

Final datasheet

Short circuit rugged 750 V EDT2 IGBT co-packed with fast soft recovery diode

Features

- $V_{CE} = 750\text{ V}$
- $I_C = 120\text{ A}$
- 750 V collector-emitter blocking voltage capability
- Suitable for 470 V V_{DC} systems and increase overvoltage margin for 400 V V_{DC} systems
- Very low $V_{CEsat} = 1.3\text{ V}$ (typ.) at $I_{Cnom} = 120\text{ A}$, 25°C
- Short circuit robust $t_{sc} = 5\text{ }\mu\text{s}$ at $V_{CE} = 470\text{ V}$, $V_{GE} = 15\text{ V}$
- Self limiting current under short circuit condition
- Positive thermal coefficient and very tight parameter distribution for easy paralleling
- Drop-in replacement for previous generation devices $I_C = 120\text{ A}$, $T_c = 100^\circ\text{C}$
- Excellent current sharing in parallel operation
- Smooth switching characteristics, low EMI signature
- Low gate charge Q_G
- Simple gate drive design
- Co-packed with fast soft recovery emitter controlled 3 diode
- TO247PLUS package with high creepage distance
- High reliability

Potential applications

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

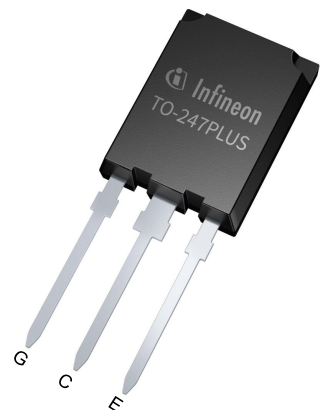
Product validation

- Qualified for automotive applications
- Qualified according to AEC-Q101

Description

Package pin definition:

- Pin C & backside - collector
- Pin E - emitter
- Pin G - gate



Halogen-free



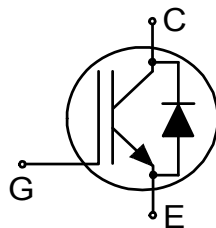
RoHS



Lead-free



Green



Type	Package	Marking
AIKQ120N75CP2	PG-TO247-3-U01	AKQ12FCP



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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
Thermal resistance, junction-ambient	$R_{th(j-a)}$				40	K/W
IGBT thermal resistance, junction-case	$R_{th(j-c)}$			0.17	0.22	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}			750	V
DC collector current, limited by T_{vjmax}	I_C		$T_c = 25\text{ °C}$	150	A
			$T_c = 100\text{ °C}$	120	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			360	A
Turn-off safe operating area		$V_{CE} \leq 750\text{ V}$, $t_p = 1\text{ }\mu\text{s}$, $T_{vj} \leq 175\text{ °C}$		360	A
Gate-emitter voltage	V_{GE}			± 20	V
Transient gate-emitter voltage	V_{GE}	$t_p < 0.1\text{ }\mu\text{s}$, $D < 0.01$		± 30	V
Short-circuit withstand time	t_{SC}	$V_{CC} \leq 470\text{ V}$, $V_{GE} = 15\text{ V}$, Allowed number of short circuits < 1000 , Time between short circuits $\geq 1.0\text{ s}$, $T_{vj} = 25\text{ °C}$		5	μs
Power dissipation	P_{tot}		$T_c = 25\text{ °C}$	682	W
			$T_c = 100\text{ °C}$	341	

Table 3 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 120 \text{ A}$, $V_{GE}=15 \text{ V}$	$T_{vj} = 25 \text{ °C}$	1.2	1.3	1.5	V
			$T_{vj} = 175 \text{ °C}$		1.53		
Gate-emitter threshold voltage	V_{GETh}	$I_C = 1.6 \text{ mA}$, $V_{CE} = V_{GE}$		5.2	5.8	6.4	V
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 750 \text{ V}$, $V_{GE}=0 \text{ V}$	$T_{vj}=25 \text{ °C}$			200	μA
			$T_{vj}=175 \text{ °C}$		4000		
Gate-emitter leakage current	I_{GES}	$V_{CE}=0 \text{ V}$, $V_{GE}=20 \text{ V}$				100	nA
Transconductance	g_{fs}	$I_C = 120 \text{ A}$, $V_{CE}=20 \text{ V}$			90		S
Short-circuit collector current	I_{SC}	$V_{CC} \leq 470 \text{ V}$, $V_{GE}=15 \text{ V}$, $t_{SC} \leq 5 \text{ }\mu\text{s}$, Allowed number of short circuits < 1000, Time between short circuits $\geq 1.0 \text{ s}$, $T_{vj}=25 \text{ °C}$	$T_{vj} = 25 \text{ °C}$		750		A
Input capacitance	C_{ies}	$V_{CE}=25 \text{ V}$, $V_{GE}=0 \text{ V}$, $f=100 \text{ kHz}$			13100		pF
Output capacitance	C_{oes}	$V_{CE}=25 \text{ V}$, $V_{GE}=0 \text{ V}$, $f=100 \text{ kHz}$			337		pF
Reverse transfer capacitance	C_{res}	$V_{CE}=25 \text{ V}$, $V_{GE}=0 \text{ V}$, $f=100 \text{ kHz}$			59		pF
Gate charge	Q_G	$V_{CC} = 600 \text{ V}$, $I_C = 120 \text{ A}$			731		nC
Turn-on delay time	$t_{d(on)}$	$V_{GE} = -8/15 \text{ V}$, $R_{G(on)} = 5 \text{ }\Omega$, $R_{G(off)} = 5 \text{ }\Omega$, $L_\sigma=50 \text{ nH}$, $C_\sigma=30 \text{ pF}$	$T_{vj} = 25 \text{ °C}$, $I_C = 120 \text{ A}$		71		ns
			$T_{vj} = 175 \text{ °C}$, $I_C = 120 \text{ A}$		50		
Rise time (inductive load)	t_r	$V_{GE} = -8/15 \text{ V}$, $R_{G(on)} = 5 \text{ }\Omega$, $R_{G(off)} = 5 \text{ }\Omega$, $L_\sigma=50 \text{ nH}$, $C_\sigma=30 \text{ pF}$	$T_{vj} = 25 \text{ °C}$, $I_C = 120 \text{ A}$		69		ns
			$T_{vj} = 175 \text{ °C}$, $I_C = 120 \text{ A}$		68		
Turn-off delay time	$t_{d(off)}$	$V_{GE} = -8/15 \text{ V}$, $R_{G(on)} = 5 \text{ }\Omega$, $R_{G(off)} = 5 \text{ }\Omega$, $L_\sigma=50 \text{ nH}$, $C_\sigma=30 \text{ pF}$	$T_{vj} = 25 \text{ °C}$, $I_C = 120 \text{ A}$		244		ns
			$T_{vj} = 175 \text{ °C}$, $I_C = 120 \text{ A}$		226		
Fall time (inductive load)	t_f	$V_{GE} = -8/15 \text{ V}$, $R_{G(on)} = 5 \text{ }\Omega$, $R_{G(off)} = 5 \text{ }\Omega$, $L_\sigma=50 \text{ nH}$, $C_\sigma=30 \text{ pF}$	$T_{vj} = 25 \text{ °C}$, $I_C = 120 \text{ A}$		50.5		ns
			$T_{vj} = 175 \text{ °C}$, $I_C = 120 \text{ A}$		67		

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-on energy ¹⁾	E_{on}	$V_{GE} = -8/15 \text{ V}$, $R_{G(on)} = 5 \Omega$, $R_{G(off)} = 5 \Omega$, $L_{\sigma} = 50 \text{ nH}$, $C_{\sigma} = 30 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 120 \text{ A}$	6.82		mJ
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 120 \text{ A}$	7.3		
Turn-off energy	E_{off}	$V_{GE} = -8/15 \text{ V}$, $R_{G(on)} = 5 \Omega$, $R_{G(off)} = 5 \Omega$, $L_{\sigma} = 50 \text{ nH}$, $C_{\sigma} = 30 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 120 \text{ A}$	3.8		mJ
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 120 \text{ A}$	4.7		
Total switching energy	E_{ts}	$V_{GE} = -8/15 \text{ V}$, $R_{G(on)} = 5 \Omega$, $R_{G(off)} = 5 \Omega$, $L_{\sigma} = 50 \text{ nH}$, $C_{\sigma} = 30 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 120 \text{ A}$	10.3		mJ
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 120 \text{ A}$	12.1		
Operating junction temperature	T_{vj}		-40		175	$^{\circ}\text{C}$

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	$T_C = 25 \text{ }^{\circ}\text{C}$	150	A
		$T_C = 100 \text{ }^{\circ}\text{C}$	120	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}		360	A
Power dissipation	P_{tot}	$T_C = 25 \text{ }^{\circ}\text{C}$	375	W
		$T_C = 100 \text{ }^{\circ}\text{C}$	170	

Table 5 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode forward voltage	V_F	$I_F = 120 \text{ A}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$	1.7	1.95	V
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$	1.74		

(table continues...)

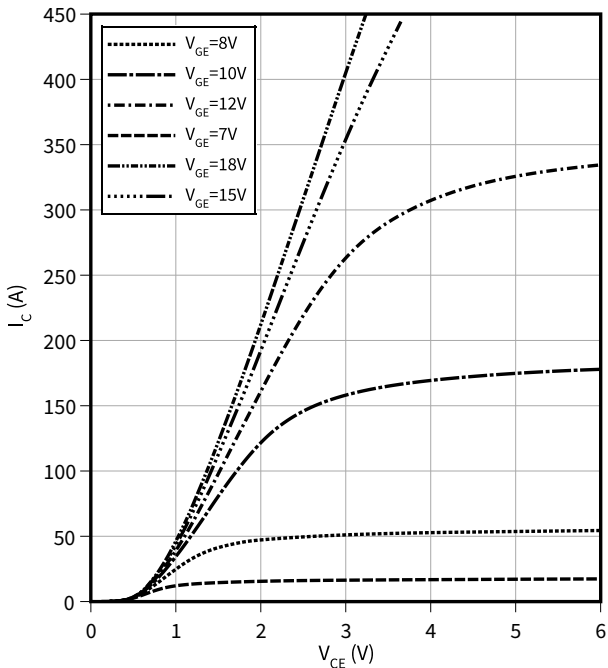
Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode reverse recovery charge	Q_{rr}	$V_R < 470 \text{ V}$, $R_{G(on)} = 4.8 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C}$, $I_F = 120 \text{ A}$, $-di_F/dt = 1070 \text{ A}/\mu\text{s}$	3.58		μC
			$T_{vj} = 175 \text{ } ^\circ\text{C}$, $I_F = 120 \text{ A}$, $-di_F/dt = 1055 \text{ A}/\mu\text{s}$	5.28		
Diode peak reverse recovery current	I_{rrm}	$V_R < 470 \text{ V}$, $R_{G(on)} = 4.8 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C}$, $I_F = 120 \text{ A}$, $-di_F/dt = 1070 \text{ A}/\mu\text{s}$	33		A
			$T_{vj} = 175 \text{ } ^\circ\text{C}$, $I_F = 120 \text{ A}$, $-di_F/dt = 1055 \text{ A}/\mu\text{s}$	43		
Reverse recovery energy	E_{rec}	$V_R < 470 \text{ V}$, $V_{GE} = -8/15 \text{ V}$, $R_{G(on)} = 4.8 \text{ } \Omega$, $L_\sigma = 50 \text{ nH}$, $C_\sigma = 30 \text{ pF}$	$T_{vj} = 25 \text{ } ^\circ\text{C}$, $I_F = 120 \text{ A}$, $-di_F/dt = 1070 \text{ A}/\mu\text{s}$	1.24		mJ
			$T_{vj} = 175 \text{ } ^\circ\text{C}$, $I_F = 120 \text{ A}$, $-di_F/dt = 1055 \text{ A}/\mu\text{s}$	1.61		
Operating junction temperature	T_{vj}		-40		175	$^\circ\text{C}$

4 Characteristics diagrams

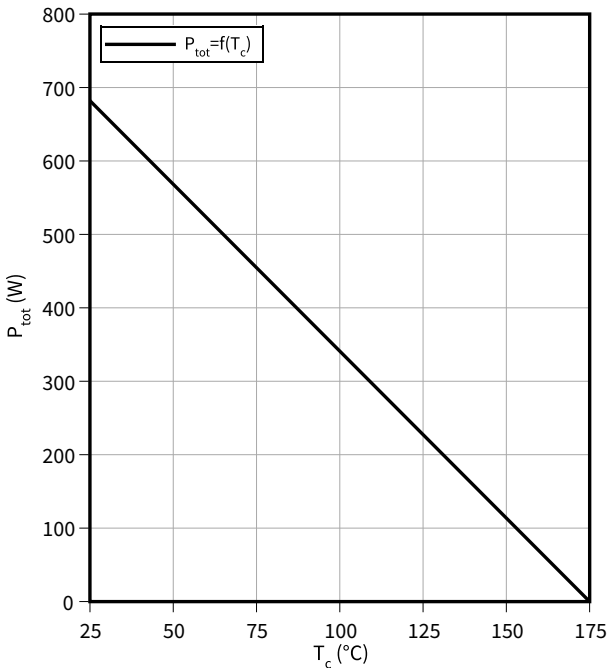
Typical output characteristic

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



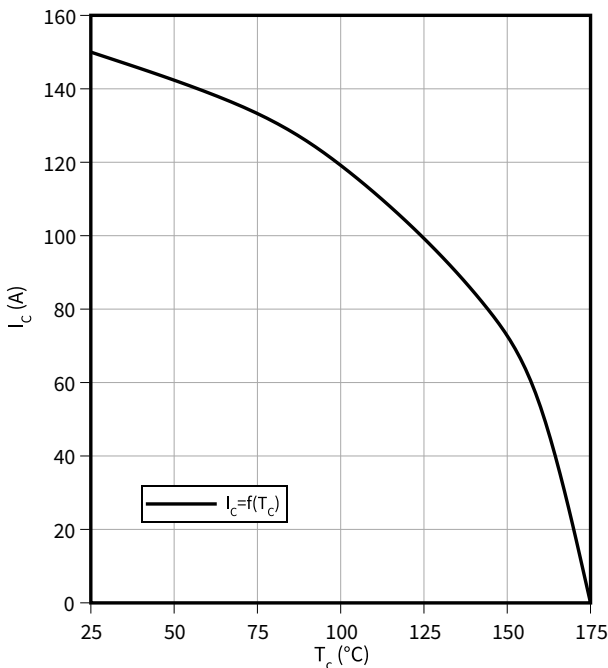
Power dissipation as a function of case temperature

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



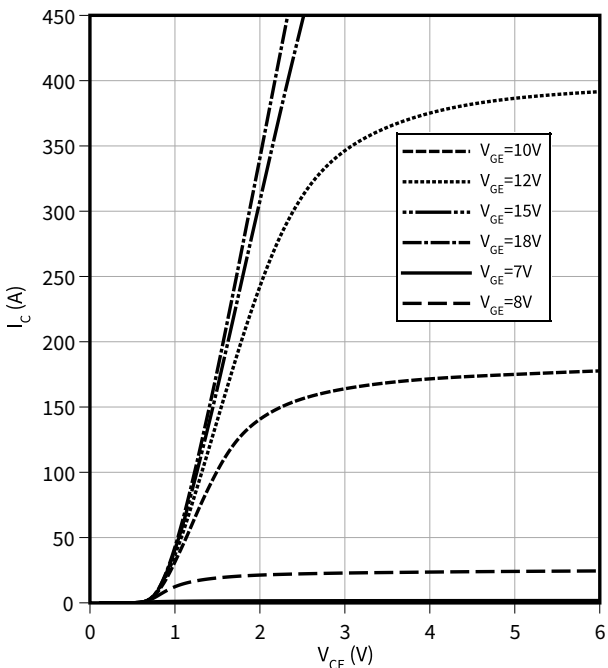
Collector current as a function of case temperature

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



Typical output characteristic

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

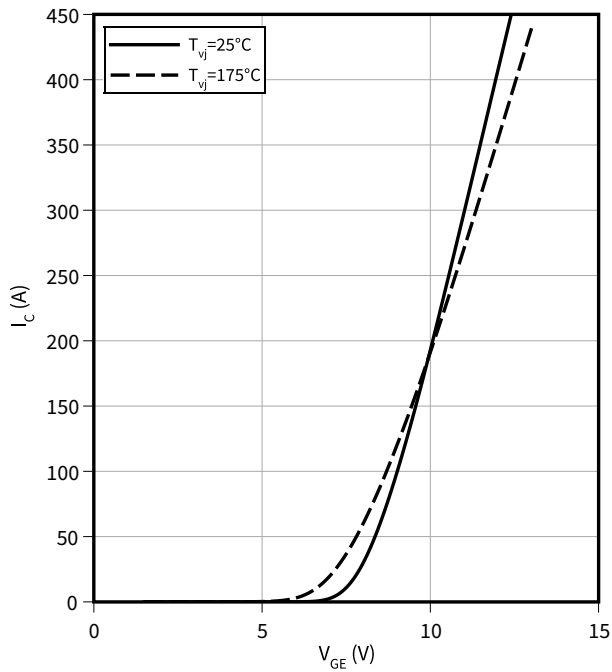


4 Characteristics diagrams

Typical transfer characteristic

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

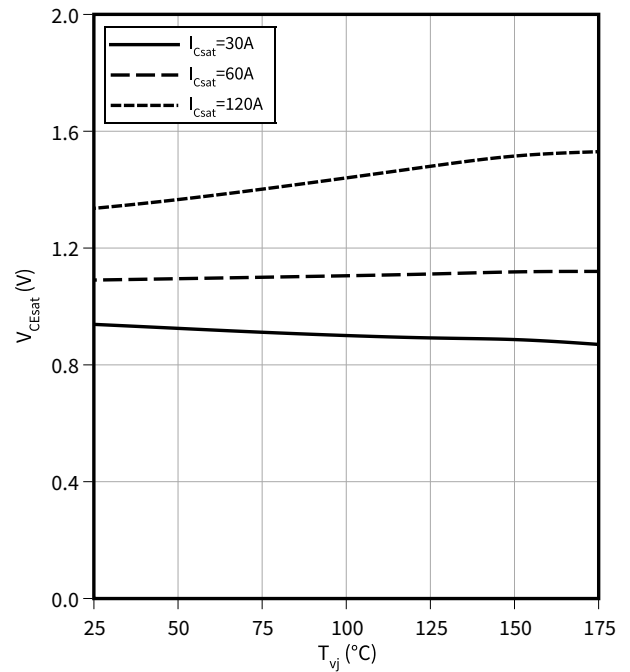
$$V_{CE} = 20 \text{ V}$$



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

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

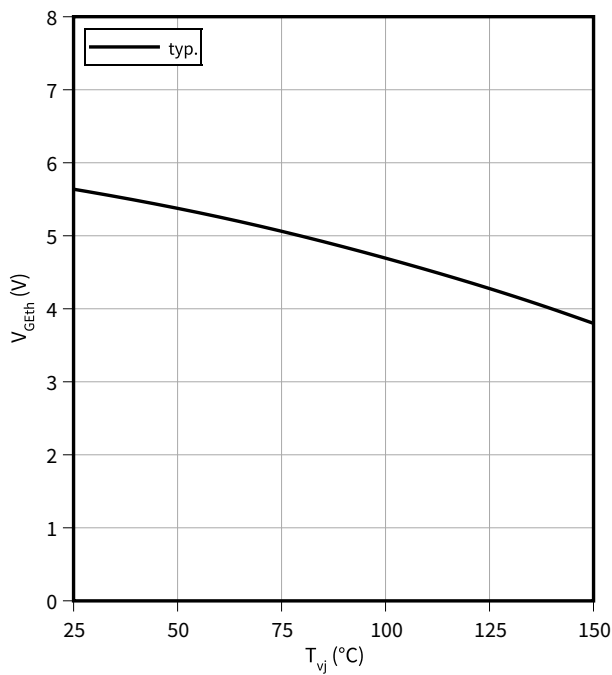
$$V_{GE} = 15 \text{ V}$$



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

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

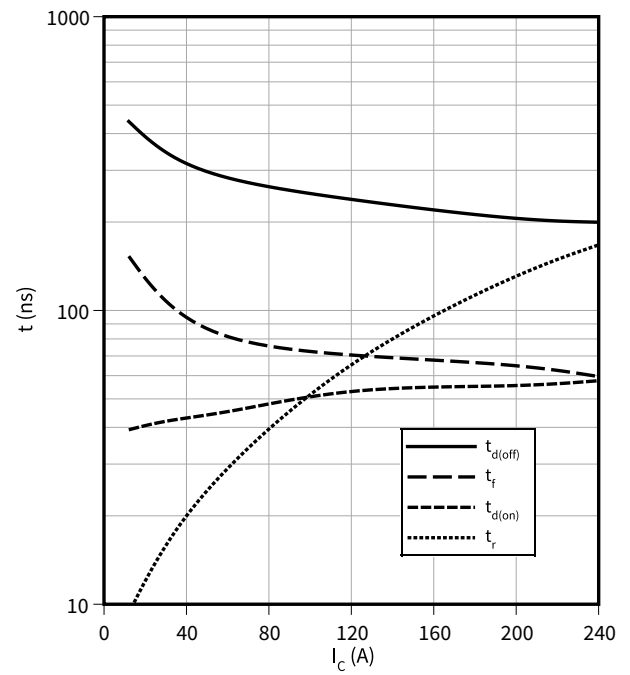
$$I_C = 1.60 \text{ mA}$$



Typical switching times as a function of collector current

$$t = f(I_C)$$

$$R_{G(off)} = 5.0 \Omega, V_{CE} = 470 \text{ V}, T_{vj} = 175^\circ\text{C}, V_{GE} = -8/15 \text{ V}, R_{G(on)} = 5 \Omega$$

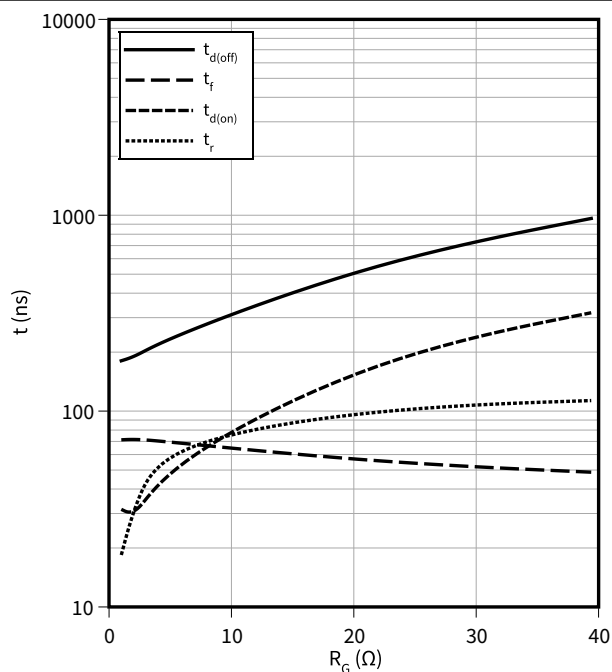


4 Characteristics diagrams

Typical switching times as a function of gate resistor

$$t = f(R_G)$$

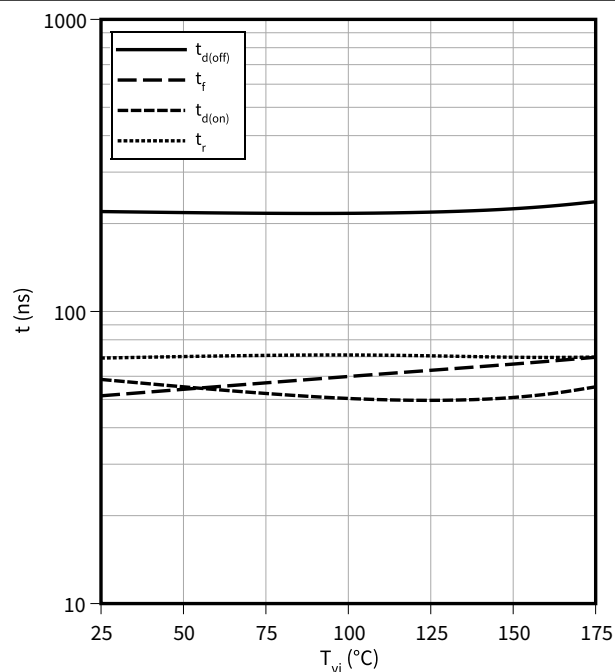
$I_C = 120.0 \text{ A}$, $V_{CE} = 470 \text{ V}$, $T_{vj} = 175 \text{ }^\circ\text{C}$, $V_{GE} = -8/15 \text{ V}$



Typical switching times as a function of junction temperature

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

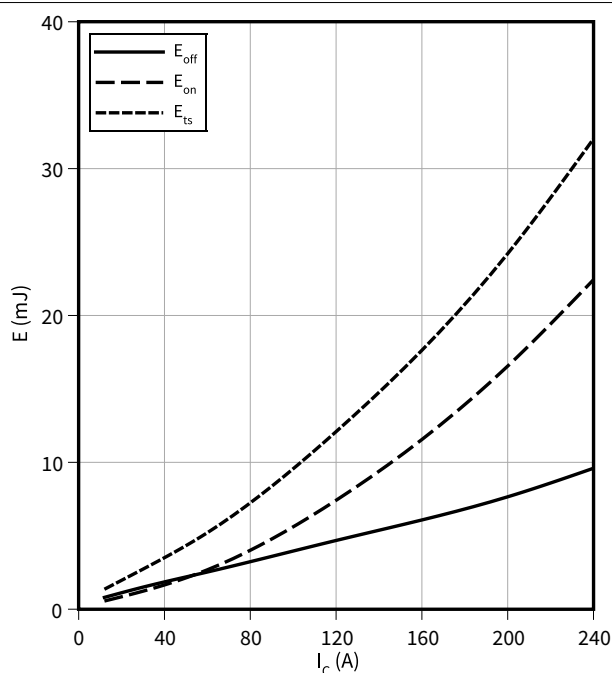
$I_C = 120.0 \text{ A}$, $R_{G(off)} = 5.0 \text{ } \Omega$, $V_{CE} = 470 \text{ V}$, $V_{GE} = -8/15 \text{ V}$, $R_{G(on)} = 5 \text{ } \Omega$



Typical switching energy losses as a function of collector current

$$E = f(I_C)$$

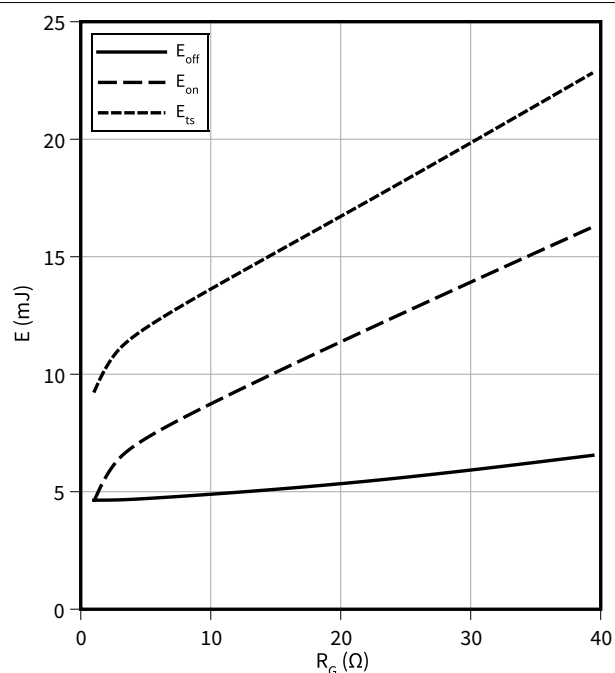
$R_{G(off)} = 5.0 \text{ } \Omega$, $V_{CE} = 470 \text{ V}$, $T_{vj} = 175 \text{ }^\circ\text{C}$, $V_{GE} = -8/15 \text{ V}$, $R_{G(on)} = 5 \text{ } \Omega$



Typical switching energy losses as a function of gate resistor

$$E = f(R_G)$$

$I_C = 120.0 \text{ A}$, $V_{CE} = 470 \text{ V}$, $T_{vj} = 175 \text{ }^\circ\text{C}$, $V_{GE} = -8/15 \text{ V}$

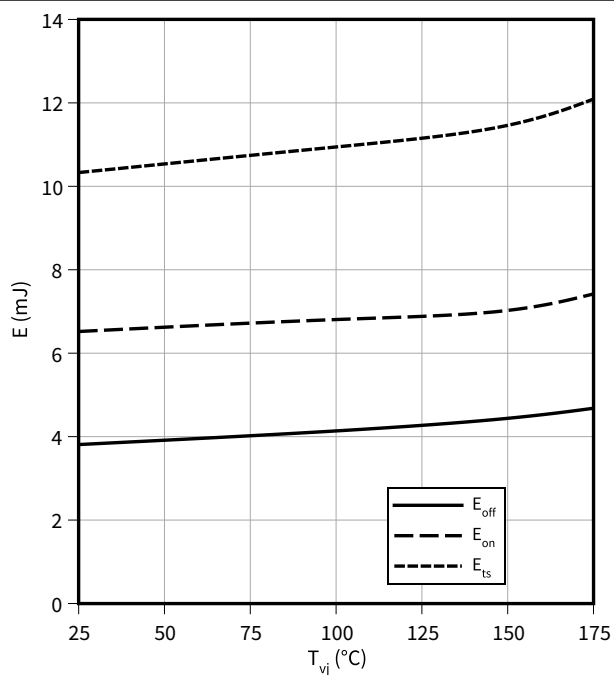


4 Characteristics diagrams

Typical switching energy losses as a function of junction temperature

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

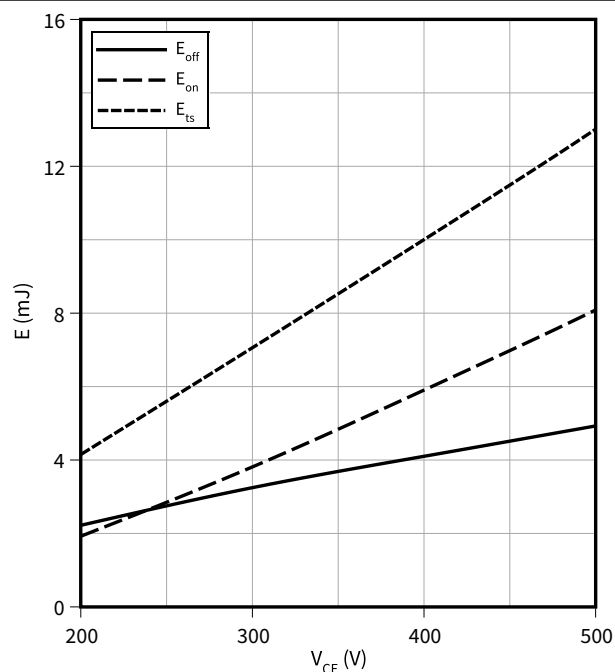
$I_C = 120.0 \text{ A}$, $R_{G(off)} = 5.0 \text{ } \Omega$, $V_{CE} = 470 \text{ V}$, $V_{GE} = -8/15 \text{ V}$, $R_{G(on)} = 5 \text{ } \Omega$



Typical switching energy losses as a function of collector emitter voltage

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

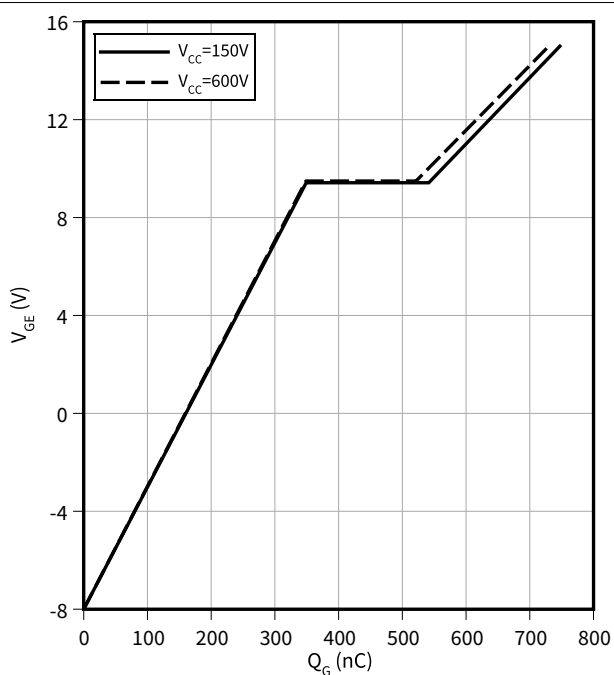
$I_C = 120 \text{ A}$, $R_{G(off)} = 5 \text{ } \Omega$, $T_{vj} \leq 175 \text{ }^\circ\text{C}$, $V_{GE} = -8/15 \text{ V}$, $R_{G(on)} = 5 \text{ } \Omega$



Typical gate charge

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

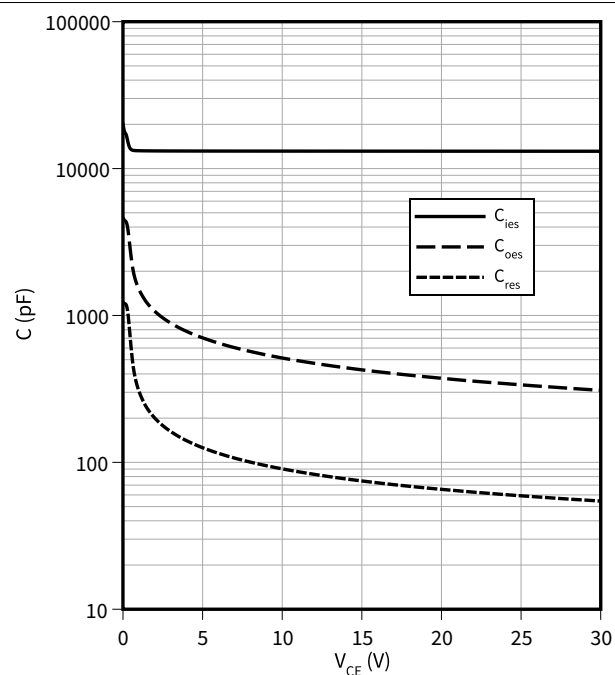
$I_C = 120.0 \text{ A}$



Typical capacitance as a function of collector-emitter voltage

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

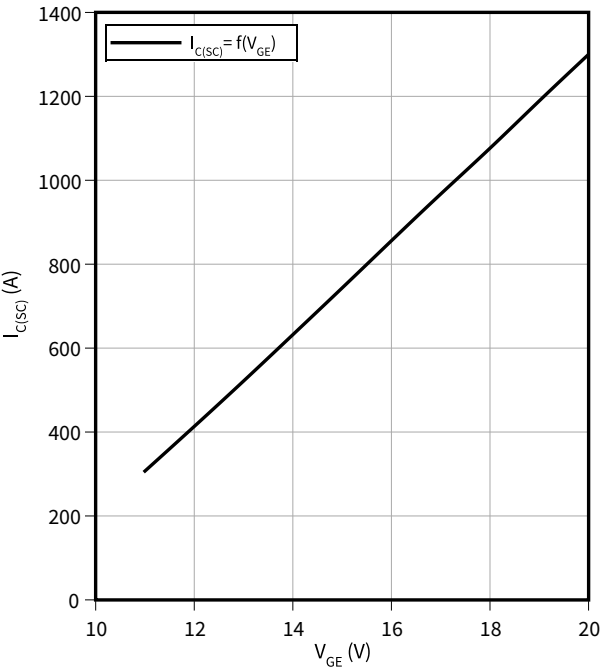
$f = 100 \text{ kHz}$, $V_{GE} = 0 \text{ V}$



4 Characteristics diagrams

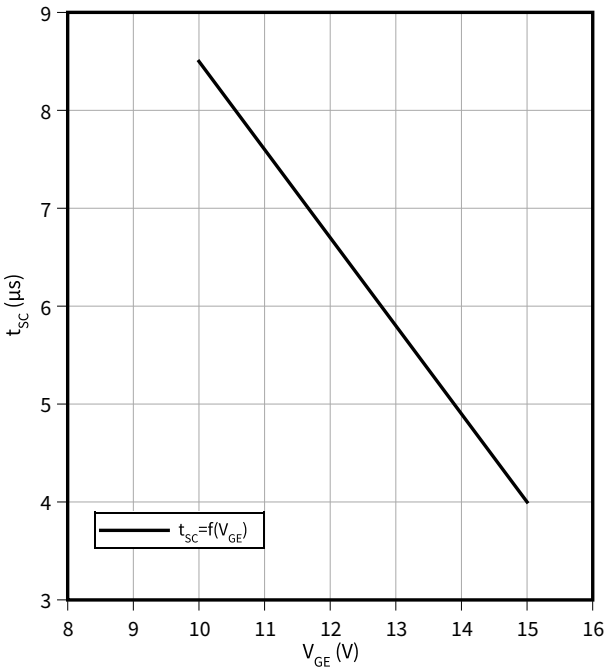
Typical short circuit collector current as a function of gate-emitter voltage

$I_{C(SC)} = f(V_{GE})$
 $T_{vj} \leq 175\text{ }^{\circ}\text{C}, V_{CC} \leq 470\text{ V}$



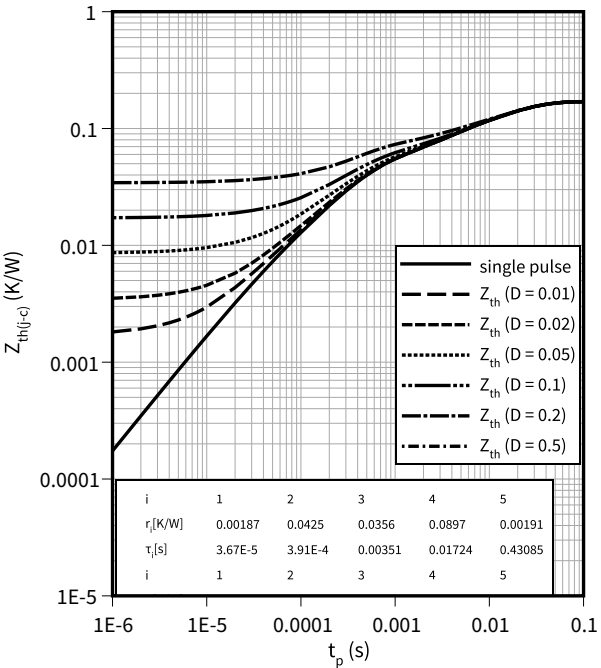
Typical Short circuit withstand time as a function of gate-emitter voltage

$t_{SC} = f(V_{GE})$
 $T_{vj} \leq 175\text{ }^{\circ}\text{C}, V_{CC} \leq 470\text{ V}$



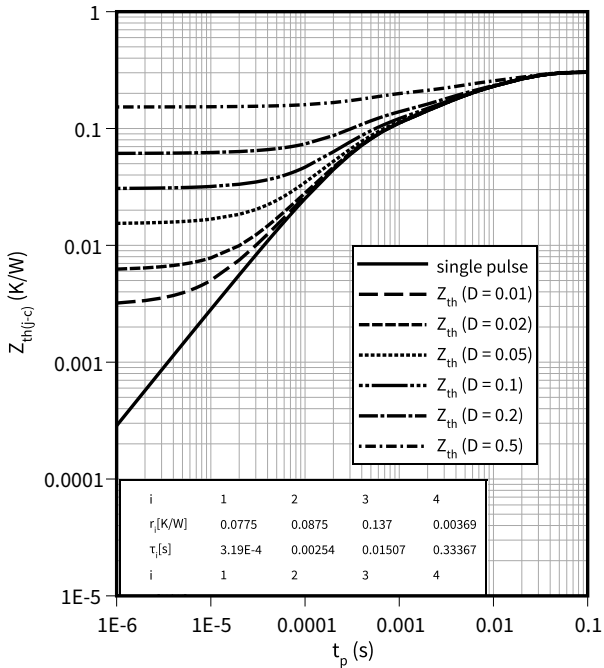
IGBT typical transient thermal impedance as a function of pulse width

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



Diode typical transient thermal impedance as a function of pulse width

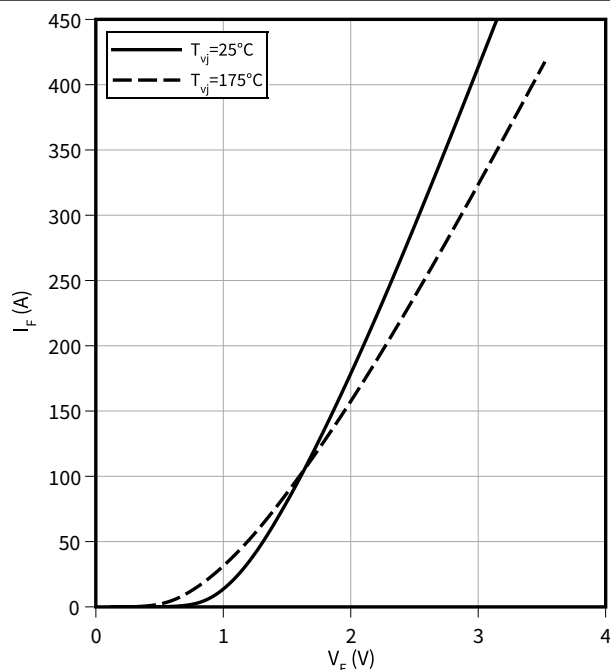
$Z_{th(j-c)} = f(t_p)$
 $D = t_p/T$



4 Characteristics diagrams

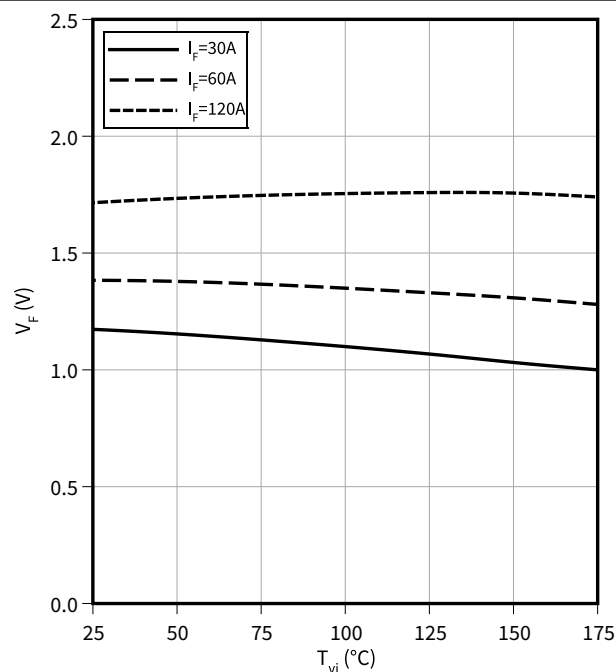
Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$



Typical diode forward voltage as a function of junction temperature

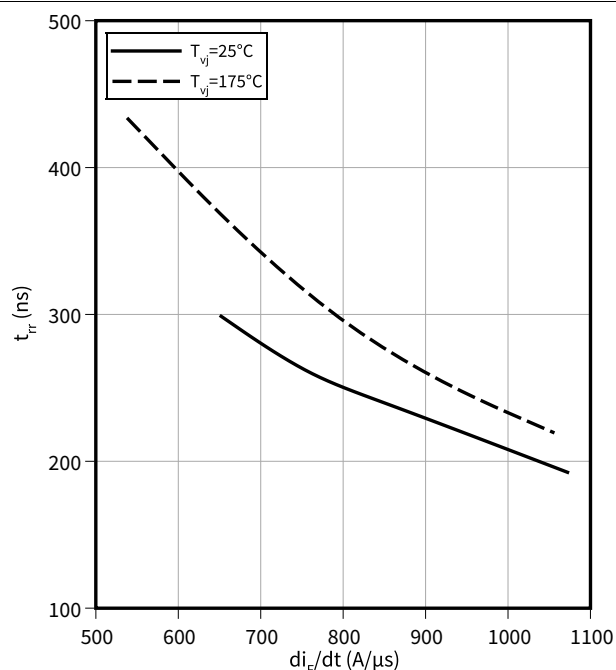
$$V_F = f(T_{vj})$$



Typical reverse recovery time as a function of diode current slope

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

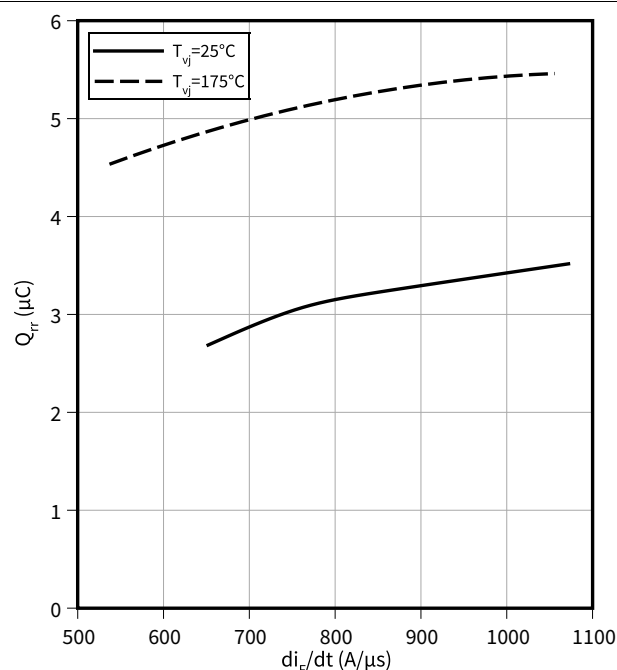
$$V_R = 470 \text{ V}, I_F = 120.0 \text{ A}$$



Typical reverse recovery charge as a function of diode current slope

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

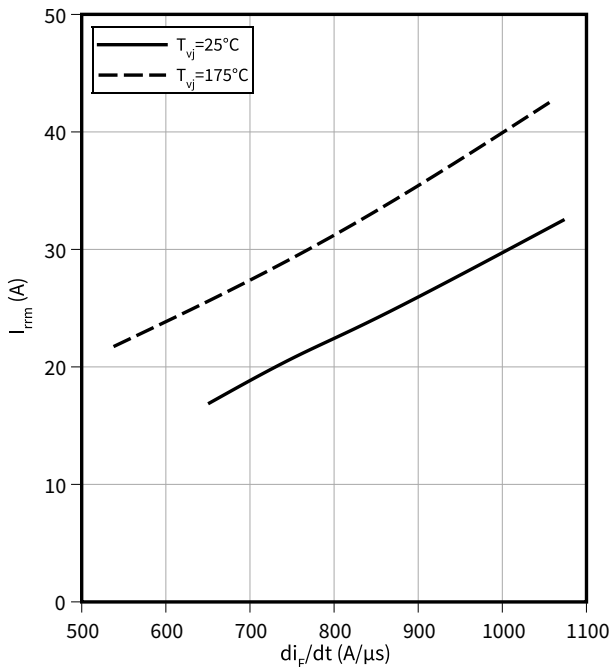
$$V_R = 470 \text{ V}, I_F = 120.0 \text{ A}$$



4 Characteristics diagrams

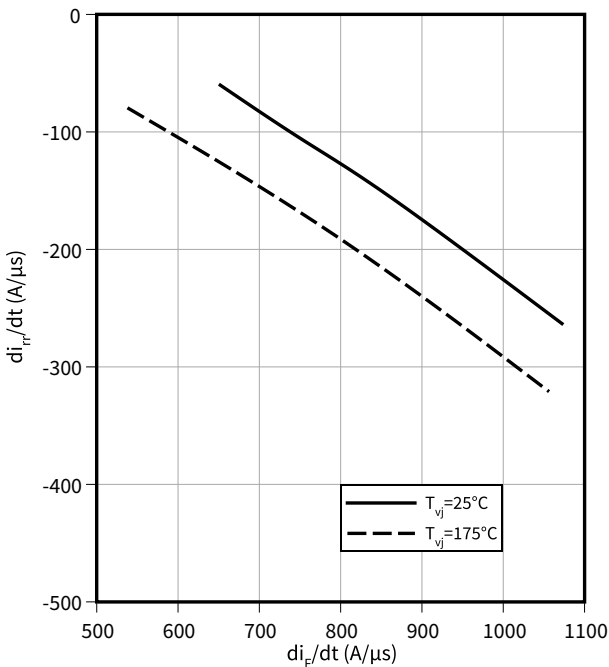
Typical reverse recovery current as a function of diode current slope

$I_{rrm} = f(di_F/dt)$
 $V_R = 470\text{ V}, I_F = 120.0\text{ A}$



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

$di_{rr}/dt = f(di_F/dt)$
 $V_R = 470\text{ V}, I_F = 120.0\text{ A}$



5 Package outlines

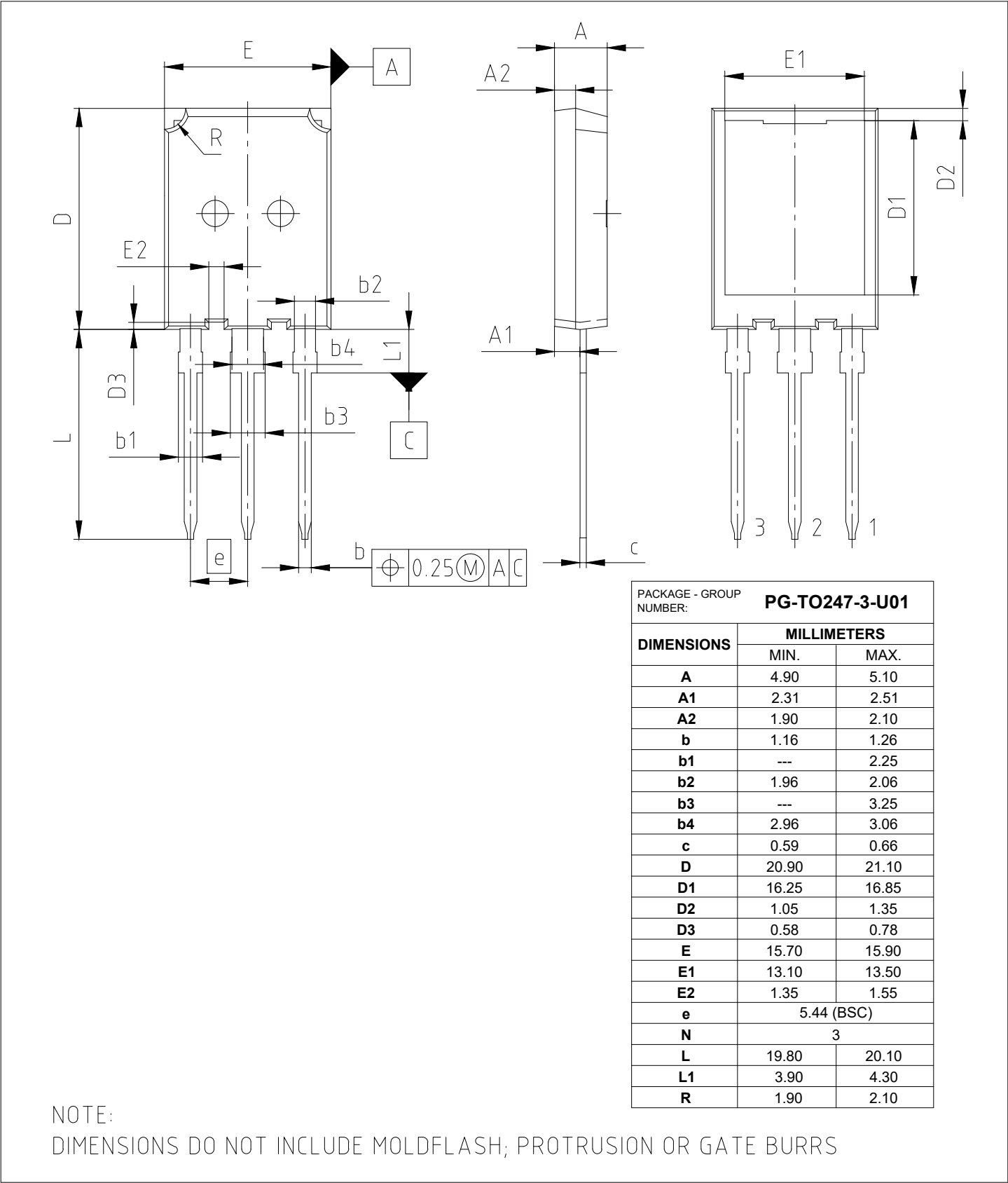


Figure 1

Revision history

Document revision	Date of release	Description of changes
1.00	2022-02-16	Final datasheet
1.10	2022-04-07	Updated VF and Rthjc
1.20	2025-06-11	Package drawing, transient thermal impedance plots, and qualification labels updated according to the latest guidelines
1.30	2025-07-03	Qualification labels updated according to the latest guidelines

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