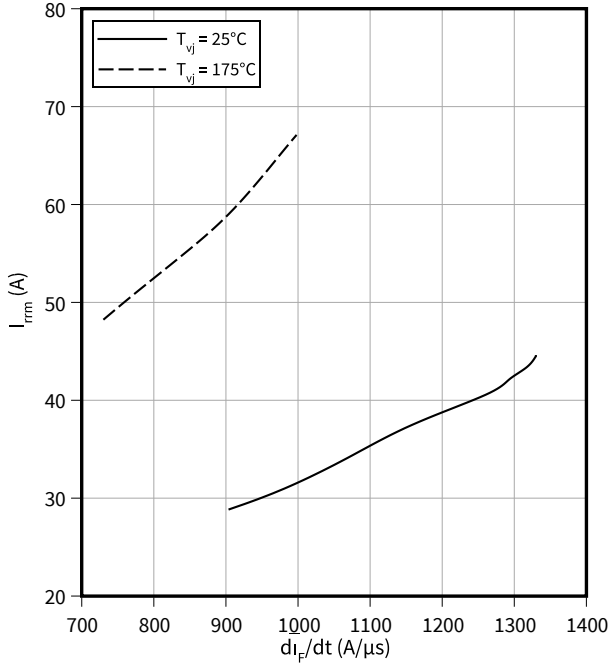
$V_R = 400\text{ V}, I_F = 120\text{ A}$



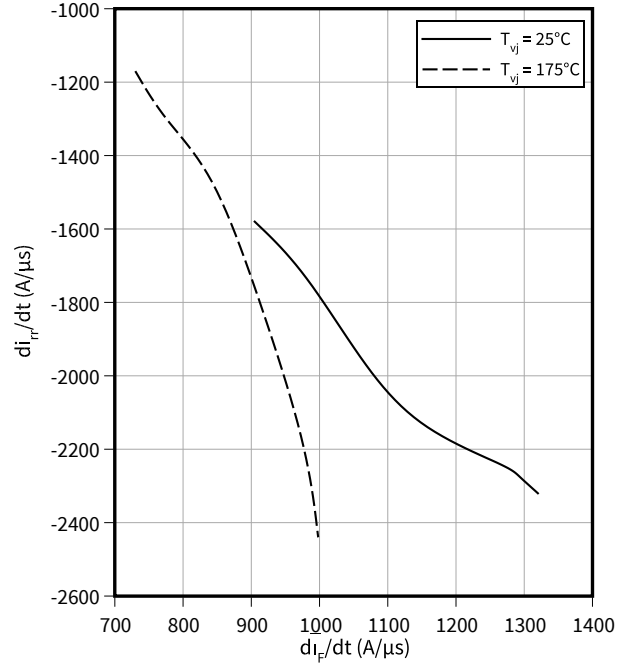
Typical reverse recovery current as a function of diode current slope

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

$V_R = 400\text{ V}, I_F = 120\text{ A}$



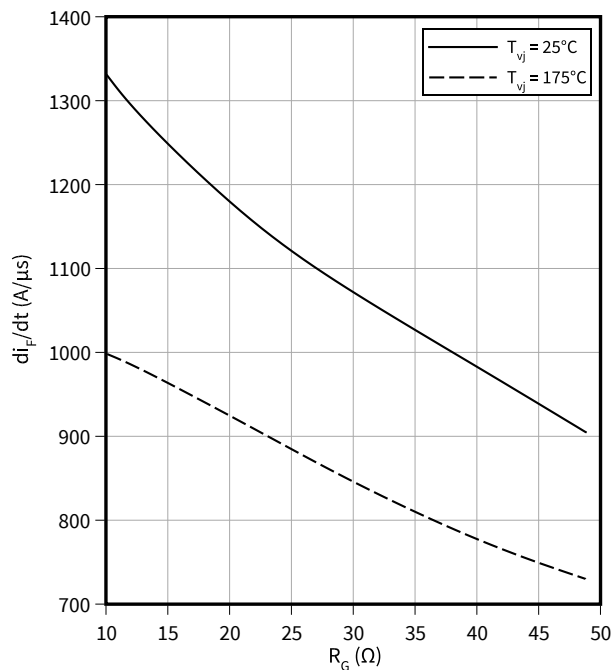
Typical diode peak rate of fall of reverse recovery current as a function of diode current slope
 $di_{rr}/dt = f(di_F/dt) V_R = 400\text{ V}, I_F = 120\text{ A}$



4 Characteristics diagrams

Typical diode current slope as a function of gate resistor $di_F/dt = f(R_G)$

$V_R = 400\text{ V}$, $I_F = 120\text{ A}$



5 Package outlines

5 Package outlines

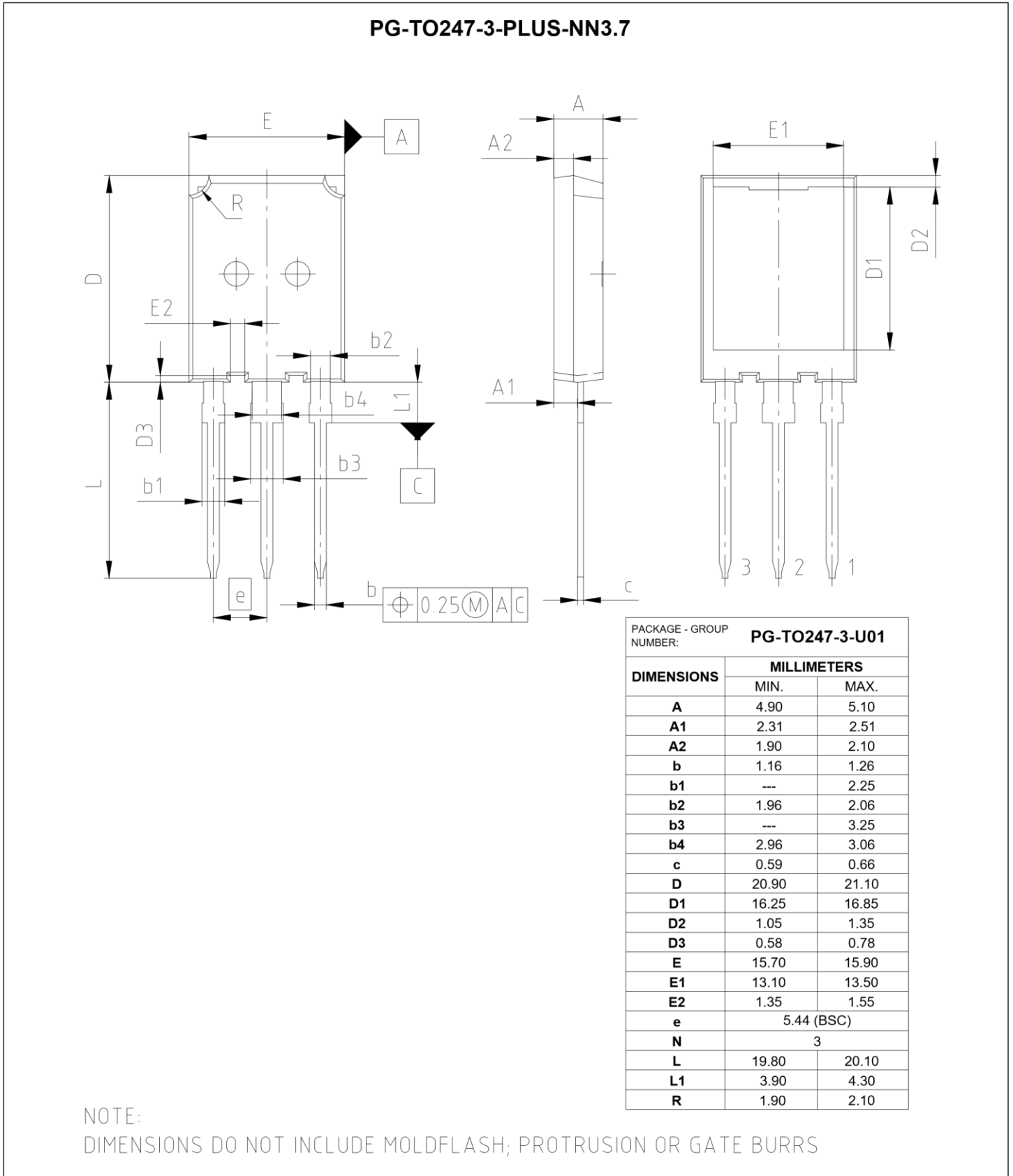


Figure 1

6 Testing conditions

6 Testing conditions

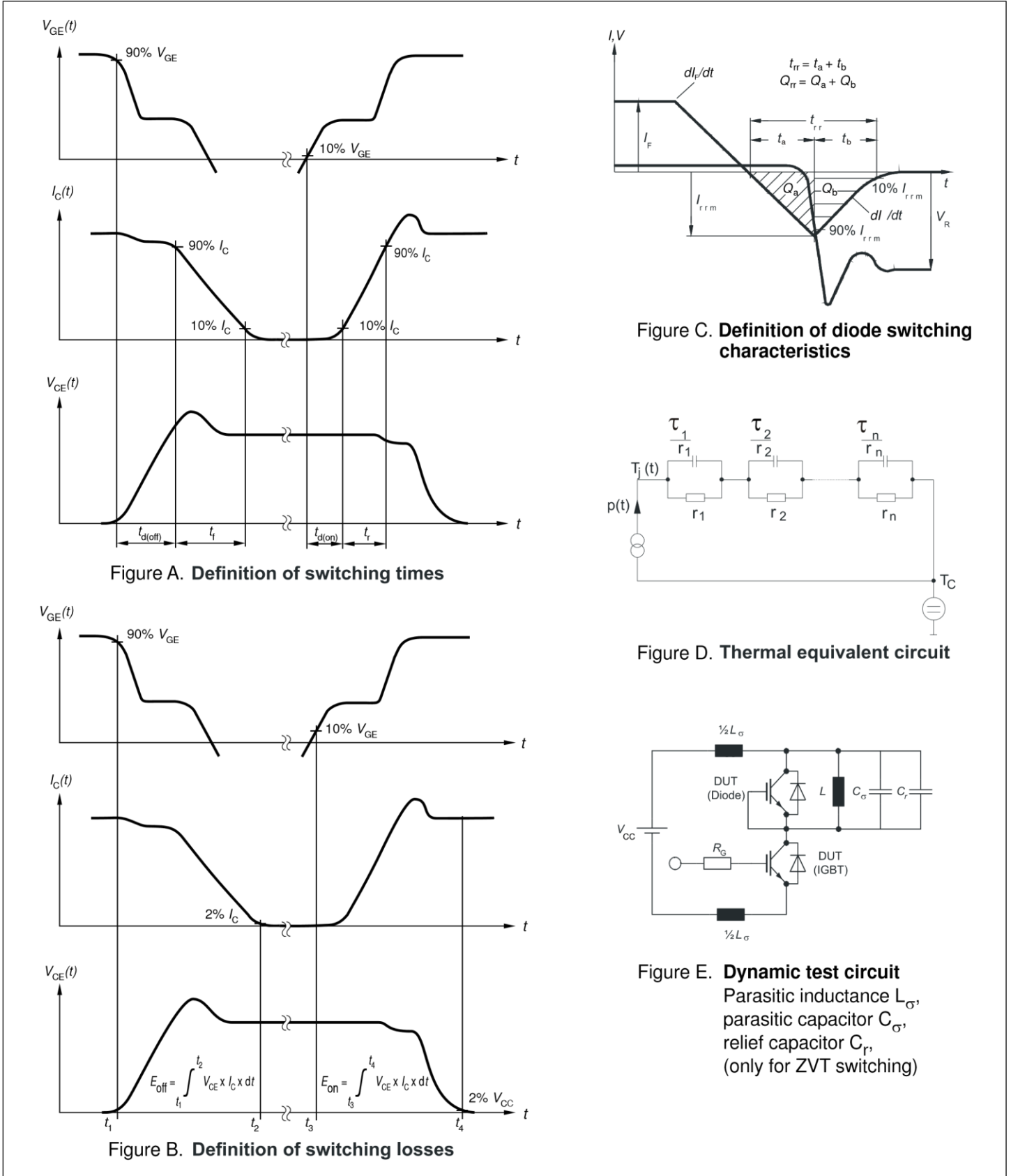


Figure 2

Revision history

Revision history

Document revision	Date of release	Description of changes
1.00	2023-01-24	Final datasheet
1.10	2023-04-27	Correction of switching values in Table 3 Update of diagrams $t = f(R_G)$ and $E = f(R_G)$

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