

1. General description

High speed IGBT with anti-parallel diode in TO3PF package.



2. Features and benefits

- High speed with low switching losses
- Fast and soft recovery anti-parallel diode
- Positive $V_{CE(sat)}$ temperature coefficient
- Trench gate field-stop technology
- Halogen Free package and Pb-free lead finish, RoHS compliant
- Low thermal resistance

3. Applications

- Power Factor Correction
- Welding Converter
- Industrial Inverter

4. Quick reference data

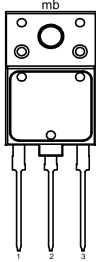
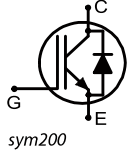
Table 1. Quick reference data

Symbol	Parameter	Value			Unit	
V_{CE}	Collector-emitter voltage, $T_j \geq 25\text{ °C}$	650			V	
I_C	DC collector current, limited by $T_{j(max)}$ ⁽¹⁾ $T_C = 100\text{ °C}$	50			A	
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}; I_C = 50\text{ A}; T_j = 25\text{ °C}$	-	1.65	2	V

Note (1): I_C and other electrical parameters definition follow TO247 package.

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate		 <p style="text-align: center;"><i>sym200</i></p>
2	C	collector		
3	E	emitter		
mb	C	mounting base; connected to collector		

6. Ordering information

Table 3. Ordering information

Type number	Package Name	Orderable part number	Packing method	Small packing quantity	Package version	Package issue date
WG50N65DHJ	TO3PF	WG50N65DHJQ	Tube	30	SOT1293	16-Mar-2006

7. Marking

Table 4. Marking codes

Type number	Marking codes
WG50N65DHJ	WG50N 65DHJ

8. Limiting values

Table 5. Limiting values

Symbol	Parameter	Value	Unit
V_{CE}	Collector-emitter voltage, $T_j \geq 25\text{ °C}$	650	V
I_C	DC collector current, limited by $T_{j(max)}$ $T_C = 25\text{ °C}$ $T_C = 100\text{ °C}$	91 50	A
$I_{C(puls)}$	Pulsed collector current, t_p limited by $T_{j(max)}$	200	A
-	Turn off safe operating area $V_{CE} \leq 600\text{ V}$, $T_j \leq 150\text{ °C}$, $t_p = 1\text{ }\mu\text{s}$	200	A
I_F	Diode forward current, limited by $T_{j(max)}$ $T_C = 25\text{ °C}$ $T_C = 100\text{ °C}$	100 50	A
V_{GE}	Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 10\text{ }\mu\text{s}$, $D < 0.010$)	± 20	V
P_{tot}	Power dissipation $T_C = 25\text{ °C}$ Power dissipation $T_C = 100\text{ °C}$	278 111	W
T_{stg}	Storage temperature	-55 to 150	°C
T_j	Operating junction temperature	-55 to 150	°C
-	Peak soldering temperature	260	°C
M	Mounting Torque with washer	0.55	Nm

9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-h)}$	IGBT thermal resistance from junction to heatsink		-	-	2.1	K/W
$R_{th(j-h)}$	Diode thermal resistance from junction to heatsink		-	-	2.9	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient		-	40	-	K/W

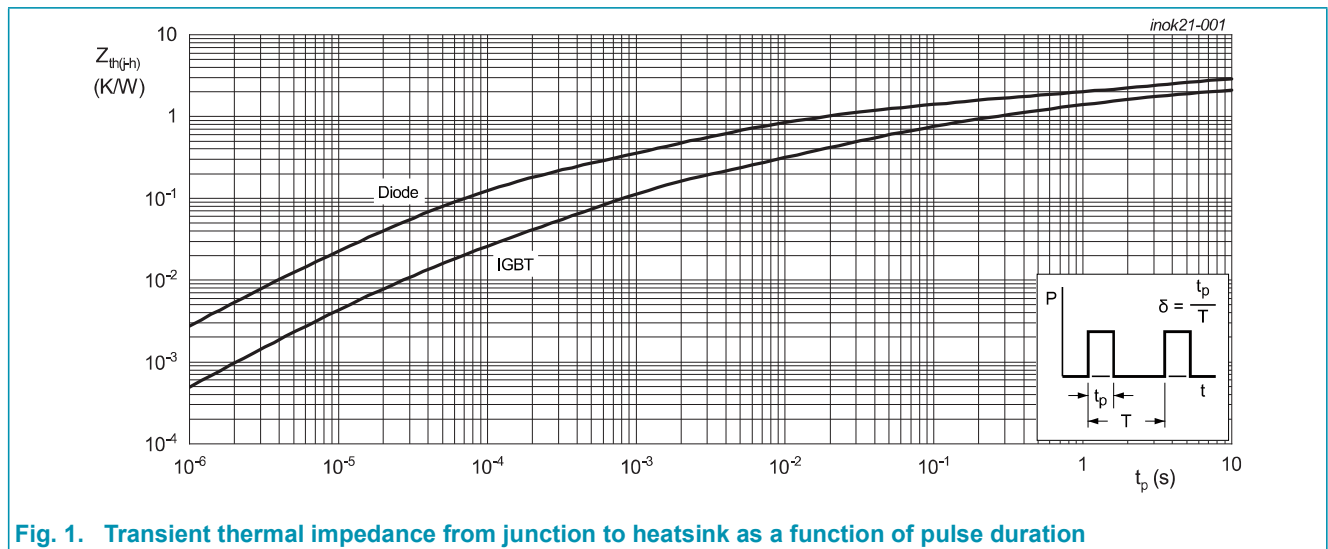


Fig. 1. Transient thermal impedance from junction to heatsink as a function of pulse duration

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
BV_{CES}	Collector-emitter breakdown voltage	$V_{GE} = 0\text{ V}; I_C = 0.2\text{ mA}$	650	-	-	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}; I_C = 50\text{ A}; T_j = 25\text{ °C}$	-	1.65	2	V
		$V_{GE} = 15\text{ V}; I_C = 50\text{ A}; T_j = 150\text{ °C}$	-	2.05	-	V
V_F	Diode forward voltage	$V_{GE} = 0\text{ V}; I_F = 30\text{ A}; T_j = 25\text{ °C}$	-	1.7	2.4	V
		$V_{GE} = 0\text{ V}; I_F = 30\text{ A}; T_j = 150\text{ °C}$	-	1.55	-	V
$V_{GE(th)}$	Gate-emitter threshold voltage	$I_C = 0.25\text{ mA}; V_{CE} = V_{GE}$	4	5	6	V
I_{CES}	Zero gate voltage collector current	$V_{CE} = 650\text{ V}; V_{GE} = 0\text{ V}; T_j = 25\text{ °C}$	-	-	10	uA
		$V_{CE} = 650\text{ V}; V_{GE} = 0\text{ V}; T_j = 150\text{ °C}$	-	-	2	mA
g_{fs}	Transconductance	$V_{CE} = 20\text{ V}; I_C = 50\text{ A}$	-	50	-	S
Dynamic characteristics						
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}; V_{GE} = 0\text{ V}; f = 1\text{ MHz}; T_j = 25\text{ °C}$	-	3800	-	pF
C_{oes}	Output capacitance		-	130	-	pF
C_{res}	Reverse transfer capacitance		-	70	-	pF
Q_G	Gate charge	$V_{CC} = 520\text{ V}; I_C = 50\text{ A}; V_{GE} = 15\text{ V}; T_j = 25\text{ °C}$	-	160	-	nC

11. Switching Characteristics

Table 8. Switching Characteristics, Inductive Load

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
IGBT characteristics						
$t_{d(on)}$	Turn-on delay time	$T_J = 25\text{ }^\circ\text{C};$ $V_{CC} = 400\text{ V}; I_C = 50\text{ A}; V_{GE} = 15\text{V} / 0\text{V};$ $R_G = 10\text{ ohm};$ Energy losses include "tail" and diode reverse recovery	-	66	-	nS
t_r	Rise time		-	61	-	nS
$t_{d(off)}$	Turn-off delay time		-	163	-	nS
t_f	Fall time		-	76	-	nS
E_{on}	Turn-on energy		-	1.7	-	mJ
E_{off}	Turn-off energy		-	0.6	-	mJ
E_{ts}	Total switching energy		-	2.3	-	mJ
$t_{d(on)}$	Turn-on delay time	$T_J = 150\text{ }^\circ\text{C};$ $V_{CC} = 400\text{ V}; I_C = 50\text{ A}; V_{GE} = 15\text{V} / 0\text{V};$ $R_G = 10\text{ ohm};$ Energy losses include "tail" and diode reverse recovery	-	62	-	nS
t_r	Rise time		-	61	-	nS
$t_{d(off)}$	Turn-off delay time		-	170	-	nS
t_f	Fall time		-	95	-	nS
E_{on}	Turn-on energy		-	1.9	-	mJ
E_{off}	Turn-off energy		-	0.8	-	mJ
E_{ts}	Total switching energy		-	2.7	-	mJ
Diode characteristics						
t_{rr}	Reverse recovery time	$T_J = 25\text{ }^\circ\text{C};$ $V_R = 400\text{ V}; I_F = 30\text{ A}; dI_F/dt = 500\text{A/us}$	-	105	-	nS
Q_r	Reverse recovery charge		-	570	-	nC
I_{RM}	Reverse recovery peak current		-	11	-	A
t_{rr}	Reverse recovery time	$T_J = 150\text{ }^\circ\text{C};$ $V_R = 400\text{ V}; I_F = 30\text{ A}; dI_F/dt = 500\text{A/us}$	-	127	-	nS
Q_r	Reverse recovery charge		-	1265	-	nC
I_{RM}	Reverse recovery peak current		-	17	-	A

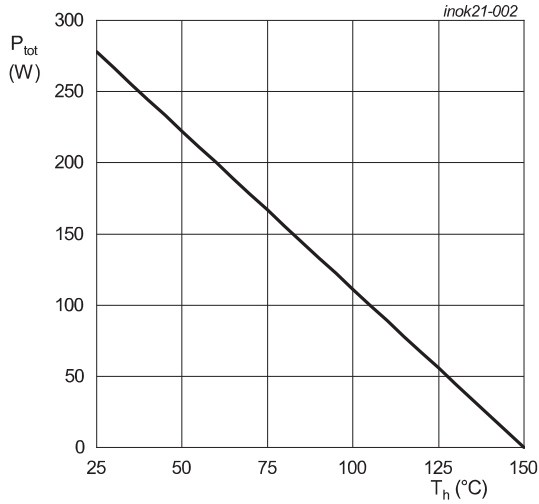


Fig. 2. Power dissipation as a function of case temperature

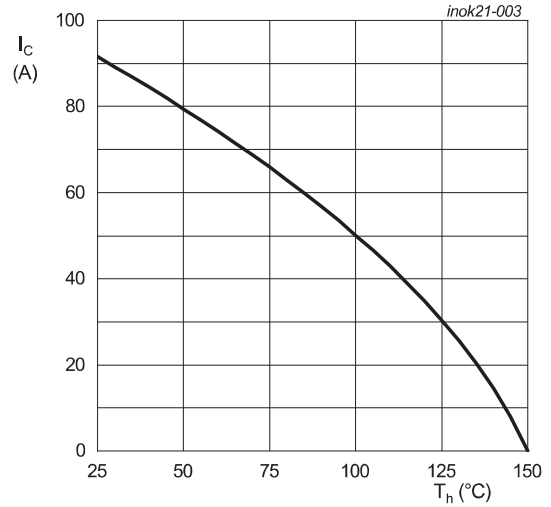


Fig. 3. Collector current as a function of case temperature
 $V_{GE} = 15 \text{ V}; T_j = 150 \text{ }^\circ\text{C}$

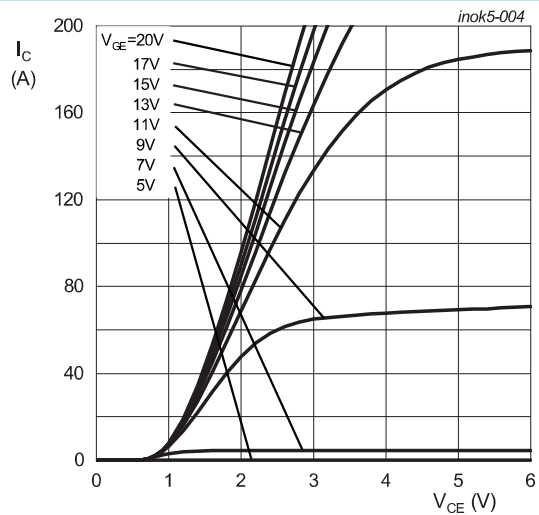


Fig. 4. Typical output characteristic
 $T_j = 25 \text{ }^\circ\text{C}$

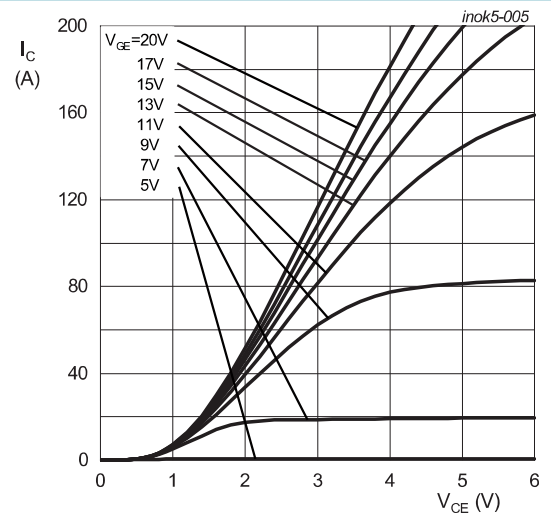
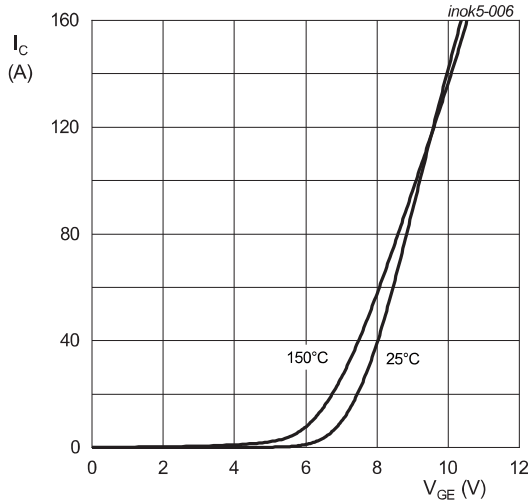
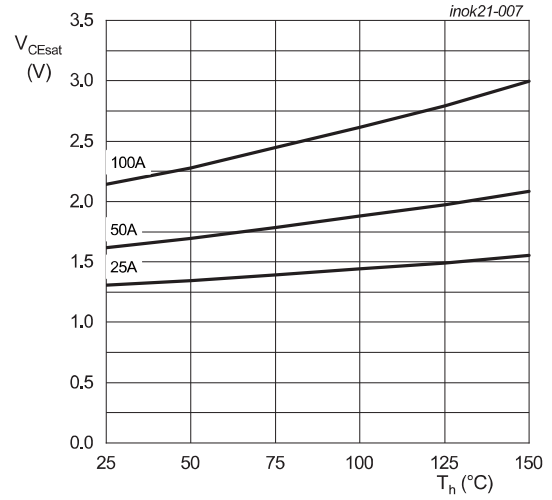


Fig. 5. Typical output characteristic
 $T_j = 150 \text{ }^\circ\text{C}$



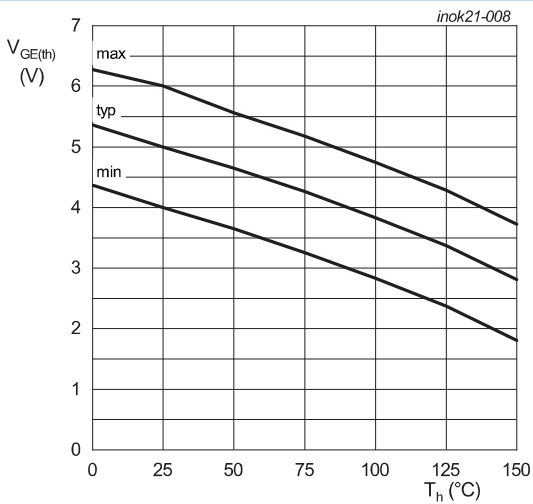
$V_{CE} = 20\text{ V}$

Fig. 6. Typical transfer characteristic



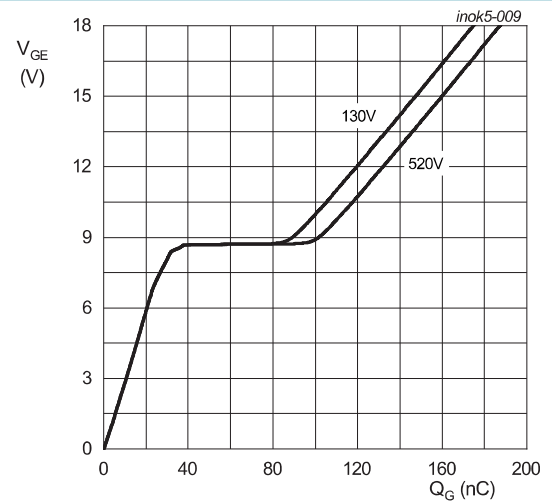
$V_{GE} = 15\text{ V}$

Fig. 7. Typical collector-emitter saturation voltage as a function of junction temperature



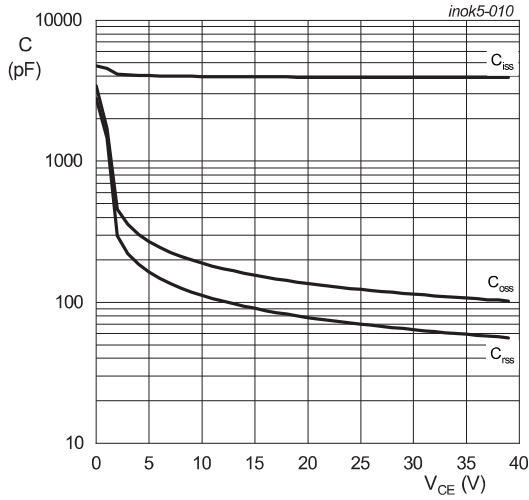
$I_C = 0.5\text{ mA}$

Fig. 8. Gate-emitter threshold voltage as a function of junction temperature



$I_C = 50\text{ A}$

Fig. 9. Typical gate charge



$V_{GE} = 0 \text{ V}; f = 1 \text{ MHz}$

Fig. 10. Typical capacitance as a function of collector-emitter voltage

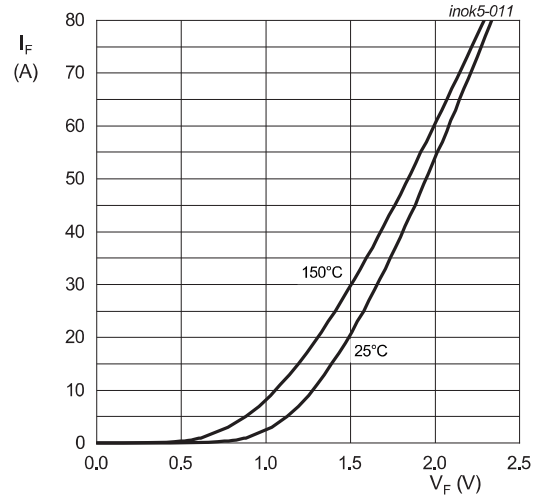
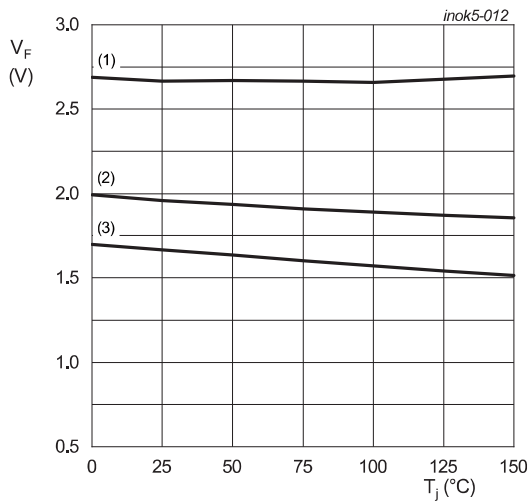
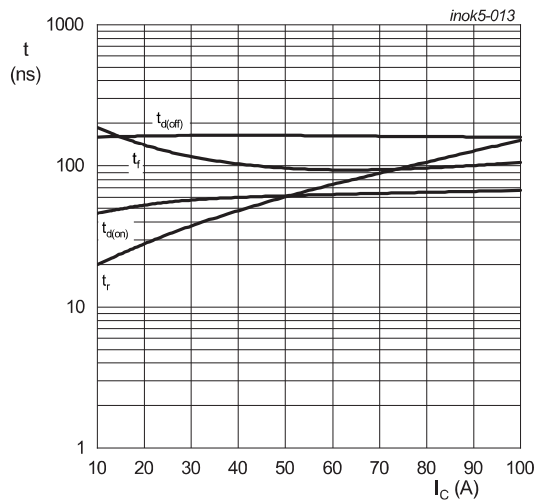


Fig. 11. Typical diode forward current as a function of forward voltage



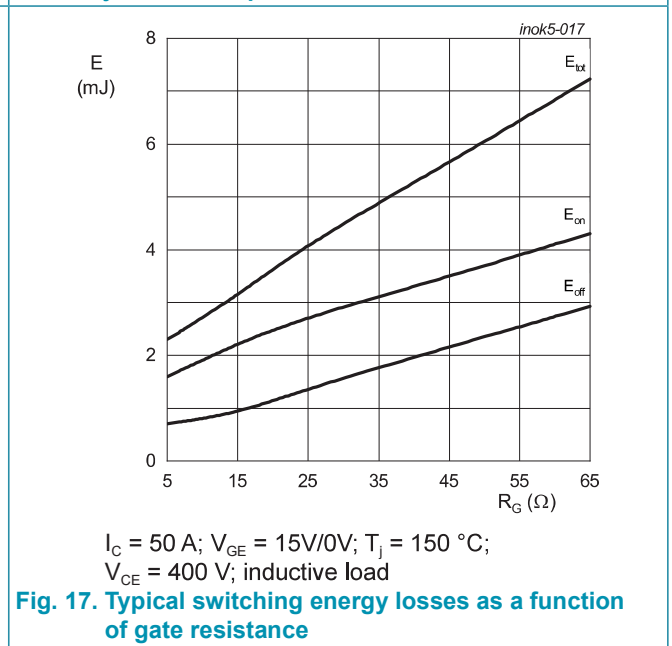
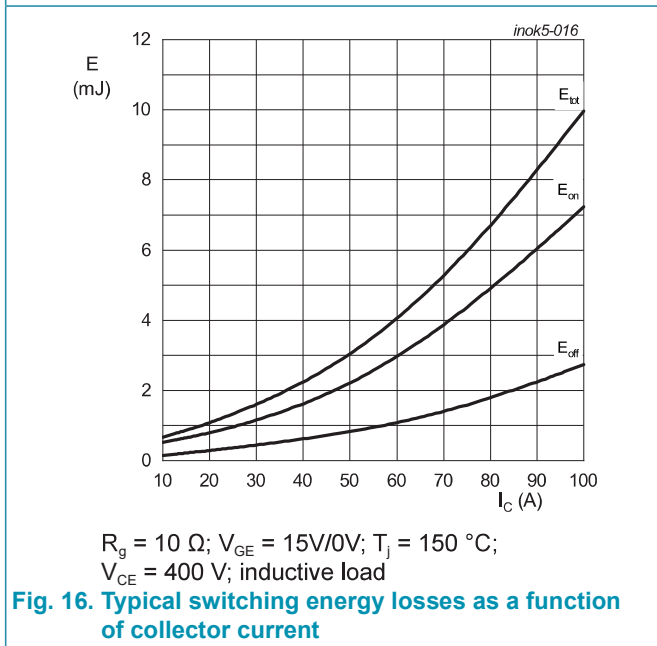
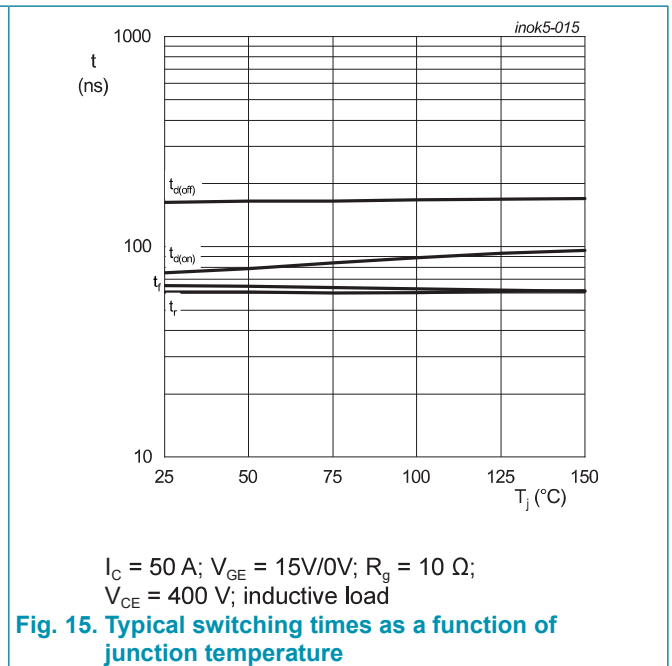
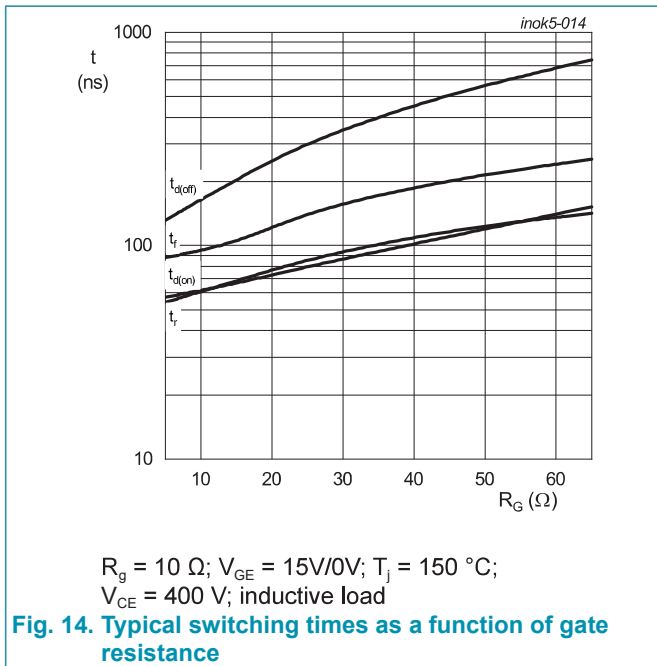
- (1) $I_F = 100 \text{ A}$
- (2) $I_F = 50 \text{ A}$
- (3) $I_F = 30 \text{ A}$

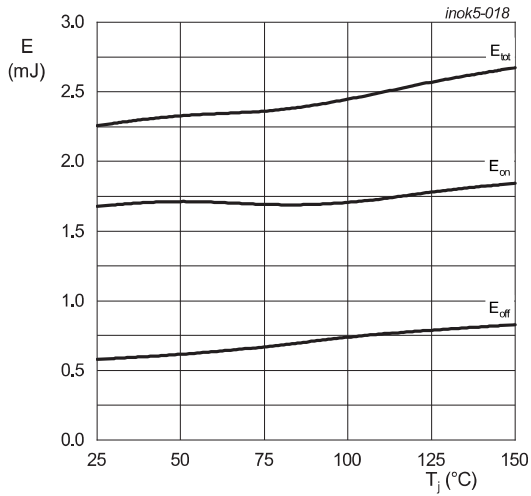
Fig. 12. Typical diode forward voltage as a function of junction temperature



$R_g = 10 \text{ } \Omega; V_{GE} = 15\text{V}/0\text{V}; T_j = 150 \text{ } ^\circ\text{C};$
 $V_{CE} = 400 \text{ V};$ inductive load

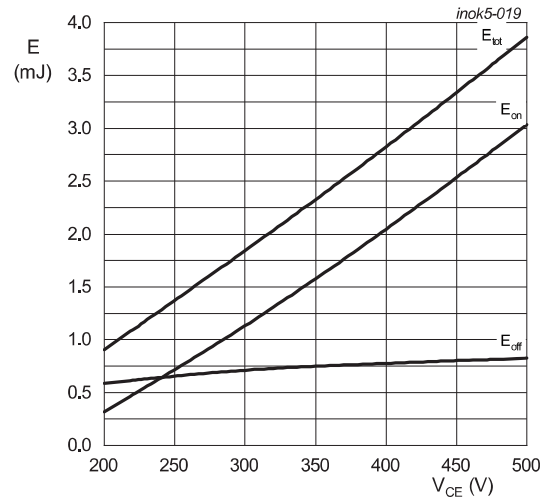
Fig. 13. Typical switching times as a function of collector current





$I_C = 50 \text{ A}$; $V_{CE} = 15\text{V}/0\text{V}$; $R_g = 10 \text{ }\Omega$;
 $V_{CE} = 400 \text{ V}$; inductive load

Fig. 18. Typical switching energy losses as a function of junction temperature



$I_C = 50 \text{ A}$; $V_{CE} = 15\text{V}/0\text{V}$; $T_j = 150 \text{ }^\circ\text{C}$;
 $R_g = 10 \text{ }\Omega$; inductive load

Fig. 19. Typical switching energy losses as a function of collector emitter voltage

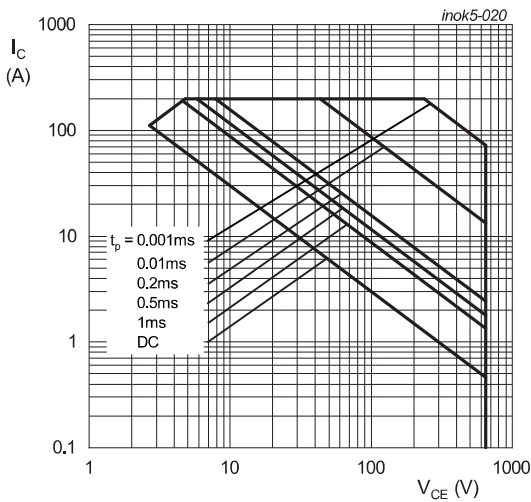


Fig. 20. Forward bias safe operating area

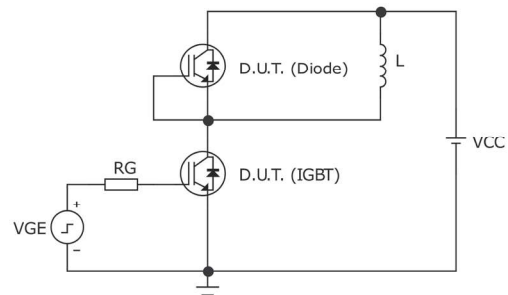


Fig. 21. Test circuit for inductive load switching

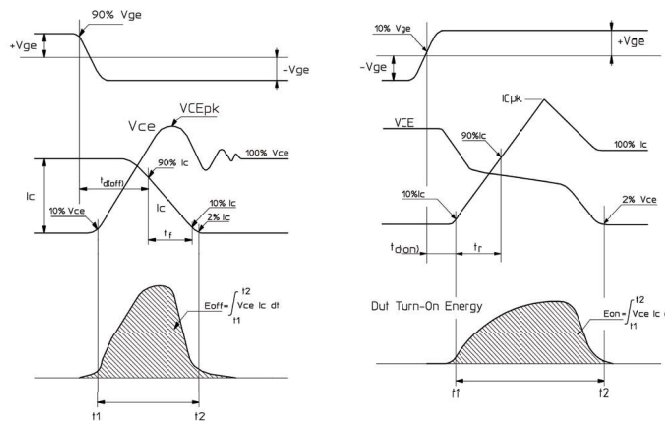
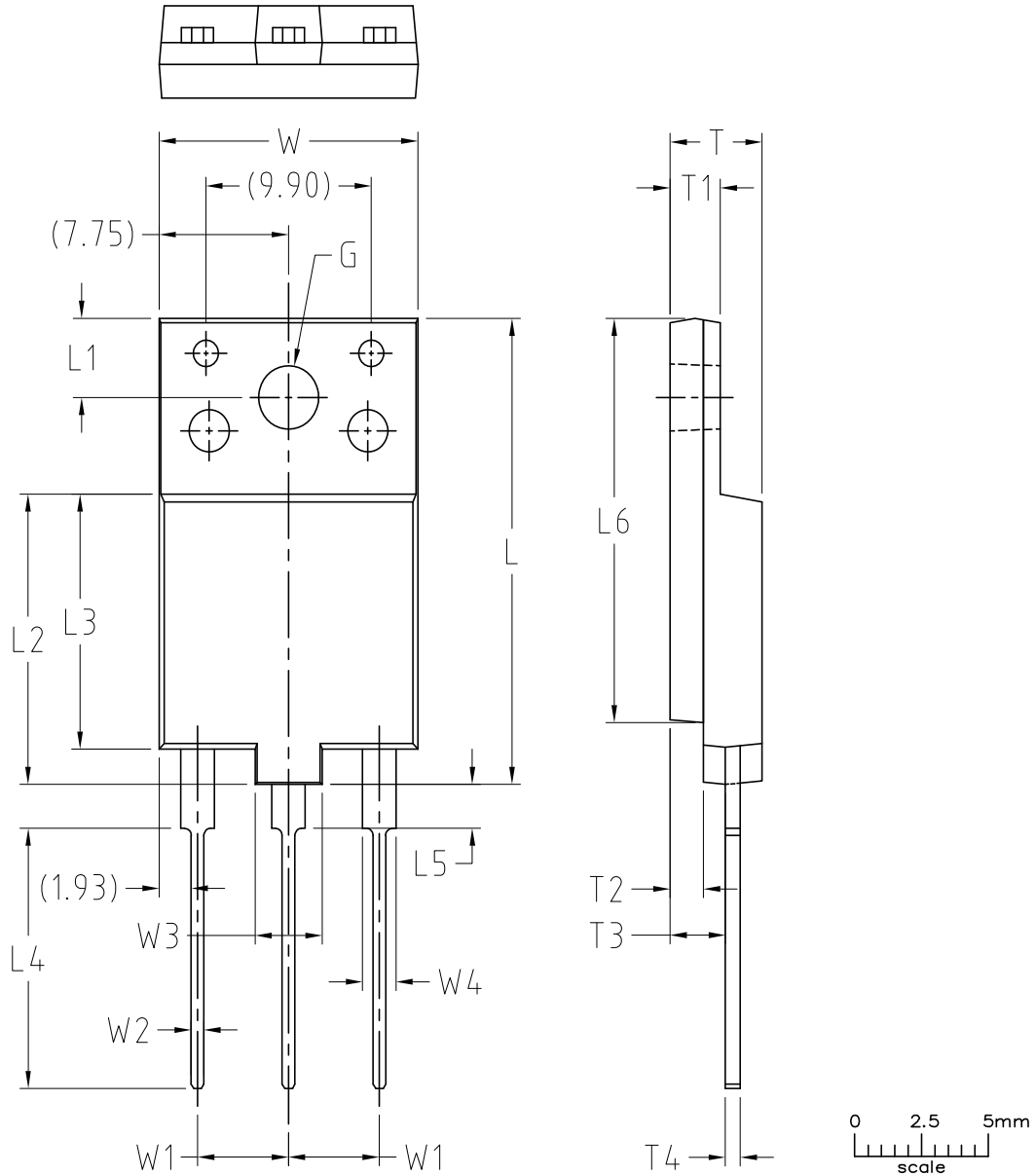


Fig. 22. Definition of switching times and losses

12. Package outline

Plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-3P 'full pack'

TO3PF



Remark : (X) the dimension X in brackets is for reference

UNIT	W	W1	W2	W3	W4	L	L1	L2	L3	L4	L5	L6	T	T1	T2	T3	T4	G(∅)
mm	15.7	5.75	0.95	4.20	2.20	26.7	4.6	16.7	14.7	15.0	2.7	23.2	5.7	3.2	2.2	3.5	1.1	3.8
	15.3	5.15	0.65	3.80	1.80	26.3	4.4	16.3	14.3	14.6	2.3	22.8	5.3	2.8	1.8	3.1	0.8	3.4

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ		
		TO-3PF			

13. Legal information

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Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
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