Final datasheet

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

Features

- V_{CE} = 600 V
- I_C = 75 A
- Designed for DC/AC converters for automotive application
- Very low V_{CEsat} = 1.5 V (typ.)
- Maximum junction temperature T_{vjmax} = 175°C
- Dynamically stress tested
- Short circuit withstand time 5 µs
- 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

AEC Qualified

Halogen-free

RoHS

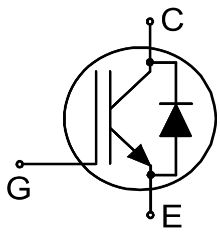
Potential applications

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

Product validation

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

Description



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}	$T_{vj} \geq 25$ °C		600	V
DC collector current, limited by T_{vjmax}	I_C		$T_c = 25$ °C	80[1)]	A
			$T_c = 100$ °C	75	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			225	A
Turn-off safe operating area		$V_{CE} \leq 600$ V, $t_p \leq 1$ μs, $T_{vj} \leq 175$ °C		225	A
Gate-emitter voltage	V_{GE}			±20	V
Short-circuit withstand time	t_{SC}	$V_{GE} = 15$ V, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s	$V_{CC} \leq 400$ V, $T_{vj} = 150$ °C	5	μs
Power dissipation	P_{tot}	$T_{vj} = 175$ °C	$T_c = 25$ °C	428	W
			$T_c = 100$ °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}	$I_C = 0.2$ mA, $V_{GE} = 0$ V		600			V
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 75$ A, $V_{GE} = 15$ V	$T_{vj} = 25$ °C		1.5	2	V
			$T_{vj} = 175$ °C		1.9		
Gate-emitter threshold voltage	V_{GEth}	$I_C = 1.2$ mA, $V_{CE} = V_{GE}$		4.1	4.9	5.7	V
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 600$ V, $V_{GE} = 0$ V	$T_{vj} = 25$ °C			40	µA
			$T_{vj} = 175$ °C		1750		
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0$ V, $V_{GE} = 20$ V				100	nA
Transconductance	g_{fs}	$I_C = 75$ A, $V_{CE} = 20$ V			41		S
Short-circuit collector current	I_{SC}	$V_{CC} \leq 400$ V, $V_{GE} = 15$ V, $t_{SC} \leq 5$ µs, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, $T_{vj} = 150$ °C			690		A
Input capacitance	C_{ies}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 1000$ kHz			4620		pF
Output capacitance	C_{oes}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 1000$ kHz			288		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 1000$ kHz			137		pF
Gate charge	Q_G	$V_{CC} = 480$ V, $I_C = 75$ A, $V_{GE} = 0/15$ V			470		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_G = 5\ \Omega$, $L_\sigma = 100$ nH, $C_\sigma = 39$ pF	$T_{vj} = 25$ °C, $I_C = 75$ A		33		ns
			$T_{vj} = 175$ °C, $I_C = 75$ A		32		
Rise time (inductive load)	t_r	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_G = 5\ \Omega$, $L_\sigma = 100$ nH, $C_\sigma = 39$ pF	$T_{vj} = 25$ °C, $I_C = 75$ A		36		ns
			$T_{vj} = 175$ °C, $I_C = 75$ A		37		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_G = 5\ \Omega$, $L_\sigma = 100$ nH, $C_\sigma = 39$ pF	$T_{vj} = 25$ °C, $I_C = 75$ A		330		ns
			$T_{vj} = 175$ °C, $I_C = 75$ A		363		
Fall time (inductive load)	t_f	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_G = 5\ \Omega$, $L_\sigma = 100$ nH, $C_\sigma = 39$ pF	$T_{vj} = 25$ °C, $I_C = 75$ A		35		ns
			$T_{vj} = 175$ °C, $I_C = 75$ 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 V, V_{GE} = 0/15 V, R_G = 5 Ω, L_σ = 100 nH, C_σ = 39 pF	T_{vj} = 25 °C, I_C = 75 A		2		mJ
			T_{vj} = 175 °C, I_C = 75 A		2.9		
Turn-off energy	E_{off}	V_{CC} = 400 V, V_{GE} = 0/15 V, R_G = 5 Ω, L_σ = 100 nH, C_σ = 39 pF	T_{vj} = 25 °C, I_C = 75 A		2.5		mJ
			T_{vj} = 175 °C, I_C = 75 A		2.9		
Total switching energy	E_{ts}	V_{CC} = 400 V, V_{GE} = 0/15 V, R_G = 5 Ω, L_σ = 100 nH, C_σ = 39 pF	T_{vj} = 25 °C, I_C = 75 A		4.5		mJ
			T_{vj} = 175 °C, I_C = 75 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 °C	80[1]	A
			T_c = 100 °C	75	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			225	A
Power dissipation	P_{tot}	T_{vj} = 175 °C	T_c = 25 °C	250	W
			T_c = 100 °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 A	T_{vj} = 25 °C		1.65	2.05	V
			T_{vj} = 175 °C		1.6		

(table continues...)

Table 5 (continued) Characteristic values

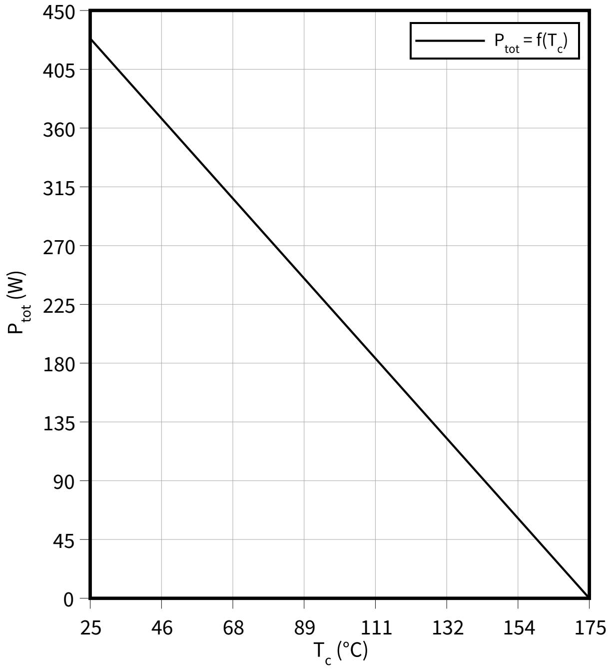
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode reverse recovery time	t_{rr}	V_R = 400 V	T_{vj} = 25 °C, I_F = 75 A, $-di_F/dt$ = 1460 A/µs		121		ns
			T_{vj} = 175 °C, I_F = 75 A, $-di_F/dt$ = 1460 A/µs		182		
Diode reverse recovery charge	Q_{rr}	V_R = 400 V	T_{vj} =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

4 Characteristics diagrams

Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$

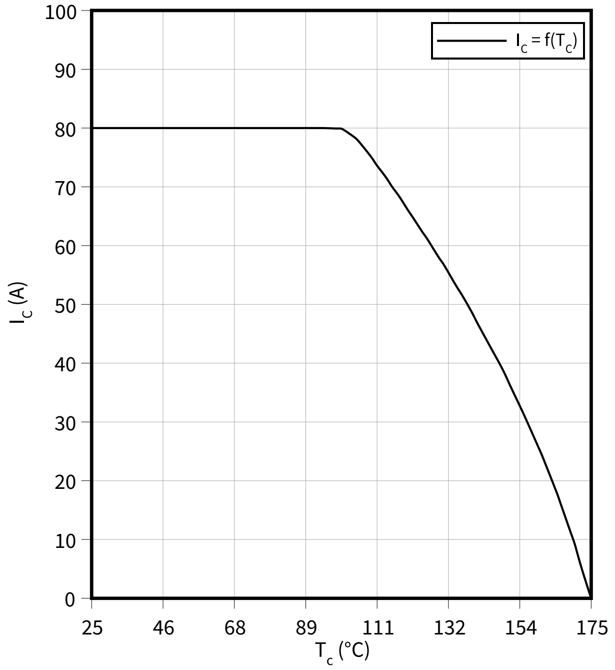
$T_{vj} \leq 175$ °C



Collector current as a function of case temperature

$I_C = f(T_c)$

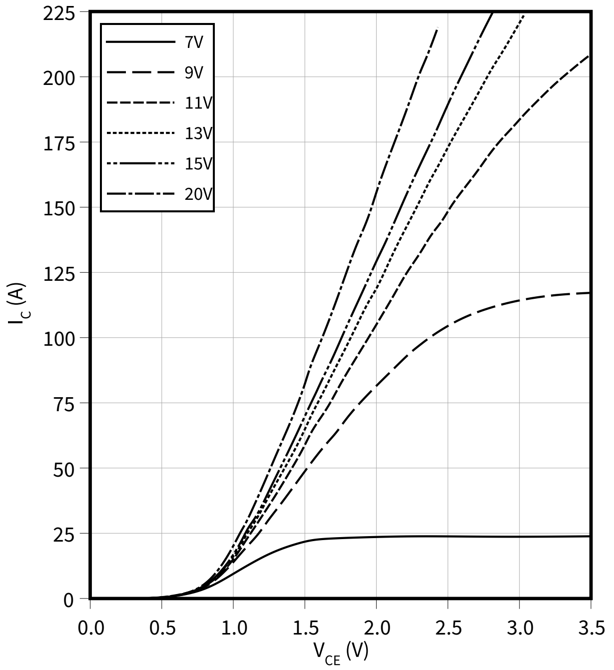
$T_{vj} \leq 175$ °C, $V_{GE} \geq 15$ V



Typical output characteristic

$I_C = f(V_{CE})$

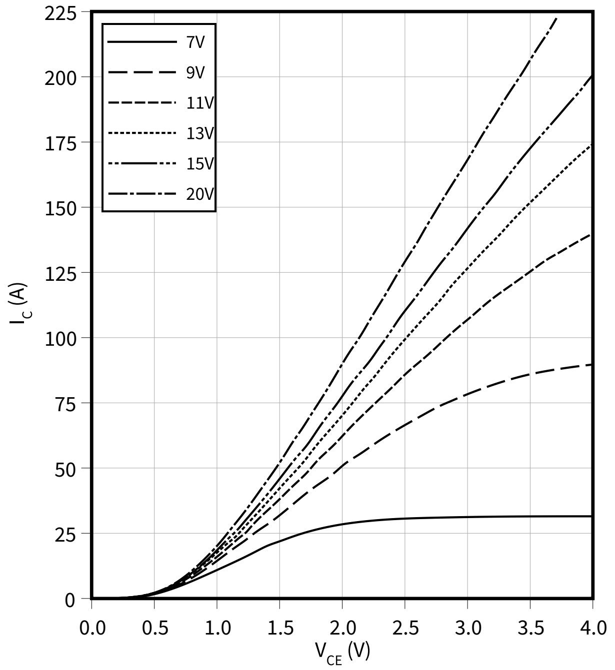
$T_{vj} = 25$ °C



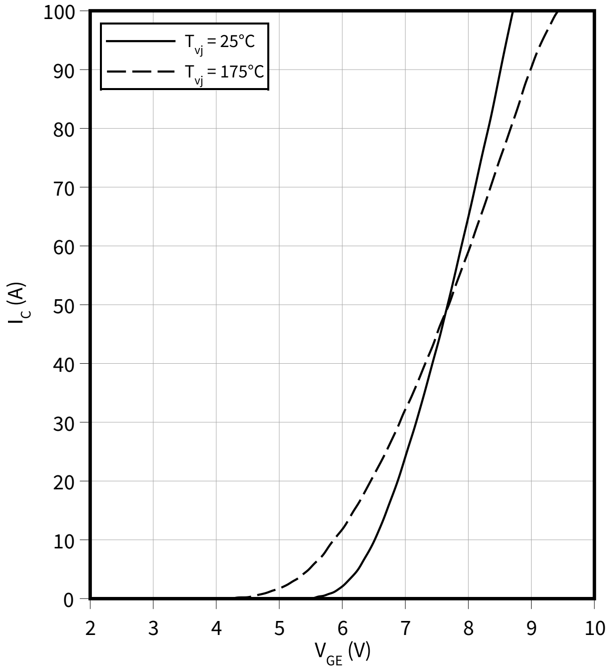
Typical output characteristic

$I_C = f(V_{CE})$

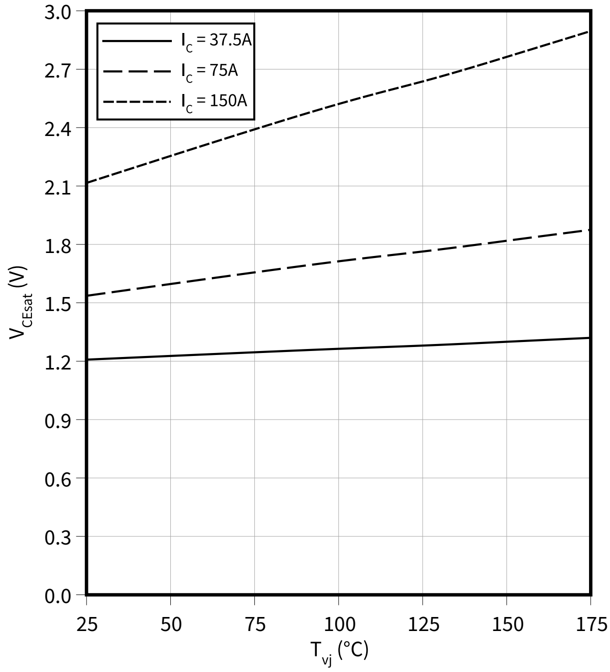
$T_{vj} = 175$ °C



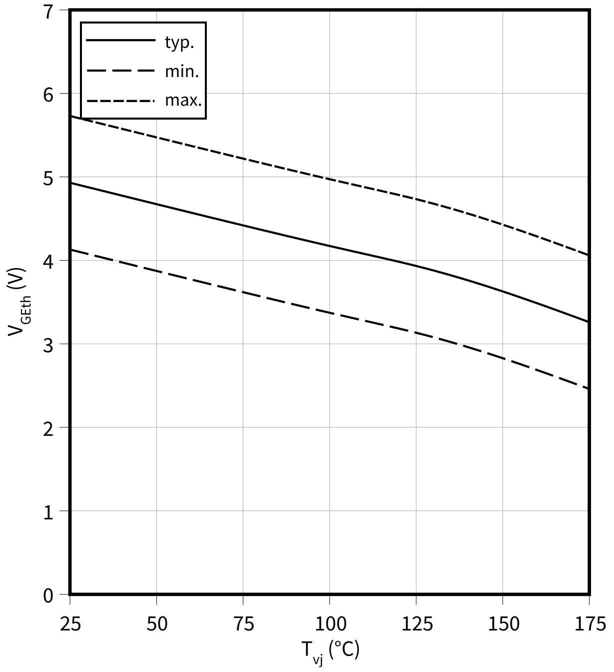
Typical transfer characteristic
$I_C = f(V_{GE})$
$V_{CE} = 20$ V



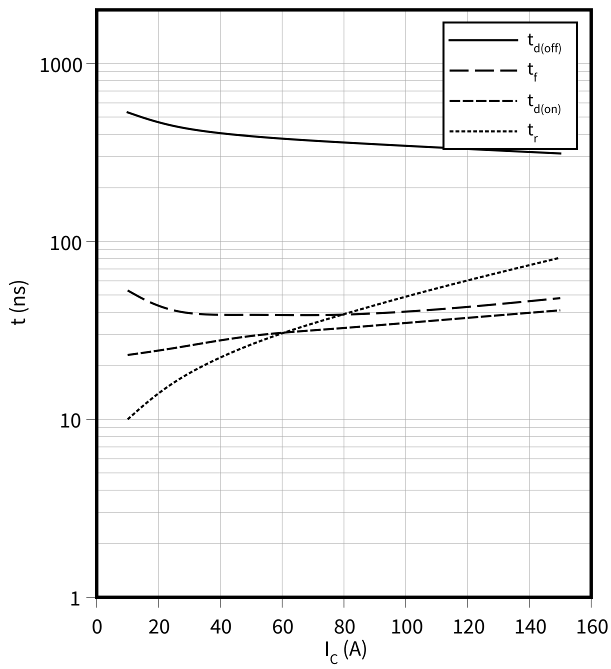
Typical collector-emitter saturation voltage as a function of junction temperature
$V_{CEsat} = f(T_{vj})$
$V_{GE} = 15$ V



Gate-emitter threshold voltage as a function of junction temperature
$V_{GEth} = f(T_{vj})$
$I_C = 1.2$ mA



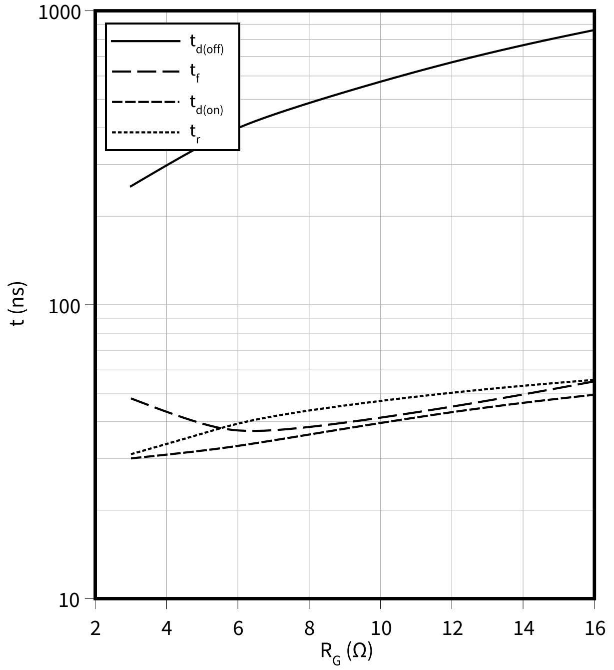
Typical switching times as a function of collector current
$t = f(I_C)$
$V_{CE} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 5\ \Omega$



Typical switching times as a function of gate resistor

$t = f(R_G)$

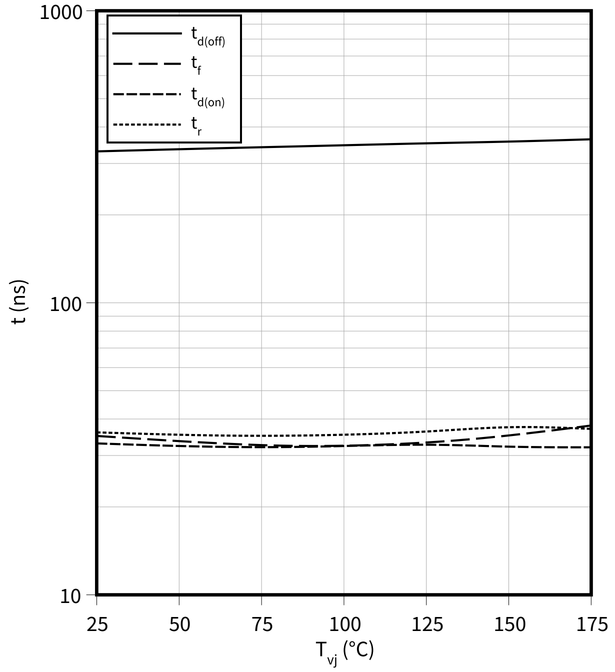
$I_C = 75$ A, $V_{CE} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



Typical switching times as a function of junction temperature

$t = f(T_{vj})$

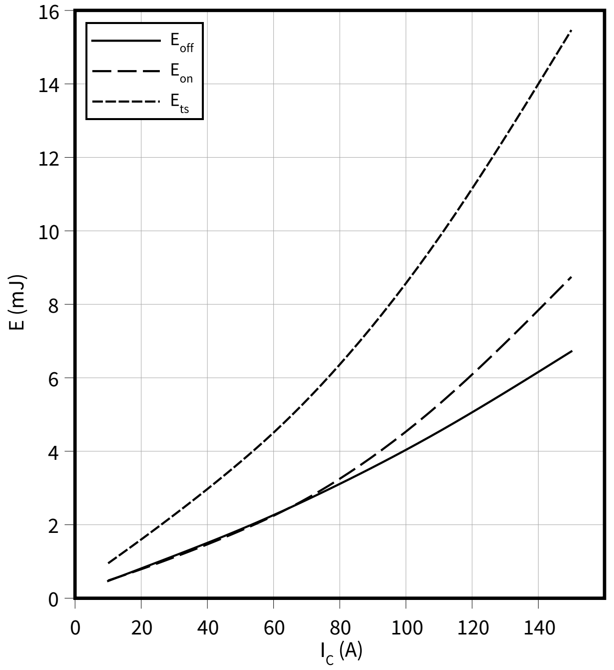
$I_C = 75$ A, $V_{CE} = 400$ V, $V_{GE} = 0/15$ V, $R_G = 5$ Ω



Typical switching energy losses as a function of collector current

$E = f(I_C)$

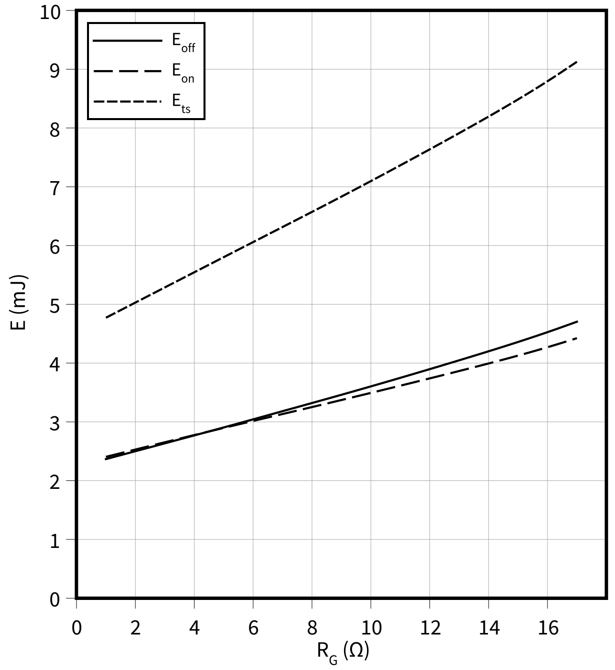
$V_{CE} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 5$ Ω



Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

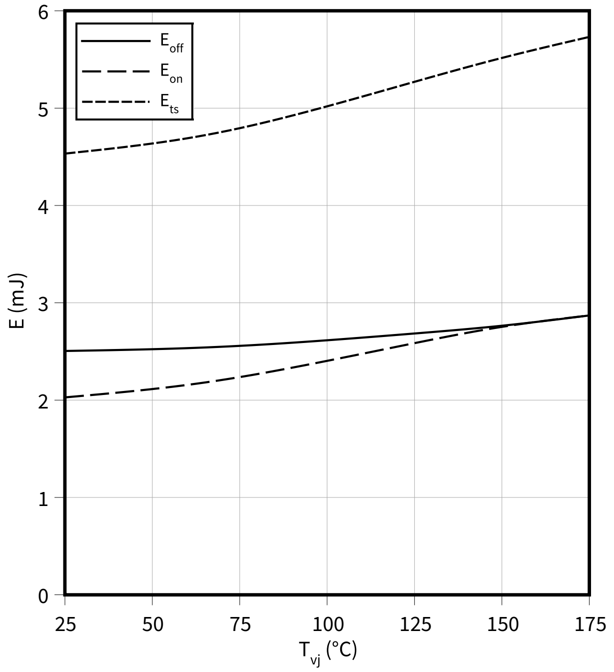
$I_C = 75$ A, $V_{CE} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

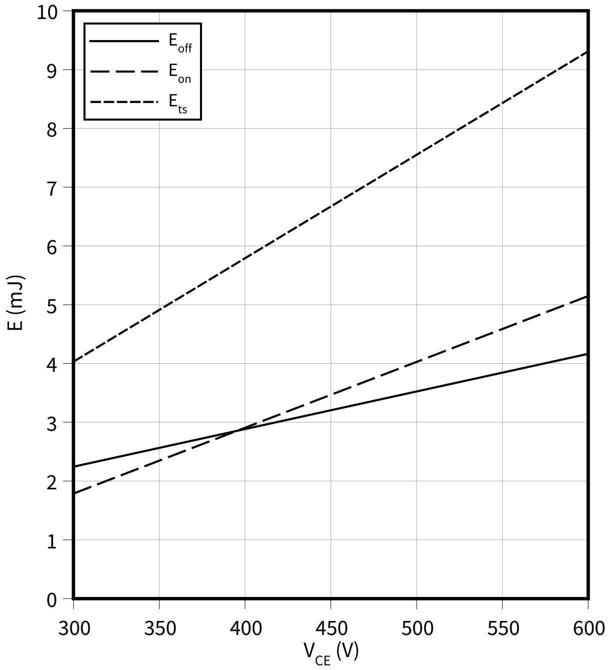
$I_C = 75$ A, $V_{CE} = 400$ V, $V_{GE} = 0/15$ V, $R_G = 5\ \Omega$



Typical switching energy losses as a function of collector emitter voltage

$E = f(V_{CE})$

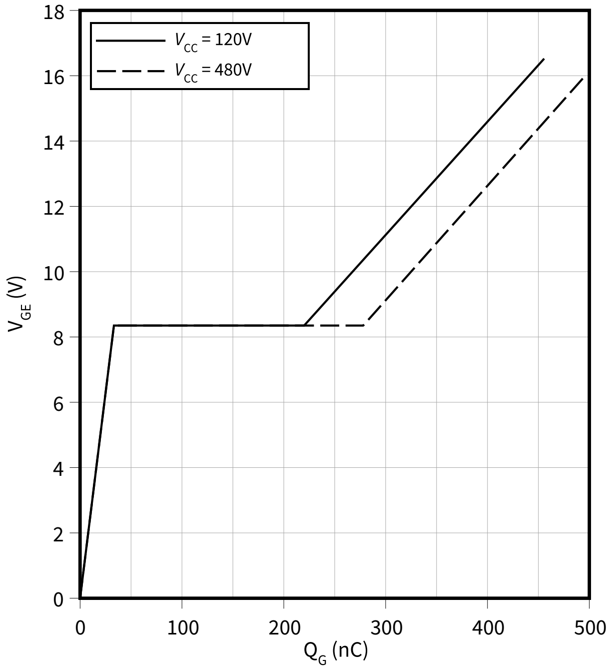
$I_C = 75$ A, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 5\ \Omega$



Typical gate charge

$V_{GE} = f(Q_G)$

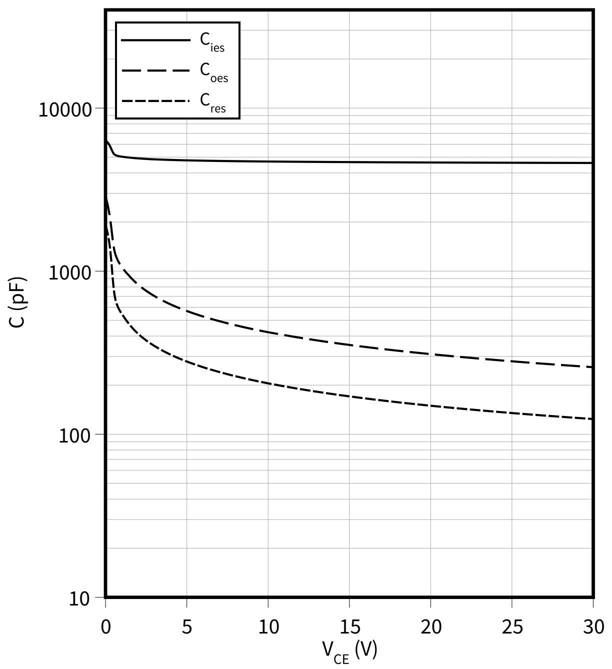
$I_C = 75$ A



Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$

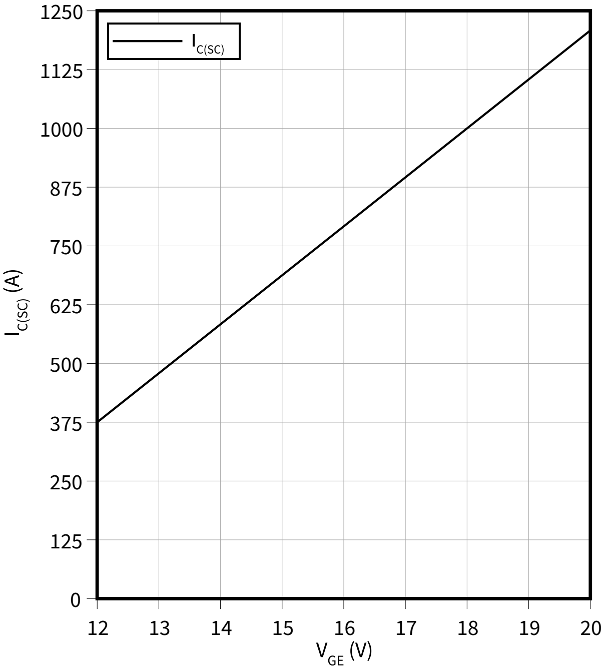
f = 1000 kHz, $V_{GE} = 0$ V



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

$I_{C(SC)} = f(V_{GE})$

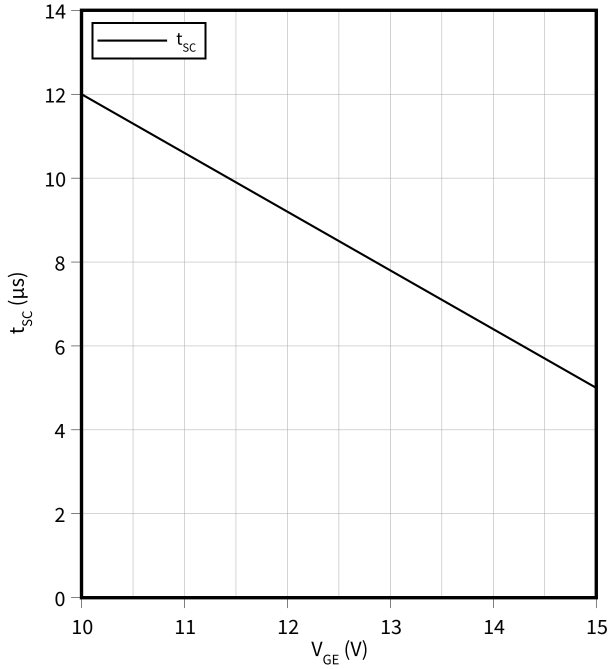
$V_{CE} = 400$ V, $T_{vj} = 150$ °C



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

$t_{SC} = f(V_{GE})$

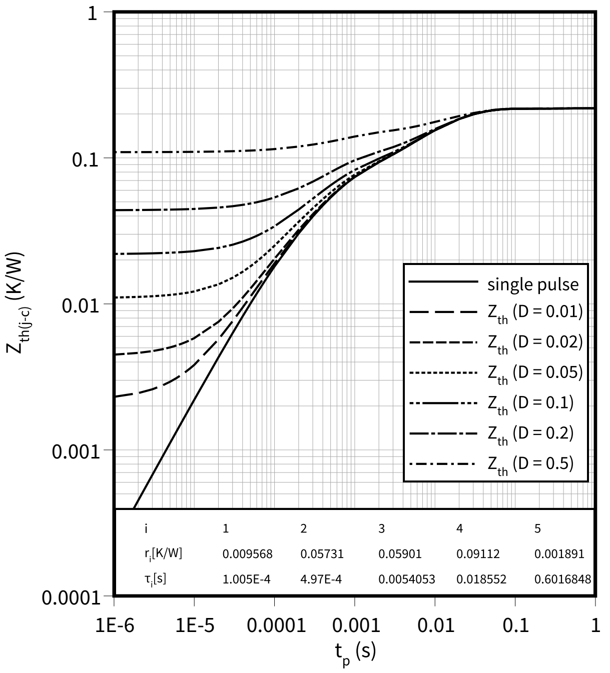
$T_{vj} = 150$ °C, $V_{CC} \leq 400$ V



IGBT typical transient thermal impedance as a function of pulse width

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

$D = t_p/T$

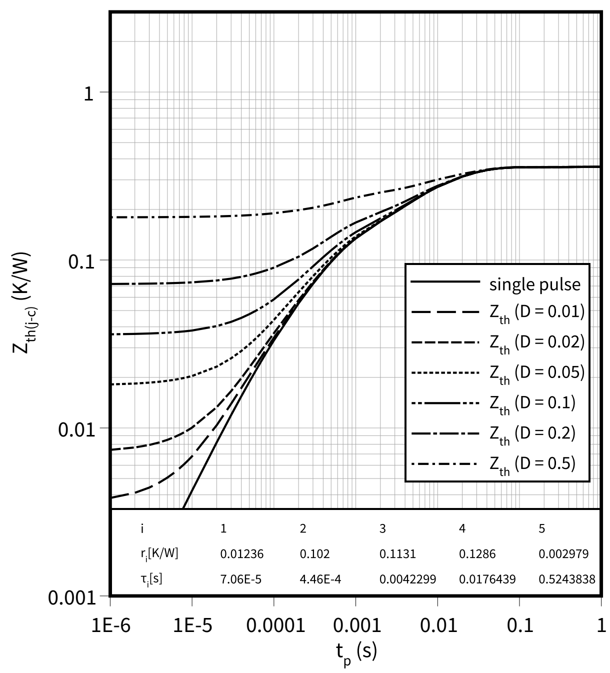


i	1	2	3	4	5
r_i[K/W]	0.009568	0.05731	0.05901	0.09112	0.001891
τ_i[s]	1.005E-4	4.97E-4	0.0054053	0.018552	0.6016848

Diode typical transient thermal impedance as a function of pulse width

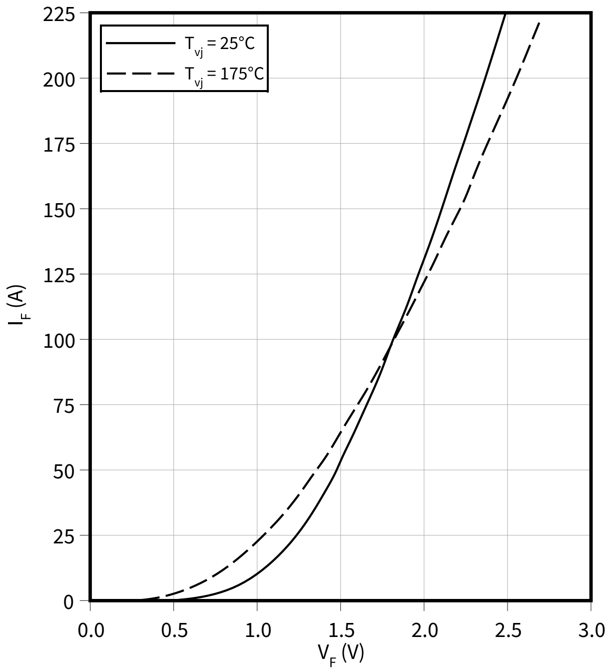
$Z_{th(j-c)} = f(t_p)$

$D = t_p/T$

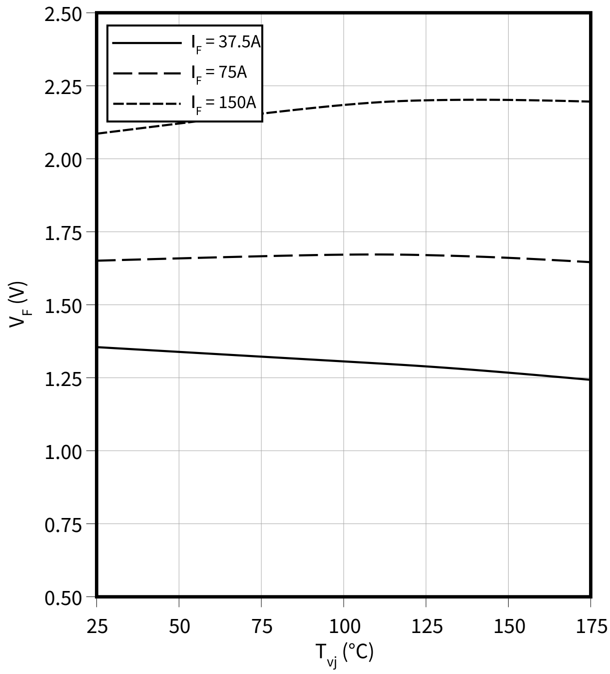


i	1	2	3	4	5
r_i[K/W]	0.01236	0.102	0.1131	0.1286	0.002979
τ_i[s]	7.06E-5	4.46E-4	0.0042299	0.0176439	0.5243838

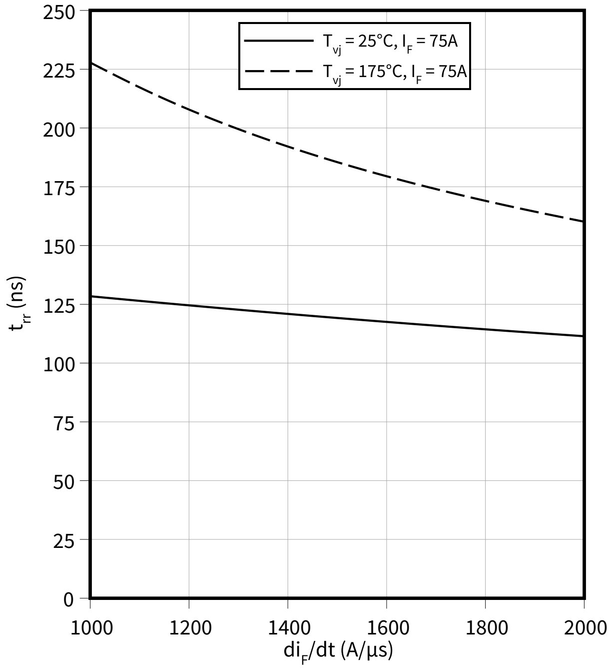
Typical diode forward current as a function of forward voltage
$I_F = f(V_F)$



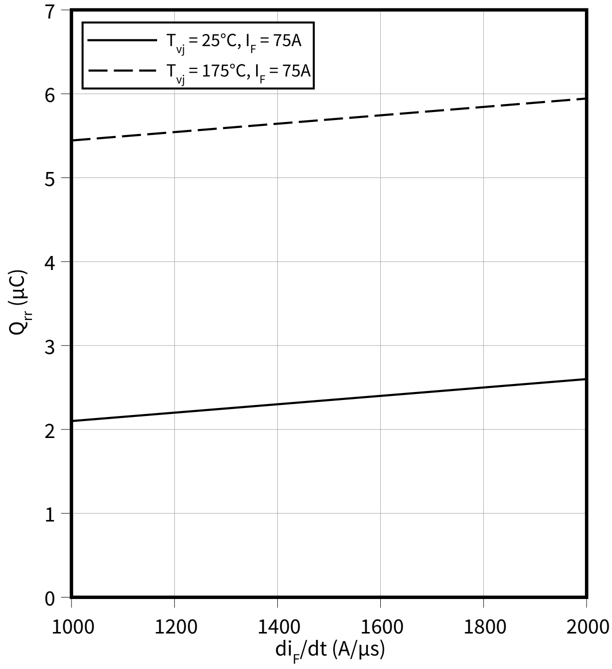
Typical diode forward voltage as a function of junction temperature
$V_F = f(T_{vj})$

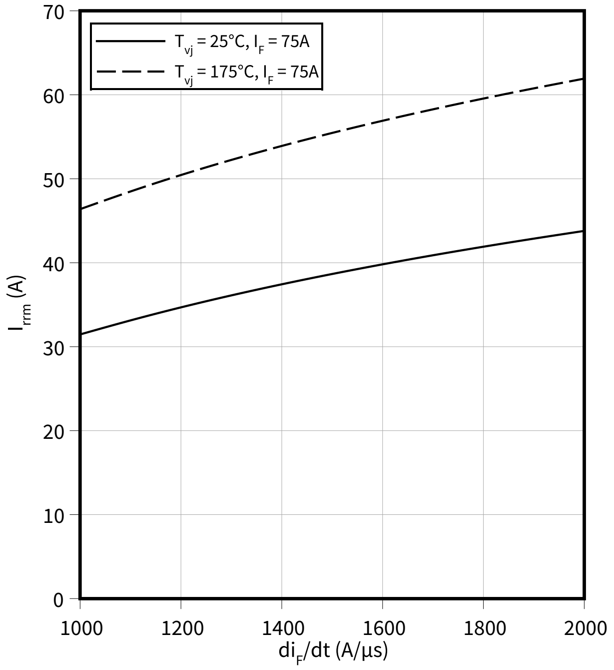
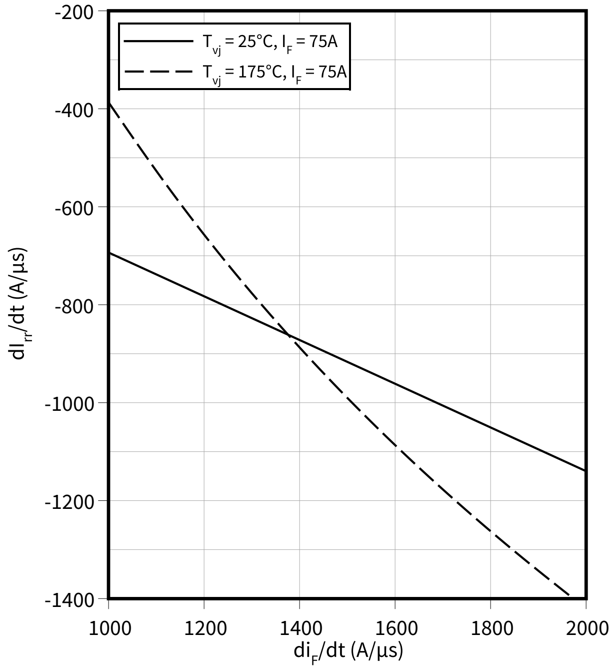


Typical reverse recovery time as a function of diode current slope
$t_{rr} = f(di_F/dt)$
$V_R = 400$ V

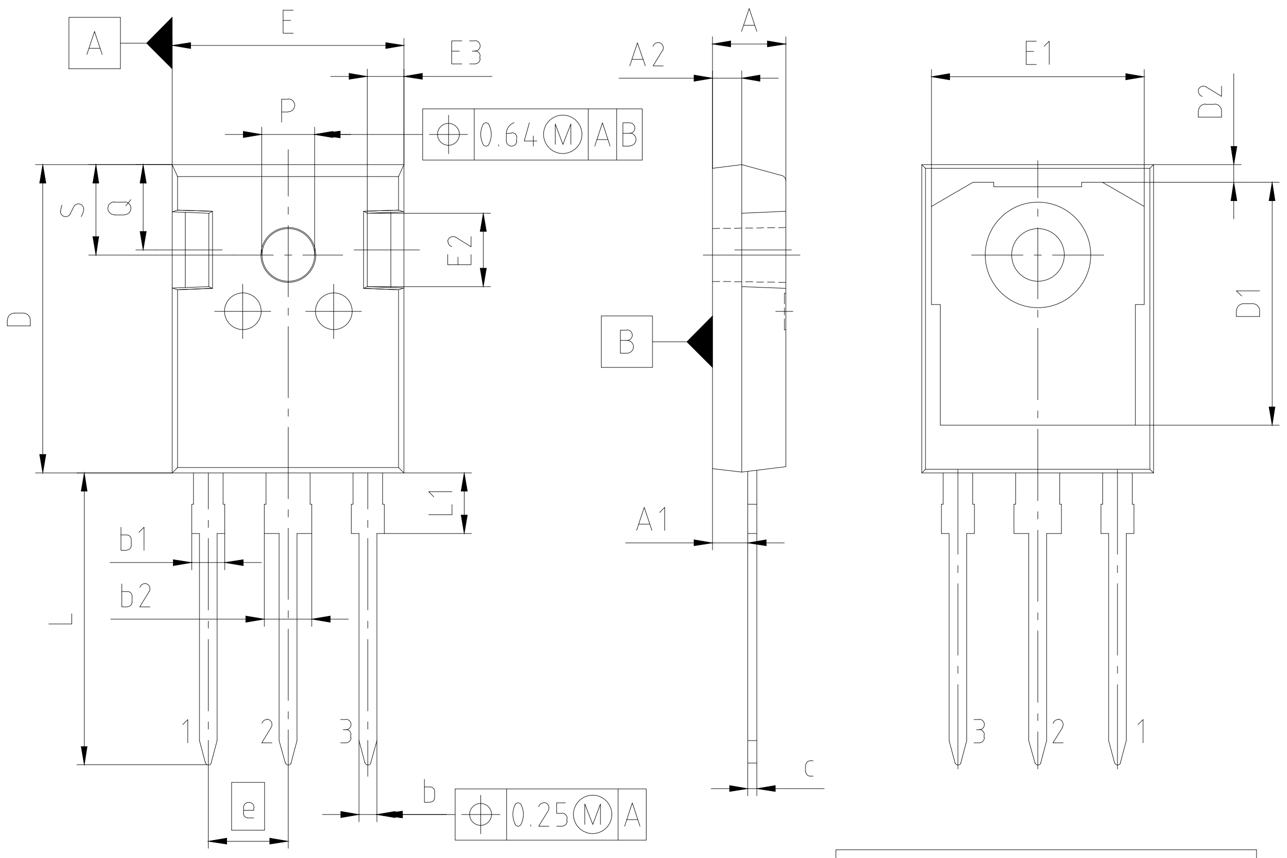


Typical reverse recovery charge as a function of diode current slope
$Q_{rr} = f(di_F/dt)$
$V_R = 400$ V



Typical reverse recovery current as a function of diode current slope $I_{rrm} = f(di_F/dt)$ $V_R = 400$ V	**Typical diode peak rate of fall of reverse recovery current as a function of diode current slope** $dI_{rr}/dt = f(di_F/dt)$ $V_R = 400$ V
	

5 Package outlines



PACKAGE - GROUP NUMBER:	PG-TO247-3-U06	
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.83	5.21
A1	2.27	2.54
A2	1.85	2.16
b	1.07	1.33
b1	1.90	2.41
b2	2.87	3.38
c	0.55	0.68
D	20.80	21.10
D1	16.25	17.65
D2	0.95	1.35
E	15.70	16.13
E1	13.10	14.15
E2	3.68	5.10
E3	1.00	2.60
e	5.44	
N	3	
L	19.80	20.32
L1	3.95	4.47
øP	3.50	3.70
Q	5.49	6.00
S	6.04	6.30

NOTE:
DIMENSIONS DO NOT INCLUDE MOLDFLASH; PROTRUSION OR GATE BURRS

Figure 1

6 Testing conditions

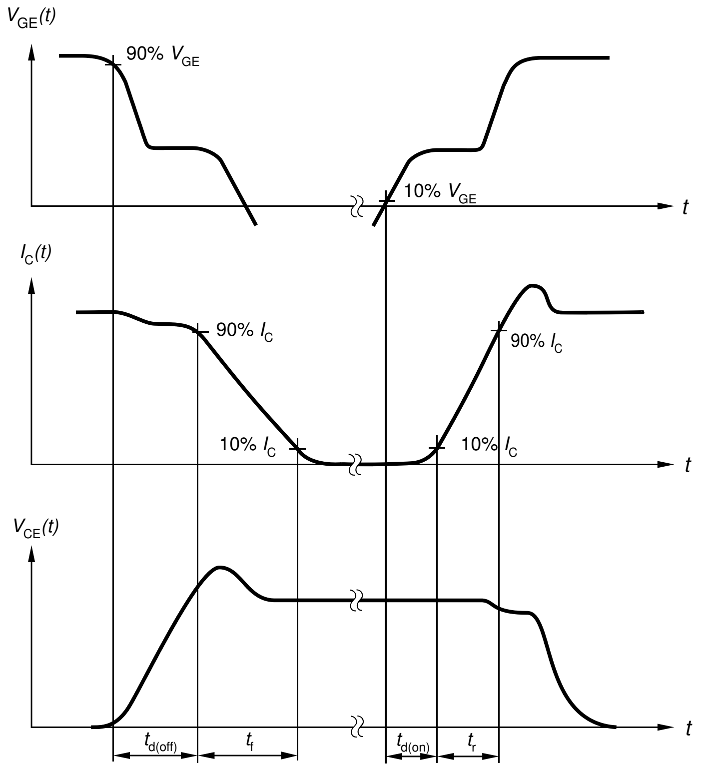


Figure A. **Definition of switching times**

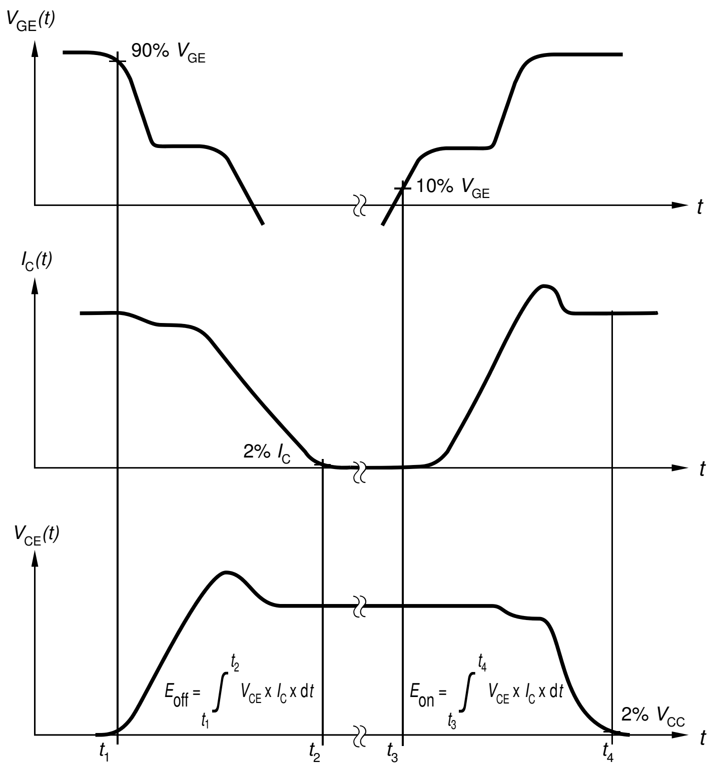


Figure B. **Definition of switching losses**

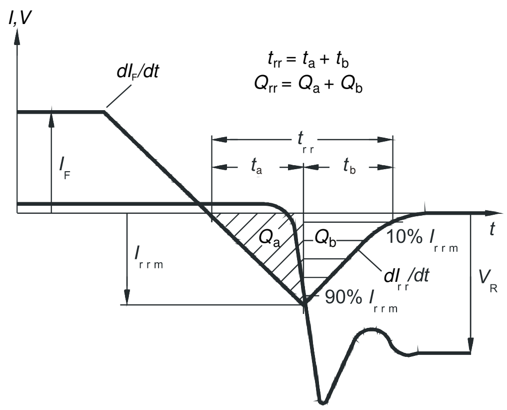


Figure C. **Definition of diode switching characteristics**

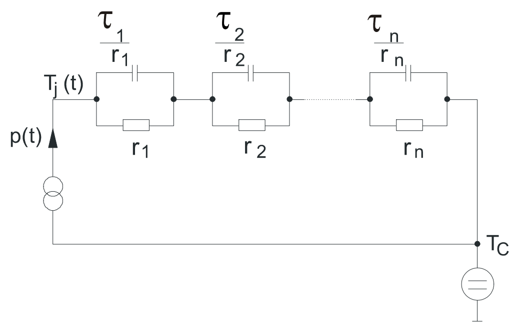


Figure D. **Thermal equivalent circuit**

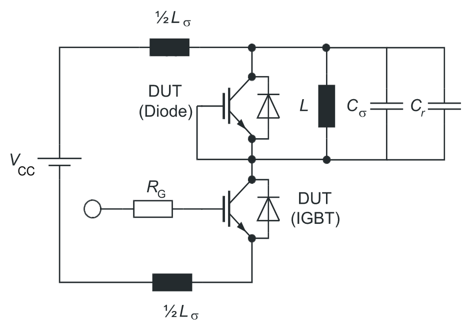


Figure E. **Dynamic test circuit**
Parasitic inductance L_{σ},
parasitic capacitor C_{σ},
relief capacitor C_{r},
(only for ZVT switching)

Figure 2

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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