

**Final datasheet**

**TRENCHSTOP™ IGBT 7 PR7 Reverse Conducting IGBT for boost PFC stage with improved EMI characteristics offering the best-in-class performance for high power and high switching frequency applications**

**Features**

- $V_{CE} = 670\text{ V}$
- $I_C = 60\text{ A}$
- Pin-to-pin creepage distance > 4.8 mm
- Pin-to-pin clearance distance > 3.4 mm
- Optimized monolithic diode for PFC applications
- Improved EMI behavior with lower dv/dt
- Very low  $V_{CEsat} = 1.4\text{ V (typ.)}$  at 25°C
- Stable temperature behavior
- Low temperature dependence of  $V_{CEsat}$  and  $E_{sw}$
- 2 kV ESD HBM compliant
- Easy parallel switching capability based on positive temperature coefficient of  $V_{CEsat}$
- Product spectrum and PSpice Models: <http://www.infineon.com/igbt/>

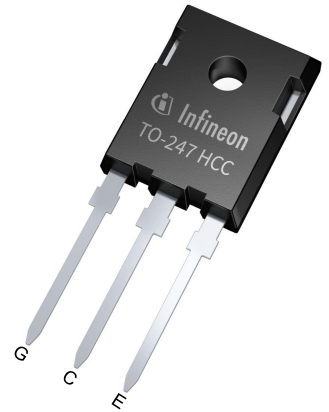
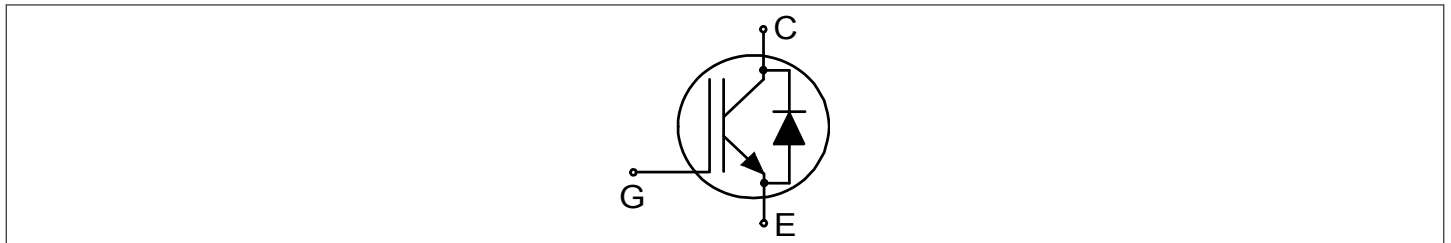
**Potential applications**

- Residential Aircon / Commercial Aircon
- Residential HVAC / Commercial HVAC

**Product validation**

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

**Description**



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

Type	Package	Marking
IKWH60N67PR7	PG-TO247-3-U04	H60EPR7

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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 processes: 3			0.6	Nm
Thermal resistance, junction-ambient	$R_{th(j-a)}$				40	K/W
IGBT thermal resistance, junction-case	$R_{th(j-c)}$			0.53	0.69	K/W

## 2 IGBT

**Table 2** Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Collector-emitter voltage	$V_{CE}$	$T_{vj} \geq 25\text{ °C}$	670	V	
DC collector current, limited by $T_{vjmax}$	$I_C$		$T_c = 25\text{ °C}$	122	A
			$T_c = 100\text{ °C}$	75	
Pulsed collector current, $t_p$ limited by $T_{vjmax}$	$I_{Cpulse}$		180	A	
Turn-off safe operating area		$V_{CE} \leq 670\text{ V}, T_{vj} \leq 175\text{ °C}$	180	A	
Gate-emitter voltage	$V_{GE}$		$\pm 20$	V	
Transient gate-emitter voltage	$V_{GE}$	$t_p \leq 0.5\text{ }\mu\text{s}, D < 0.001$	$\pm 30$	V	
Power dissipation	$P_{tot}$		$T_c = 25\text{ °C}$	283	W
			$T_c = 100\text{ °C}$	142	

**Table 3** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Collector-emitter saturation voltage	$V_{CEsat}$	$I_C = 60\text{ A}$		$T_{vj} = 25\text{ °C}$	1.4	1.75	V
				$T_{vj} = 175\text{ °C}$	1.7		

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Gate-emitter threshold voltage	$V_{GEth}$	$I_C = 0.342 \text{ mA}, V_{CE} = V_{GE}$	3.2	3.95	4.8	V
Zero gate-voltage collector current	$I_{CES}$	$V_{CE} = 670 \text{ V}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		40	mA
			$T_{vj} = 175 \text{ }^\circ\text{C}$		5	mA
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0 \text{ V}, V_{GE} = 20 \text{ V}$			100	nA
Transconductance	$g_{fs}$	$I_C = 60 \text{ A}, V_{CE} = 20 \text{ V}$		91.9		S
Input capacitance	$C_{ies}$	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		3311		pF
Output capacitance	$C_{oes}$	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		44		pF
Reverse transfer capacitance	$C_{res}$	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		17.2		pF
Gate charge	$Q_G$	$V_{CC} = 520 \text{ V}, I_C = 60 \text{ A}, V_{GE} = 15 \text{ V}$		148		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{G(on)} = 9.8 \text{ } \Omega, R_{G(off)} = 9.8 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 60 \text{ A}$		20	ns
			$T_{vj} = 175 \text{ }^\circ\text{C}, I_C = 60 \text{ A}$		18	
Rise time (inductive load)	$t_r$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{G(on)} = 9.8 \text{ } \Omega, R_{G(off)} = 9.8 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 60 \text{ A}$		24	ns
			$T_{vj} = 175 \text{ }^\circ\text{C}, I_C = 60 \text{ A}$		22	
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{G(on)} = 9.8 \text{ } \Omega, R_{G(off)} = 9.8 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 60 \text{ A}$		208	ns
			$T_{vj} = 175 \text{ }^\circ\text{C}, I_C = 60 \text{ A}$		234	
Fall time (inductive load)	$t_f$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{G(on)} = 9.8 \text{ } \Omega, R_{G(off)} = 9.8 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 60 \text{ A}$		36	ns
			$T_{vj} = 175 \text{ }^\circ\text{C}, I_C = 60 \text{ A}$		39	
Turn-on energy	$E_{on}$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{G(on)} = 9.8 \text{ } \Omega, R_{G(off)} = 9.8 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 60 \text{ A}$		1.28	mJ
			$T_{vj} = 175 \text{ }^\circ\text{C}, I_C = 60 \text{ A}$		1.83	
Turn-off energy	$E_{off}$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{G(on)} = 9.8 \text{ } \Omega, R_{G(off)} = 9.8 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 60 \text{ A}$		0.78	mJ
			$T_{vj} = 175 \text{ }^\circ\text{C}, I_C = 60 \text{ A}$		0.95	

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Total switching energy	$E_{ts}$	$V_{CC} = 400\text{ V}$ , $V_{GE} = 0/15\text{ V}$ , $R_{G(on)} = 9.8\ \Omega$ , $R_{G(off)} = 9.8\ \Omega$	$T_{vj} = 25\text{ }^\circ\text{C}$ , $I_C = 60\text{ A}$		2.06		mJ
			$T_{vj} = 175\text{ }^\circ\text{C}$ , $I_C = 60\text{ A}$		2.79		
Operating junction temperature	$T_{vj}$		-40		175	$^\circ\text{C}$	

### 3 Diode

Table 4 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Repetitive peak reverse voltage	$V_{RRM}$	$T_{vj} \geq 25\text{ }^\circ\text{C}$	670	V
Diode pulsed current, $t_p$ limited by $T_{vjmax}$	$I_{Fpulse}$		5	A

Table 5 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
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  $T_{vj} = 25\text{ }^\circ\text{C}$ , unless otherwise specified.

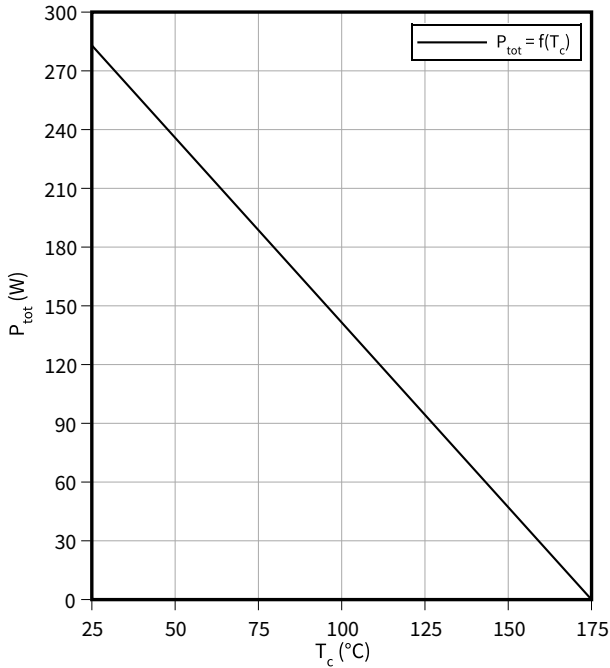
Dynamic test circuit, parasitic inductance  $L_\sigma = 30\text{ nH}$ , parasitic capacitor  $C_\sigma = 23\text{ pF}$  from Fig. C.

2nd device for EC7 Diode = IDWD60E65E7

## 4 Characteristics diagrams

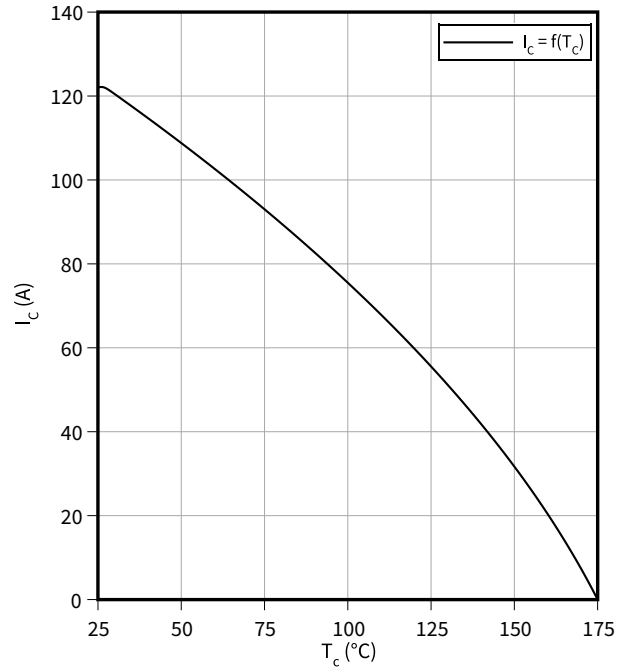
### Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$   
 $T_{vj} \leq 175\text{ °C}$



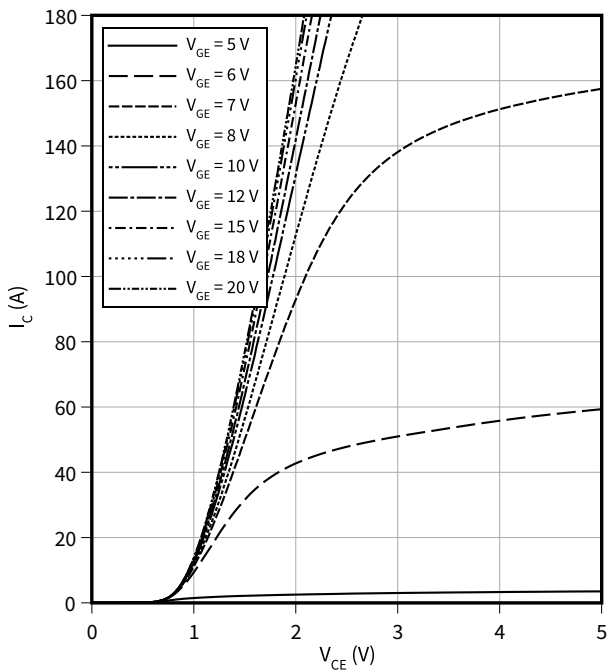
### Collector current as a function of case temperature

$I_c = f(T_c)$   
 $T_{vj} \leq 175\text{ °C}, V_{GE} \geq 15\text{ V}$



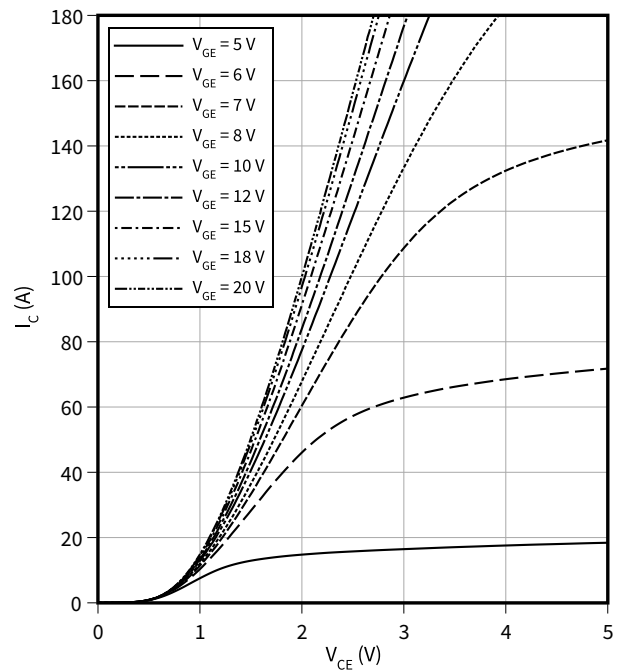
### Typical output characteristic

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



### Typical output characteristic

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

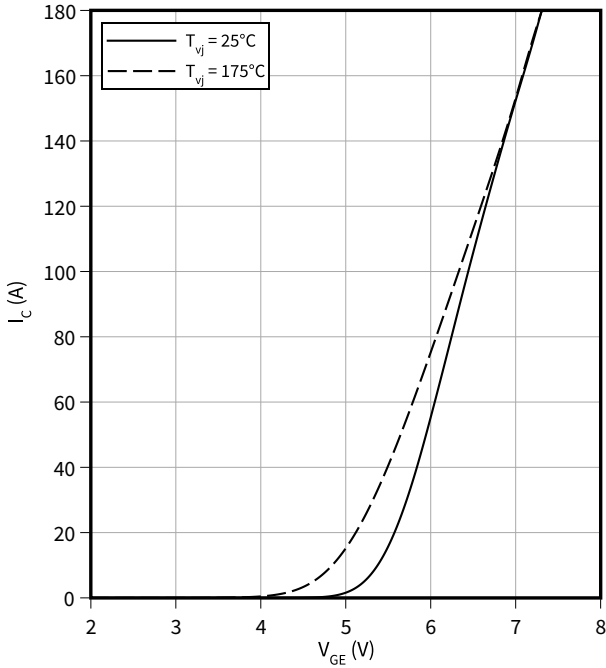


**4 Characteristics diagrams**

**Typical transfer characteristic**

$I_C = f(V_{GE})$

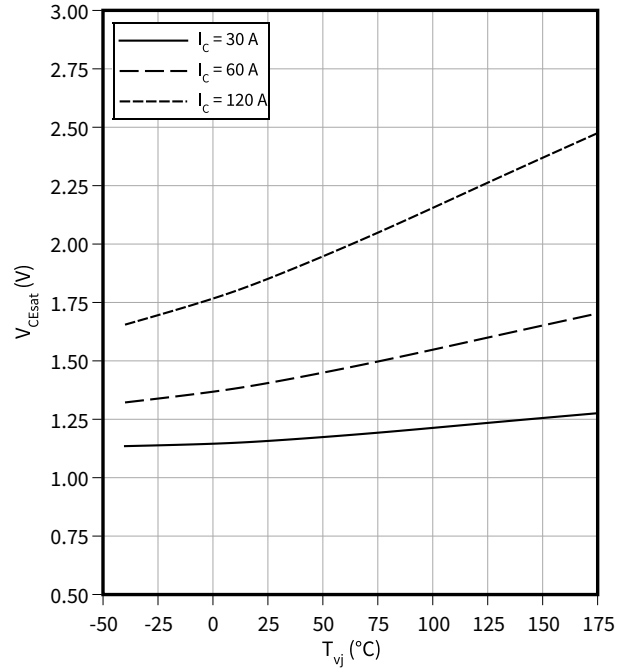
$V_{CE} = 20\text{ V}$



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

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

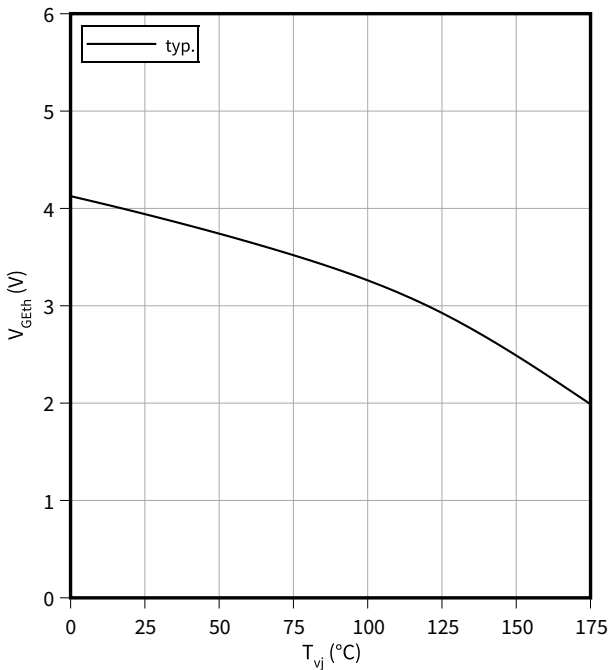
$V_{GE} = 15\text{ V}$



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

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

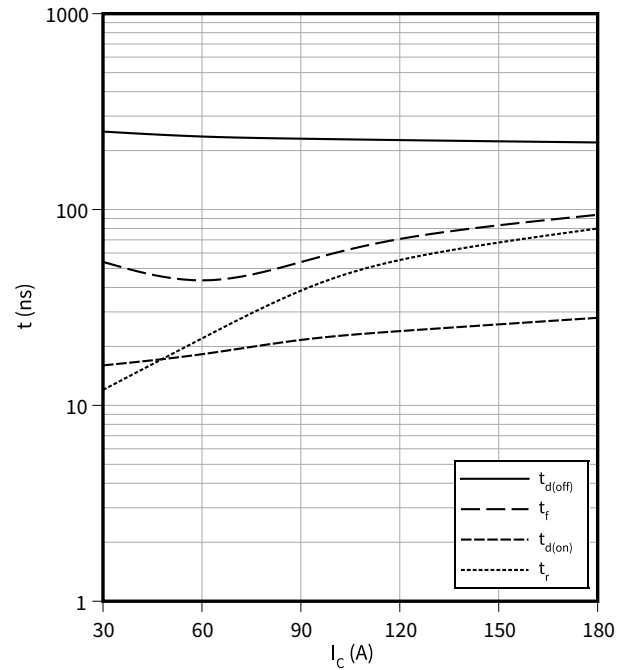
$I_C = 0.342\text{ mA}$



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

$t = f(I_C)$

$V_{CC} = 400\text{ V}, T_{vj} = 175^\circ\text{C}, V_{GE} = 0/15\text{ V}, R_G = 9.8\ \Omega$

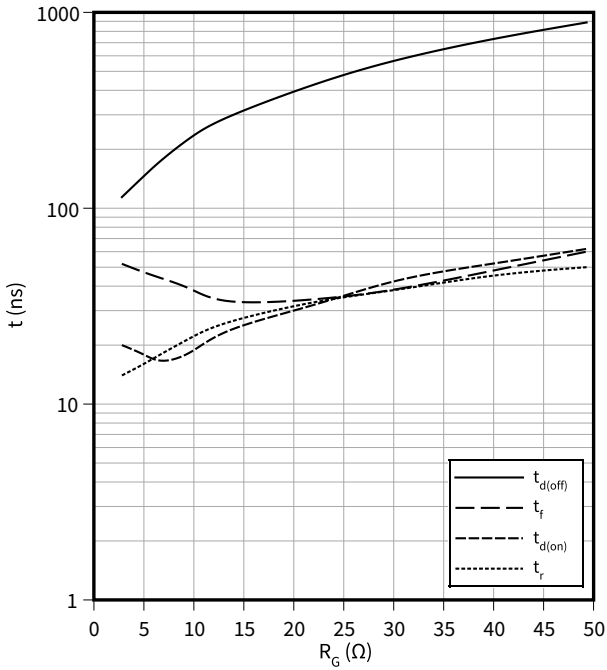


**4 Characteristics diagrams**

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

$t = f(R_G)$

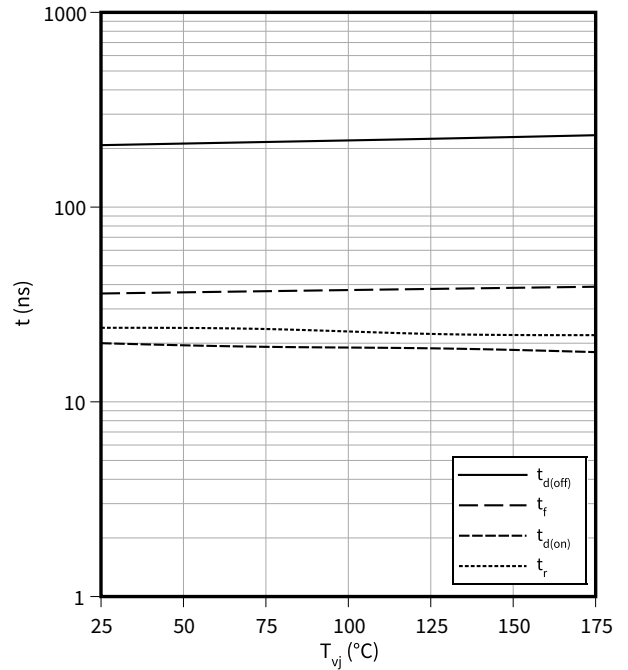
$I_C = 60 \text{ A}, V_{CC} = 400 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}, V_{GE} = 0/15 \text{ V}$



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

$t = f(T_{vj})$

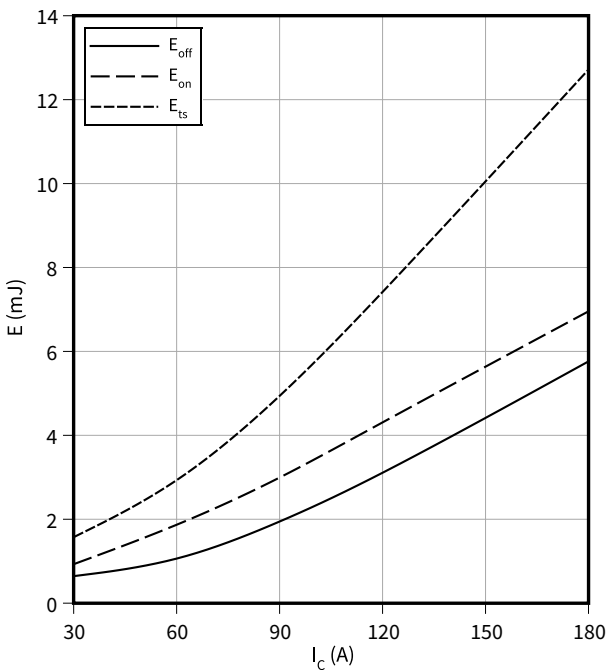
$I_C = 60 \text{ A}, V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_G = 9.8 \text{ } \Omega$



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

$E = f(I_C)$

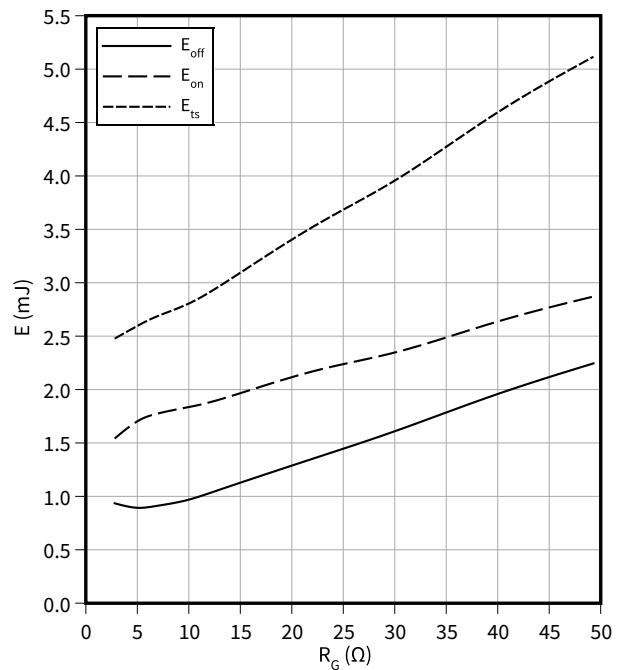
$V_{CC} = 400 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}, V_{GE} = 0/15 \text{ V}, R_G = 9.8 \text{ } \Omega$



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

$E = f(R_G)$

$I_C = 60 \text{ A}, V_{CC} = 400 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}, V_{GE} = 0/15 \text{ V}$



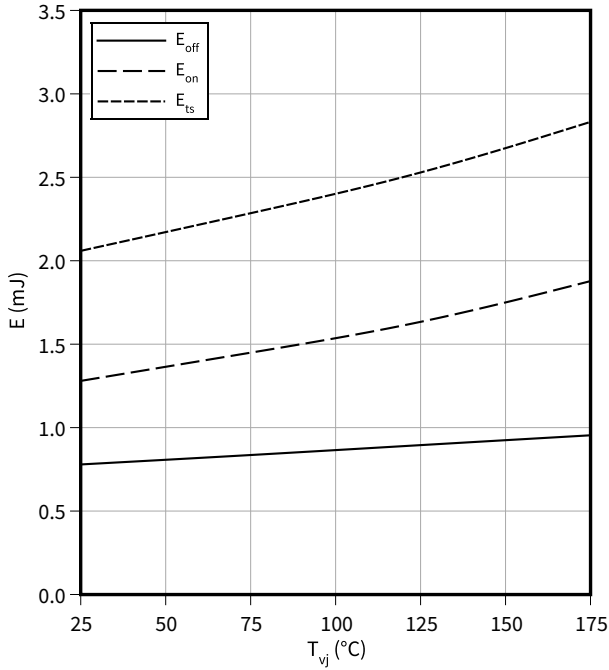


**4 Characteristics diagrams**

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

$E = f(T_{vj})$

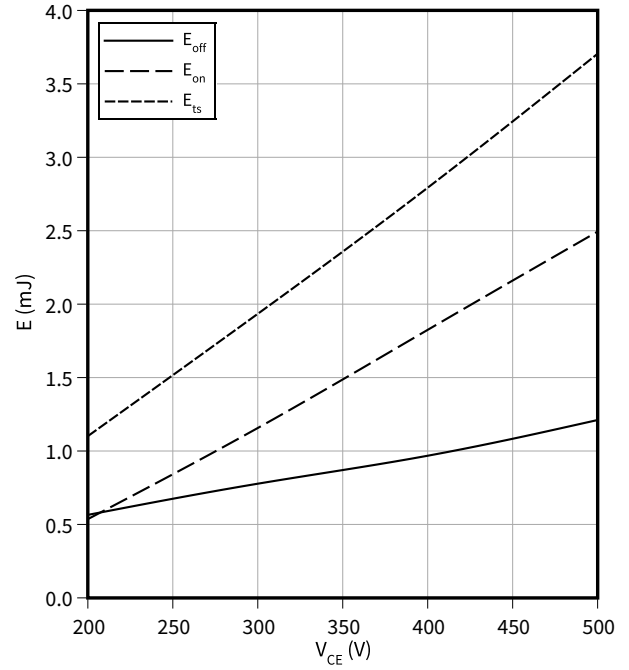
$I_C = 60\text{ A}, V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_G = 9.8\ \Omega$



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

$E = f(V_{CE})$

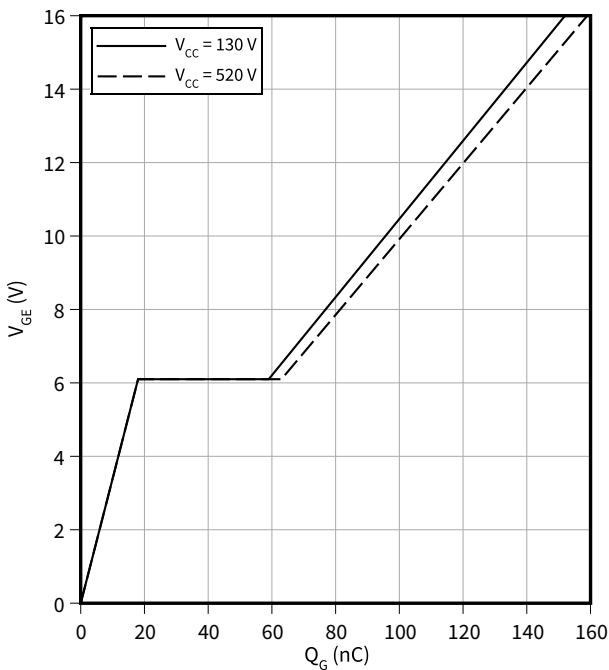
$I_C = 60\text{ A}, T_{vj} = 175\text{ °C}, V_{GE} = 0/15\text{ V}, R_G = 9.8\ \Omega$



**Typical gate charge**

$V_{GE} = f(Q_G)$

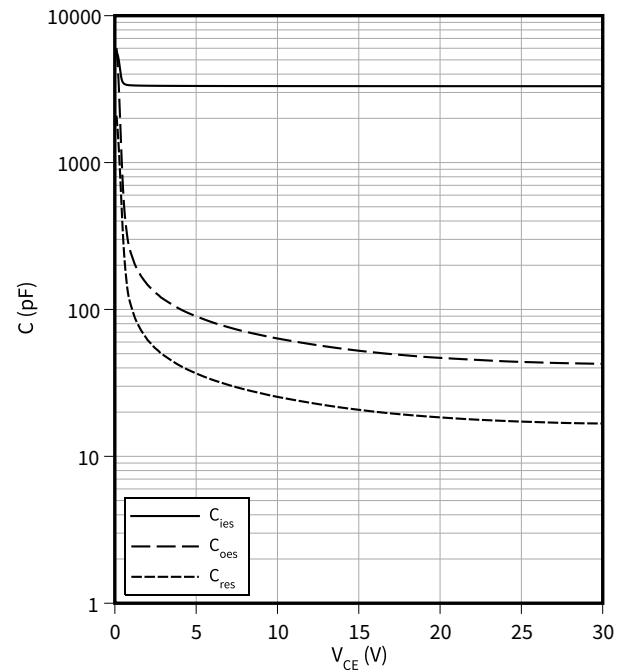
$I_C = 60\text{ A}$



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

$C = f(V_{CE})$

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

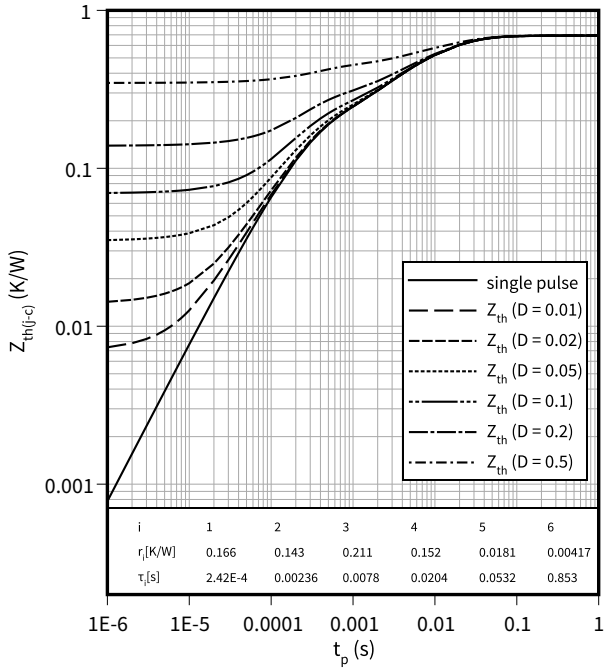


**4 Characteristics diagrams**

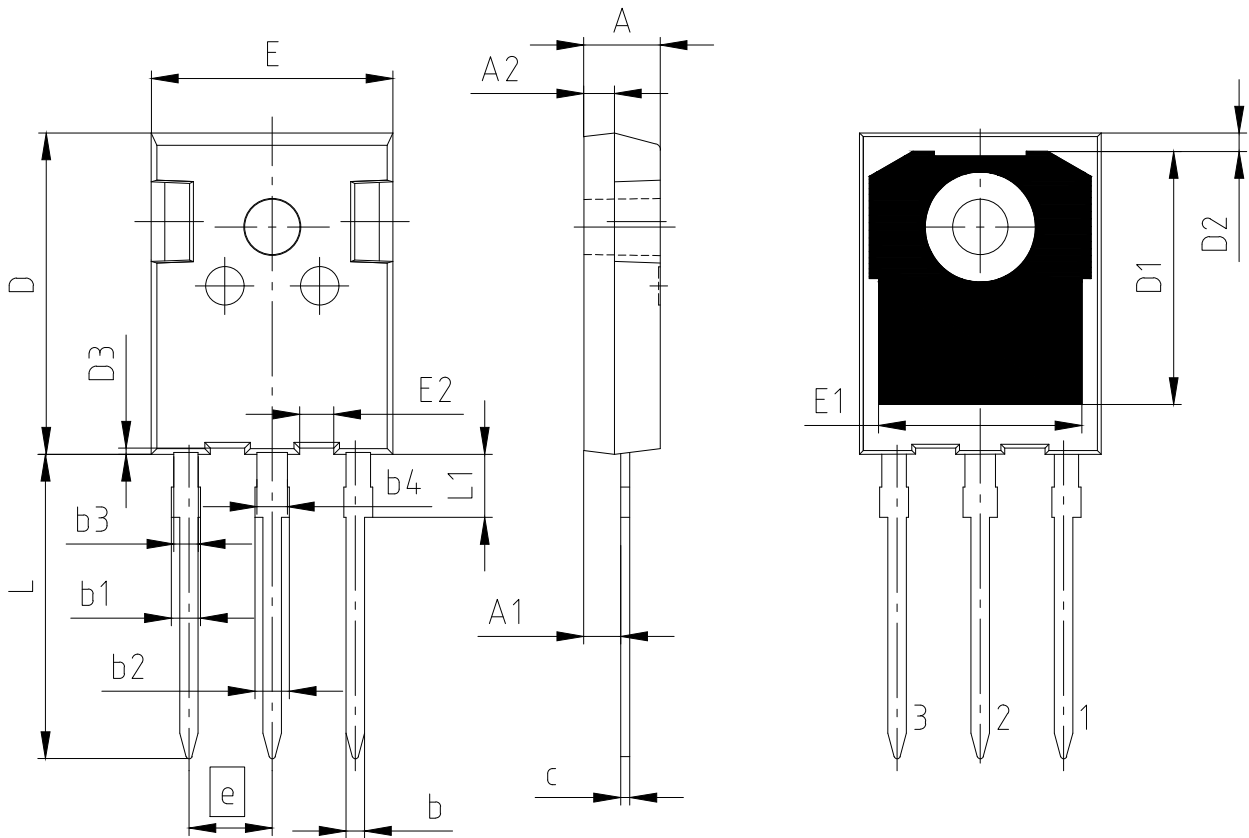
**IGBT transient thermal impedance as a function of pulse width**

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

$$D = t_p/T$$



**5 Package outlines**



PACKAGE - GROUP NUMBER: <b>PG-TO247-3-U04</b>		
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
<b>A</b>	4.90	5.10
<b>A1</b>	2.31	2.51
<b>A2</b>	1.90	2.10
<b>b</b>	1.16	1.26
<b>b1</b>		1.90
<b>b2</b>		2.30
<b>b3</b>	1.55	1.65
<b>b4</b>	1.96	2.06
<b>c</b>	0.59	0.66
<b>D</b>	20.90	21.10
<b>D1</b>	16.25	16.85
<b>D2</b>	1.05	1.35
<b>D3</b>	0.55	0.65
<b>E</b>	15.70	15.90
<b>E1</b>	13.10	13.50
<b>E2</b>	2.14	2.34
<b>e</b>	5.44	
<b>N</b>	3	
<b>L</b>	19.80	20.10
<b>L1</b>	3.95	4.30

**Figure 1**

6 Testing conditions

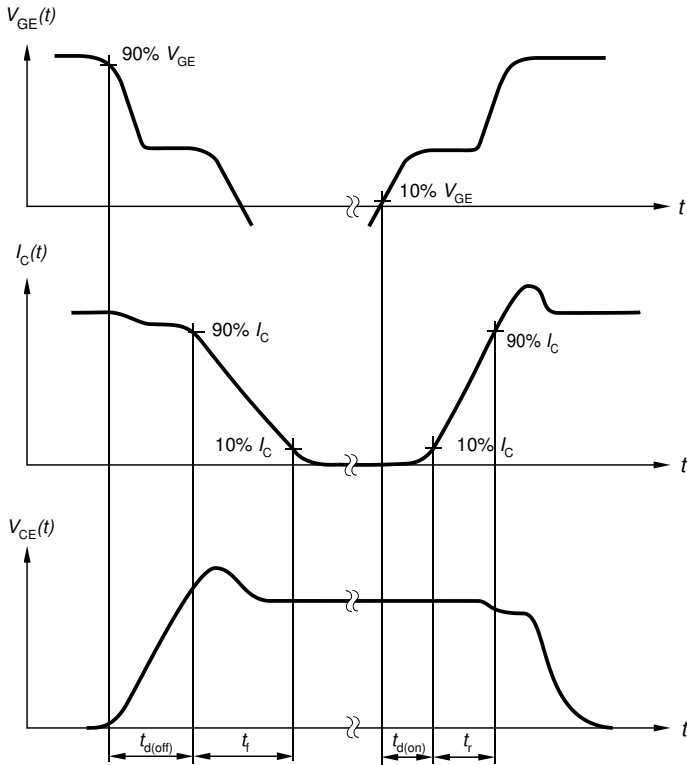


Figure A. Definition of switching times

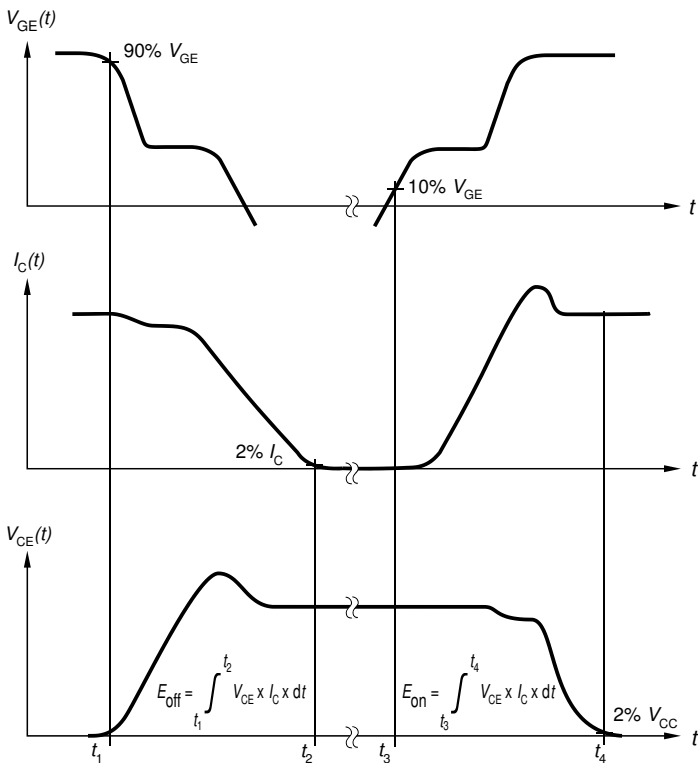


Figure B. Definition of switching losses

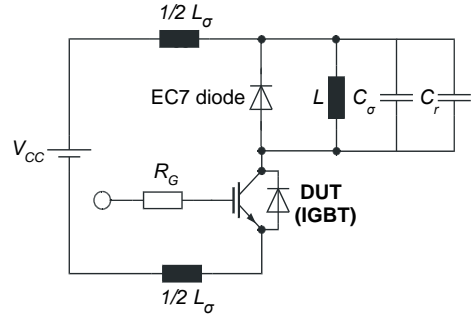


Figure C. Dynamic test circuit

Parasitic inductance  $L_{\sigma}$ ,  
 parasitic capacitor  $C_{\sigma}$ ,  
 relief capacitor  $C_r$ ,  
 (only for ZVT switching)

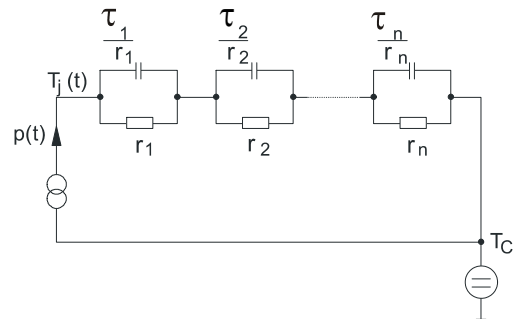


Figure D. Thermal equivalent circuit

Figure 2

**Revision history**

<b>Document revision</b>	<b>Date of release</b>	<b>Description of changes</b>
0.10	2024-08-13	Preliminary datasheet
1.00	2024-09-23	Final datasheet

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