

Final datasheet

Low loss DuoPack : IGBT in TRENCHSTOP™ and Fieldstop technology with soft, fast recovery antiparallel emitter controlled diode

Features

- $V_{CE} = 600\text{ V}$
- $I_C = 75\text{ A}$
- Designed for DC/AC converters for automotive application
- Very low $V_{CEsat} = 1.5\text{ V (typ.)}$
- Maximum junction temperature $T_{vjmax} = 175^\circ\text{C}$
- Dynamically stress tested
- Short circuit withstand time $5\text{ }\mu\text{s}$
- 100% short circuit tested
- 100% of the parts are dynamically tested
- Positive temperature coefficient in $V_{CE(sat)}$
- Low EMI
- Low gate charge Q_G
- Very soft, fast recovery antiparallel emitter controlled HE diode
- Very tight parameter distribution
- High ruggedness, temperature stable behavior
- Very high switching speed

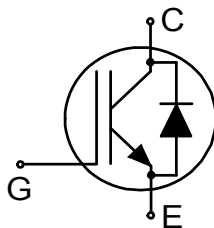
Potential applications

- Main Inverter
- Climate E-compressors
- PTC heater
- Motor drives

Product validation

- Qualified for automotive applications. Product Validation according to AEC-Q101

Description



Halogen-free



RoHS

Type	Package	Marking
AIKW75N60CT	PG-TO247-3-U06	AK75DCT



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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 ¹⁾	$R_{th(j-c)}$			0.22	0.35	K/W
Diode thermal resistance, junction-case ¹⁾	$R_{th(j-c)}$			0.36	0.6	K/W

1) Defined by simulation, not subject to production test

2 IGBT

Table 2 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CE}	$T_{vj} \geq 25\text{ °C}$		600	V
DC collector current, limited by T_{vjmax}	I_C		$T_c = 25\text{ °C}$	80 ¹⁾	A
			$T_c = 100\text{ °C}$	75	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			225	A
Turn-off safe operating area		$V_{CE} \leq 600\text{ V}$, $t_p \leq 1\text{ }\mu\text{s}$, $T_{vj} \leq 175\text{ °C}$		225	A
Gate-emitter voltage	V_{GE}			± 20	V
Short-circuit withstand time	t_{SC}	$V_{GE} = 15\text{ V}$, Allowed number of short circuits < 1000, Time between short circuits $\geq 1.0\text{ s}$	$V_{CC} \leq 400\text{ V}$, $T_{vj} = 150\text{ °C}$	5	μs
Power dissipation	P_{tot}	$T_{vj} = 175\text{ °C}$	$T_c = 25\text{ °C}$	428	W
			$T_c = 100\text{ °C}$	214	

1) Limited by bondwire

Table 3 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter breakdown voltage	V_{BRCES}	$I_C = 0.2 \text{ mA}$, $V_{GE} = 0 \text{ V}$	600			V
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 75 \text{ A}$, $V_{GE} = 15 \text{ V}$		1.5	2	V
				1.9		
Gate-emitter threshold voltage	V_{GETh}	$I_C = 1.2 \text{ mA}$, $V_{CE} = V_{GE}$	4.1	4.9	5.7	V
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 600 \text{ V}$, $V_{GE} = 0 \text{ V}$			40	μA
				1750		
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = 20 \text{ V}$			100	nA
Transconductance	g_{fs}	$I_C = 75 \text{ A}$, $V_{CE} = 20 \text{ V}$		41		S
Short-circuit collector current	I_{SC}	$V_{CC} \leq 400 \text{ V}$, $V_{GE} = 15 \text{ V}$, $t_{SC} \leq 5 \mu\text{s}$, Allowed number of short circuits < 1000, Time between short circuits $\geq 1.0 \text{ s}$, $T_{vj} = 150 \text{ }^\circ\text{C}$		690		A
Input capacitance	C_{ies}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 1000 \text{ kHz}$		4620		pF
Output capacitance	C_{oes}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 1000 \text{ kHz}$		288		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 1000 \text{ kHz}$		137		pF
Gate charge	Q_G	$V_{CC} = 480 \text{ V}$, $I_C = 75 \text{ A}$, $V_{GE} = 0/15 \text{ V}$		470		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 5 \Omega$, $L_\sigma = 100 \text{ nH}$, $C_\sigma = 39 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C}$, $I_C = 75 \text{ A}$	33		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$, $I_C = 75 \text{ A}$	32		
Rise time (inductive load)	t_r	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 5 \Omega$, $L_\sigma = 100 \text{ nH}$, $C_\sigma = 39 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C}$, $I_C = 75 \text{ A}$	36		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$, $I_C = 75 \text{ A}$	37		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 5 \Omega$, $L_\sigma = 100 \text{ nH}$, $C_\sigma = 39 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C}$, $I_C = 75 \text{ A}$	330		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$, $I_C = 75 \text{ A}$	363		
Fall time (inductive load)	t_f	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 5 \Omega$, $L_\sigma = 100 \text{ nH}$, $C_\sigma = 39 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C}$, $I_C = 75 \text{ A}$	35		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$, $I_C = 75 \text{ A}$	38		

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-on energy ¹⁾	E_{on}	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V},$ $R_G = 5\ \Omega, L_\sigma = 100\text{ nH},$ $C_\sigma = 39\text{ pF}$	$T_{vj} = 25\text{ °C},$ $I_C = 75\text{ A}$	2		mJ
			$T_{vj} = 175\text{ °C},$ $I_C = 75\text{ A}$	2.9		
Turn-off energy	E_{off}	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V},$ $R_G = 5\ \Omega, L_\sigma = 100\text{ nH},$ $C_\sigma = 39\text{ pF}$	$T_{vj} = 25\text{ °C},$ $I_C = 75\text{ A}$	2.5		mJ
			$T_{vj} = 175\text{ °C},$ $I_C = 75\text{ A}$	2.9		
Total switching energy	E_{ts}	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V},$ $R_G = 5\ \Omega, L_\sigma = 100\text{ nH},$ $C_\sigma = 39\text{ pF}$	$T_{vj} = 25\text{ °C},$ $I_C = 75\text{ A}$	4.5		mJ
			$T_{vj} = 175\text{ °C},$ $I_C = 75\text{ A}$	5.8		
Operating junction temperature	T_{vj}		-40		175	°C

1) Includes IGBT losses caused by the reverse recovery current

3 Diode

Table 4 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Diode forward current, limited by T_{vjmax}	I_F		$T_c = 25\text{ °C}$	80 ¹⁾	A
			$T_c = 100\text{ °C}$	75	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			225	A
Power dissipation	P_{tot}	$T_{vj} = 175\text{ °C}$	$T_c = 25\text{ °C}$	250	W
			$T_c = 100\text{ °C}$	125	

1) Limited by bondwire

Table 5 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	$I_F = 75\text{ A}$	$T_{vj} = 25\text{ °C}$		1.65	2.05	V
			$T_{vj} = 175\text{ °C}$		1.6		

(table continues...)

Table 5 (continued) Characteristic values

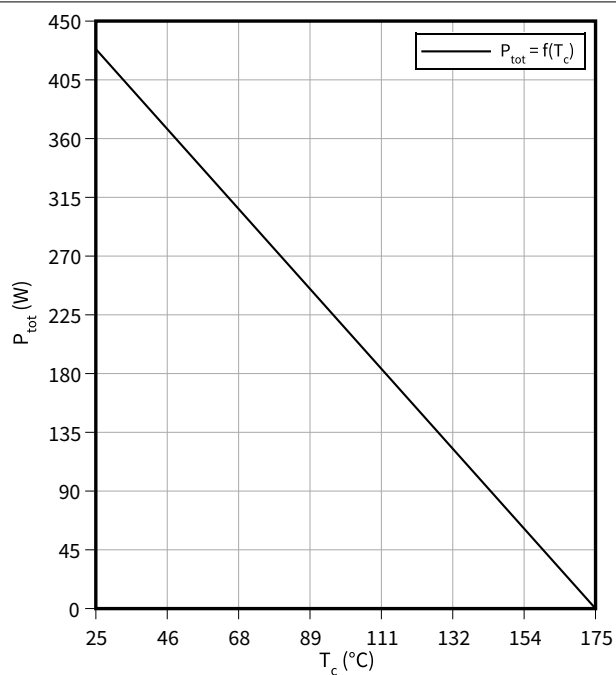
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode reverse recovery time	t_{rr}	$V_R = 400 \text{ V}$	$T_{vj} = 25 \text{ °C}$, $I_F = 75 \text{ A}$, $-di_F/dt = 1460 \text{ A/}\mu\text{s}$		121		ns
			$T_{vj} = 175 \text{ °C}$, $I_F = 75 \text{ A}$, $-di_F/dt = 1460 \text{ A/}\mu\text{s}$		182		
Diode reverse recovery charge	Q_{rr}	$V_R = 400 \text{ V}$	$T_{vj} = 25 \text{ °C}$, $I_F = 75 \text{ A}$, $-di_F/dt = 1460 \text{ A/}\mu\text{s}$		2.4		μC
			$T_{vj} = 175 \text{ °C}$, $I_F = 75 \text{ A}$, $-di_F/dt = 1460 \text{ A/}\mu\text{s}$		5.8		
Diode peak reverse recovery current	I_{rrm}	$V_R = 400 \text{ V}$	$T_{vj} = 25 \text{ °C}$, $I_F = 75 \text{ A}$, $-di_F/dt = 1460 \text{ A/}\mu\text{s}$		39		A
			$T_{vj} = 175 \text{ °C}$, $I_F = 75 \text{ A}$, $-di_F/dt = 1460 \text{ A/}\mu\text{s}$		56		
Diode peak rate of fall of reverse recovery current	di_{rr}/dt	$V_R = 400 \text{ V}$	$T_{vj} = 25 \text{ °C}$, $I_F = 75 \text{ A}$, $-di_F/dt = 1460 \text{ A/}\mu\text{s}$		-920		A/ μs
			$T_{vj} = 175 \text{ °C}$, $I_F = 75 \text{ A}$, $-di_F/dt = 1460 \text{ A/}\mu\text{s}$		-1000		
Operating junction temperature	T_{vj}			-40		175	°C

4 Characteristics diagrams

Power dissipation as a function of case temperature

$$P_{\text{tot}} = f(T_c)$$

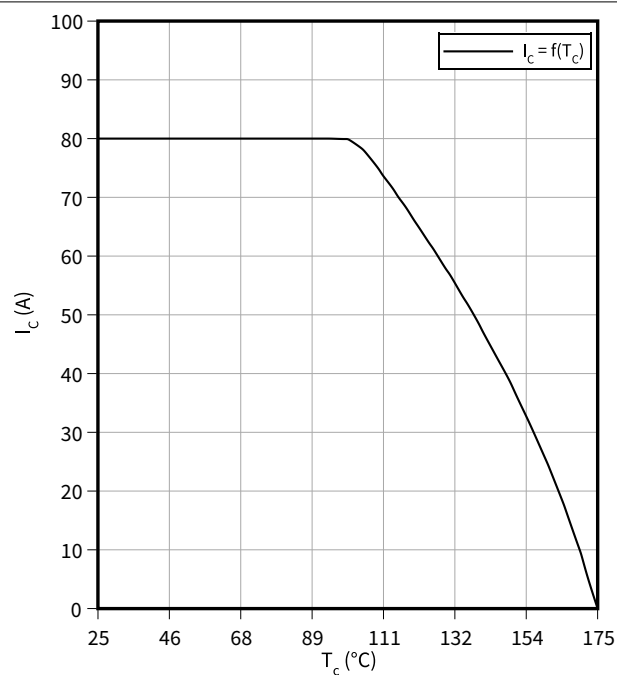
$$T_{vj} \leq 175^\circ\text{C}$$



Collector current as a function of case temperature

$$I_C = f(T_c)$$

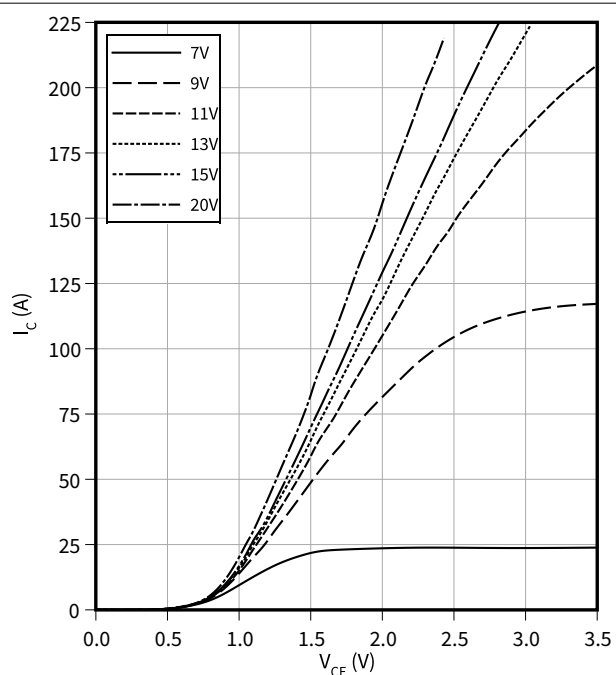
$$T_{vj} \leq 175^\circ\text{C}, V_{GE} \geq 15\text{ V}$$



Typical output characteristic

$$I_C = f(V_{CE})$$

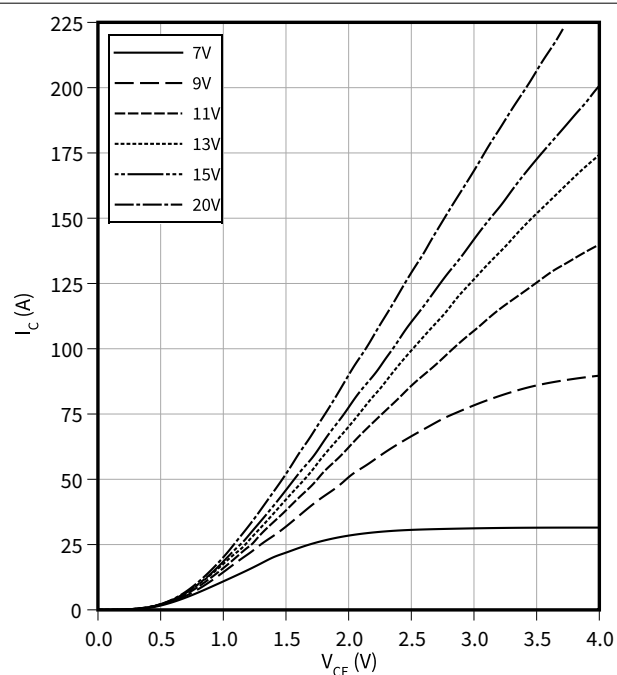
$$T_{vj} = 25^\circ\text{C}$$



Typical output characteristic

$$I_C = f(V_{CE})$$

$$T_{vj} = 175^\circ\text{C}$$

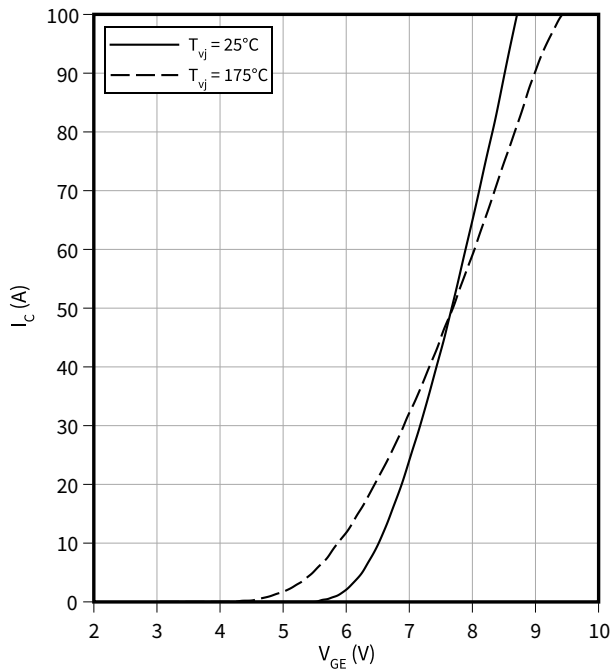


4 Characteristics diagrams

Typical transfer characteristic

$$I_C = f(V_{GE})$$

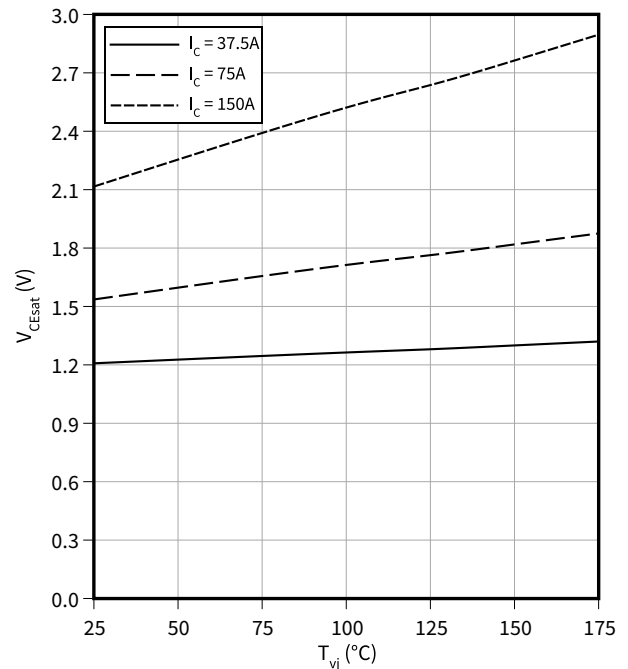
$$V_{CE} = 20 \text{ V}$$



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

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

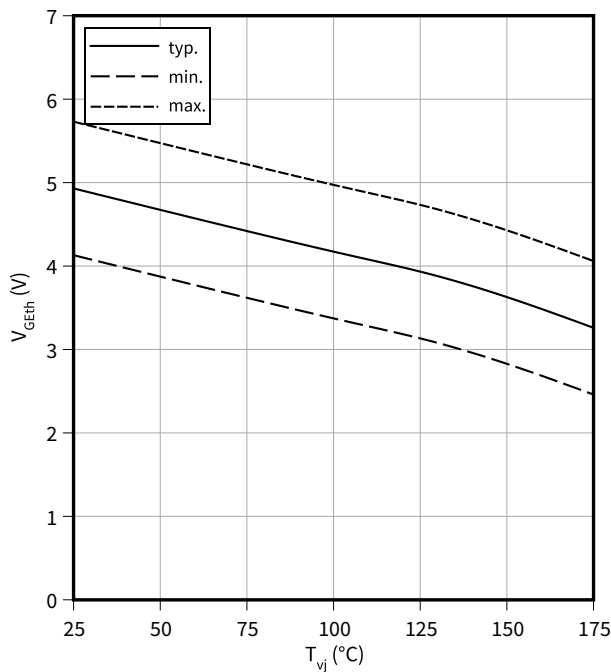
$$V_{GE} = 15 \text{ V}$$



Gate-emitter threshold voltage as a function of junction temperature

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

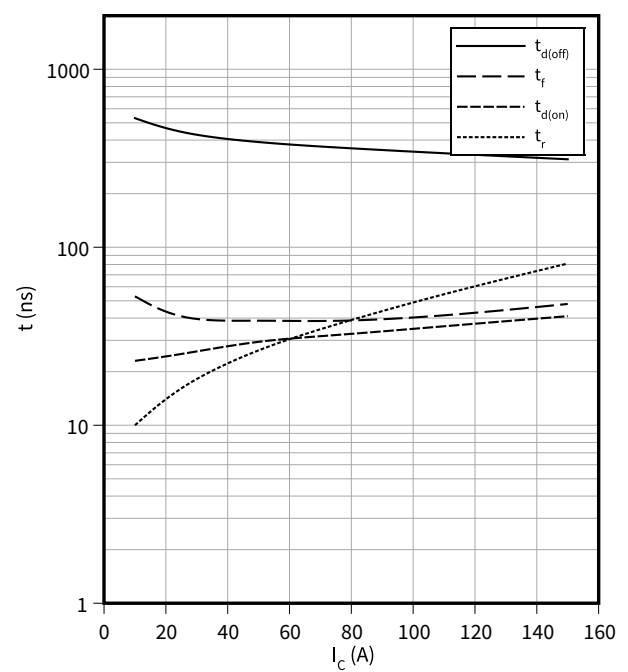
$$I_C = 1.2 \text{ mA}$$



Typical switching times as a function of collector current

$$t = f(I_C)$$

$$V_{CE} = 400 \text{ V}, T_{vj} = 175^\circ\text{C}, V_{GE} = 0/15 \text{ V}, R_G = 5 \Omega$$

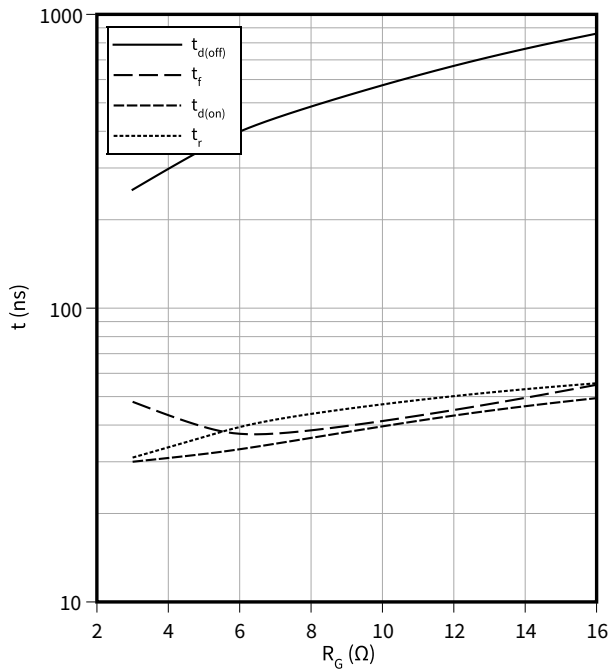


4 Characteristics diagrams

Typical switching times as a function of gate resistor

$$t = f(R_G)$$

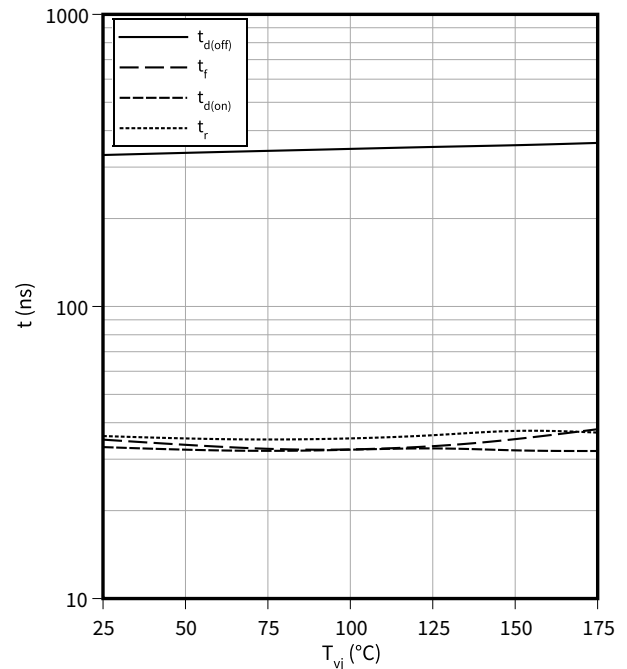
$$I_C = 75 \text{ A}, V_{CE} = 400 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}, V_{GE} = 0/15 \text{ V}$$



Typical switching times as a function of junction temperature

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

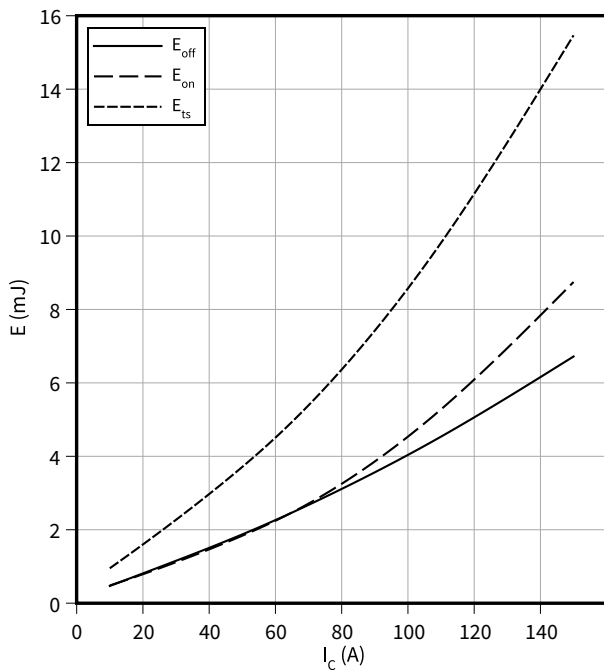
$$I_C = 75 \text{ A}, V_{CE} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_G = 5 \text{ } \Omega$$



Typical switching energy losses as a function of collector current

$$E = f(I_C)$$

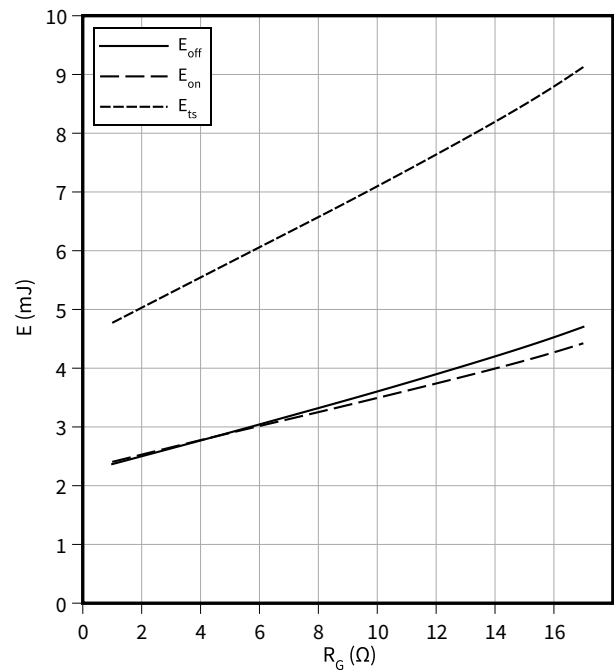
$$V_{CE} = 400 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}, V_{GE} = 0/15 \text{ V}, R_G = 5 \text{ } \Omega$$



Typical switching energy losses as a function of gate resistor

$$E = f(R_G)$$

$$I_C = 75 \text{ A}, V_{CE} = 400 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}, V_{GE} = 0/15 \text{ V}$$

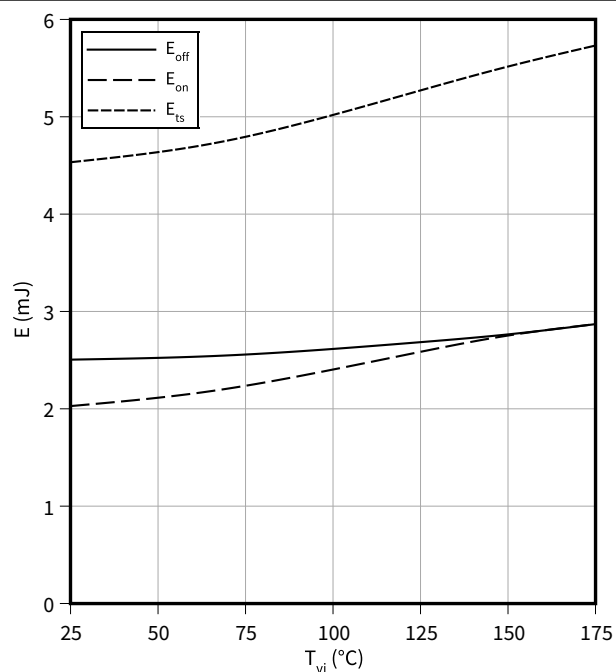


4 Characteristics diagrams

Typical switching energy losses as a function of junction temperature

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

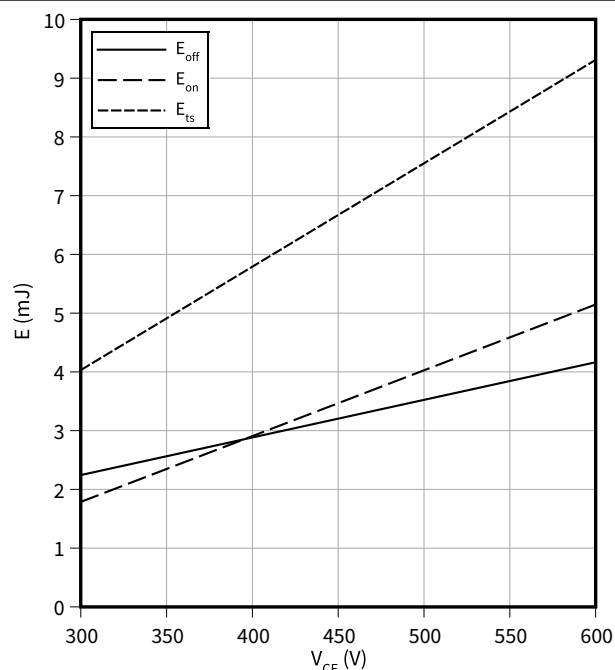
$$I_C = 75 \text{ A}, V_{CE} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_G = 5 \Omega$$



Typical switching energy losses as a function of collector emitter voltage

$$E = f(V_{CE})$$

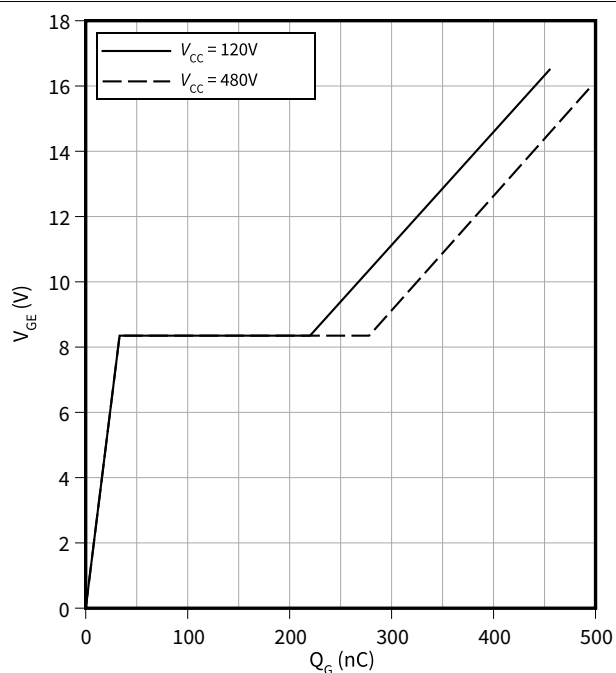
$$I_C = 75 \text{ A}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 5 \Omega$$



Typical gate charge

$$V_{GE} = f(Q_G)$$

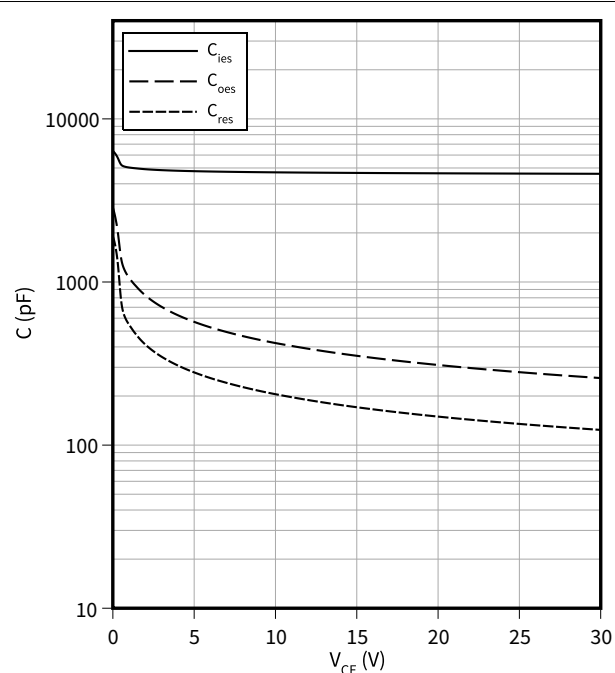
$$I_C = 75 \text{ A}$$



Typical capacitance as a function of collector-emitter voltage

$$C = f(V_{CE})$$

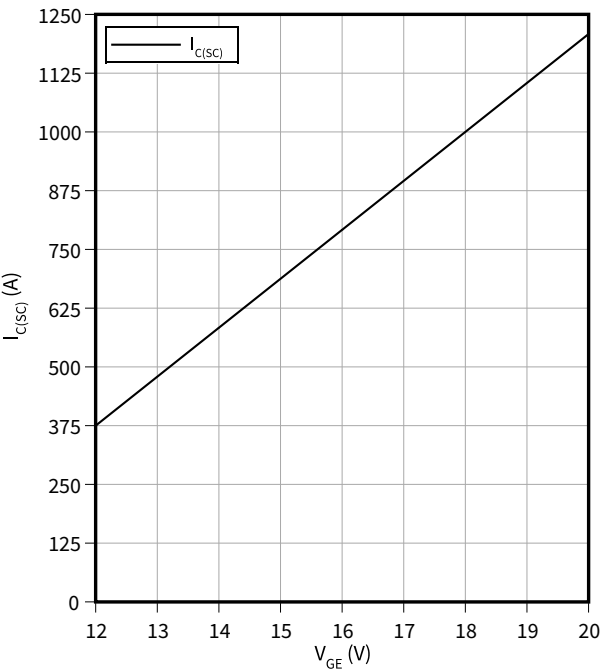
$$f = 1000 \text{ kHz}, V_{GE} = 0 \text{ V}$$



4 Characteristics diagrams

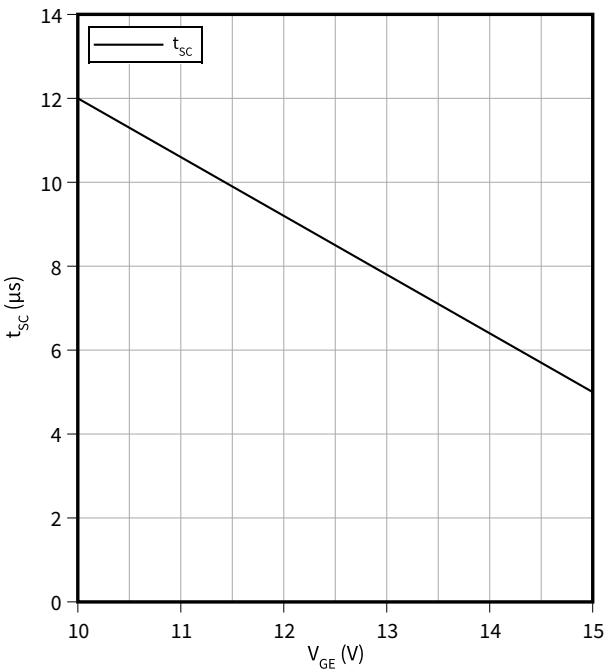
Typical short circuit collector current as a function of gate-emitter voltage

$I_{C(SC)} = f(V_{GE})$
 $V_{CE} = 400\text{ V}, T_{vj} = 150\text{ °C}$



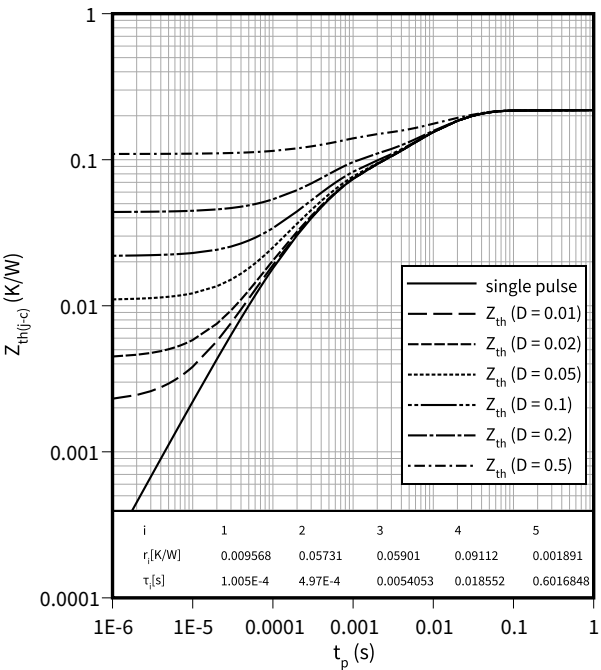
Short circuit withstand time as a function of gate-emitter voltage

$t_{SC} = f(V_{GE})$
 $T_{vj} = 150\text{ °C}, V_{CC} \leq 400\text{ V}$



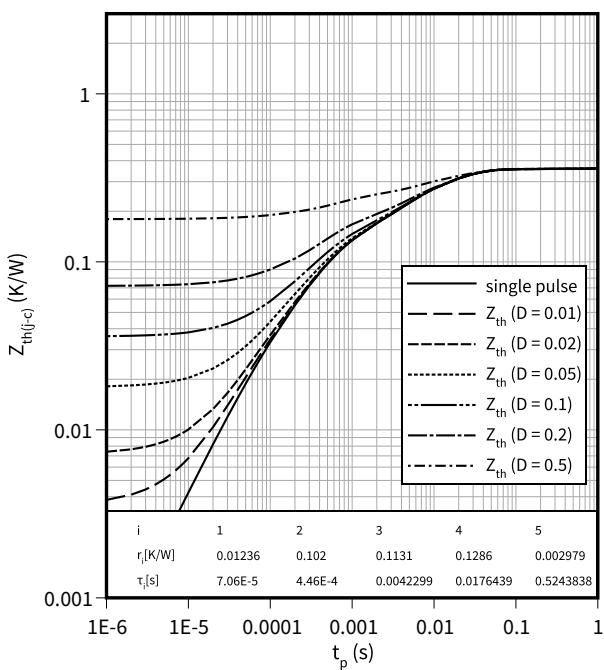
IGBT typical transient thermal impedance as a function of pulse width

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



Diode typical transient thermal impedance as a function of pulse width

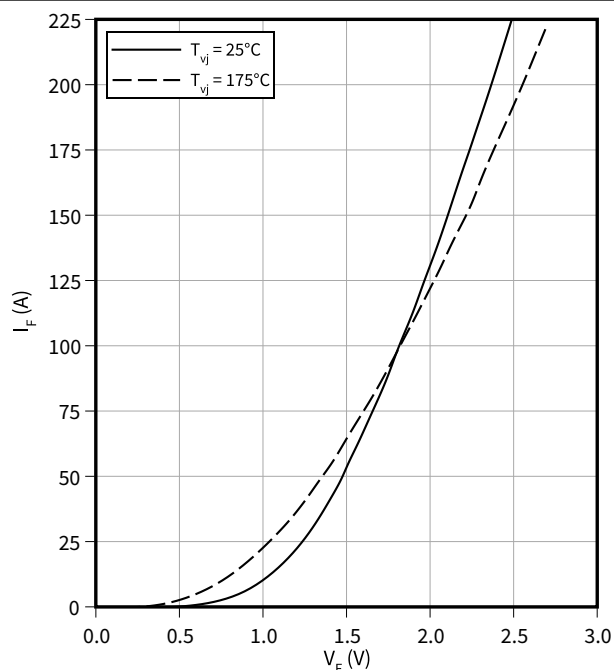
$Z_{th(j-c)} = f(t_p)$
 $D = t_p/T$



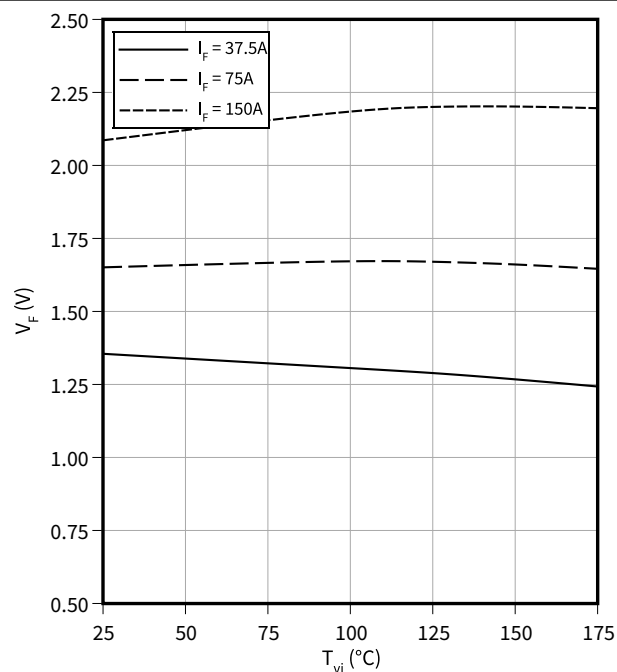
4 Characteristics diagrams

Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$

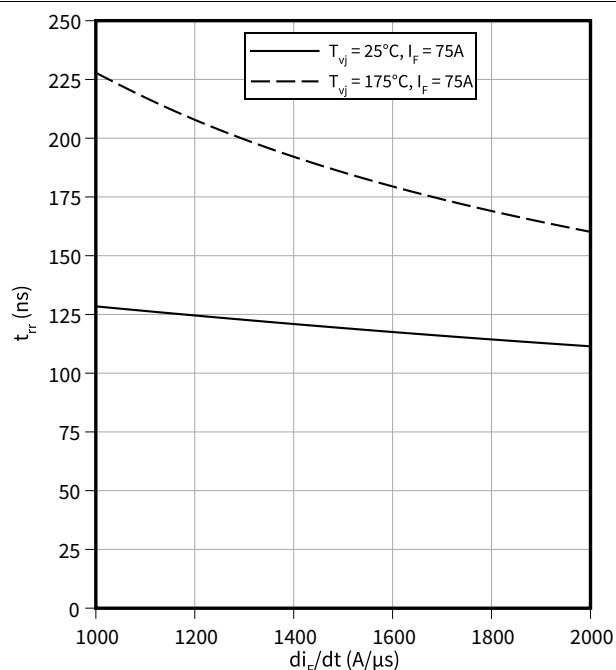

Typical diode forward voltage as a function of junction temperature

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


Typical reverse recovery time as a function of diode current slope

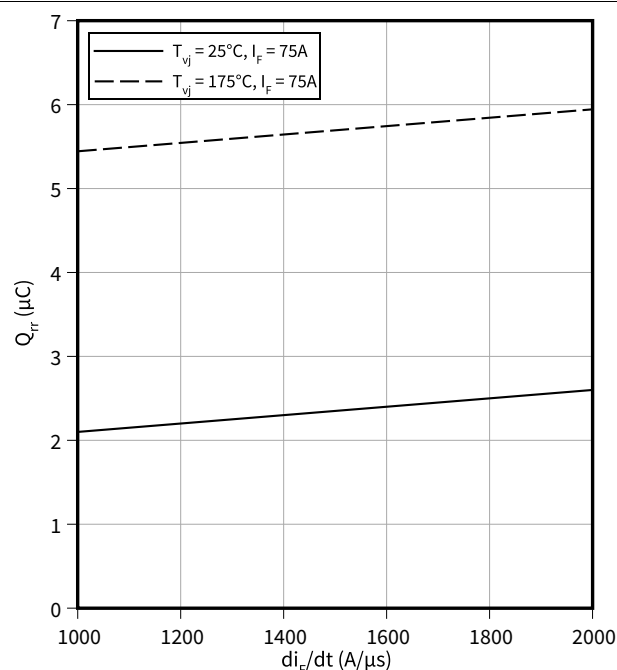
$$t_{rr} = f(di_F/dt)$$

$$V_R = 400 \text{ V}$$


Typical reverse recovery charge as a function of diode current slope

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

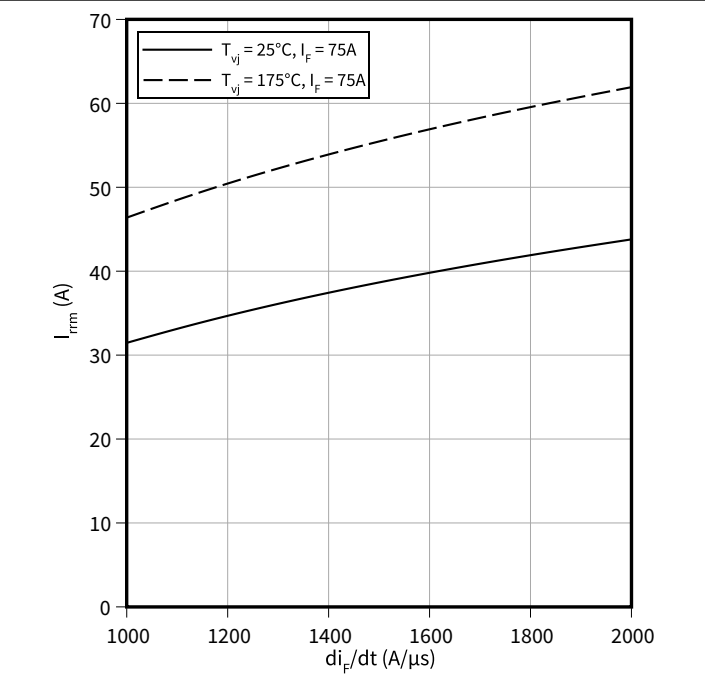
$$V_R = 400 \text{ V}$$



4 Characteristics diagrams

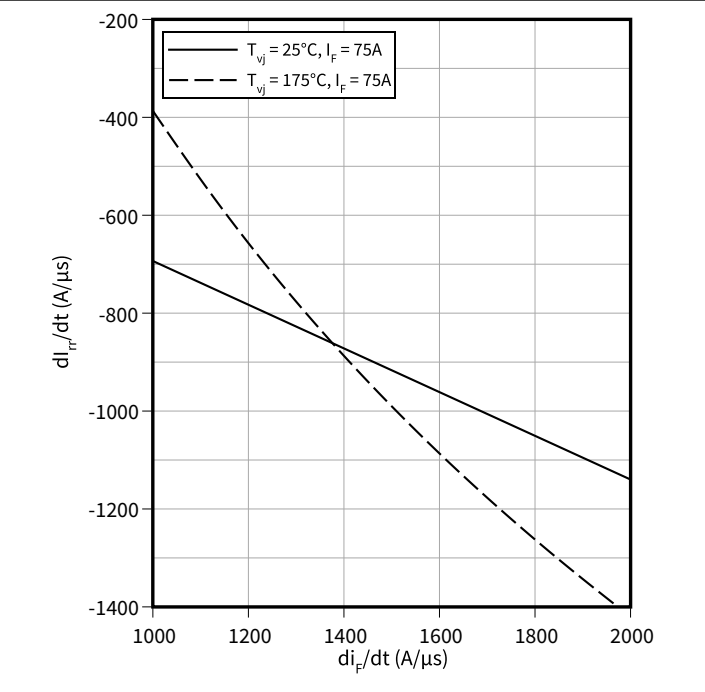
Typical reverse recovery current as a function of diode current slope

$I_{rrm} = f(di_F/dt)$
 $V_R = 400\text{ V}$



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

$dI_{rr}/dt = f(di_F/dt)$
 $V_R = 400\text{ V}$



5 Package outlines

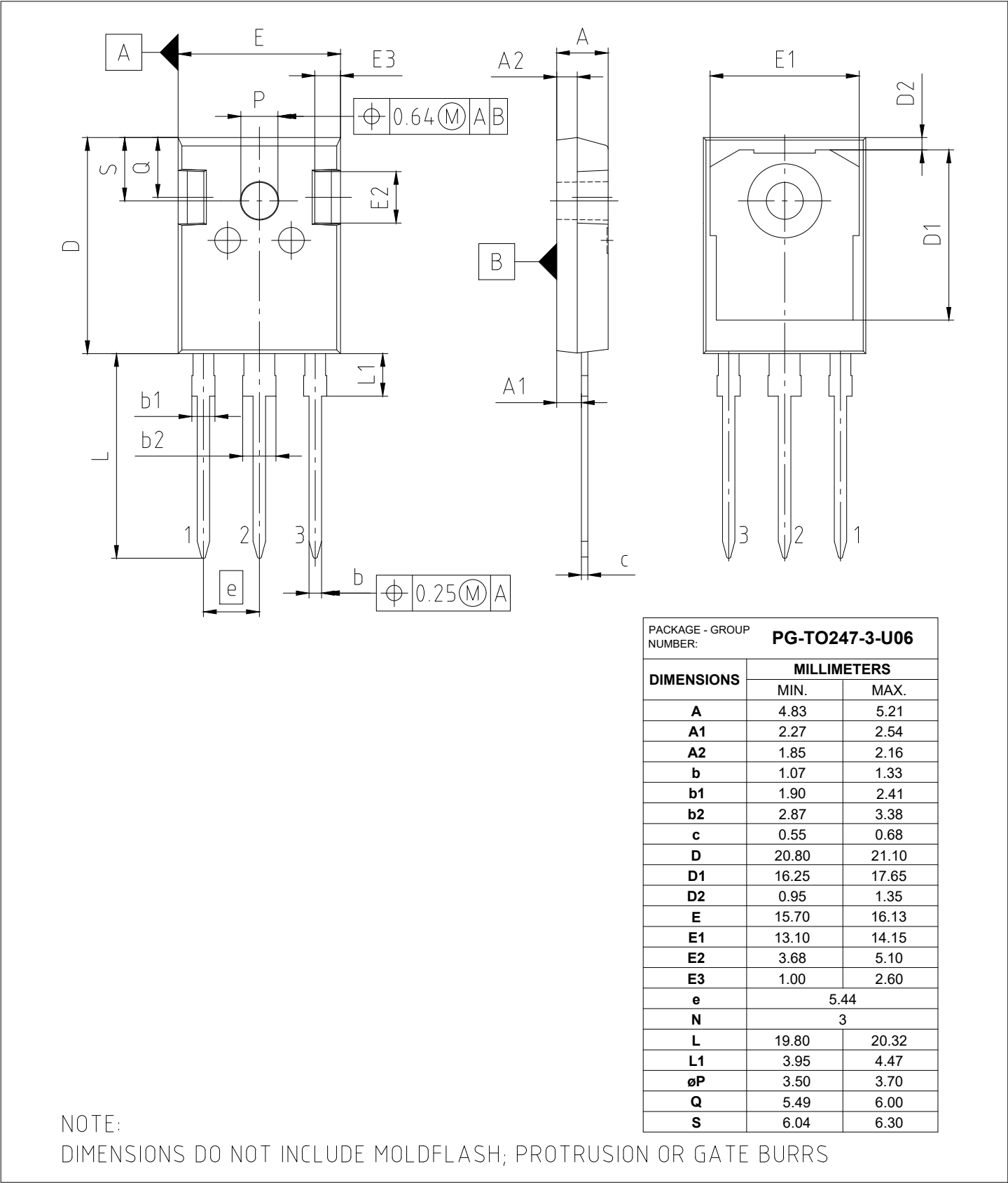


Figure 1

6 Testing conditions

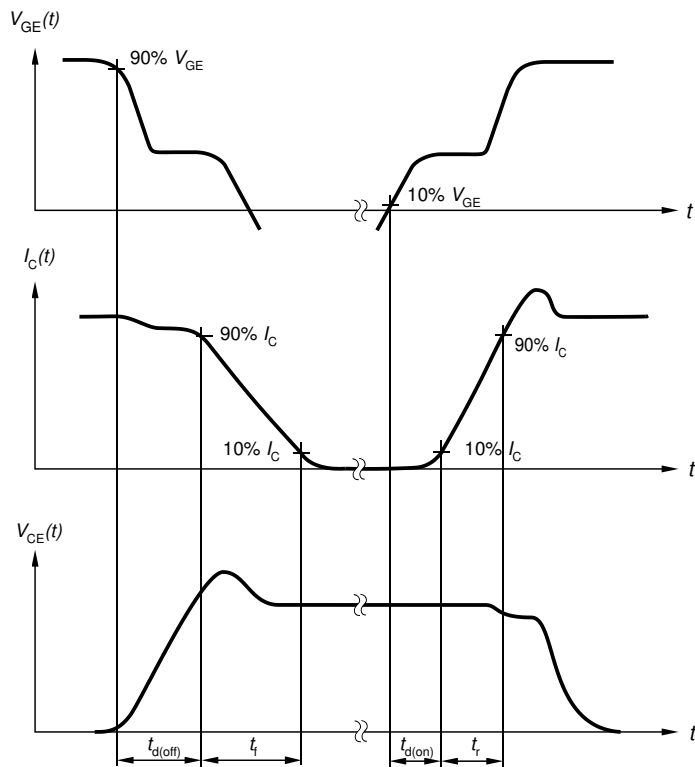


Figure A. Definition of switching times

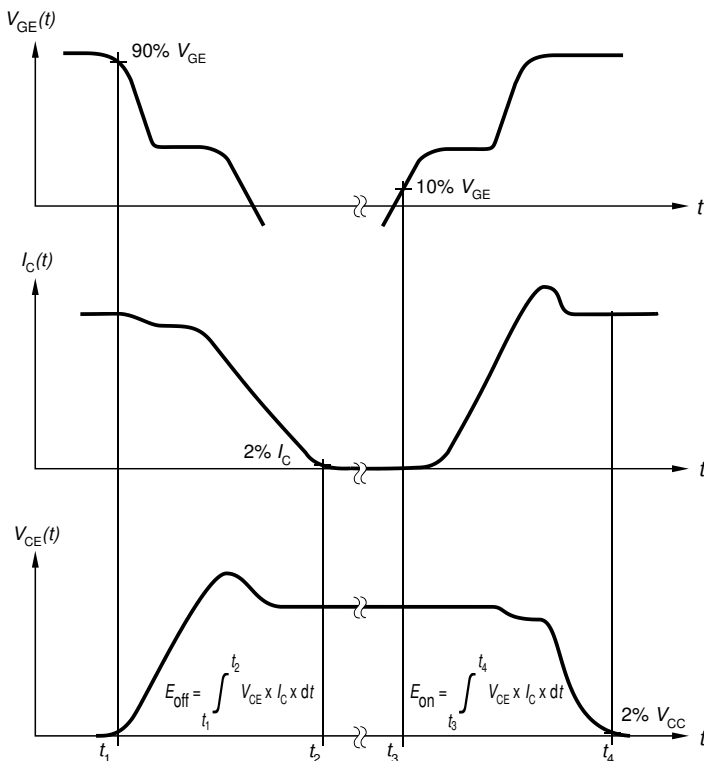


Figure B. Definition of switching losses

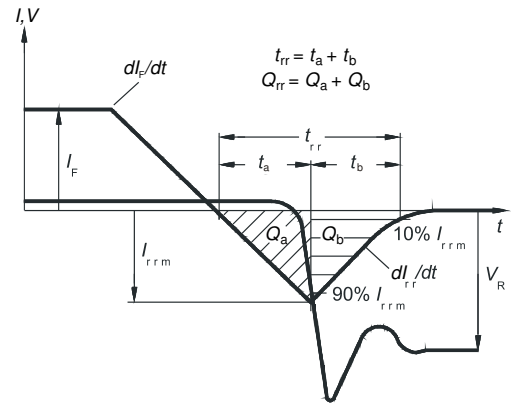


Figure C. Definition of diode switching characteristics

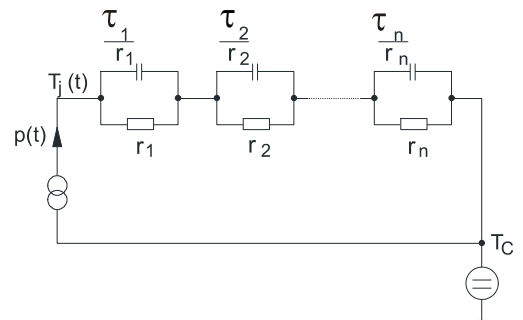


Figure D. Thermal equivalent circuit

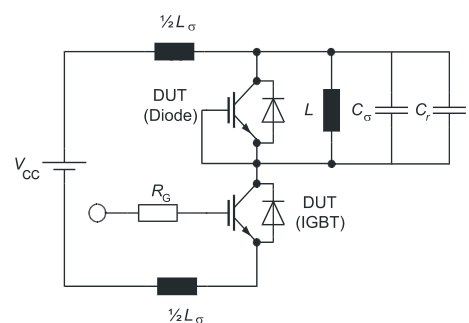


Figure E. **Dynamic test circuit**
 Parasitic inductance L_σ ,
 parasitic capacitor C_σ ,
 relief capacitor C_r ,
 (only for ZVT switching)

Revision history

Document revision	Date of release	Description of changes
V2.1	2017-02-09	Data sheet created
n/a	2020-11-30	Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy
1.10	2025-01-13	Package drawing, transient thermal impedance plots and qualification labels updated according to the latest guidelines

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