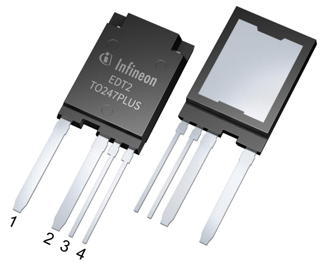
Final datasheet

Duo Pack EDT2™ IGBT and emitter controlled diode in TO247PLUS package



Halogen-free

RoHS

AEC Qualified

Features

- V_{CE} = 750 V
- I_C = 120 A
- Suitable for 470 V V_{DC} systems and increased overvoltage margin for 400 V V_{DC} systems
- Very low V_{CEsat} (C-KE) = 1.21 V (typ.) at I_{Cnom} = 120 A, 25°C
- Up to 40% less System R_{th} due to reflow capability, increased power output
- 30% Less Turn On Energy loss compared to 3 pin devices due to Kelvin emitter
- Short circuit robust t_{sc} = 3 µs at V_{CE} = 470 V, V_{GE} = 15 V
- Self limiting current under short circuit condition
- Positive thermal coefficient and very tight parameter distribution for easy paralleling
- Excellent current sharing in parallel operation
- Smooth switching characteristics
- Low gate charge Q_G
- Simple gate driver design
- Co-packed with fast soft recovery emitter controlled diode (Emcon3)
- Low EMI signature
- TO247PLUS package with high creepage distance 6.6 mm
- High reliability and operating lifetime, proven power cycling sec. robustness
- Wide Power pins (2 mm) for high current busbar
- Resistive weldable pins for direct busbar connections
- Lead-free plated pins and back

Potential applications

- xEV traction inverter
- DC-link discharge switch
- Automotive aux-drives

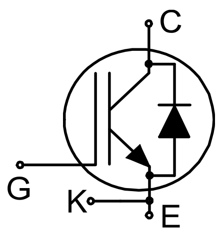
Product validation

- Qualified according to AEC-Q101 for automotive applications
- Qualified Reflow device 260°C according to JEDEC J-STD-020 MSL2

Description

Package pin definition:

- Pin C (1) & backside - collector
- Pin E (2) - emitter
- Pin K (3) - Kelvin emitter
- Pin G (4) - gate



Type	Package	Marking
AIKYX120N75CP2	PG-TO247-4-PLUS-WT7	AKYX12FCP

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1 Package

Table 1 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Internal emitter inductance	L_E	simulated starting from L2 at 1 MHz		3.8		nH
Collector-emitter loop inductance	L_{CE}	simulated starting from L2 at 1 MHz		6.2		nH
Main emitter pin resistance	R_E	Simulated starting from L2 at 10 kHz		0.41		mΩ
Storage temperature	T_{stg}		-55		150	°C
Soldering temperature	T_{sold}	reflow soldering (MSL2 according to JEDEC J-STD-020)			260	°C
Thermal resistance, junction-ambient	$R_{th(j-a)}$			40		K/W
IGBT thermal resistance, junction-case	$R_{th(j-c)}$			0.2	0.26[1)]	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$			0.35	0.45[1)]	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		750	V
DC collector current, limited by T_{vjmax}	I_C		$T_c = 25$ °C	150	A
			$T_c = 100$ °C	120	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			360	A
Turn-off safe operating area		$V_{CE} \leq 750$ V, $T_{vj} \leq 175$ °C		360	A
Gate-emitter voltage	V_{GE}			±20	V
Transient gate-emitter voltage	V_{GE}	$t_p = 10$ µs, $D < 0.01$		±30	V
Short-circuit withstand time	t_{SC}	$V_{CC} \leq 470$ V, $V_{GE} = -8/15$ V, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, $T_{vj} = 25$ °C		3	µs
Power dissipation	P_{tot}	$T_{vj} = 175$ °C	$T_c = 25$ °C	577	W
			$T_c = 100$ °C	288	

Table 3 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	I_C = 120 A, V_{GE} = 15 V	T_{vj} = 25 °C	1.2	1.35	1.5	V
			T_{vj} = 175 °C		1.55		
Collector-Kelvin emitter saturation voltage	V_{CEsat} *(C-KE)*	I_C = 120 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.21		V
Gate-emitter threshold voltage	V_{GEth}	I_C = 1.6 mA, $V_{CE} = V_{GE}$		5.2	5.8	6.4	V
Zero gate-voltage collector current	I_{CES}	V_{CE} = 750 V, V_{GE}=0 V	T_{vj} = 25 °C			200	µA
			T_{vj} = 175 °C		5		mA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V				100	nA
Transconductance	g_{fs}	I_C = 120 A, V_{CE} = 20 V			89		S
Short-circuit collector current	I_{SC}	V_{CC} ≤ 470 V, V_{GE} = -8/15 V, t_{SC} ≤ 3 µs, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, T_{vj} = 25 °C			1150		A
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE}=0 V, f = 100 kHz			13500		pF
Output capacitance	C_{oes}	V_{CE} = 25 V, V_{GE}=0 V, f = 100 kHz			337		pF
Reverse transfer capacitance	C_{res}	V_{CE} = 25 V, V_{GE}=0 V, f = 100 kHz			59		pF
Gate charge	Q_G	V_{CC} = 600 V, I_C = 120 A, V_{GE} = -8/15 V			765		nC
Turn-on delay time	$t_{d(on)}$	V_{CC} = 470 V, V_{GE} = -8/15 V, $R_{G(on)}$ = 4.8 Ω, L_σ = 20 nH, C_σ = 15 pF	T_{vj} = 25 °C, I_C = 120 A		48		ns
			T_{vj} = 175 °C, I_C = 120 A		48		
Rise time (inductive load)	t_r	V_{CC} = 470 V, V_{GE} = -8/15 V, $R_{G(on)}$ = 4.8 Ω, L_σ = 20 nH, C_σ = 15 pF	T_{vj} = 25 °C, I_C = 120 A		27		ns
			T_{vj} = 175 °C, I_C = 120 A		32		
Turn-off delay time	$t_{d(off)}$	V_{CC} = 470 V, V_{GE} = -8/15 V, $R_{G(on)}$ = 4.8 Ω, L_σ = 20 nH, C_σ = 15 pF	T_{vj} = 25 °C, I_C = 120 A		202		ns
			T_{vj} = 175 °C, I_C = 120 A		276		
Fall time (inductive load)	t_f	V_{CC} = 470 V, V_{GE} = -8/15 V, $R_{G(on)}$ = 4.8 Ω, L_σ = 20 nH, C_σ = 15 pF	T_{vj} = 25 °C, I_C = 120 A		65		ns
			T_{vj} = 175 °C, I_C = 120 A		129		

(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} = 470 V, V_{GE} = -8/15 V, $R_{G(on)}$ = 4.8 Ω, L_{σ} = 20 nH, C_{σ} = 15 pF	T_{vj} = 25 °C, I_C = 120 A		3.3		mJ
			T_{vj} = 175 °C, I_C = 120 A		5		
Turn-off energy	E_{off}	V_{CC} = 470 V, V_{GE} = -8/15 V, $R_{G(on)}$ = 4.8 Ω, L_{σ} = 20 nH, C_{σ} = 15 pF	T_{vj} = 25 °C, I_C = 120 A		3.6		mJ
			T_{vj} = 175 °C, I_C = 120 A		6.4		
Total switching energy	E_{ts}	V_{CC} = 470 V, V_{GE} = -8/15 V, $R_{G(on)}$ = 4.8 Ω, L_{σ} = 20 nH, C_{σ} = 15 pF	T_{vj} = 25 °C, I_C = 120 A		6.9		mJ
			T_{vj} = 175 °C, I_C = 120 A		11.4		
Operating junction temperature	T_{vj}			-40		175	°C

1) includes IGBT losses caused by the reverse recovery current

***Note**: Electrical Characteristic, at T_{vj} = 25°C, unless otherwise specified.*

3 Diode

Table 4 **Maximum rated values**

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}	T_{vj} ≥ 25 °C		750	V
Diode forward current, limited by T_{vjmax}	I_F		T_c = 25 °C	150	A
			T_c = 100 °C	120	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			360	A
Power dissipation	P_{tot}	T_{vj} = 175 °C	T_c = 25 °C	333	W
			T_c = 100 °C	167	

Table 5 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 120 A	T_{vj} = 25 °C	1.6	1.8	2	V
			T_{vj} = 175 °C		1.8		

(table continues...)

Table 5 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode reverse recovery charge	Q_{rr}	V_R = 470 V	T_{vj} = 25 °C, I_F = 120 A, $-di_F/dt$ = 4282 A/µs		4.1		µC
			T_{vj} = 175 °C, I_F = 120 A, $-di_F/dt$ = 3628 A/µs		10.9		
Diode peak reverse recovery current	I_{rrm}	V_R = 470 V	T_{vj} = 25 °C, I_F = 120 A, $-di_F/dt$ = 4282 A/µs		60.8		A
			T_{vj} = 175 °C, I_F = 120 A, $-di_F/dt$ = 3628 A/µs		90.9		
Reverse recovery energy	E_{rec}	V_R = 470 V, L_σ = 20 nH, C_σ = 15 pF	T_{vj} = 25 °C, I_F = 120 A, $-di_F/dt$ = 4282 A/µs		1.6		mJ
			T_{vj} = 175 °C, I_F = 120 A, $-di_F/dt$ = 3628 A/µs		3.9		
Operating junction temperature	T_{vj}			-40		175	°C

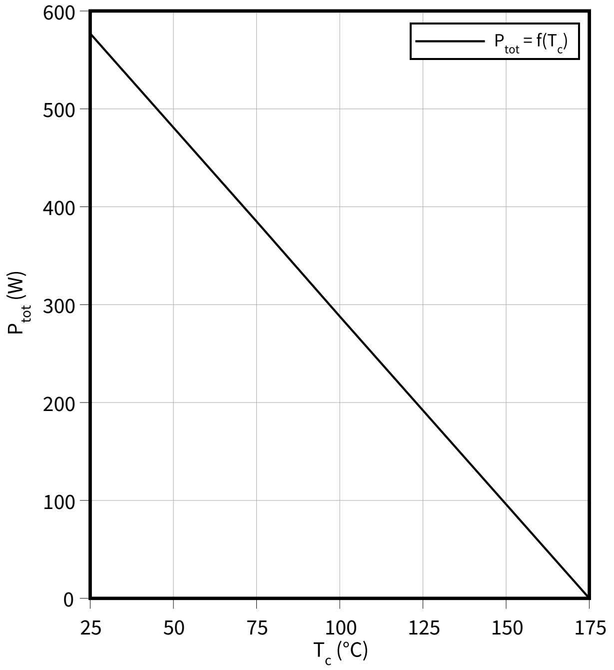
***Note**: For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.*

4 Characteristics diagrams

Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$

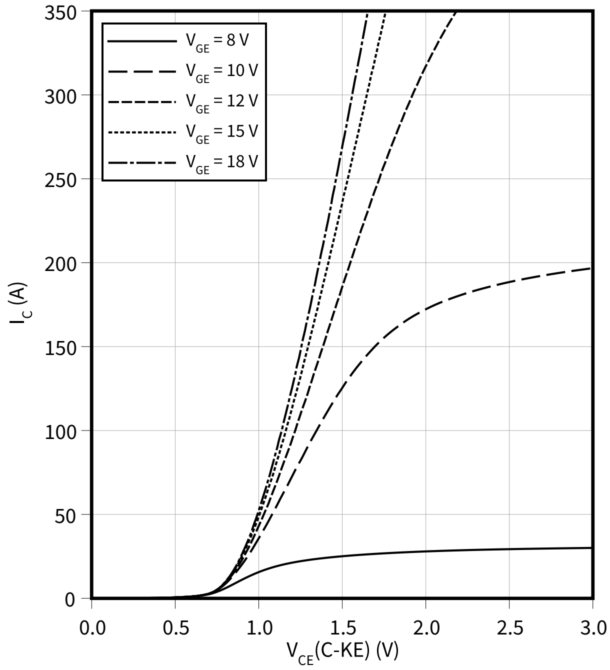
$T_{vj} \leq 175$ °C



Typical output characteristic

$I_C = f(V_{CE}$(C-KE))

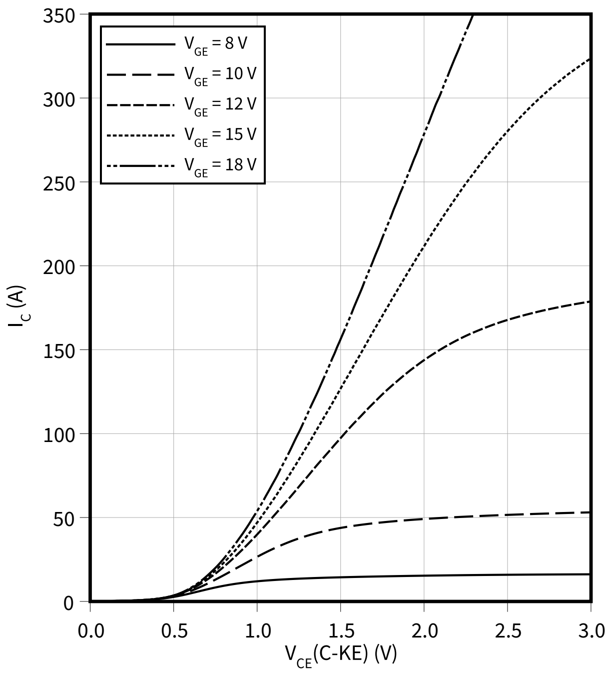
$T_{vj} = 25$ °C



Typical output characteristic

$I_C = f(V_{CE}$(C-KE))

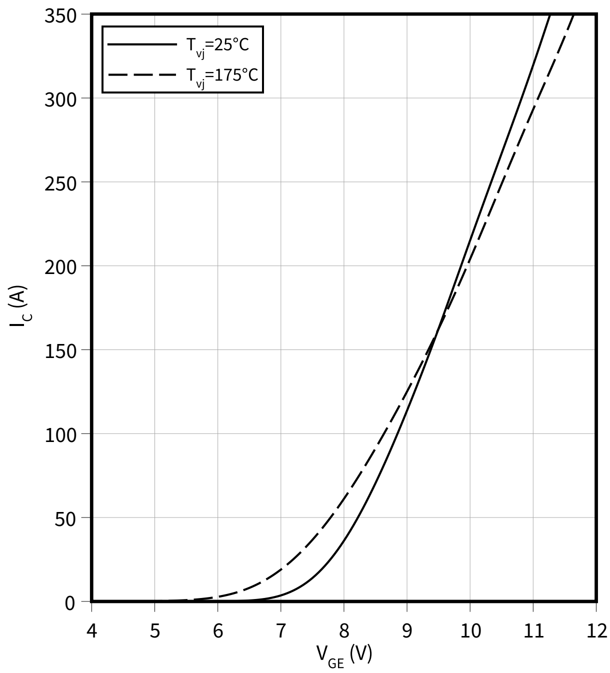
$T_{vj} = 175$ °C

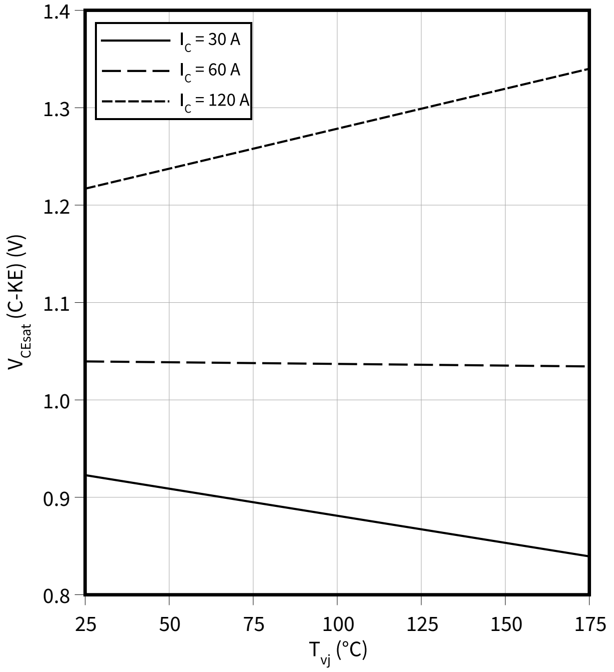
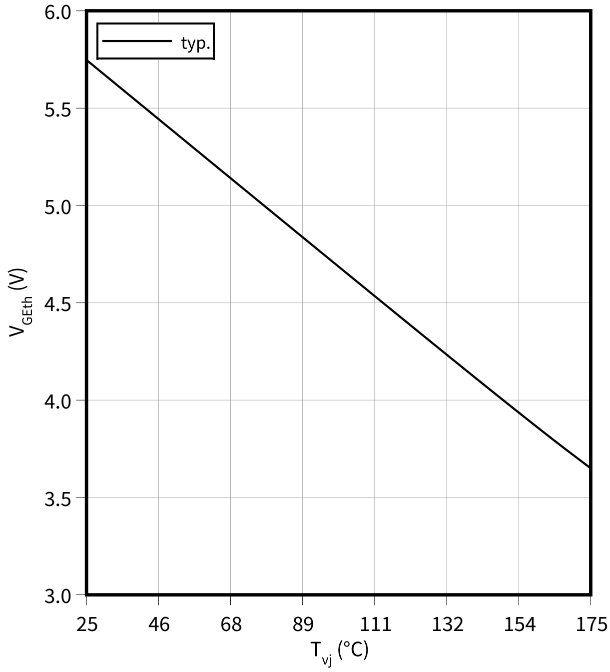
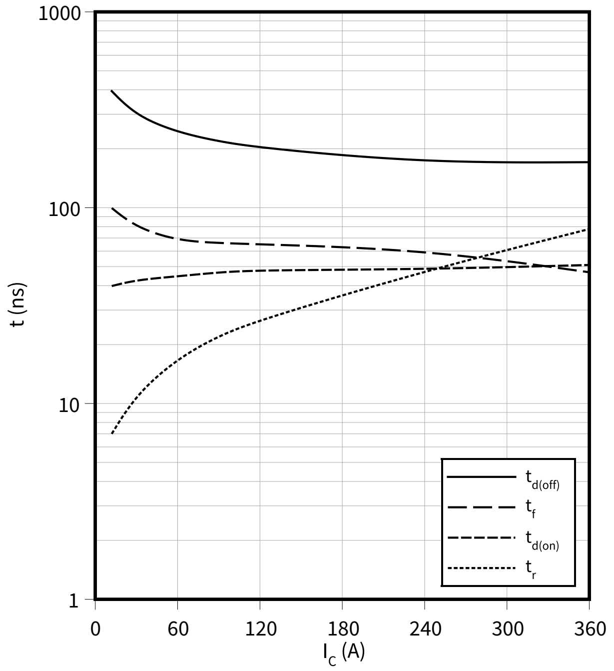
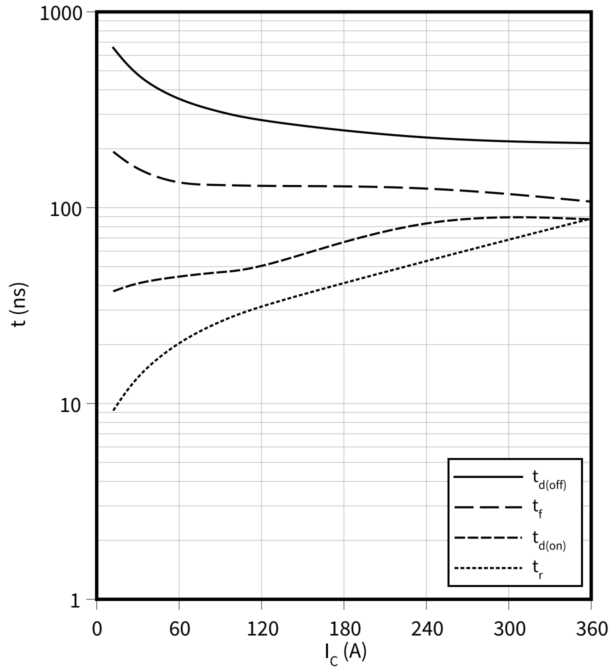


Typical transfer characteristic

$I_C = f(V_{GE})$

$V_{CE} = 20$ V

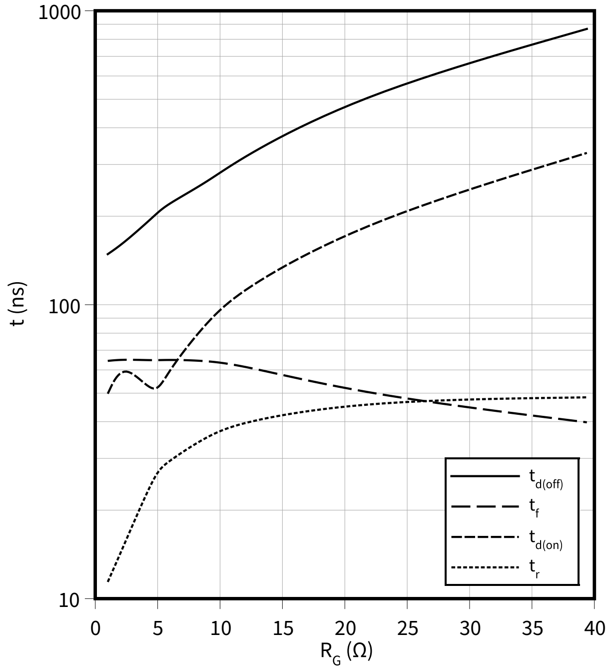


Typical collector-Kelvin emitter saturation voltage as a function of junction temperature V_{CEsat} (C-KE) = f(T_{vj})	**Gate-emitter threshold voltage as a function of junction temperature** V_{GEth} = f(T_{vj}) I_C = 1.6 mA
	
Typical switching times as a function of collector current t = f(I_C) V_{CC} = 470 V, T_{vj} = 25 °C, R_G = 4.8 Ω	**Typical switching times as a function of collector current** t = f(I_C) V_{CC} = 470 V, T_{vj} = 175 °C, R_G = 4.8 Ω
	

Typical switching times as a function of gate resistor

$t = f(R_G)$

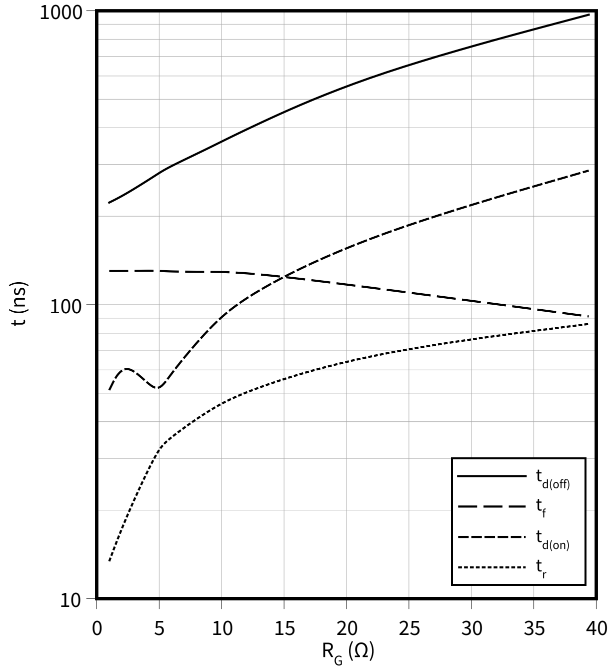
$I_C = 120$ A, $V_{CC} = 470$ V, $T_{vj} = 25$ °C



Typical switching times as a function of gate resistor

$t = f(R_G)$

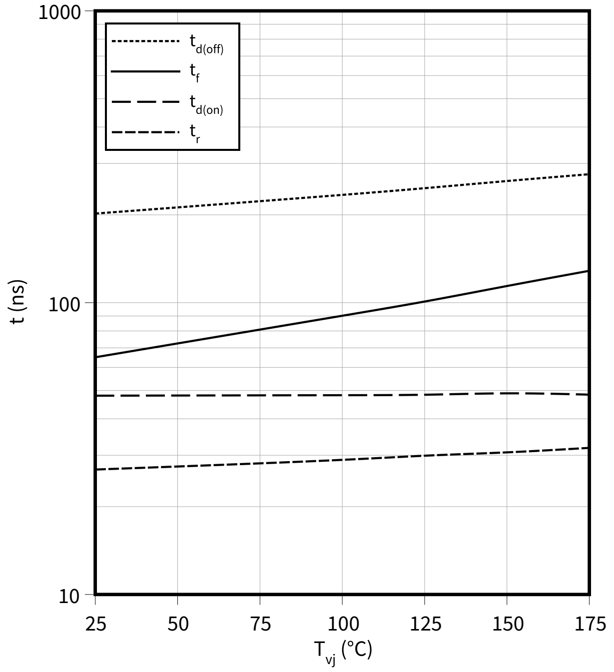
$I_C = 120$ A, $V_{CC} = 470$ V, $T_{vj} = 175$ °C



Typical switching times as a function of junction temperature

$t = f(T_{vj})$

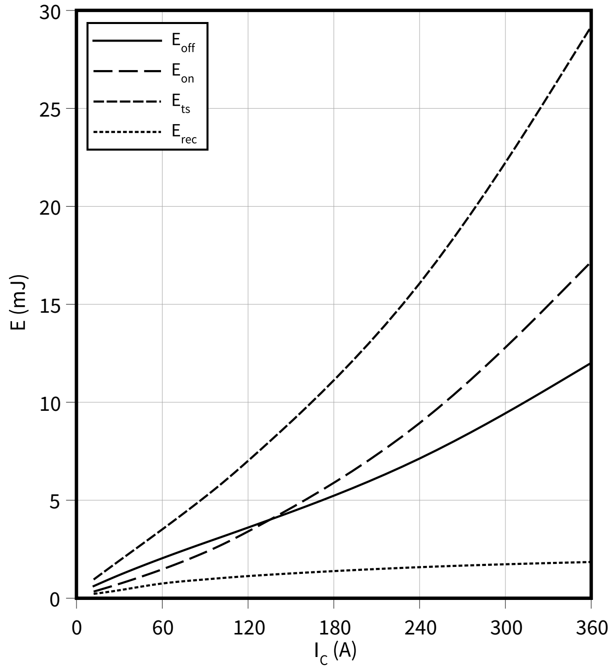
$I_C = 120$ A, $V_{CC} = 470$ V, $R_G = 4.8$ Ω



Typical switching energy losses as a function of collector current

$E = f(I_C)$

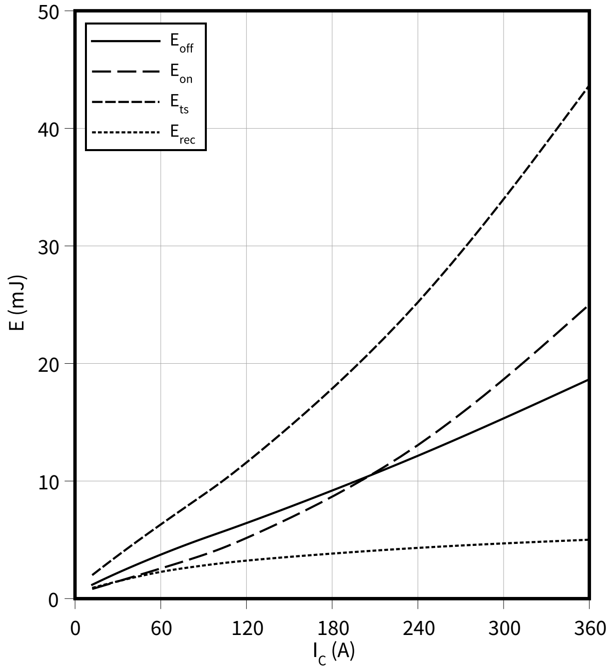
$V_{CC} = 470$ V, $T_{vj} = 25$ °C, $R_G = 4.8$ Ω



Typical switching energy losses as a function of collector current

$E = f(I_C)$

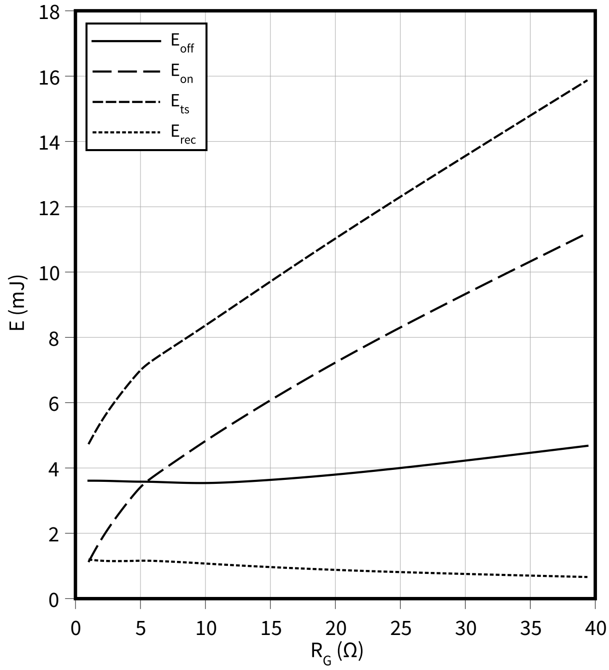
$V_{CC} = 470$ V, $T_{vj} = 175$ °C, $R_G = 4.8$ Ω



Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

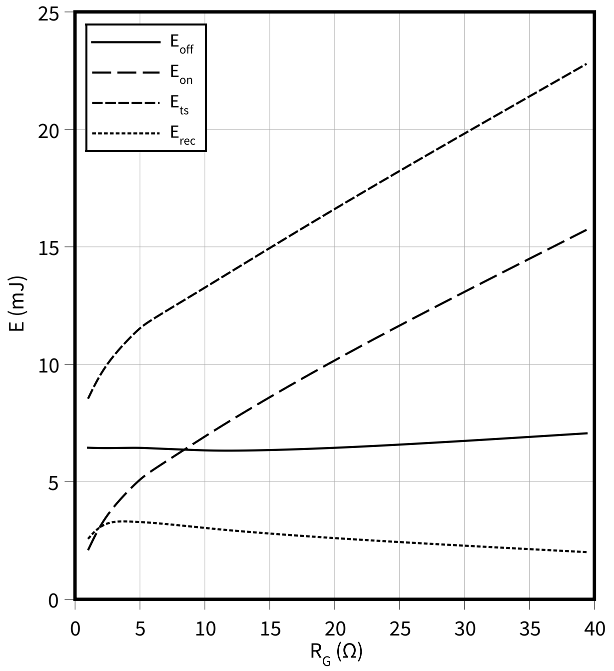
$I_C = 120$ A, $V_{CC} = 470$ V, $T_{vj} = 25$ °C



Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

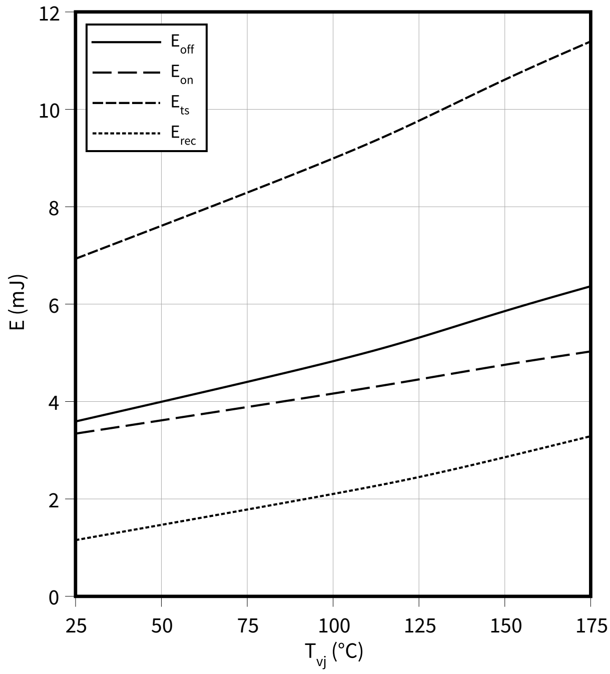
$I_C = 120$ A, $V_{CC} = 470$ V, $T_{vj} = 175$ °C

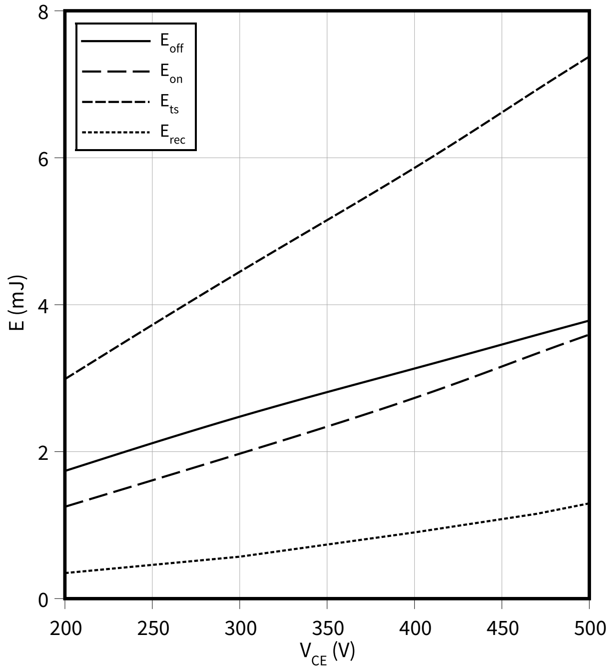
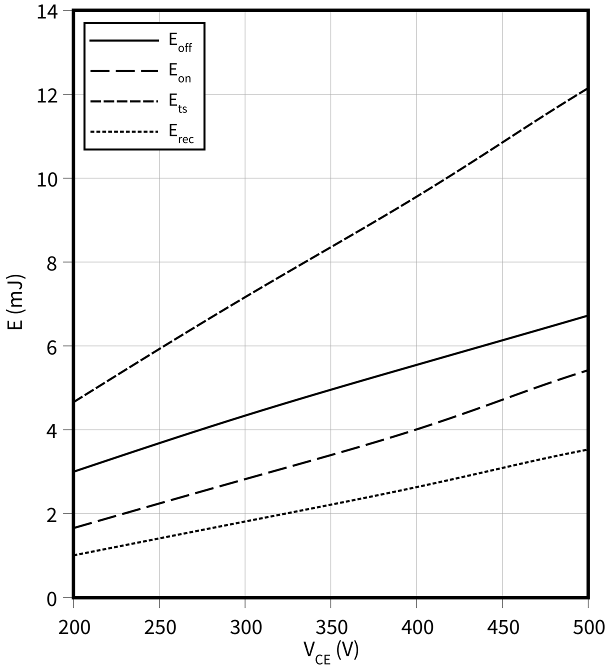
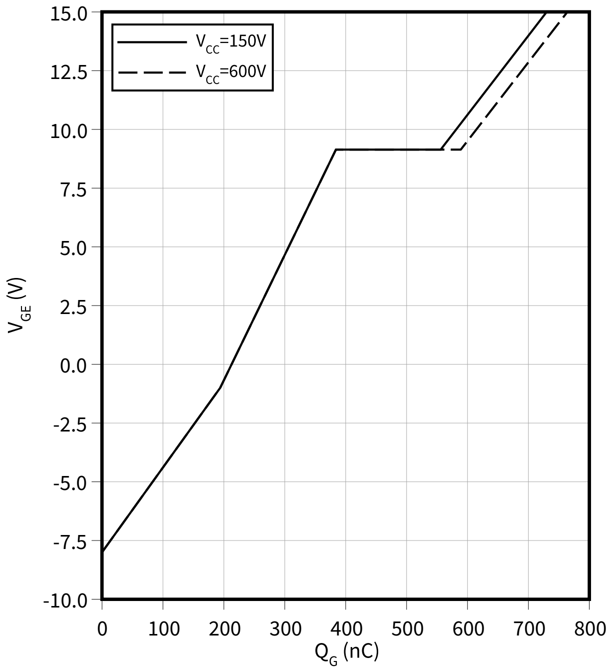
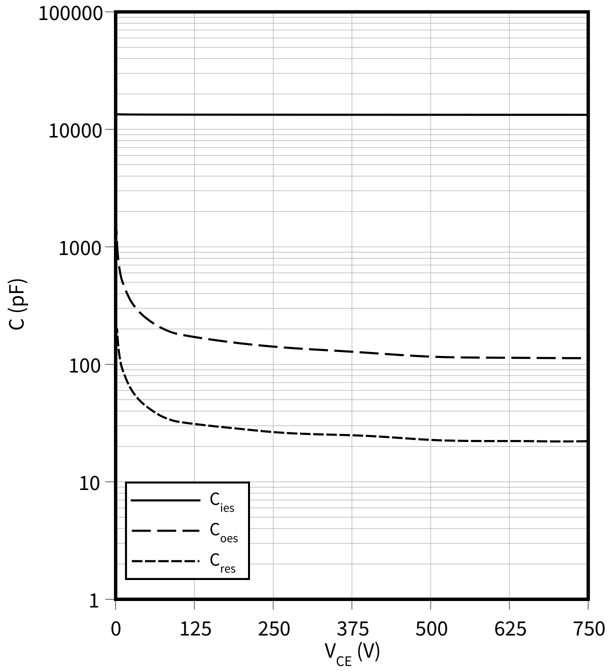


Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

$I_C = 120$ A, $V_{CC} = 470$ V, $R_G = 4.8$ Ω

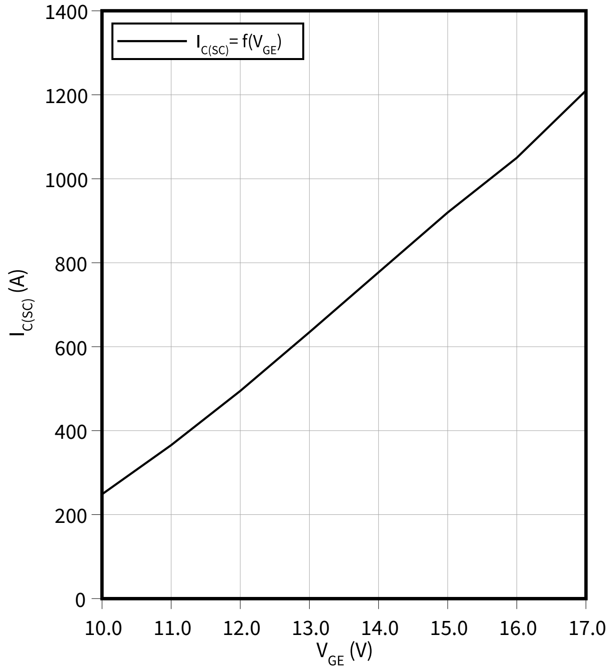


Typical switching energy losses as a function of collector emitter voltage $E = f(V_{CE})$ $I_C = 120$ A, $T_{vj} = 25$ °C, $R_G = 4.8\ \Omega$	**Typical switching energy losses as a function of collector emitter voltage** $E = f(V_{CE})$ $I_C = 120$ A, $T_{vj} = 175$ °C, $R_G = 4.8\ \Omega$
	
Typical gate charge $V_{GE} = f(Q_G)$ $I_C = 120$ A	**Typical capacitance as a function of collector-emitter voltage** $C = f(V_{CE})$ f = 100 kHz
	

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

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

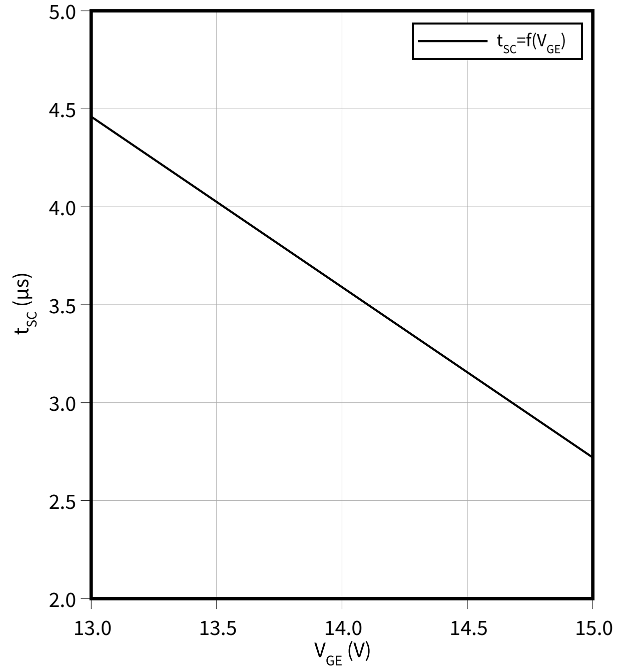
$T_{vj} = 175$ °C, $V_{CC} = 470$ V



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

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

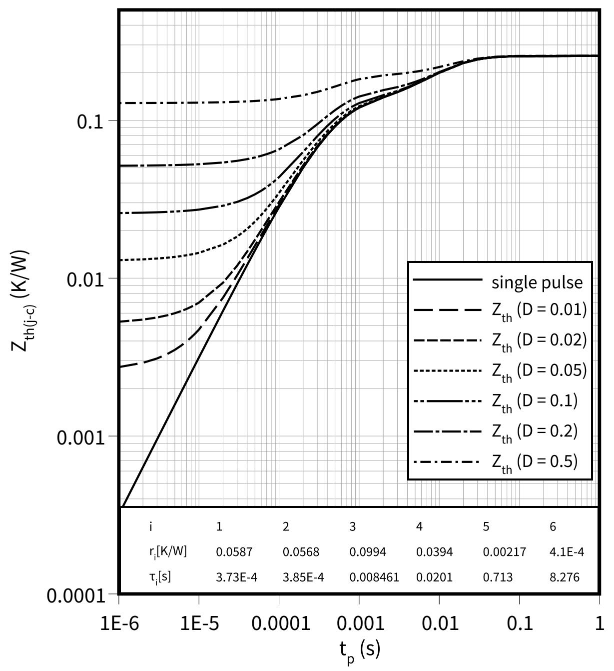
$T_{vj} = 175$ °C, $V_{CC} = 470$ V



IGBT transient thermal impedance as a function of pulse width

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

$D = t_p/T$

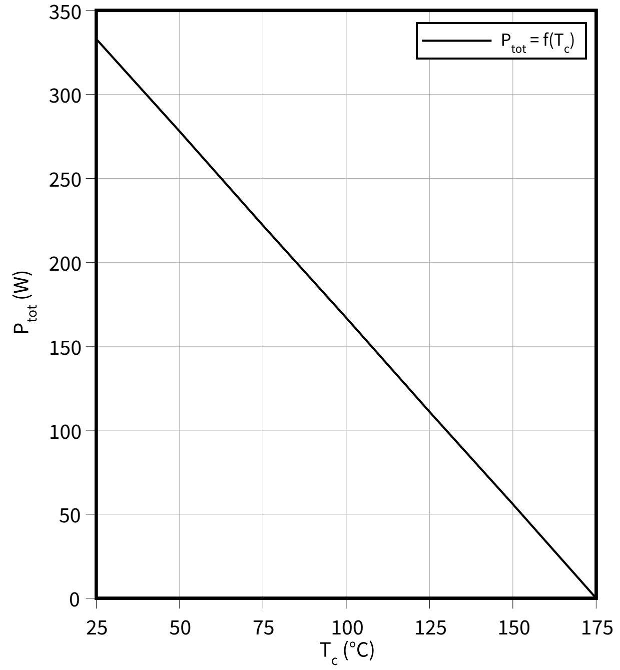


i	1	2	3	4	5	6
r_i[K/W]	0.0587	0.0568	0.0994	0.0394	0.00217	4.1E-4
τ_i[s]	3.73E-4	3.85E-4	0.008461	0.0201	0.713	8.276

Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$

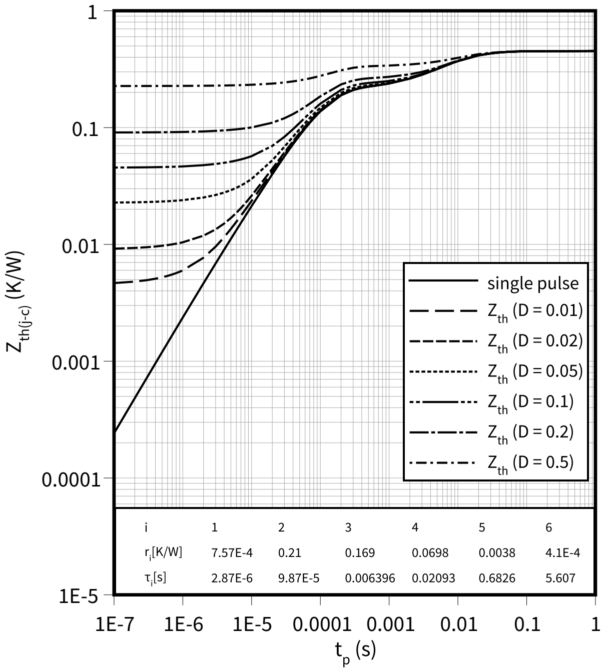
$T_{vj} \leq 175$ °C



Diode transient thermal impedance as a function of pulse width

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

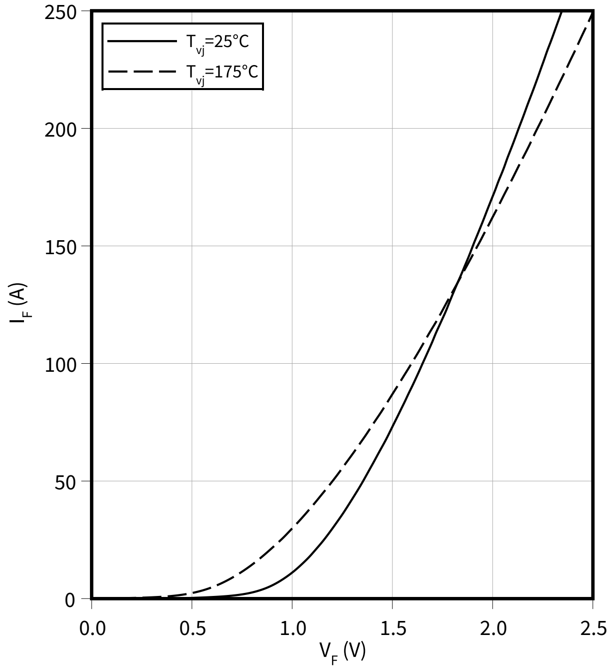
$D = t_p/T$



i	1	2	3	4	5	6
r_i[K/W]	7.57E-4	0.21	0.169	0.0698	0.0038	4.1E-4
τ_i[s]	2.87E-6	9.87E-5	0.006396	0.02093	0.6826	5.607

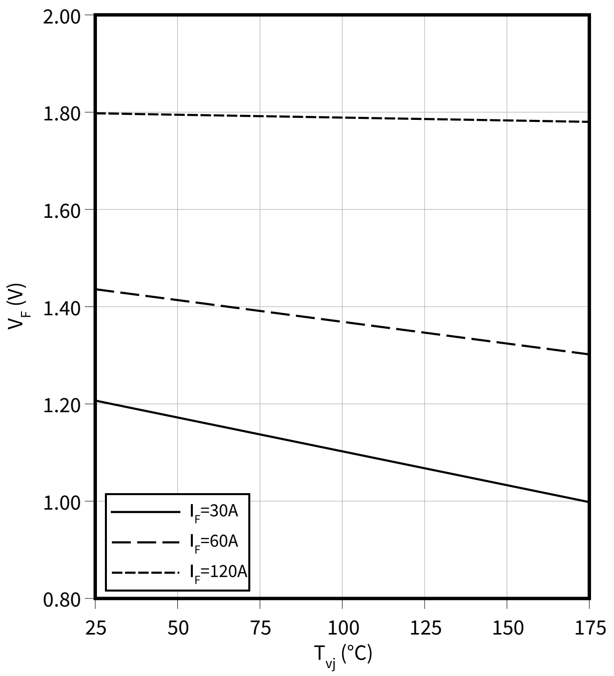
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



Typical diode forward voltage as a function of junction temperature

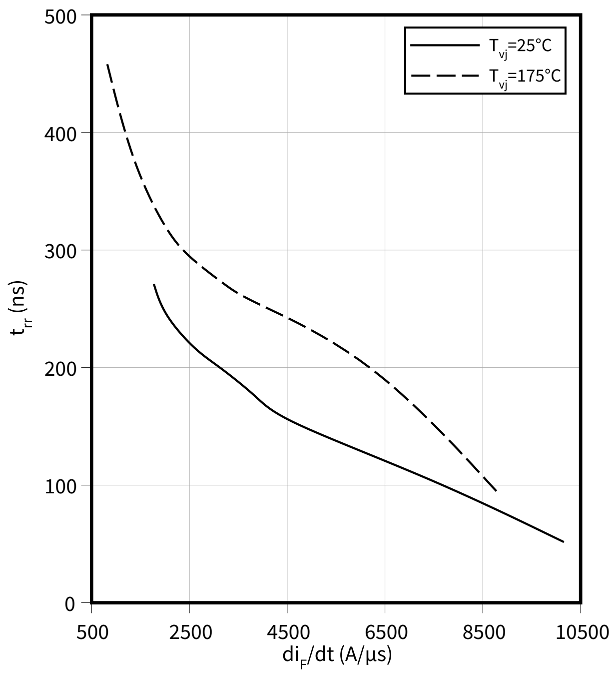
$V_F = f(T_{vj})$



Typical reverse recovery time as a function of diode current slope

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

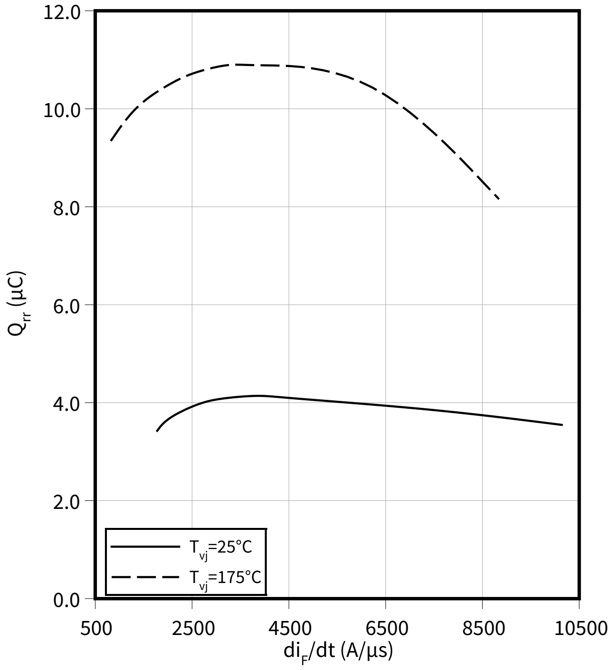
$V_R = 470$ V, $I_F = 120$ A



Typical reverse recovery charge as a function of diode current slope

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

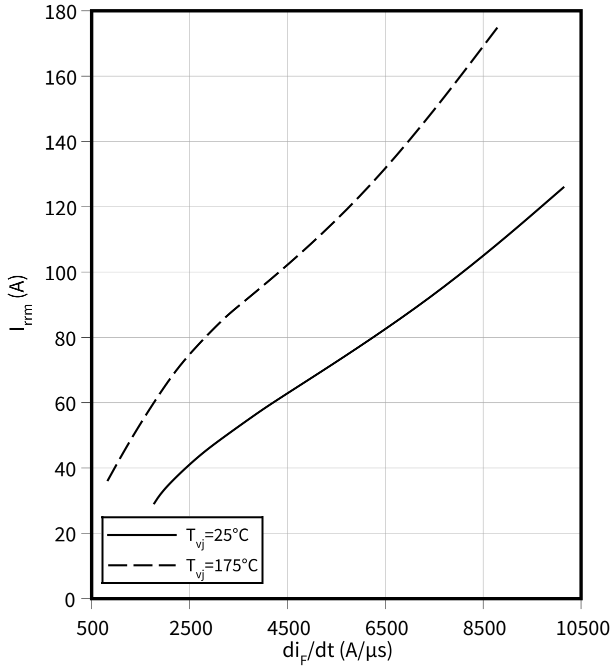
$V_R = 470$ V, $I_F = 120$ A



Typical reverse recovery current as a function of diode current slope

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

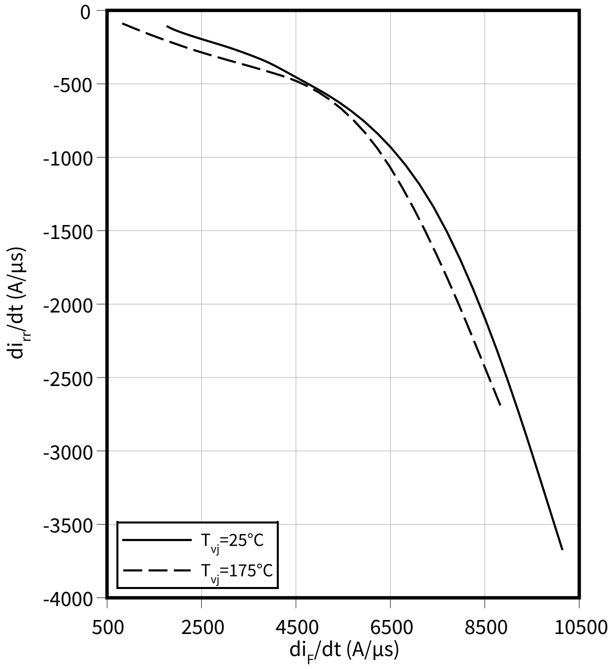
$V_R = 470$ V, $I_F = 120$ A



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

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

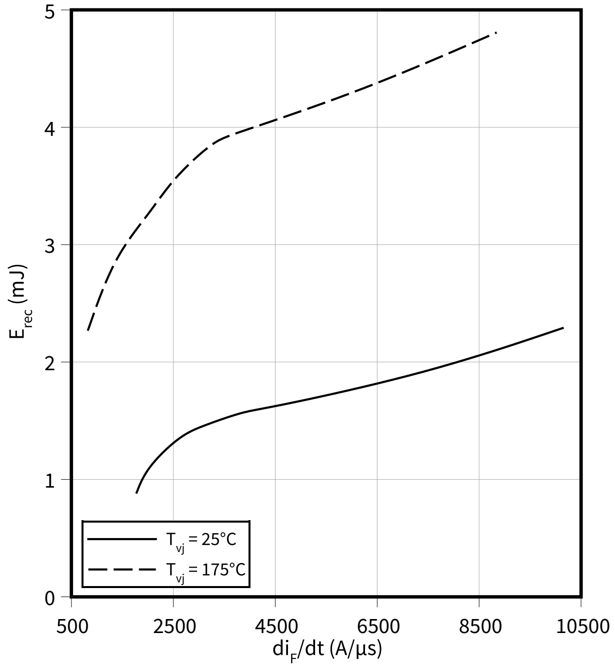
$V_R = 470$ V, $I_F = 120$ A



Typical reverse energy losses as a function of diode current slope

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

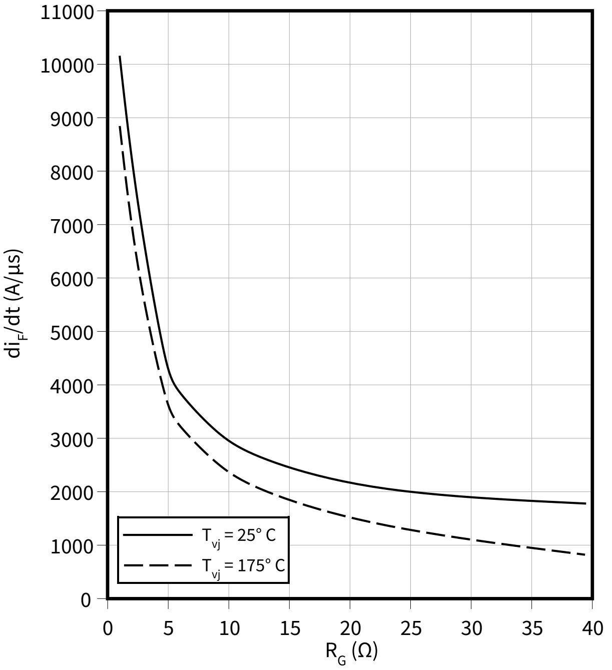
$V_R = 470$ V, $I_F = 120$ A



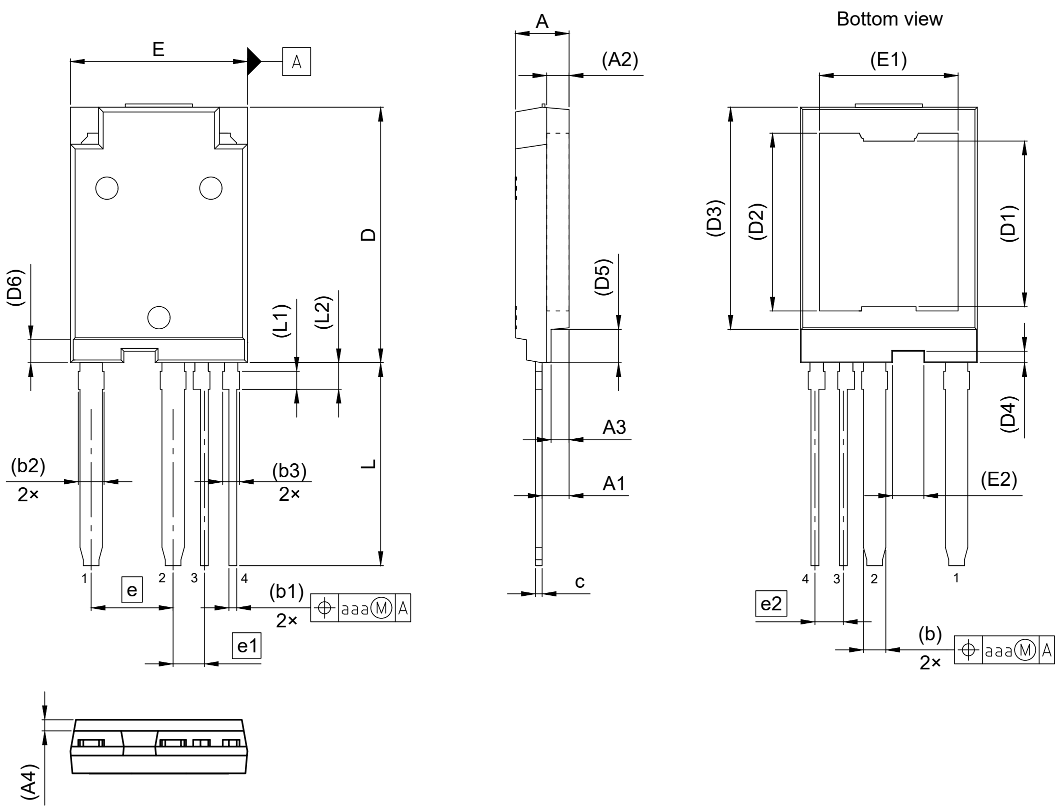
Typical diode current slope as a function of gate resistor

$di_F/dt = f(R_G)$

$V_R = 470$ V, $I_F = 120$ A



5 Package outlines



PACKAGE - GROUP NUMBER: **PG-TO247-4-U06**

DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.7	4.9
A1	2.16	2.66
A2	2	
A3	1.51	1.71
A4	0.99	
b	2	
b1	0.7	
b2	2.3	
b3	1.5	
c	0.5	0.7
D	22.7	22.9
D1	14.79	
D2	15.86	
D3	19.82	

DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
D4	1.03	
D5	2.98	
D6	2.05	
E	15.7	15.9
E1	12.38	
E2	2.8	
e	7.32	
e1	2.79	
e2	2.54	
L	18.01	18.21
L1	1.6	
L2	2.36	
aaa	0.25	

1) All metal surfaces tin plated except area of cut
2) Mold gate protrusion after degating.
All dimensions are in units mm
The drawing is in compliance with ISO 128-30, Projection Method 3 [⌖◁]
Drawing according to ISO 8015, general tolerances

Figure 1

6 Testing conditions

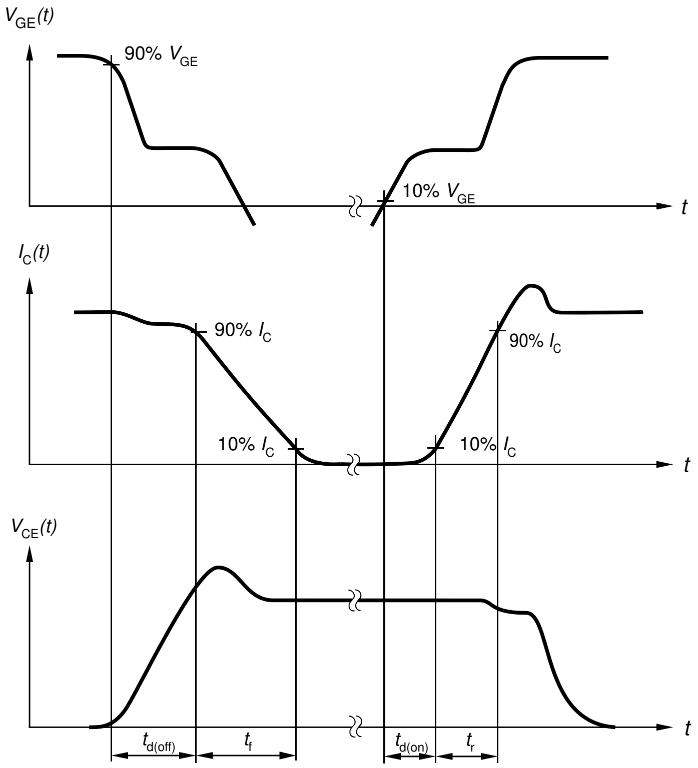


Figure A. **Definition of switching times**

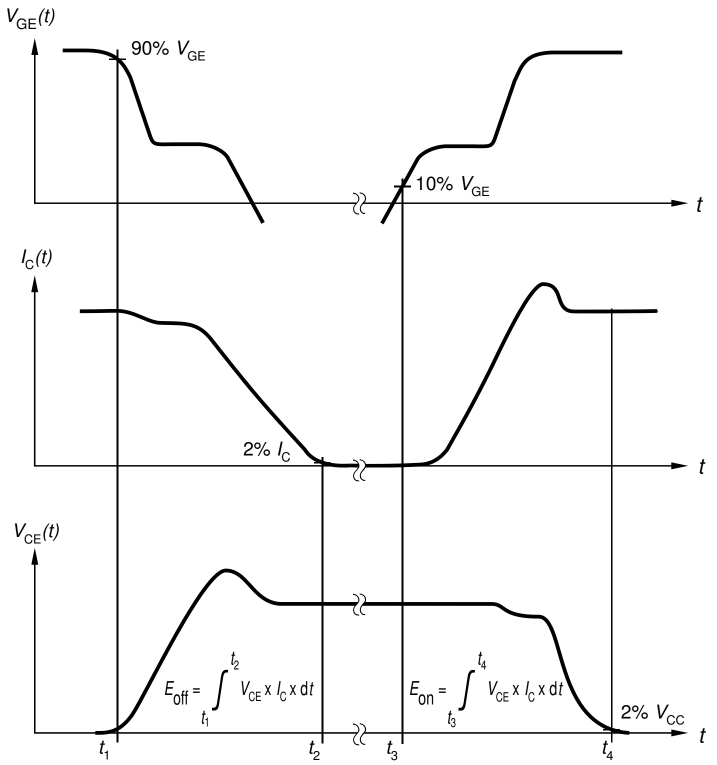


Figure B. **Definition of switching losses**

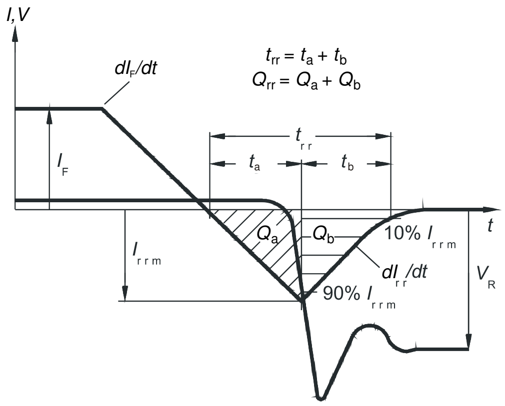


Figure C. **Definition of diode switching characteristics**

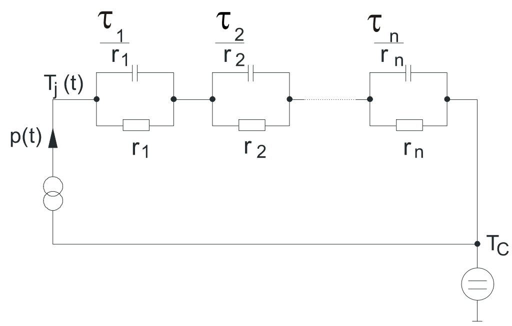


Figure D. **Thermal equivalent circuit**

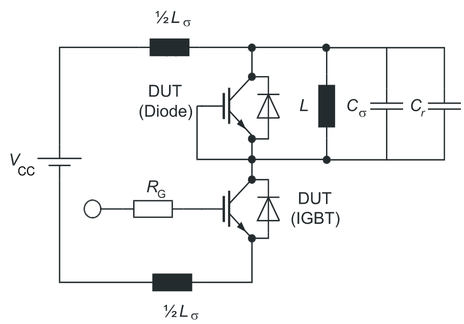


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Figure 2

Revision history

Document revision	Date of release	Description of changes
0.10	2024-03-26	Preliminary datasheet
1.00	2024-07-19	Final datasheet

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Edition 2024-07-23

Published by

Infineon Technologies AG

81726 Munich, Germany

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Document reference
IFX-ABB835-002