WG50N65DHJ

IGBT

Rev.01 - 23 July 2021

1. General description

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

RoHS Halogen-Free

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

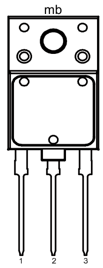
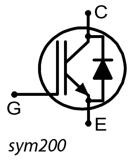
Table 1. Quick reference data

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

Note (1): IC 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		
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, $T_j \geq 25$ °C	650	V
I_C	DC collector current, limited by $T_{j(max)}$ $T_C = 25$ °C $T_C = 100$ °C	 91 50	A
$I_{C(puls)}$	Pulsed collector current, t_p limited by $T_{j(max)}$	200	A
-	Turn off safe operating area $V_{CE} \leq 600$ V, $T_j \leq 150$ °C, $t_p = 1$ µs	200	A
I_F	Diode forward current, limited by $T_{j(max)}$ $T_C = 25$ °C $T_C = 100$ °C	 100 50	A
V_{GE}	Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 10$ us, D < 0.010)	±20	V
P_{tot}	Power dissipation $T_C = 25$ °C Power dissipation $T_C = 100$ °C	278 111	W
T_{stg}	Storage temperature	-55 to 150	°C
T_j	Operating junction temperature	-55 to 150	°C
-	Peak soldering temperture	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

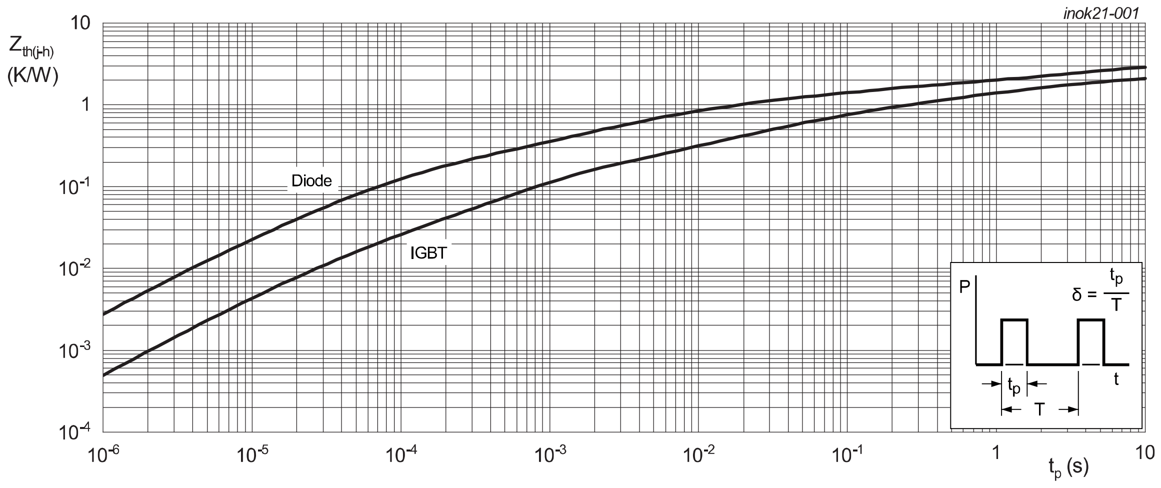


Fig. 1. Transient thermal impedance from junction to heatsink as a function of pulse duration

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
BV_{CES}	Collector-emitter breakdown voltage	V_{GE} = 0 V; I_C = 0.2 mA		650	-	-	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V; I_C = 50 A; T_j = 25 °C		-	1.65	2	V
		V_{GE} = 15 V; I_C = 50 A; T_j = 150 °C		-	2.05	-	V
V_F	Diode forward voltage	V_{GE} = 0 V; I_F = 30 A; T_j = 25 °C		-	1.7	2.4	V
		V_{GE} = 0 V; I_F = 30 A; T_j = 150 °C		-	1.55	-	V
$V_{GE(th)}$	Gate-emitter threhold voltage	I_C = 0.25 mA; V_{CE} = V_{GE}		4	5	6	V
I_{CES}	Zero gate voltage collector current	V_{CE} = 650 V; V_{GE} = 0 V; T_j = 25 °C		-	-	10	uA
		V_{CE} = 650 V; V_{GE} = 0 V; T_j = 150 °C		-	-	2	mA
g_{fs}	Transconductance	V_{CE} = 20 V; I_C = 50 A		-	50	-	S
Dynamic characteristics							
C_{ies}	Input capacitance	V_{CE} = 25 V; V_{GE} = 0V; f = 1 MHz; T_j = 25 °C		-	3800	-	pF
C_{oes}	Output capacitance			-	130	-	pF
C_{res}	Reverse transfer capacitance			-	70	-	pF
Q_G	Gate charge	V_{CC} = 520 V; I_C = 50 A; V_{GE} = 15 V; T_j = 25 °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 °C; V_{CC} = 400 V; I_C = 50 A; V_{GE} = 15V / 0V; R_G = 10 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 °C; V_{CC} = 400 V; I_C = 50 A; V_{GE} = 15V / 0V; R_G = 10 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 °C; V_R = 400 V; I_F = 30 A; dI_F/dt = 500A/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 °C; V_R = 400 V; I_F = 30 A; dI_F/dt = 500A/us		-	127	-	nS
Q_r	Reverse recovery charge			-	1265	-	nC
I_{RM}	Reverse recovery peak current			-	17	-	A

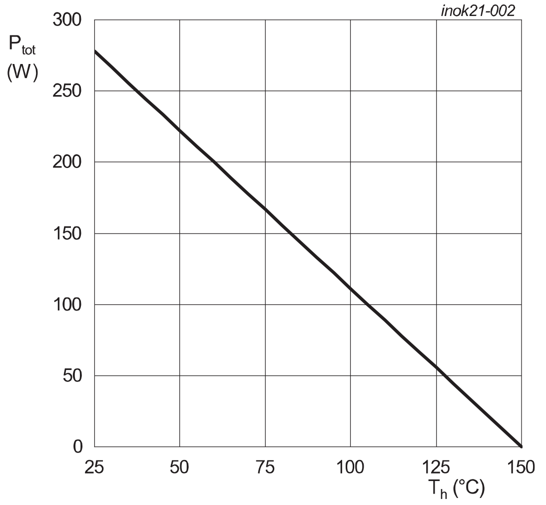
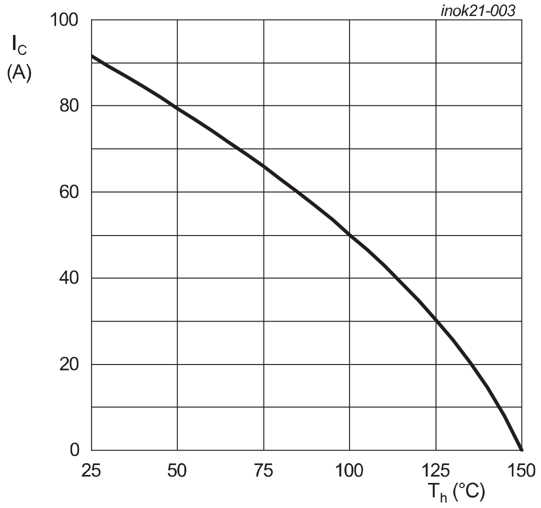
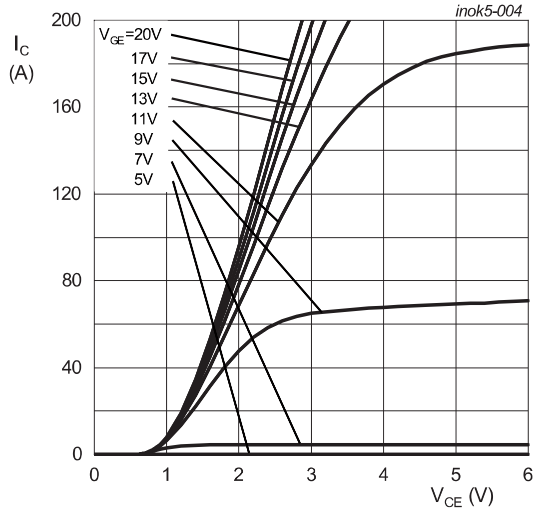


Fig. 2. Power dissipation as a function of case temperature



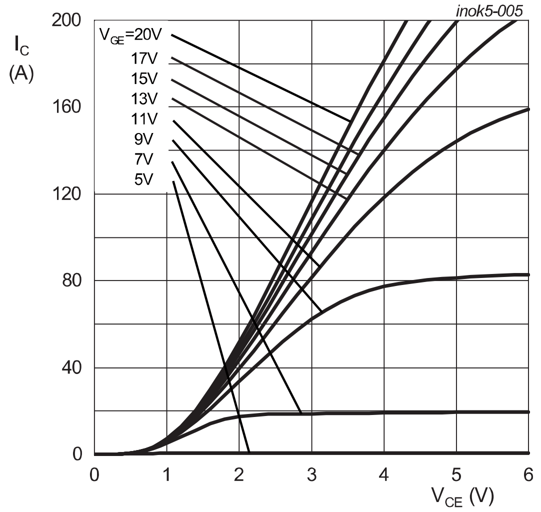
V_{GE} = 15 V; T_j = 150 °C

Fig. 3. Collector current as a function of case temperature



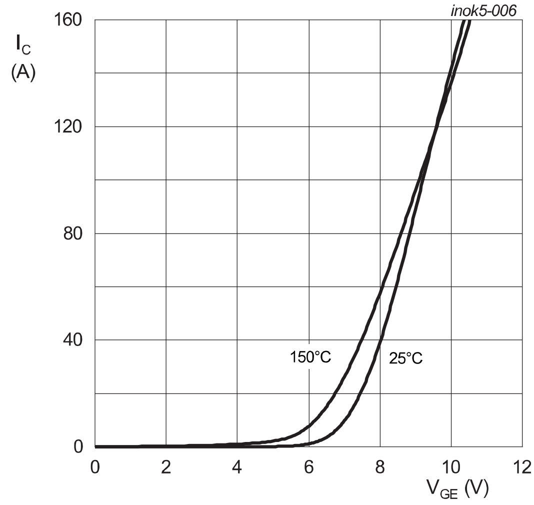
T_j = 25 °C

Fig. 4. Typical output characteristic



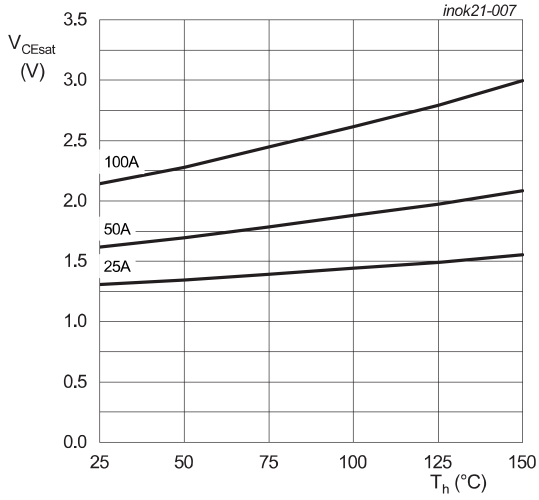
T_j = 150 °C

Fig. 5. Typical output characteristic



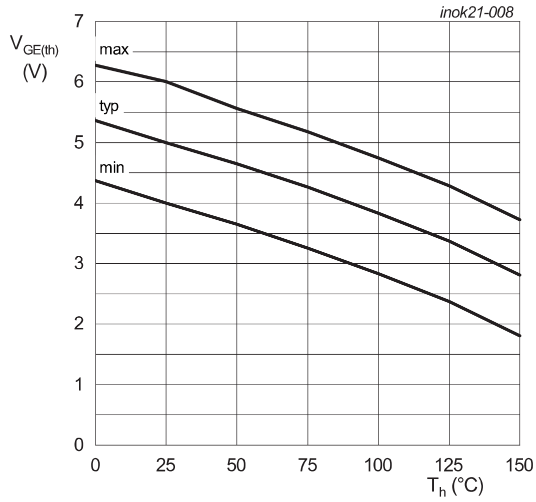
V_{CE} = 20 V

Fig. 6. Typical transfer characteristic



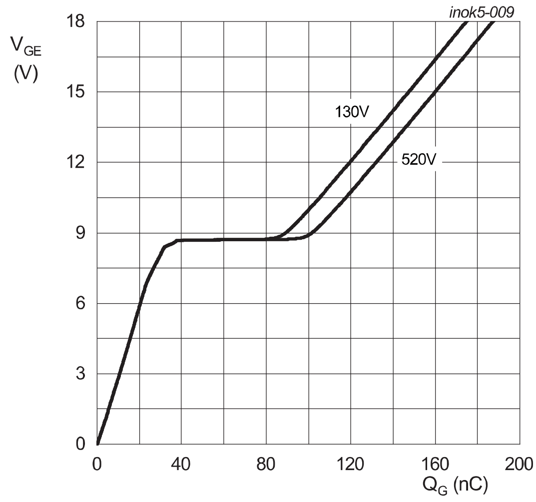
V_{GE} = 15 V

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



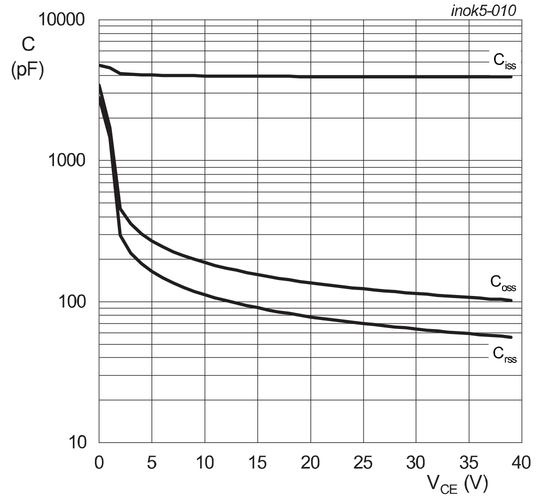
I_C = 0.5 mA

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



I_C = 50 A

Fig. 9. Typical gate charge



V_{GE} = 0 V; f = 1 MHz

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

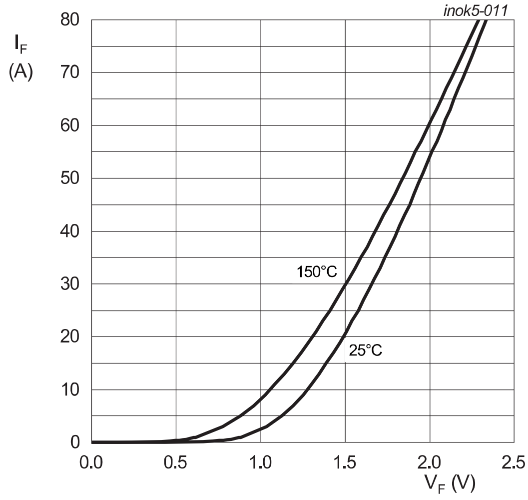
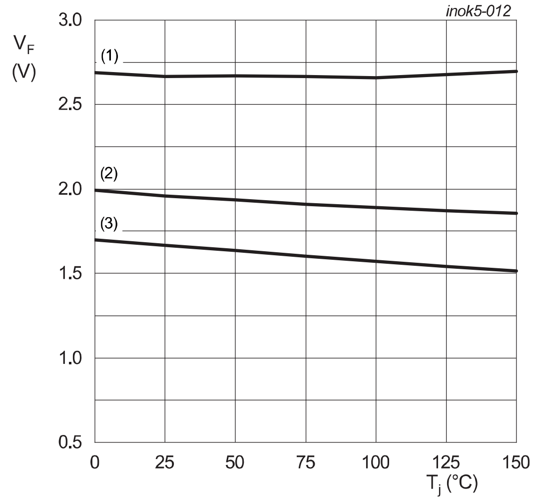


Fig. 11. Typical diode forward current as a function of forward voltage

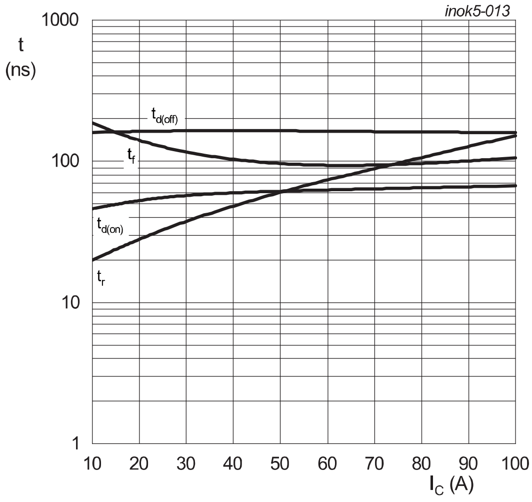


(1) I_F = 100 A

(2) I_F = 50 A

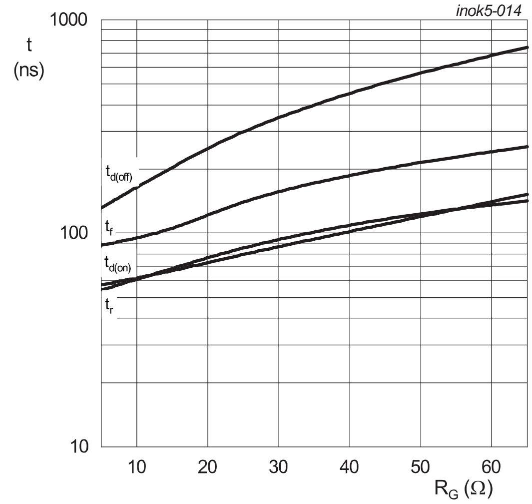
(3) I_F = 30 A

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



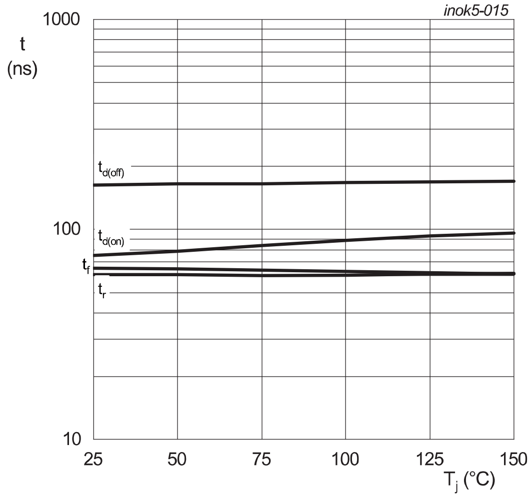
R_g = 10 Ω; V_{GE} = 15V/0V; T_j = 150 °C;
V_{CE} = 400 V; inductive load

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



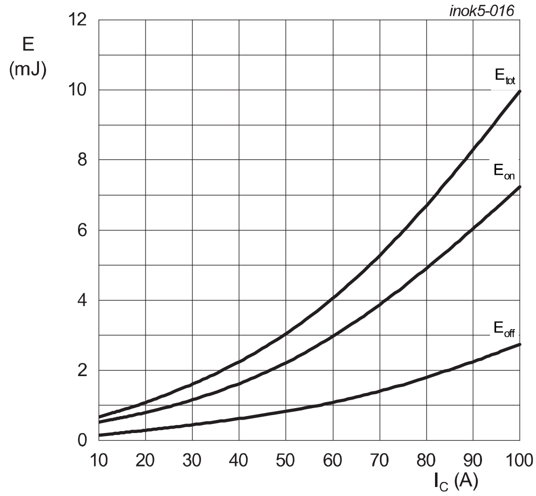
R_g = 10 Ω; V_{GE} = 15V/0V; T_j = 150 °C;
V_{CE} = 400 V; inductive load

Fig. 14. Typical switching times as a function of gate resistance



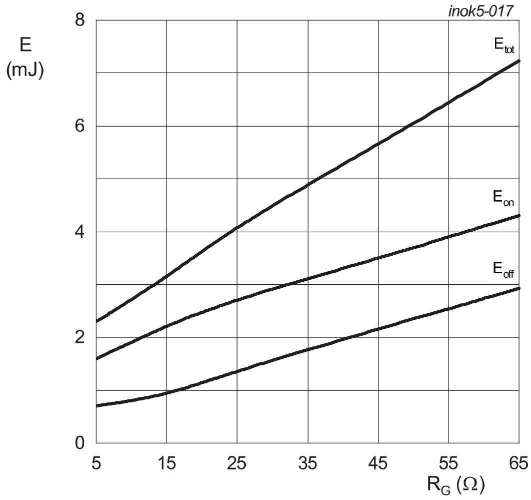
I_C = 50 A; V_{GE} = 15V/0V; R_g = 10 Ω;
V_{CE} = 400 V; inductive load

Fig. 15. Typical switching times as a function of junction temperature



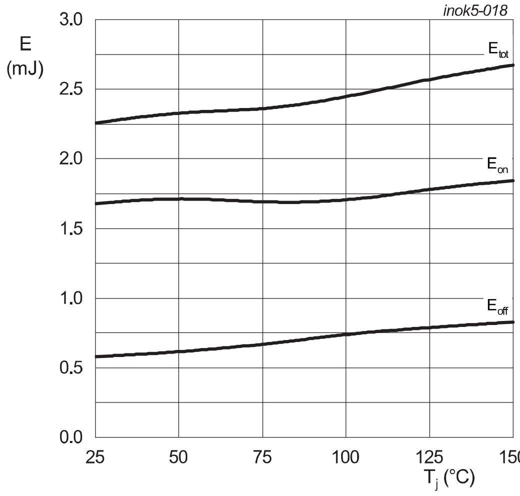
R_g = 10 Ω; V_{GE} = 15V/0V; T_j = 150 °C;
V_{CE} = 400 V; inductive load

Fig. 16. Typical switching energy losses as a function of collector current



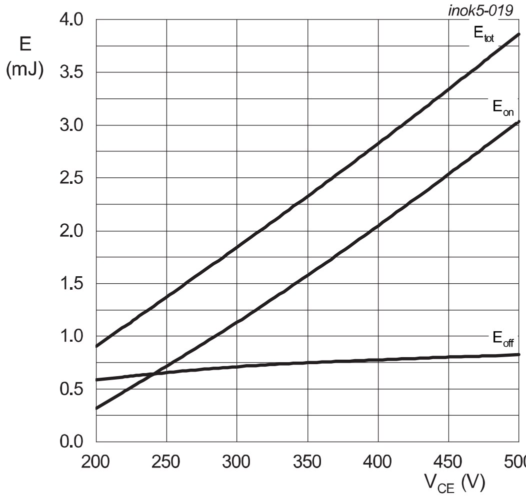
I_C = 50 A; V_{GE} = 15V/0V; T_j = 150 °C;
V_{CE} = 400 V; inductive load

Fig. 17. Typical switching energy losses as a function of gate resistance



I_C = 50 A; V_{CE} = 15V/0V; R_g = 10 Ω;
V_{CE} = 400 V; inductive load

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



I_C = 50 A; V_{CE} = 15V/0V; T_j = 150 °C;
R_g = 10 Ω; inductive load

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

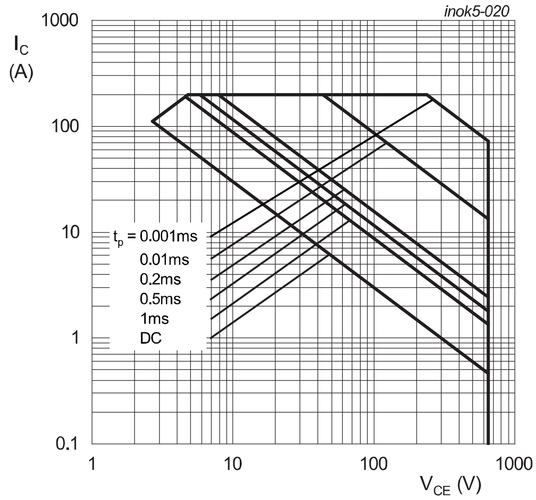


Fig. 20. Forward bias safe operating area

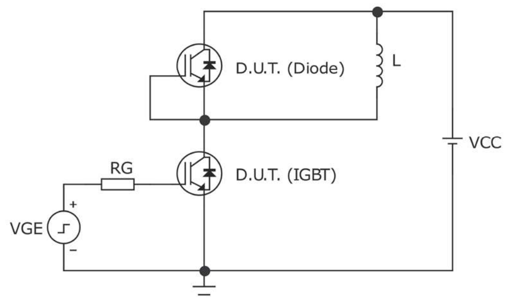


Fig. 21. Test circuit for inductive load switching

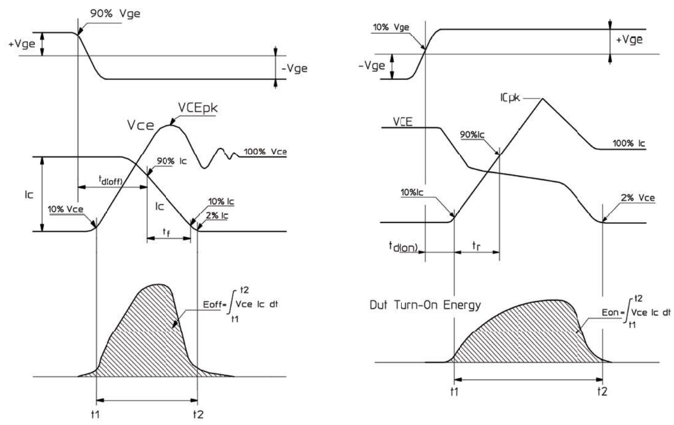
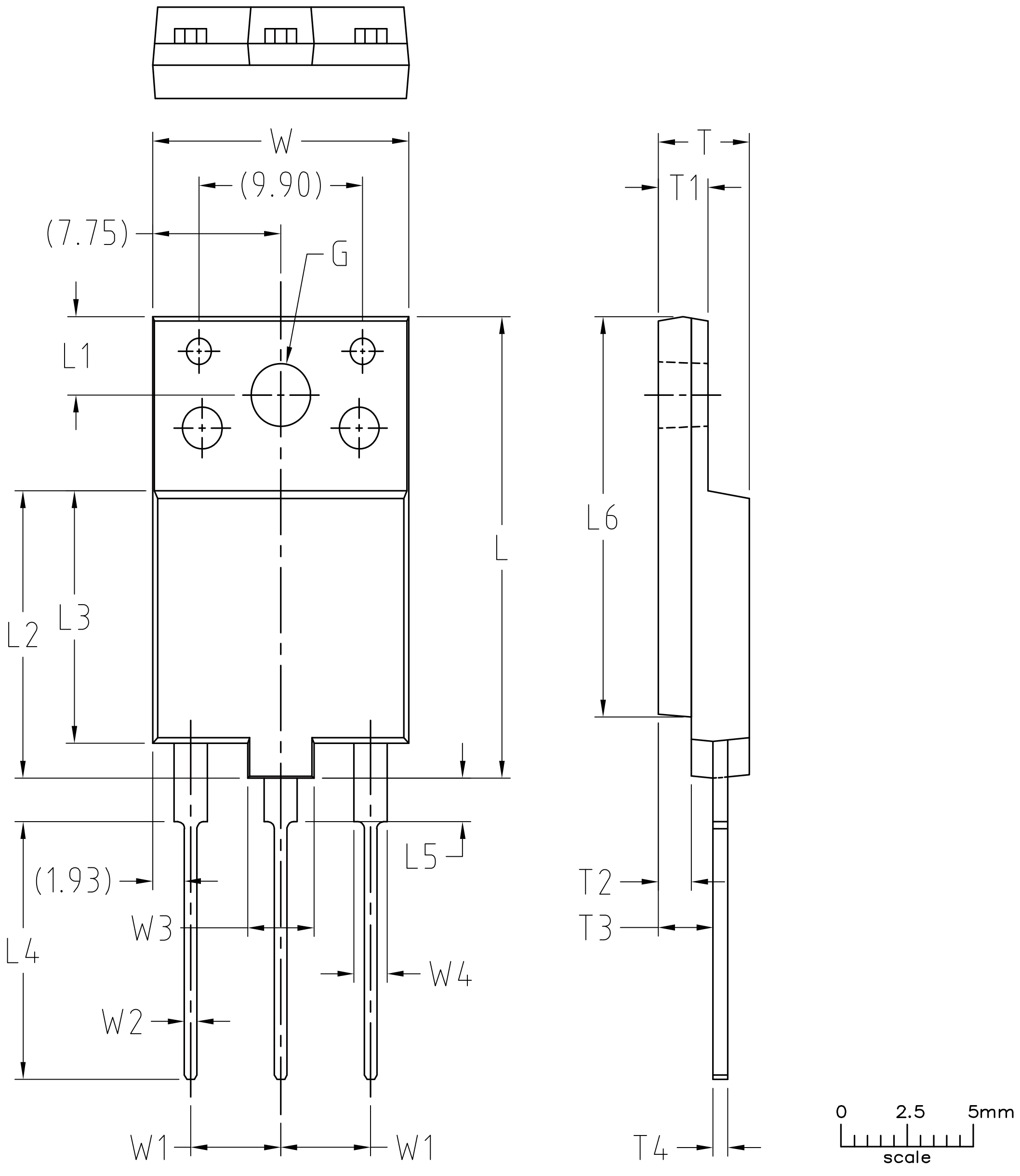


Fig. 22. Definition of switching times and losses

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 blackets is for reference

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

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

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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.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

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Date of release: 23 July 2021